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2019

SECONDARY 4

Express Exam Paper

Pure Physics

1	Anglo-Chinese Ind	SA1
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5	CHIJ St Nicholas	SA2
6	Dunman High School	SA2
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9	Spore Chinese Girls	SA2
10	Tanjong Katong Girl	SA2
11	Unity Sec	SA2
12	Whitley Sec	SA2

Anglo-Chinese School
(Independent)

MID-YEAR EXAMINATION 2019
YEAR 4 EXPRESS

6091/01

PHYSICS **PAPER 1**

Thursday **13 May 2019** **1 hour**

INSTRUCTIONS TO STUDENTS
Write your index number in the spaces provided on the Answer Sheet.
Write in soft pencil.
Do not open this booklet until you are told to do so.

There are **forty** questions on this paper. Answer **all** questions.
For each question there are four possible answers **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
Calculators are allowed for this paper.

Take **g** to be **10 m s^{-2}**.

This paper consists of **16** printed pages.

NAME:	NO:	CLASS: 4E1

ADMIRALTY SECONDARY SCHOOL

PRELIMINARY EXAMINATION 2019

SUBJECT	:	Physics
CODE/PAPER	:	6091 / 1
LEVEL/STREAM	:	Secondary 4 Express
DATE	:	3 September 2019
TIME	:	1130h – 1230h
DURATION	:	1 hour

Instructions to candidates:
Write your Name, Class and Index Number on all the work you hand in.
Do not use staples, paper clips, highlighters, glue or correction fluid.

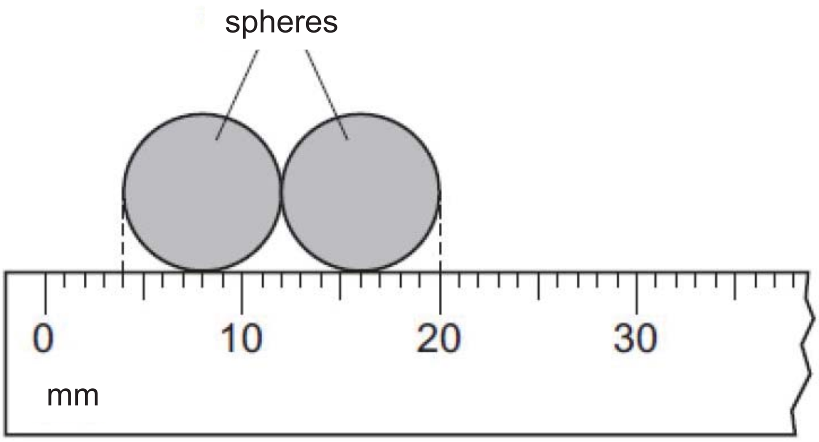
Answer **all** questions.
For each question there are four possible answers **A, B, C** and **D**.
Choose the **one** you consider correct and record your choice on the OTAS sheet.

	Marks	
Section A		**40**

DO NOT TURN OVER THIS PAPER UNTIL YOU ARE TOLD TO DO SO.

Answer all questions.

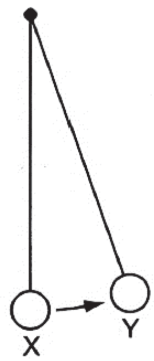
1 The diagram below shows two identical spheres placed next to each other.



What is the radius of each sphere?

A 2 mm **B** 4 mm **C** 8 mm **D** 16 mm

2 It takes 1.5 s for the pendulum to swing from X to Y.

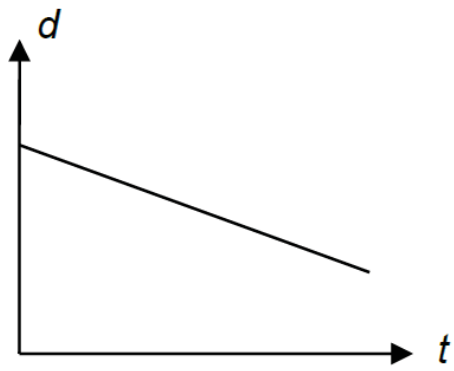


How many complete oscillations are there in 1 minute?

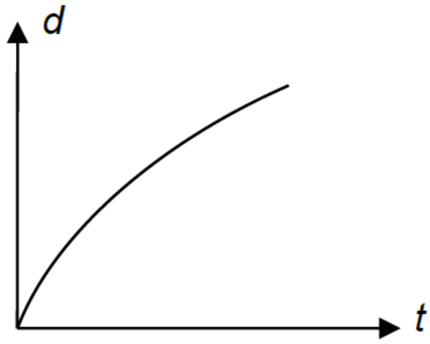
A 10 **B** 20 **C** 40 **D** 80

3 Which of the following distance−time (d−t) graphs represent deceleration?

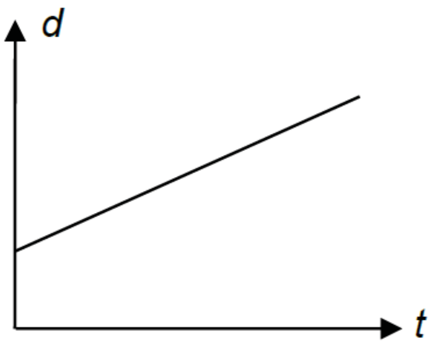
A



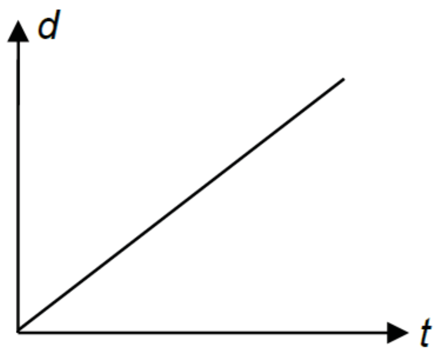
B



C



D



4 A stone is thrown upwards from the top of a building. Which row describes the acceleration and the velocity of the stone when it reaches maximum height?

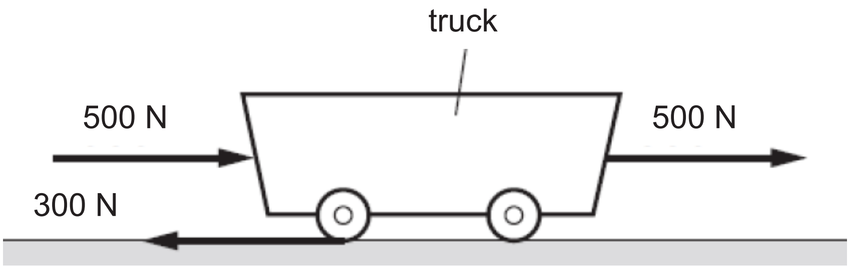
	acceleration / m/s^2	velocity/ m/s
A	0	0
B	0	10
C	10	0
D	10	10

5 An object falls from a height of 120 m. How much time does it take to reach the ground?

A 4.9 s B 10.0 s C 12.0 s D 15.6 s

.

6 The following diagram shows all the horizontal forces acting on a moving truck.



Which of the following best describes the motion of the truck?

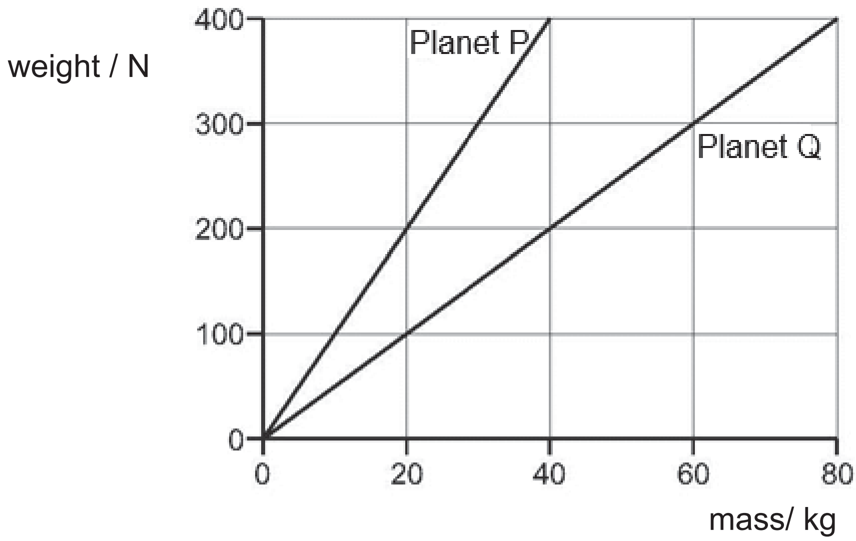
A The truck will stop.

B The truck will move to the right.

C The truck will move to the left.

D The truck will accelerate to the right.

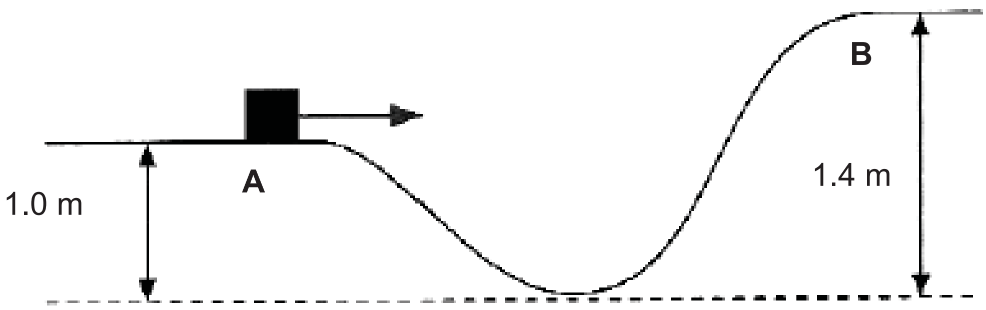
7 The diagram below shows how the weight varies with mass on Planets P and Q



An object weighs 400 N on Planet P. The object is then taken to Planet Q. Which of the following is correct?

	mass of object on Planet Q / kg	weight of object on Planet Q / N
A	40	200
B	40	400
C	80	200
D	80	400

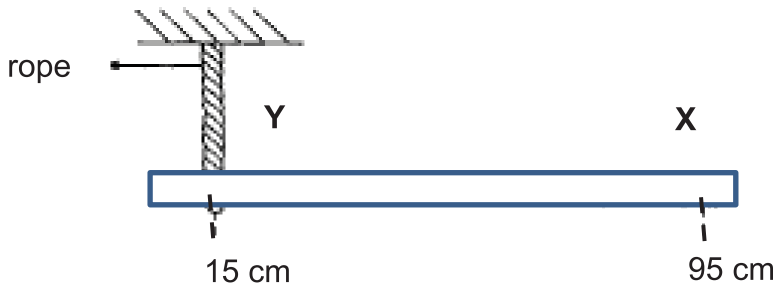
8 A small box of mass 2.0 kg moves along a track as shown in the figure. The speeds of the objects at point A and B are 4.0 m/s and 1.0 m/s respectively. The total distance between A and B is 2.5 m.



What is the average friction acting on the box as it moves from A to B?

A 2.8 N **B** 5.6 N **C** 6.0 N **D** 8.0 N

9 In the diagram below, the uniform metre rule is pivoted at X and held up at the point Y by a rope.



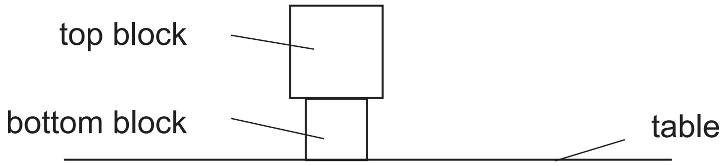
Given that the weight of the metre rule is 4.0 N, calculate the tension in the rope that is needed to ensure that the rule stays horizontal.

A 1.8 N **B** 2.3 N **C** 3.1 N **D** 5.1 N

10 An object is slightly displaced by an external force. When the external force is removed, the object returns to its original position.
What state of equilibrium is the object in?

A stable **B** neutral **C** unstable **D** rotational

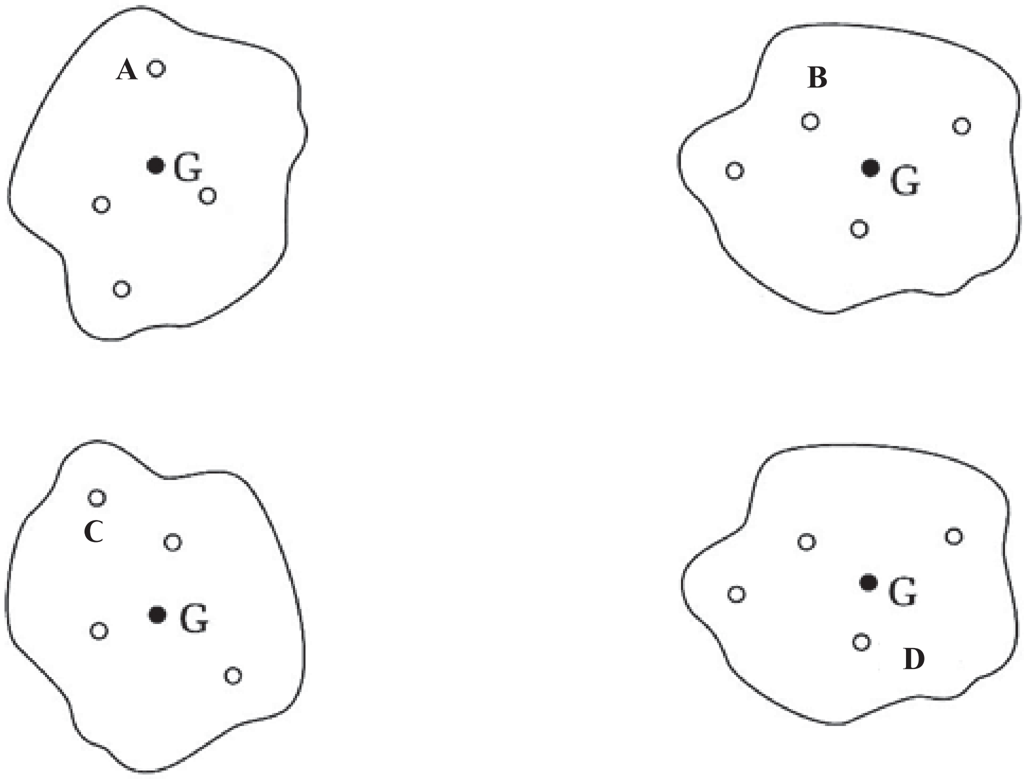
11 Two blocks are stacked on top of one another on a table.



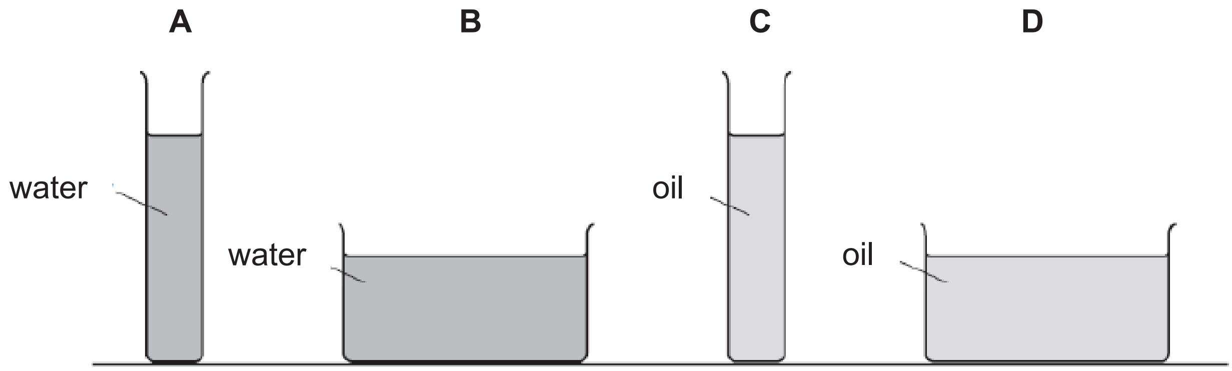
The weight of the top block is Q and the weight of the bottom block is R.
The base area of top block is X and the base area of bottom block is Y.
What is the pressure acting on the table by the blocks?

A (Q+R) / X **B** (Q+R) / Y **C** (Q-R) / X **D** (Q-R) / Y

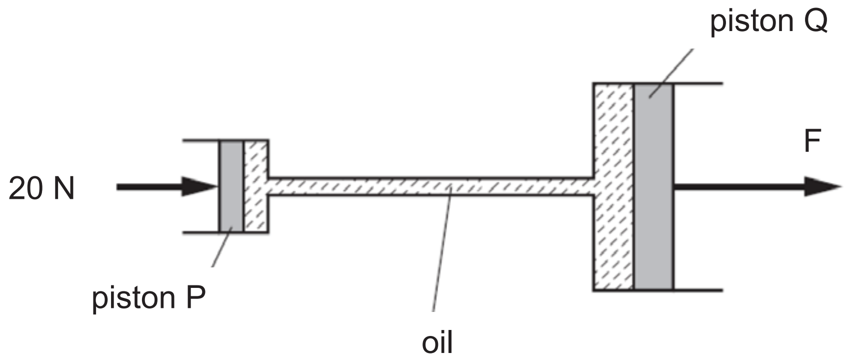
12 Four holes, **A**, **B**, **C** and **D** are made on a uniform lamina. The centre of gravity of the lamina is at **G**. Which one of the following shows correctly the lamina hanging freely about each of the holes?



13 The diagram shows four containers containing water or oil. Oil floats on water. Which of the container will have the higher pressure at the base of the container?



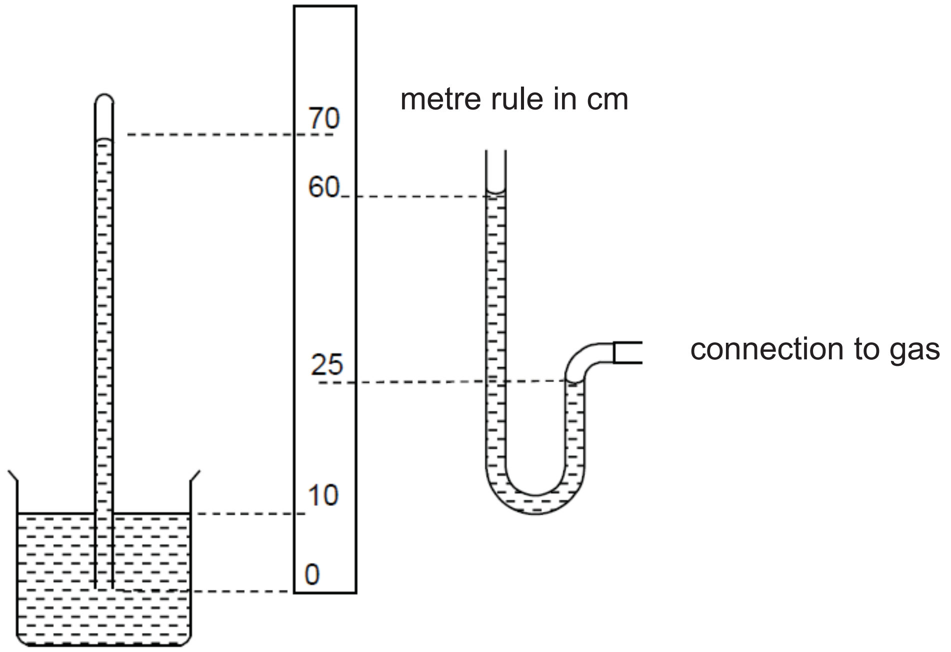
14 The diagram below shows a simple hydraulic system, where a 20 N force is acting on piston P. Piston P has an area of 5.0 cm^2 and piston Q has an area of 30.0 cm^2.



What is the magnitude of force F?

A 4.0 N **B** 20 N **C** 120 N **D** 3000 N

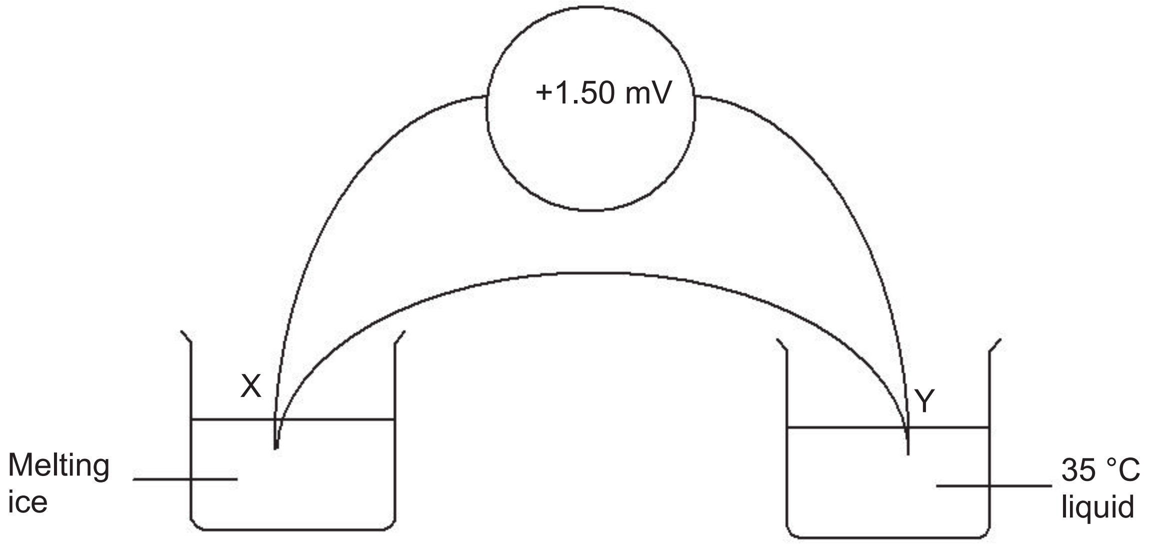
15 A mercury barometer and mercury manometer are placed in the same room placed on a top of a mountain. The manometer is connected to a gas cylinder.



What is the pressure of the gas?

A 35 cm Hg **B** 45 cm Hg **C** 60 cm Hg **D** 95 cm Hg

16 The diagram shows a thermocouple when junction X and Y are placed in melting ice and liquid at 35 °C respectively.



What is the voltmeter reading when junction X is replaced by boiling water at 100 °C?

A -2.79 mV **B** -1.92 mV **C** +1.92 mV **D** +2.79 mV

17 Which diagram represents the change in arrangement of the particles of water when it freezes?

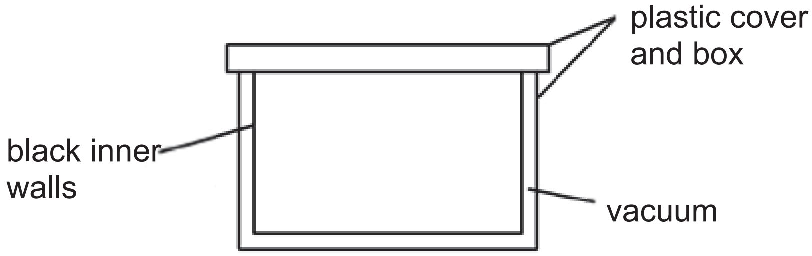
A

B

C

D

18 The diagram shows a container used to keep food warm for delivery.



Which of the following explanation is incorrect?

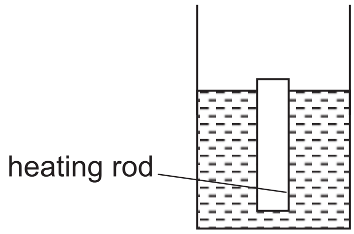
A Plastic is a poor conductor of heat, hence heat loss will be reduced through conduction.

B Plastic cover reduces the formation of convection current, preventing the cooling of food contents in the container.

C Vacuum reduces heat loss due to conduction as it does not have a medium to transfer the heat.

D Black inner wall is a poor absorber of infra-red radiation, hence does not absorb heat from the food.

19 A hot piece of heating rod is immersed into a beaker of water.



Bubbles are observed in the water at the surface area in contact with the heating rod. Which of the following statement best explains the observation?

A Conduction of water in contact with the rod causes bubbles to be formed.

B Convection current caused by the hot rod causes bubbles to be formed.

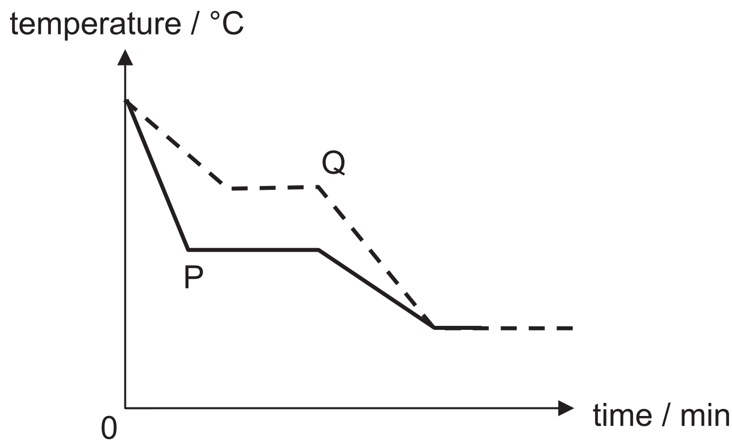
C Evaporation of water next to the heating rod causes bubbles to be formed.

D Radiation to the water cause water to boil, causing bubbles to be formed.

20 An electrical heater is used to heat a 2 kg piece of metal from 30 °C to 40 °C. The specific heat capacity of the metal is 720 J / kgK. The heater was turned on for 20 s and it is known that 20 % of the energy supplied is lost to the surrounding.
What is the power rating of the heater?

A 720 W **B** 864 W **C** 900 W **D** 14400 W

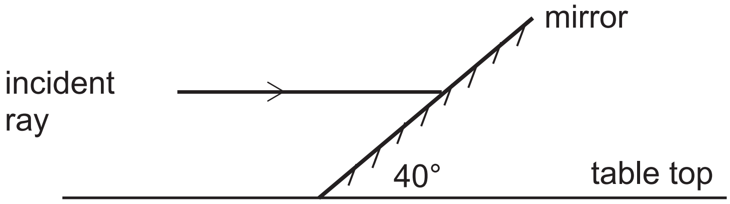
21 Two liquids, P and Q, of the same masses are placed in a room for cooling. Their cooling curves are shown in the diagram below.



Which of the following statement correctly describes the two liquids, P and Q?

A Both P and Q has the same specific latent heat of fusion.
B Both P and Q have the same freezing point.
C P has a higher specific latent heat of fusion than Q.
D Q has a lower freezing point than P.

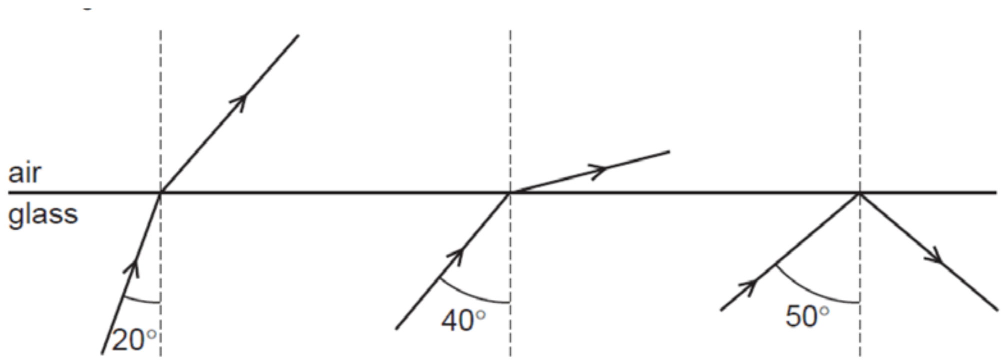
22 A plane mirror is inclined at 40 ° to the table top. An incident ray parallel to the table top strikes the mirror and a reflected ray is formed.



What is the angle of reflection?

A 20 ° **B** 40 ° **C** 50 ° **D** 100 °

23 Three rays of light are incident between a glass block and air. The diagram is not drawn to scale.



Which of the following is most likely to be the critical angle of the glass?

A 25° **B** 35° **C** 45° **D** 55°

24 An object is placed 35 cm from a converging lens and a real image of the same size as the object is formed. The object is now moved so that it is 20 cm from the lens. Which statement is correct?

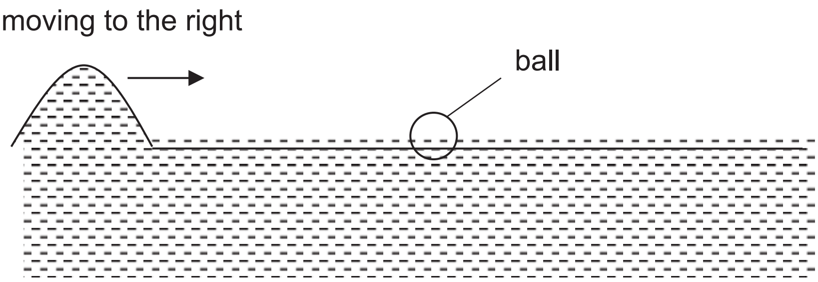
A The new image is bigger and its distance from the lens is less than 35 cm

B The new image is smaller and its distance from the lens is less than 35 cm.

C The new image is bigger and its distance from the lens is greater than 35 cm

D The new image is smaller and its distance from the lens is greater than 35 cm.

25 A ball floats on water in a swimming pool.



When the wave reaches the ball, how will the ball be displaced?

A upwards **B** downwards **C** to the left **D** to the right

26 Which of the following is **not** an application of infrared radiation?

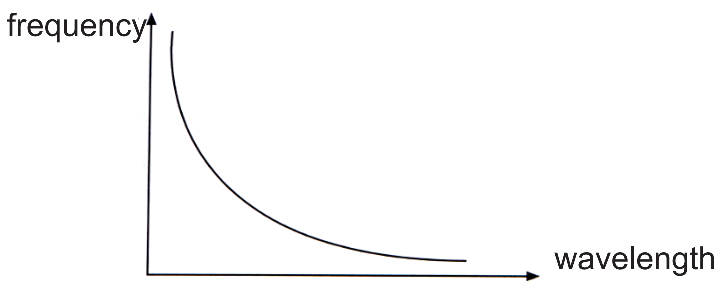
A remote control

B ear thermometer

C night vision goggles

D sunbeds used for skin tanning

27 The diagram shows the relationship between the frequency of electromagnetic radiation and the wavelength of the waves



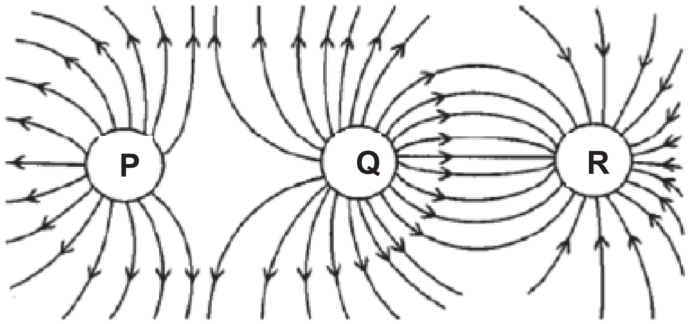
Which of the following relationship can be interpreted from the graph?

A The velocity of EM waves is a constant.
B The higher the wavelength, the higher the energy of the wave.
C Frequency is directly proportional to the energy of waves.
D Waves of higher frequency travel faster than waves of lower frequency.

28 A starting pistol is fired at the starting line of a race and the echo from the wall is heard 0.5 s later. The speed of sound in air is 330 m/s.
What is the distance between the starting line and the wall?

A 82.5 m **B** 165 m **C** 330 m **D** 660 m

29 The electric field patterns produced by three charged spheres are as shown.



What are the charges on spheres P, Q and R?

	P	Q	R
A	negative	negative	positive
B	positive	positive	negative
C	positive	negative	negative
D	negative	positive	negative

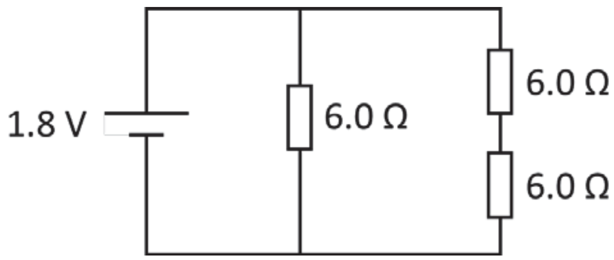
30 A battery drives 100 C of charge around a closed circuit.
The total work done is 750 J. What is the electromotive force of the battery?

A 0.13 V **B** 0.75 V **C** 7.5 V **D** 75 kV

31 The resistance of a wire is 1.0 Ω.
A second wire is made of the same material but has twice the length and half the diameter. What is the resistance of the second wire?

A 0.25 Ω **B** 2.0 Ω **C** 4.0 Ω. **D** 8.0 Ω.

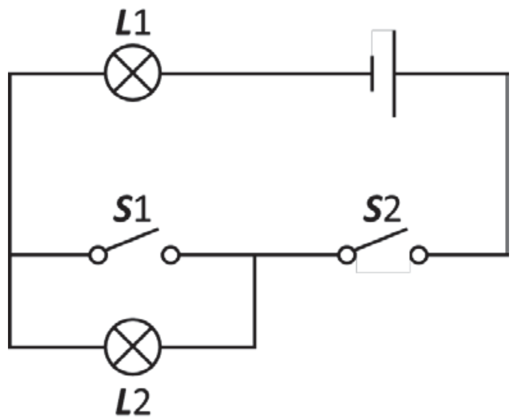
32 A 1.8 V power supply is connected to a circuit consisting of three 6.0 Ω resistors.



What is the amount of work done by the battery in 1 minute?

A 18 J **B** 48.6 J **C** 108 J **D** 778 J

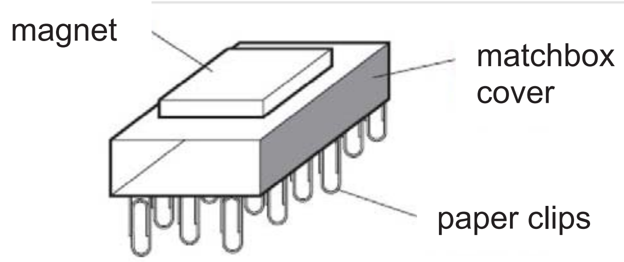
33 An electrician installed two switches, ***S***1 and ***S***2, to control two lamps, ***L***1 and ***L***2, in the following circuit.



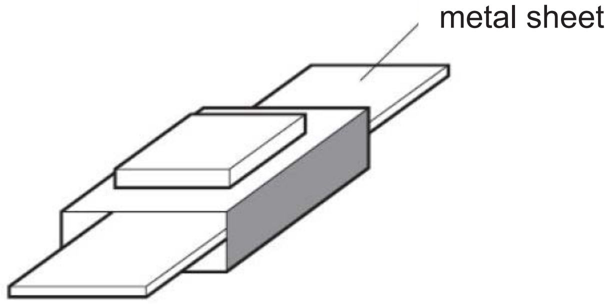
Which of the following configuration will switch on both L1 and L2 at the same time?

A S1 open, S2 closed
B S1 open, S2 open
C S1 closed, S2 closed
D S1 closed, S2 open

34 A magnet is placed on the top of a paper matchbox cover. The set-up is then placed on the tray filled with paper clips. A large number of paper clips are attracted to the based on the matchbox cover.



Metal sheets of different materials are thereafter placed inside the matchbox cover. When sheet X is placed inside, the paper clips remained; when sheet Y is placed inside, the paper clips fell off.

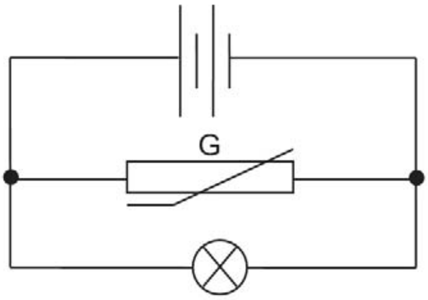


Which of the following metals are the sheets made of?

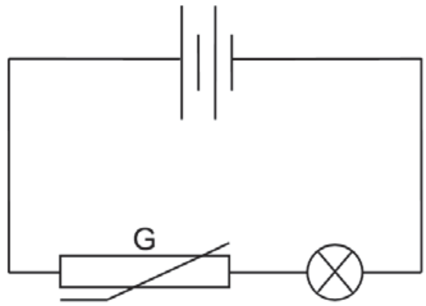
	X	Y
A	Aluminum	Copper
B	Copper	Iron
C	Iron	Aluminum
D	Iron	Copper

35 In which of the circuits will the filament lamp be less bright if the temperature of the component G decreases?

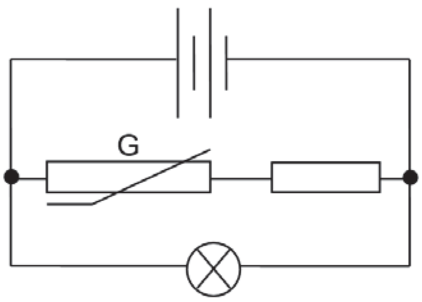
A



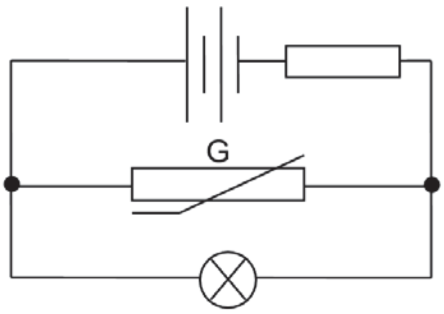
B



C

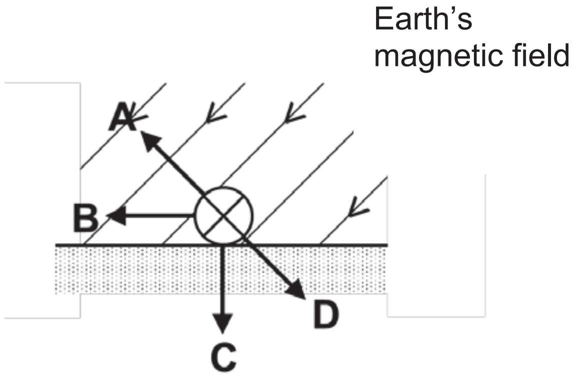


D

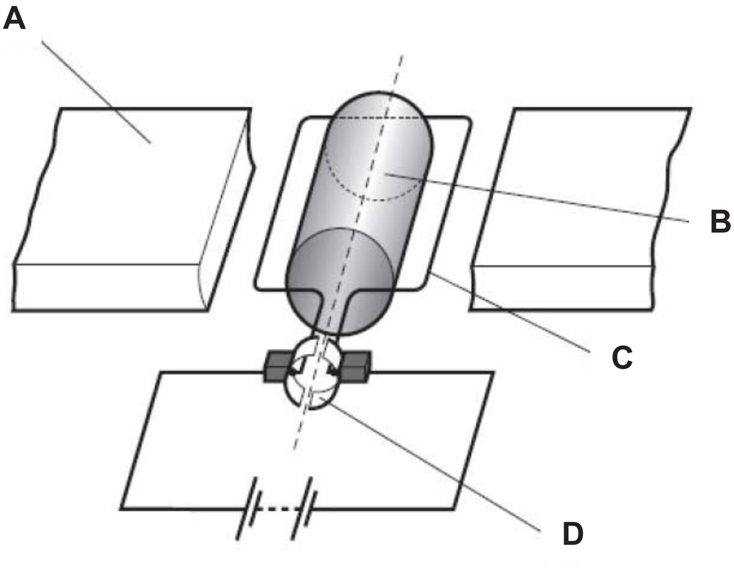


36 The diagram shows the cross-section of a cable lying on the ground. There is a direct current in the cable. The Earth's magnetic field is in the direction shown.

In which direction does the electromagnetic force act on the cable?

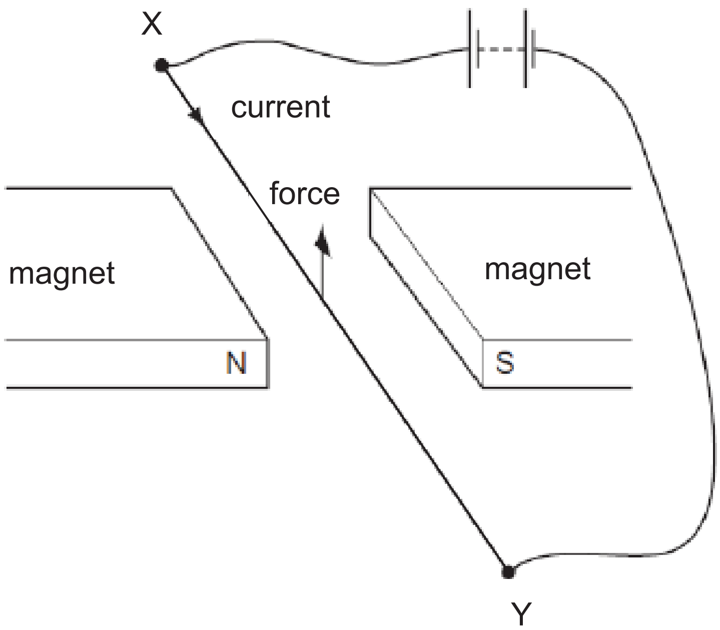


37 The diagram below shows a simple d.c. motor. Which of the following labelled parts indicates the commutator?



38 The diagram below shows a current passing from X to Y.

There is an upward force on the wire.



What will be observed if the direction of current reverses?

A The wire will move upwards.
B The wire will move downwards.
C The wire will move towards the left.
D The wire will move towards the right.

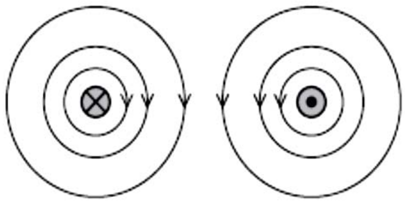
39 Which of the following does not affect the magnitude of induced e.m.f in a simple a.c. generator?

A speed of rotation of coil
B distance between magnet and rectangular coil
C number of turns of coil per unit length
D resistance of rectangular coil

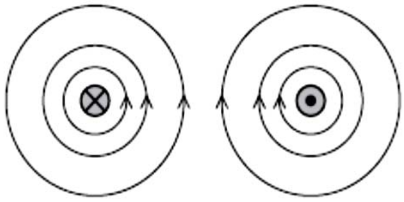
40 Two straight electrical conductors are parallel to each other. Each conductor carries a current, one into the plane of the paper, and one out of the plane of the paper.

Which diagram accurately represent the magnetic field around the two wires?

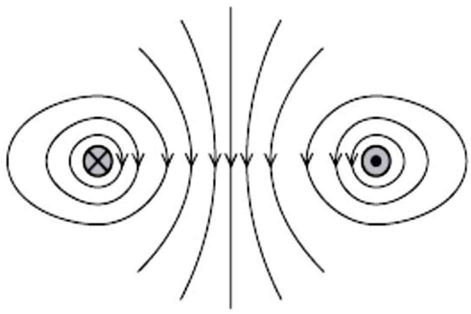
A



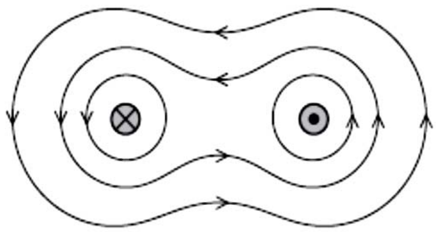
B



C



D



END OF PAPER

NAME :	NO:	CLASS: 4E1

ADMIRALTY SECONDARY SCHOOL

Admiralty secondary school

PRELIMINARY EXAMINATION 2019

SUBJECT	:	Physics
CODE	:	6091 / 2
LEVEL/STREAM	:	Secondary 4 Express
DATE	:	30 August 2019
TIME	:	0800-0945 hrs
DURATION	:	1 hour 45 minutes

Instructions to candidates:
Write your Name, Class and Index Number on all the work you hand in.
Write in dark blue or black pen on both sides of the paper.
You may use a soft pencil for any diagrams, graphs, tables or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Section A: Short answer questions [50 marks]
Answer all questions. Write your answers in the spaces provided in the question paper.

Section B: Structured questions [30 marks]
Answer all questions. Write your answers in the spaces provided in the question paper.
Question 13 has a choice of either / or.

Candidates are reminded that all quantitative answers should include appropriate units.
The use of an approved scientific calculator is expected, where appropriate.
The number of marks is given in brackets [ ] at the end of each question or part question.
.

For Examiner's Use	
Section A	/ 50
Section B	/ 30
Total	/ 80

DO NOT TURN OVER THIS PAPER UNTIL YOU ARE TOLD TO DO SO.

This question paper consists of 19 printed pages including this cover page.

Section A
Answer all questions.

1 Fig. 1 shows the velocity time graph of a 150 kg unmanned rocket launched from the surface of planet X. The planet has no atmospheric layer.

It rises vertically upwards with constant acceleration and after some time, a malfunction causes the rocket's engine to cut off suddenly. On its downward journey to the ground, the rocket falls with negligible air resistance.

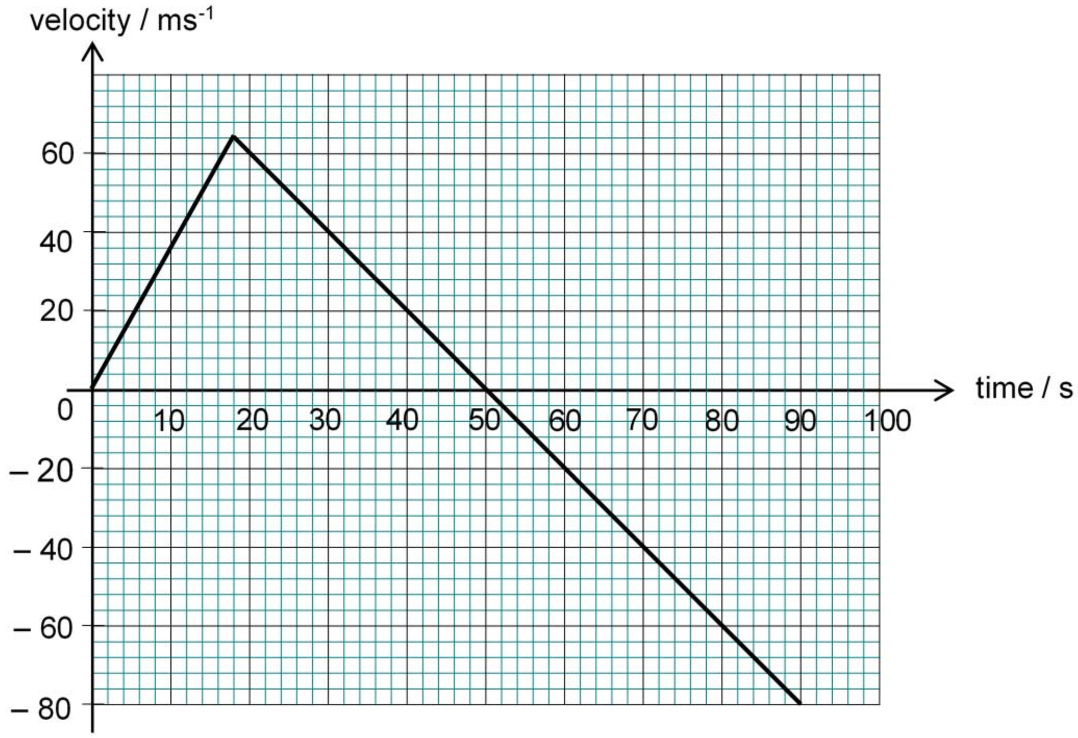


Fig. 1

(a) Using Fig. 1 , determine the total distance travelled upwards from the surface of planet X.

upwards distance travelled = ……………………… [2]

(b) What is the gravitational field strength of planet X?

gravitational field strength = ………………………………… [2]

(c) Hence, or otherwise, determine the weight of the unmanned rocket on planet X.

weight = …………………………………. [2]

2 Fig. 2 shows the flood prevention system at Marina Barrage. Water is pumped out from Marina reservoir to the sea in instances of heavy rain.

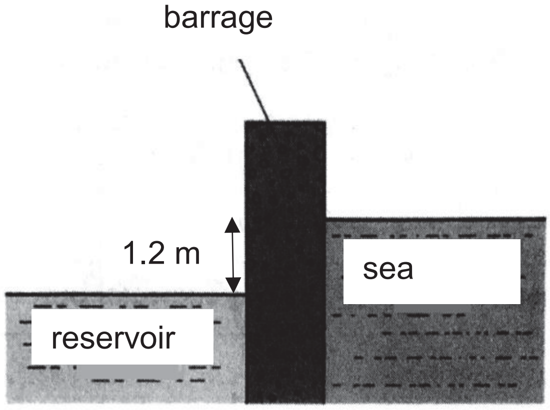


Fig. 2

(a) Water is released from the reservoir to the sea. The height difference of the reservoir and the sea is 1.2m, and 200 m^3 of water is released per second to maintain the reservoir's height.
Calculate the power required by the pump if it is 80% efficient.
(take density of water as 1000 kg / m^3)

power = …………………………………. [3]

(b) Explain why there is a need for a higher power input than the answer in (a) in real life.

…………………………………………………………………………………..

…………………………………………………………………………………..

…………………………………………………………………………………..

………………………………………………………………………………….. [2]

3 A steam engine uses the energy from steam to turn the turbine. Fig. 3 shows a safety valve that is fitted to a steam engine. When the pressure of steam rises above the safety level, the safety valve opens to release steam.

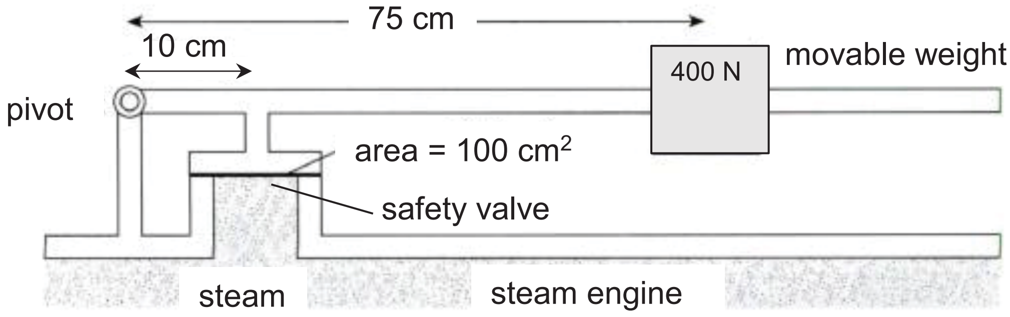


Fig. 3

(a) Explain, in terms of moments, how the safety valve works.

....

....

....

....

....

.... [3]

(b) Calculate the minimum force acting on the safety valve before it opens.

force = ... [2]

(c) Suggest how the safety valve can be adjusted so that it would release steam at a lower pressure.

....

....

....

.... [2]

4 Two liquids A and B are contained in a U-tube, as shown in Fig. 4.
The liquids do not mix.

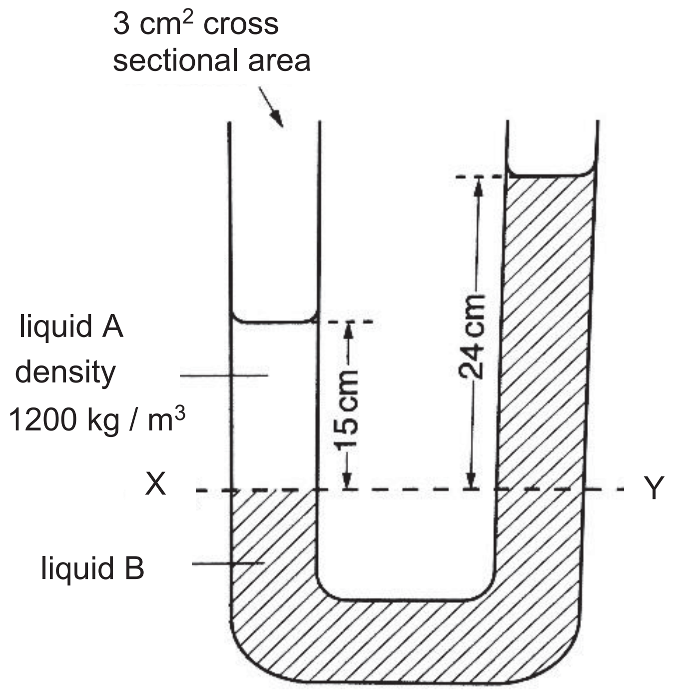


Fig. 4

Point X is at the junction between liquids A and B.
Point Y is at the same horizontal level in liquids B. The surface of liquid A is 15 cm above point X. The surface of liquid B is 24 cm above point Y. The density of liquid A is 1200 kg / m^3. Assume gravitational field strength is 10 N/kg.

(a) Calculate the pressure at point X due to liquid A.

pressure = ………………………………… [2]

(b) Hence, determine the density of liquid B.

density = ………………………………… [2]

5 Fig. 5 shows a side view and a plane view of a container used to serve hot drinks.

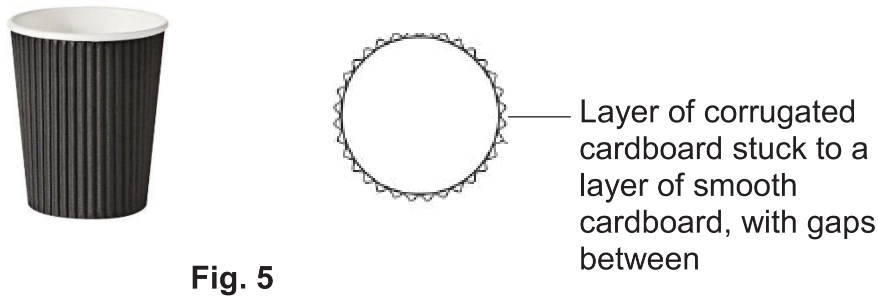


Fig. 5

(a) Explain how the design allows the person to safely hold the cup with hot drinks.

....

....

....

.... [2]

(b) Two cups of coffee, one in a corrugated cardboard cup, another in a ceramic mug, contains coffee of the same temperature.
After 5 minutes, predict which container will contain coffee with the higher temperature. Explain your answer.

....

....

....

.... [2]

6 Fig. 6 shows a pool of water of depth 1.00 m. Rays of light travel in water from an underwater lamp.

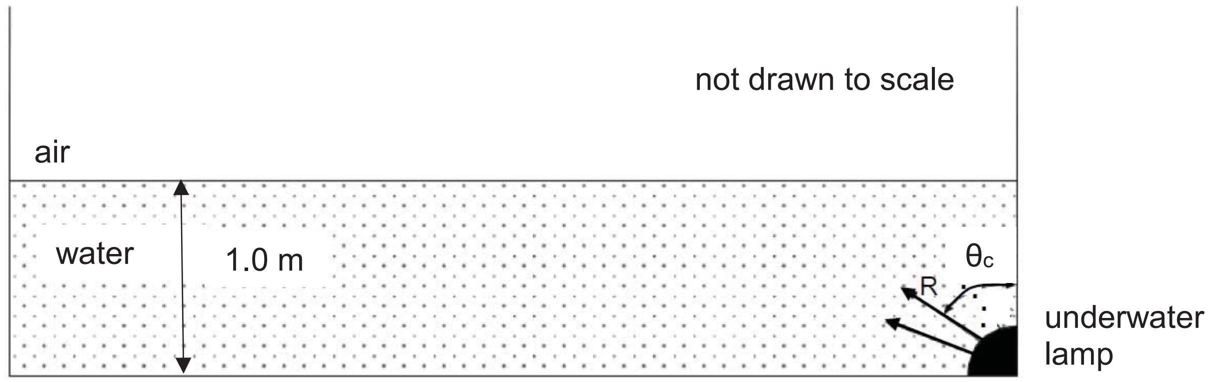


Fig. 6

Given that the refractive index of water in the pool is 1.33.

(a) Determine the speed of light in water.

speed of light in water = ………………………………… [2]

(b) Calculate critical angle, θ_c and complete ray R on Fig. 6

θ_c = ………………………………… [3]

7 Fig. 7 shows an application of electrostatic charges known as electrostatic coating. A nozzle produces paint droplets, all of which are given a positive charge. The metal panel is given a negative charge.

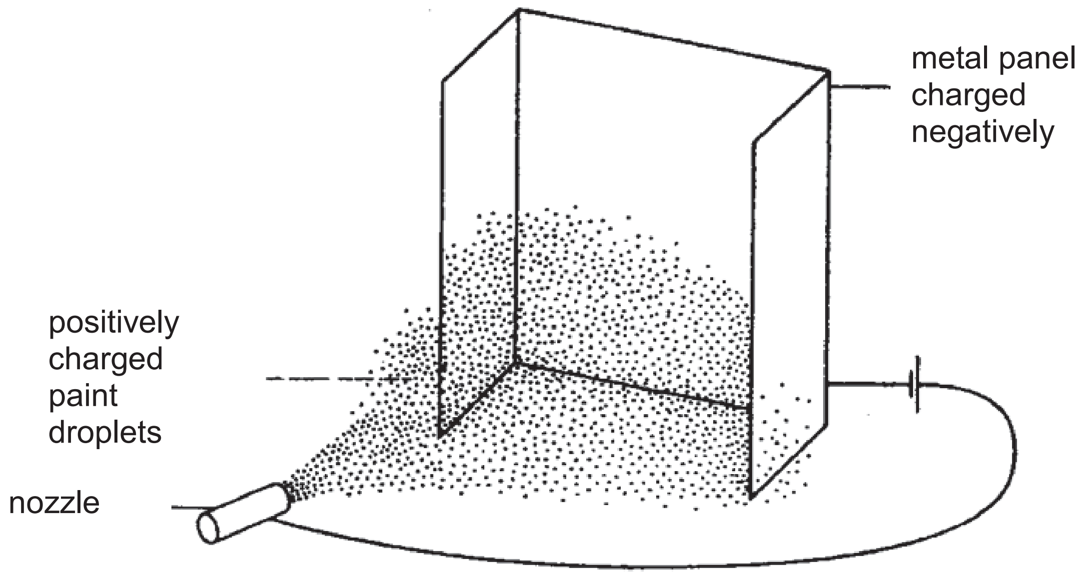


Fig. 7

(a) Explain how this method reduces the amount of paint needed to paint a large surface.

....

....

....

.... [2]

(b) A student suggests that the metal panel can be of neutral charge as the positively charged paint droplets would be attracted to neutral objects too. Explain why his suggestion is not feasible in this context.

....

....

....

.... [2]

8 Fig. 8 shows the circuit of an electric iron with a metal casing connected to the live (L), neutral (N) and earth (E) terminals.

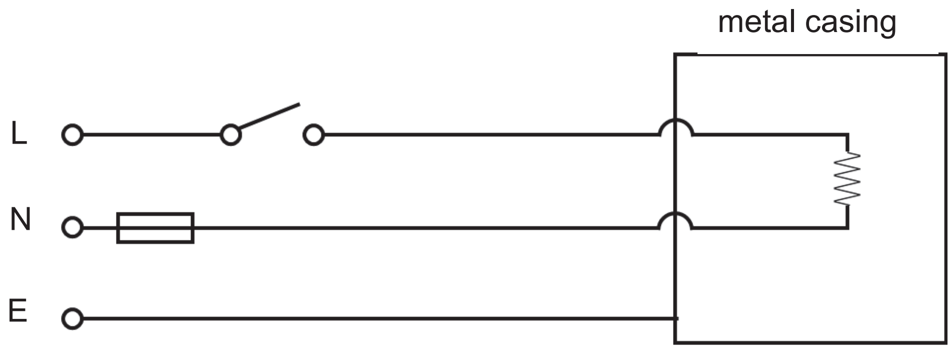


Fig. 8

(a) Explain how the earth wire protects the user from an electrical shock.

....

....

....

.... [2]

(b) There is a hazard in the circuitry in Fig. 8.
Identify the hazard and explain why it is unsafe.

....

....

....

.... [2]

(c) The power rating of the iron is 220 V, 2400 W.

(i) The iron is used for 10 minutes daily for 30 days in a month. How much does it cost if each unit of electricity is $0.20?

cost = …………………………………. [2]

(ii) Determine the power of the iron when it is plugged into a 110 V power socket.

cost = …………………………………. [2]

9 Fig. 9 shows the representation of a step-up transformer.

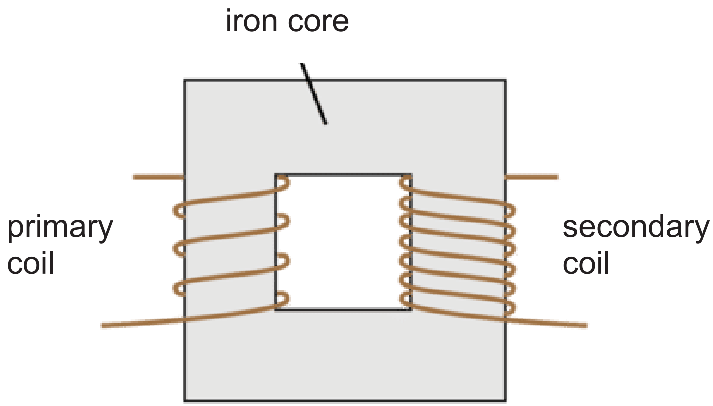


Fig. 9

(a) State one way to increase the secondary voltage of a step-up transformer.

……………………………………………………………………………………....... [1]

(i) Explain the function of the iron core and why it cannot be replaced by steel.

……………………………………………………………………………….........

……………………………………………………………………………….........

……………………………………………………………………………….......... [2]

(b) A step up transformer has an input voltage of 240 V, 13 A, with a turns ratio of 200.

(i) Calculate the output current of the transformer.

Output current = ……………….. [2]

(ii) Explain why step-up transformers are usually used before electricity is transmitted by transmisson cables.

……………………………………………………………………………………..

……………………………………………………………………………………..

……………………………………………………………………………………..

…………………………………………………………………………………….. [2]

Section B
Answer all the questions in this section.
Question 12 is in the form Either / Or.

10 Fig. 10.1 shows some information from the manufacturer of a car.
The kerb mass refers to the mass of the car without passengers and cargo.
The gross mass refers to the mass of the car with passengers and/or cargo.

kerb mass	850 kg
gross mass (with a 70 kg driver)	920 kg
gross mass (with a 70 kg driver and a 70 kg passenger)	990 kg

	with one driver only	with one driver and passenger
maximum acceleration	3.50 m/s^2	3.25 m/s^2
maximum speed	50.0 m/s	50.0 m/s

Fig. 10.1

(a) When the mass of the people in the car doubles from 70 kg to 140 kg, there is only a slight decrease in the maximum acceleration.

Explain why the acceleration did not decrease by half when the mass of people doubled.

....

.... [1]

(b) Calculate the shortest time for the car, with a driver and a passenger inside, to achieve the maximum speed from rest.

time = ... [2]

(c) Ignoring air resistance, calculate the maximum forward thrust of the car engine.

[2]

maximum thrust = ...

(d) The driver takes the car for a test drive without any passenger. While travelling at the maximum speed, the driver sees a police car ahead and applies the brake after 2.0 s. The car decelerates uniformly and comes to rest a short distance away from the police car.

Fig. 10.2 shows how the speed of the car varies with time after the driver sees the police car.

time / s	speed / m/s
0.0	50.0
2.0	50.0
4.0	40.0
6.0	30.0
8.0	20.0
10.0	10.0
12.0	0.0

Fig. 10.2

(i) State what it means by "decelerates uniformly".

…………………………………………………………………………………..

...………………………………………………………………………… [1]

(ii) Calculate the distance travelled by the car during the deceleration.

distance = ……………………. [2]

(iii) Describe how the distance between the car and the police car changes before and after the driver applies the brake.

…………………………………………………………………………………

…………………………………………………………………………………

…………………………………………………………………………………

………………………………………………………………………………….. [2]

11 **(a)** Water is in liquid state at room temperature of 25 °C.

(i) Using kinetic theory of matter, describe the change that occurs when water evaporates.

…………………………………………………………………………………

…………………………………………………………………………………

…………………………………………………………………………………

………………………………………………………………………………… [2]

(ii) State one difference between the molecules in steam and molecules in water.

…………………………………………………………………………………

………………………………………………………………………………….. [1]

(b) Fig. 11.1 shows liquid nitrogen, below its boiling point, stored in a vacuum flask. The boiling point of nitrogen is -196 °C.

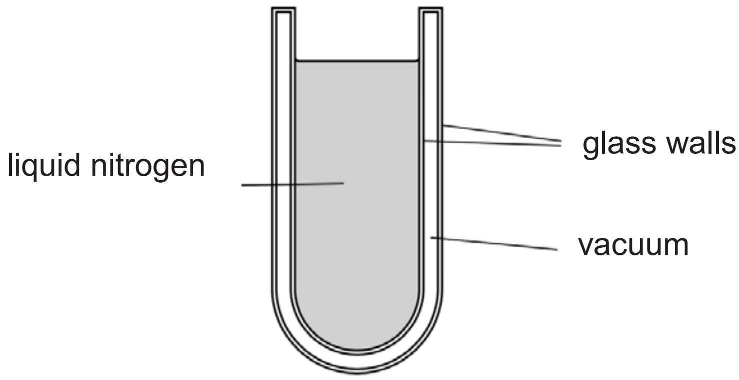


Fig. 11.1

The flask has 2 glass walls with a vacuum between them.
State and explain the purpose of having a vacuum between the two layers of glass walls

…………………………………………………………………………………

…………………………………………………………………………………

…………………………………………………………………………………

…………………………………………………………………………………

…………………………………………………………………………………

………………………………………………………………………………… [3]

(c) The liquid nitrogen reaches its boiling point of -196 °C. A small piece of metal at 20 °C is lowered slowly into the liquid nitrogen. Bubbles form within the liquid nitrogen as it boils. The small piece of metal has a mass of 50 g. When it is lowered into the liquid nitrogen, the metal cools to -196 °C. The specific heat capacity of the metal is 0.39 J/(gK). The specific latent heat of vaporisation of nitrogen is 200 J/g.

(i) Calculate the thermal energy lost by the metal as it cools.

thermal energy lost = ……………………. [2]

(ii) Hence, determine the mass of nitrogen that boils away.

mass of nitrogen = ……………………. [2]

12 Either

A circuit is set up as shown in Fig. 12.1. The resistance of the LDR varies from 800 Ω to 2400 Ω under different brightness.

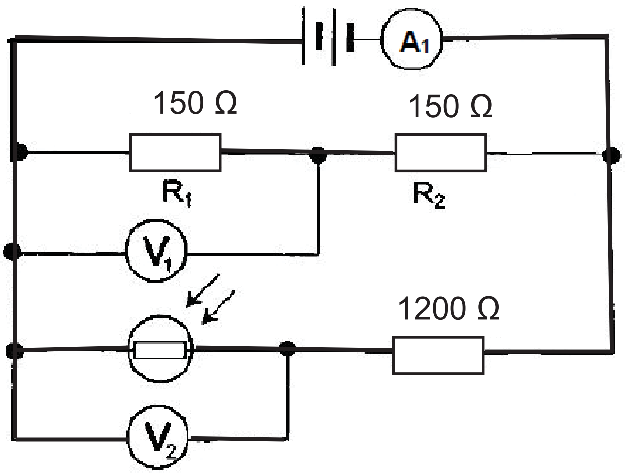


Fig. 12.1

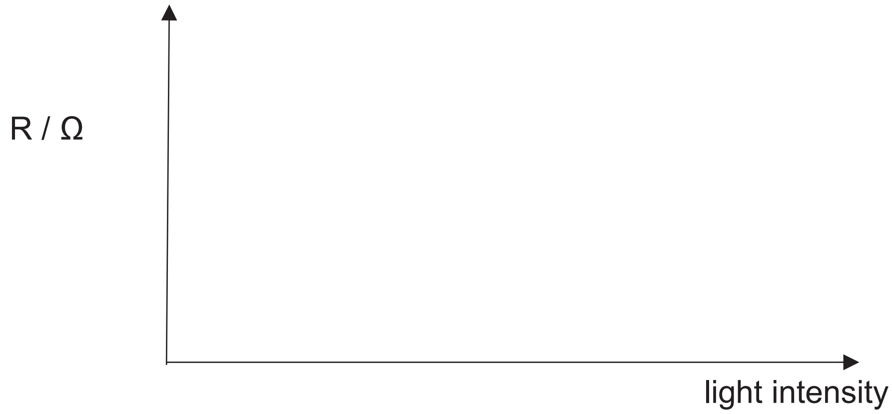
(a) State the voltmeter reading on V_1.

V_1= ……………………… [1]

(b) Calculate the reading shown on the ammeter A_1 when the LDR's resistance is 800 Ω.

reading on A_1= ……………………… [4]

(c) In Fig. 12.2, sketch the graph to show how the resistance of the LDR varies with light intensity



[1]

Fig. 12.2

(d) **(i)** Calculate the voltmeter reading V_2 when the light intensity is low.

V_2= …………………… [2]

(ii) An ammeter A_2 is connected across X and Y as shown by Fig. 12.3. State the direction of current flow and explain your answer.

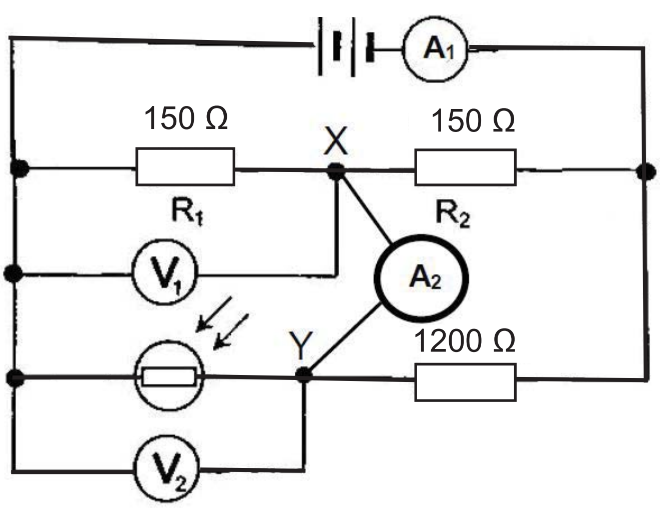


Fig. 12.3

……………………………………………………………………

……………………………………………………………………

……………………………………………………………………

…………………………………………………………………… [2]

12 Or

Fig. 12.4 shows how the vibrations of a modern electric guitar string are picked up by a small coil of wire wound around a cylindrical magnet. The string, which is made of steel, causes an electrical signal to be generated and detected.

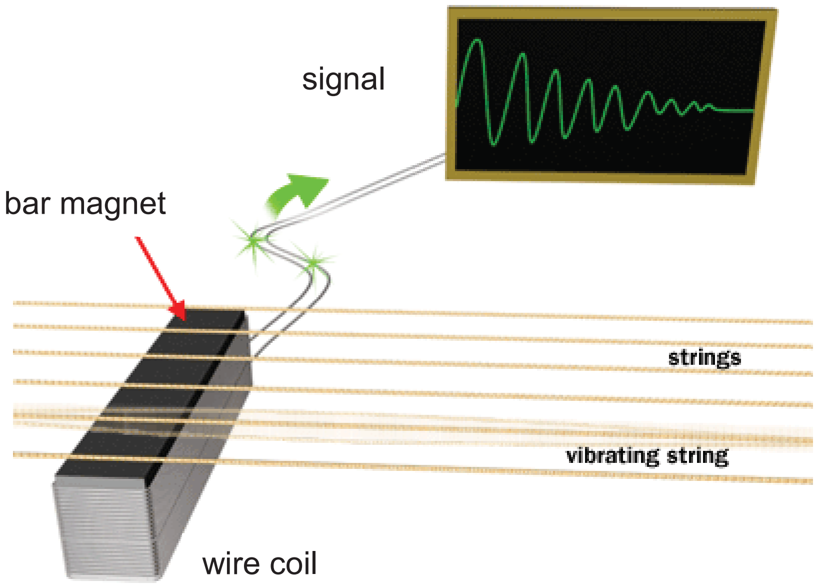


Fig. 12.4

(a) State Faraday's Law of Electromagnetic Induction.

....

....

.... [1]

(b) Using Faraday's Law, explain how the electrical signal is generated.

....

....

....

....

....

.... [3]

(c) State and explain if any signal would be generated if the string of the electrical guitar is changed to nylon.

……………………………………………………………………………………

……………………………………………………………………………………

……………………………………………………………………………………

…………………………………………………………………………………… [2]

(d) Fig. 12.5 shows the display on a screen when the signal of a note is being detected. The horizontal scale indicating the time base is set to 2.0 ms/cm.

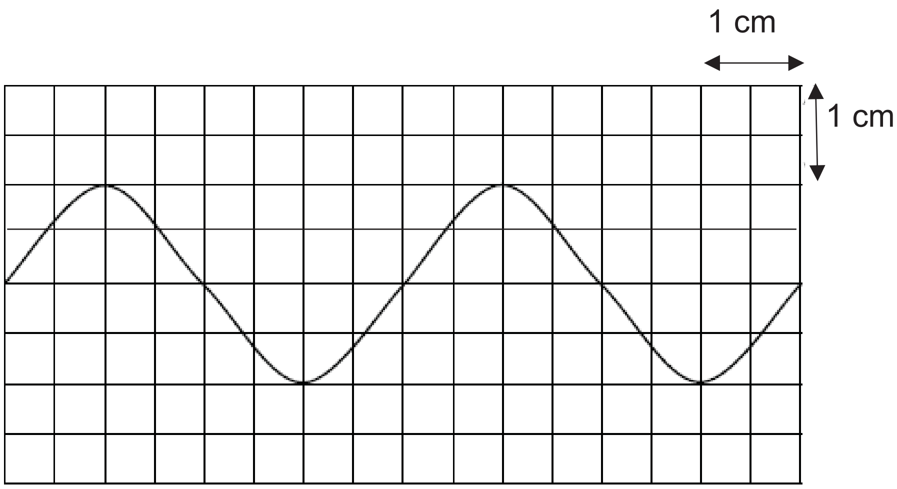


Fig. 12.5

(i) Calculate the frequency of the note being played.

frequency = ………………………………… [2]

(ii) State what happens to the frequency and amplitude of the sound wave when it is played through a loudspeaker.

……………………………………………………………………………………

……………………………………………………………………………………

……………………………………………………………………………………

…………………………………………………………………………………… [2]

End of Paper

ADMIRALTY SECONDARY SCHOOL

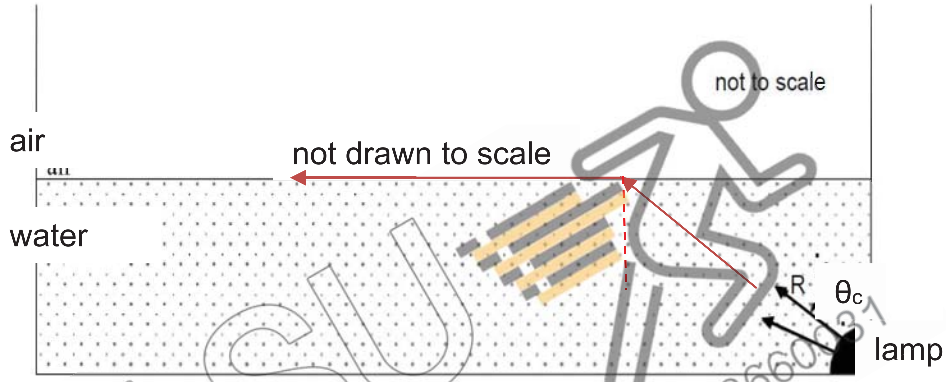
4E PPhy 6091 Prelims 2019 Marking Scheme

1.	B	2.	A	3.	B	4.	C	5.	A	6.	D	7.	A	8.	A	9.	B	10.	A
11.	B	12.	A	13.	A	14.	C	15.	D	16.	A	17.	D	18.	D	19.	C	20.	C
21.	C	22.	C	23.	C	24.	C	25.	A	26.	D	27.	A	28.	A	29.	B	30.	C
31.	D	32.	B	33.	A	34.	B	35.	B	36.	A	37.	D	38.	B	39.	D	40.	C

Paper 2 Section A

Qn No		Answers	mks
1	**(a)**	Total distance = area under graph = 0.5 x 64 x 50 = 1600 m	 [1] [1]
	(b)	Gravitational field strength = acceleration on planet X = 64/ 32 (or equivalent for gradient of graph) = 2.0 N/kg or 2.0 ms^{-2}	 [1] [1]
	(c)	Weight = mass x gravitational field strength = 150 x 2 = 300 N	 [1] [1]
2	**(a)**	Gravitational potential energy = mgh = (200 x 1000) x 10 x 1.2 = 2400 000 J Power required = 2 400 000 x 100 / 80 = 3 MW	 [1] [1] [1]
	(b)	Water needs to be raised higher than the sea level to be discharged Water cannot be drawn from the surface of the water from the reservoir / water is drawn from below the water surface Energy may be lost to friction in the process Hence the height difference is greater than 1.2m, resulting in the higher power input needed.	[2]
3	**(a)**	Movable weight exerts a clockwise moments and keeps the safety valve closed. When the steam is excessive, it will exert a large force on the safety valve, exerting an anti-clockwise moment. When the anti-clockwise moment from the steam is greater than the clockwise moment, steam releases from the safety valve.	[1] [1] [1]
	(b)	Clockwise moments = anti-clockwise moments 400 x 75 = F x 10 F = 3000 N	 [1] [1]
	(c)	Lower the weight of the movable weight Move the movable weight closer to the pivot Increase the surface area of the safety valve Shift the pivot to the right (any 1) To reduce the clockwise moments	[1] [1]
4	**(a)**	P = hρg = 0.15 x 1200 x 10 = 1800 Pa	 [1] [1]
	(b)	P = hρg 1800 = 0.24 x ρ x 10	 [1]

		750 kg /m^3= ρ	[1]

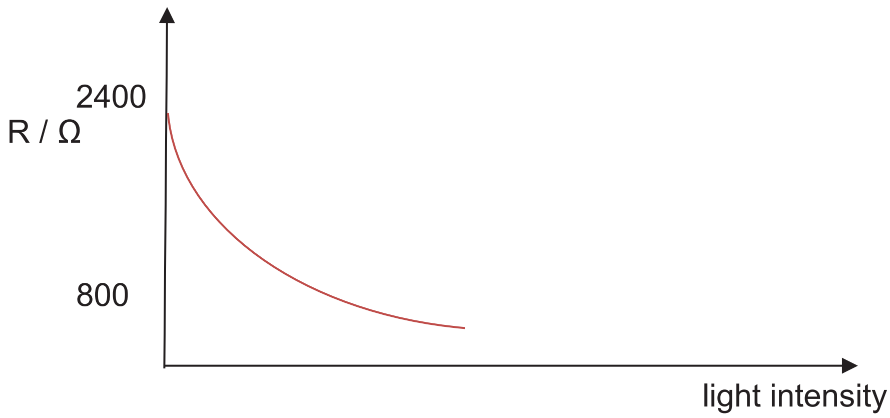
5	(a)	Layer of air in the gap Air is a poor conductor of heat, hence reducing heat conducted to hand Or less contact area with the hand. less surface area results in less conduction from the cup to the hand, hence the person holding the cup will feel less hot.	[1] [1]
	(b)	Coffee in corrugated cardboard Poor conductor of heat compared to ceramic, where the molecules are more closely packed together as solid, than gas.	[1] [1]
6	(a)	v=c/n = 3 x 10^8 / 1.33 = 2.26 x 10^8 m/s	 [1] [1]
	(b)	 n=1 / sin c 1.33 = 1/ sin c c= 48.8°	[1] [1] [1]
7	(a)	Paint droplets repel one another Spreads out uniformly to cover more area with same amount of paint	[1] [1]
	(b)	Metal panel would be positively charged due to conduction and repel other paint droplets.	[1] [1]

8	(a)	Earth wires connects to the metal casing. In the event that the live wire accidentally touches the metal casing, causing it to go 'live', the earth wire conducts away to earth, preventing electric shock from the user who touches the metal casing	[1] [1]
	(b)	Fuse should not be at neutral / should be at live wire In case of excessive current, the fuse may blow but the appliance might still be 'live'.	[1] [1]
	(c)i	Total energy = 2.4 x 10/60 x 30 = 12 kWh Cost = 12 x \$0.2 = \$2.40	 [1] [1]
	(c)ii	P = V^2/R 2400= 220 ^{2} /R R = 20.2 Ω P = 110 ^{2} /20.2 = 600 W	 [1] [1]

9	(a)i	Increase number of coil on the secondary coil	[1]
	(a)ii	Iron is easily magnetised and demagnetised Ensuring better magnetic flux linkage between the 2 coils. Steel does not magnetise or demagnetise easily. It is the change of magnetic flux that is able to induce a current, and hence an induced emf, in the secondary coil.	[1] [1]
	(b)i	$V_pI_p=V_sI_s$ 240 x 13 = (240 x 100) x I_s I_s = 0.13 A	 [1] [1]
	(b)ii	Reduce energy loss during transmission Since heat loss is P = I^2R, the lower the current, the lower the energy loss during transmission.	[1] [1]

Section B Structured Answers			
10	(a)	Although the mass of the people in the car doubled, the total mass only increased slightly, hence by F = ma, the acceleration did not decrease by half.	[1]
10	(b)	Time = speed / acceleration =50 / 3.25 = 15.4 s	 [1] [1]
	(c)	F = 990 x 3.25 = 3217.5 N **OR** F = 920 x 3.50 = 3220 N	[2]
	(d)i	Rate of decrease of velocity is constant.	[1]
	(d)ii	Distance travelled = 0.5 x 50 x (12-2) = 250 m	[1] [1]
	(d)iii	Before applying the brakes, the distance between the car and the police car decreases by 50m per second. After applying the brakes, the distance between the car and the police car decreases by less than 50m per second.	[1] [1]
11	(a)i	When water evaporates, the liquid molecules vibrate randomly at different speeds, Molecules at the surface that have enough energy to overcome the downward attractive forces of other molecules will leave the surface.	[1] [1]
	(a)ii	Molecules in steam move at high speed while molecules in water moves at slow speed. OR Molecules in steam is at boiling point, while molecules in water in not at boiling point OR Molecules in steam are far apart from each other but molecules in water are closely packed together	[1]
	(b)i	Reduce heat gain by liquid nitrogen through conduction. Vacuum does not conduct as it removes the medium, which is required for conduction to take place, hence keeping the liquid nitrogen in liquid state.	[1] [1] [1]
	(c)i	Q = mc $\Delta\theta$ = 50 x 0.39 x (-196-20) = 4212 J	 [1] [1]
	(c)ii	Q = ml_v 4212= m (200) M = 21.1 g	 [1] [1]

12 Either			
	(a)	3.0 V	[1]
	(b)	$\frac{1}{total\ R} = \frac{1}{150+150} + \frac{1}{800+1200}$ R = 261 Ω V = IR 6= I (261)	[1] [1] [1]

		I = 0.023 A	[1]
	(c)	 Fig. 12.2	[1]
	(d)i	V = 2400 / 3600 = 4.0 V	[1] [1]
	(d)ii	X to Y X has a greater potential of 3.0 V than Y at 2.0 V.	[1] [1]

12 Or			
	(a)	Faraday's Law of electromagnetic induction states that the magnitude of the induced EMF in a circuit is directly proportionate to the rate of change of magnetic flux in the current.	[1]
	(b)	When the string vibrations, the magnetic flux linking the coil changes. The change in magnetic flux generates an induced current. The induced current creates an induced emf in the coil, causing the signal to be generated.	[1] [1] [1]
	(c)	No signal will be generated. There is no change of magnetic flux as nylon is not an electrical conductor.	[1] [1]
	(d)i	Period = 8 ms Frequency = 1 / 0.008 = 125 Hz	[1] [1]
	(d)ii	Frequency remains the same Amplitude of the sound wave increases.	[1] [1]

Paper 3

1	(a)i	L = 2.5 cm d = 1.4 cm	[1]
	(a)ii	It is the diameter of a circle, and it is difficult to ensure that the measurement passes through the center of the circle, to take repeated reading from different sides and take the average. Or Difficult to determine the inner diameter, can use a inner jaw of Vernier calipers	[1]
	(a) iii	Disagree. $\pi(d/2)^2$ is the area of the circle, not circumference, so the total uncoiled length equation is not correct.	[1] [1]
	(b) i	L_1 = 8.0 cm e = 5.5 cm	[1] [1]
	(b)ii	T = 0.17 x 5.5 = 0.935 N	[1]
	(c)i	A = 60.0 cm B = 40.0 cm C = 80.0 cm	[1]
	(c)ii	W_r (0.600) + 0.9 (0.400) = 0.935 W_r = 0.958 N (actual mass is 100g)	[1] [1]
2	(a)	60.0 cm (accept 58.0cm to 62.0cm, must be 1 dp)	[1]
	(b)i	27.1s (accept 25.0s – 30.0s)	[1]
	(b)ii	T = 1.36s $T^2 = (1.36)^2 = 1.85\ s^2$	[1] [1]
	(c)	Human reaction time of starting and stopping of the stopwatch.	[1]
	(d)	Constant variable: mass of bob, distance between cork and table Description of experiment that will fulfil requirements Accurate results: take more readings then obtain the average / take time for more oscillations and then take the period. Graph of T^2 vs h m is the gradient of the graph. H can be determined from substitution of values from a point on the best fit line	[1] [1] [1] [1] [1]
3	(a)	3.0 V or measured value	[1]
	(c)	d = 10.0 cm, I = measured value to precision of 2d.p. (precision of given ammeter)	[1]
	(d)	Measured value as per correct precision and units. d / mm , I / A , V / V , 1/I / A^{-1}	[4]

	(e)	Graph of d/mm (y-axis) vs 1/I / A^{-1} (x-axis) - axes Plot - plot Best fit line - graph More than half the page - scale	[1] [1] [1] [1]
	(i)	Gradient = $(y_2-y_1) / (x_2-x_1)$ = 300 (accepted 200-500)	[1] [1]
	(ii)	Using linear law, y=mx+c Sub d = 0 (meaning **y = 0** for the graph), use a selected point on the best fit line to find the I_0.	[1] [1]
	(iii)	500	[1]
	(d)i	R = 100 E / $I_0 d_0$ (using values found above) = 10Ω (approx.)	[1] [1]
	(d)ii	Kinks in the resistance wire	[1]
	(d)iii	Take readings from portions of the wire that does not have kinks.	[1]
	(e)	Graph with a steeper gradient	[1]

Class	Register Number	Name

BARTLEY SECONDARY SCHOOL

GCE O-LEVEL PRELIMINARY EXAMINATIONS

PHYSICS **6091/01**

Sec 4 Express

Paper 1 Multiple Choice **4 Sep 2019**

1 hour

Candidates answer on the Multiple Choice Answer Sheet.
Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write your class, register number and name on all the work you hand in.
Do not use staples, paper clips, highlighters, glue or correction fluid.

There are **forty** questions in this paper. Answer **all** questions. For each question there are four possible answers, **A, B, C** and **D**.

Choose the **one** you consider correct and record your choice in soft pencil on the separate Multiple Choice Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
The use of an approved scientific calculator is expected, where appropriate.

At the end of the examination, submit the Multiple Choice Answer Sheet.

This document consists of **20** printed pages.

Set by: LHL **[Turn over**

Answer **all** questions.

For each question, there are four possible answers **A**, **B**, **C** and **D**.

Choose the **one** you consider correct and shade your choice on the Multiple Choice Answer Sheet.

1 Which of the following shows the best estimate of the diameter of Earth?

A 1.3×10^3 km **B** 1.3×10^4 km

C 1.3×10^5 km **D** 1.3×10^6 km

2 A micrometer is used to measure the thickness of a metal sheet.

Diagram 1 shows the reading on the micrometer when it is tightened with nothing between the jaws. Diagram 2 shows the reading taken with the metal sheet between the jaws.

diagram 1

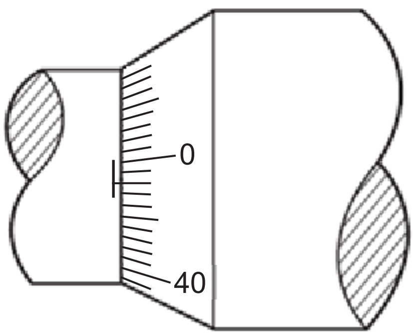
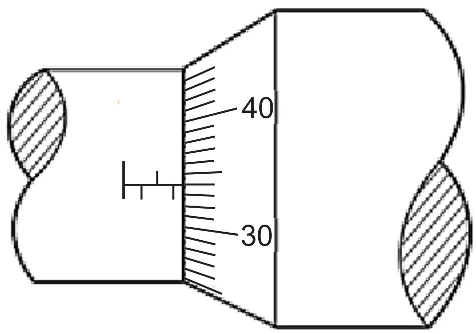


diagram 2

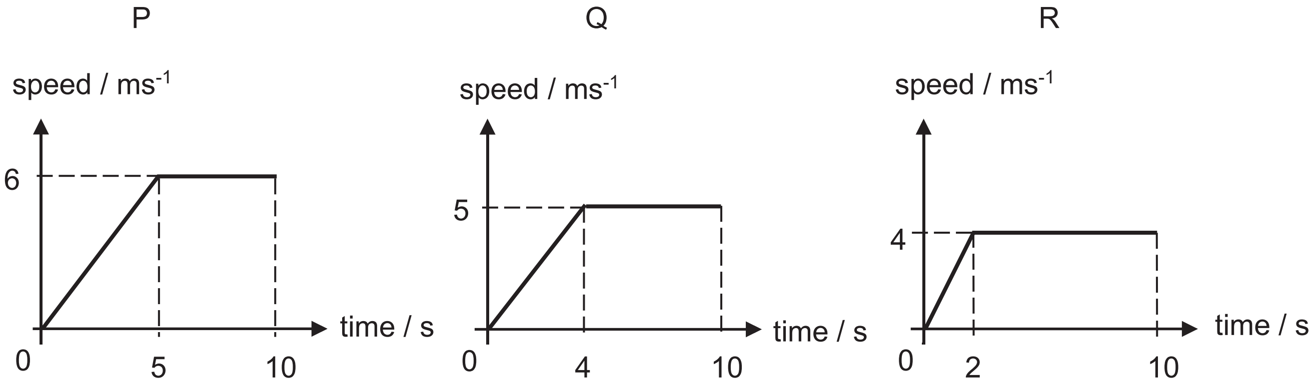


What is the thickness of the metal sheet?

A 1.82 mm **B** 1.86 mm

C 3.32 mm **D** 3.36 mm

3 Three boys P, Q, and R participated in a race against one other. They started from the same starting point. The three diagrams show their speed-time graphs.



Which statement about the positions of the boys after 10 s of the race is correct?

A P leads Q and R

B Q leads P and R

C R leads P and Q

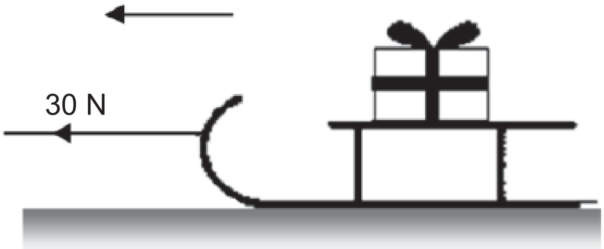
D P and R share first place

4 A skydiver falls at terminal velocity. He then opens his parachute.

Which row gives the direction of the resultant force on the skydiver and the direction of the acceleration of the skydiver, **immediately** after the parachute opens?

	resultant force	acceleration
A	downwards	downwards
B	downwards	upwards
C	upwards	downwards
D	upwards	upwards

5 A sledge of mass 15 kg is pulled across a level ground with a constant speed of 0.50 ms^{-1} by a horizontal force of 30 N.

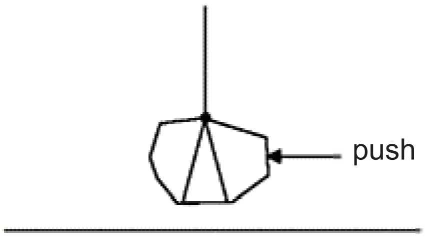


What is the frictional force experienced by the sledge?

A 7.5 N **B** 23 N

C 30 N **D** 120 N

6 A rock is hung from a rope and given a sideways push close to the surface of the Earth.



If the same arrangement were to be given the same sideways push close to the surface of the Moon, what would happen to the rock?

A The rock will move with more ease as it has less mass.

B The rock will move with more ease as it has less weight.

C The rock will move with the same ease as it has the same mass.

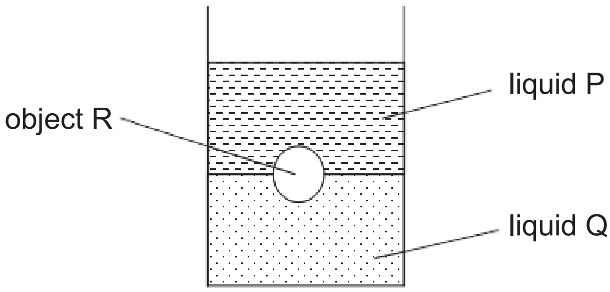
D The rock will move with the same ease as it has the same weight.

7 An astronaut conducted an experiment on Mars in which she placed a rock on a spring balance and then on a beam balance. The gravitational field strength of Mars is larger than that of the Moon.

Which set of results is correct when the same experiment with the same rock was conducted on the Moon?

	spring balance reading	beam balance reading
A	greater than in Mars	less than in Mars
B	greater than in Mars	same as in Mars
C	smaller than in Mars	less than in Mars
D	smaller than in Mars	same as in Mars

8 Two immiscible liquids, P and Q, are poured into a beaker. After the liquids have settled, an object R is placed in the beaker. The diagram below shows the final position of object R.



What conclusion can be made?

A Object R is denser than both liquids P and Q.

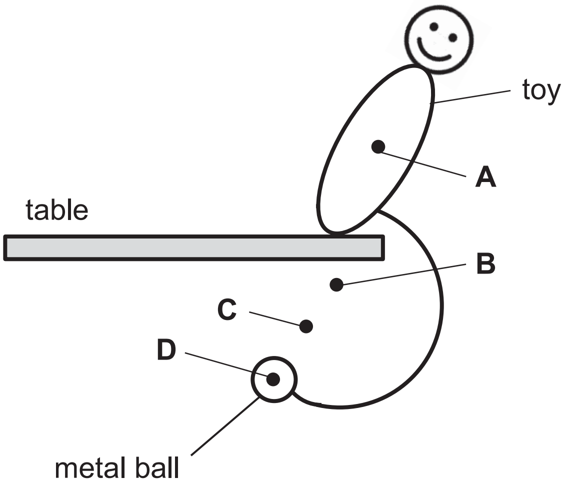
B Object R is denser than liquid P but less dense than liquid Q.

C Object R is denser than liquid Q but less dense than liquid P.

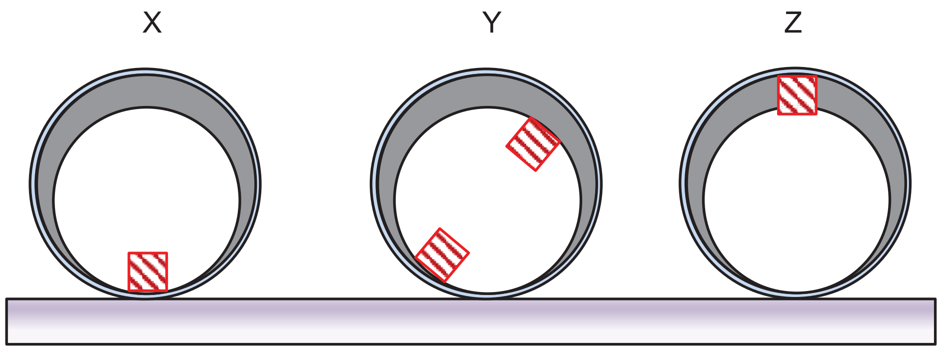
D Object R is less dense than both liquids P and Q.

9 The diagram shows a toy balanced on the edge of a table and at rest. The toy has a metal ball attached to it.

Where is the likely centre of gravity of the toy?



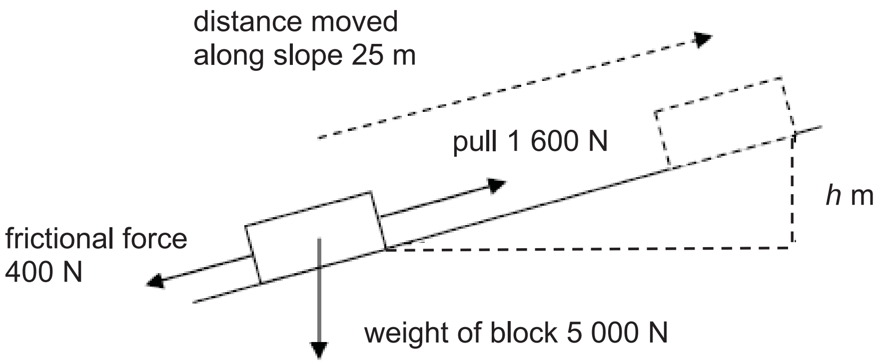
10 Three identical hollow pipes X, Y and Z have one or two identical weights attached to their inner surfaces as shown below.



Which row best describes the stability of the pipes?

	X	Y	Z
A	neutral equilibrium	stable equilibrium	unstable equilibrium
B	neutral equilibrium	unstable equilibrium	stable equilibrium
C	stable equilibrium	neutral equilibrium	unstable equilibrium
D	stable equilibrium	unstable equilibrium	neutral equilibrium

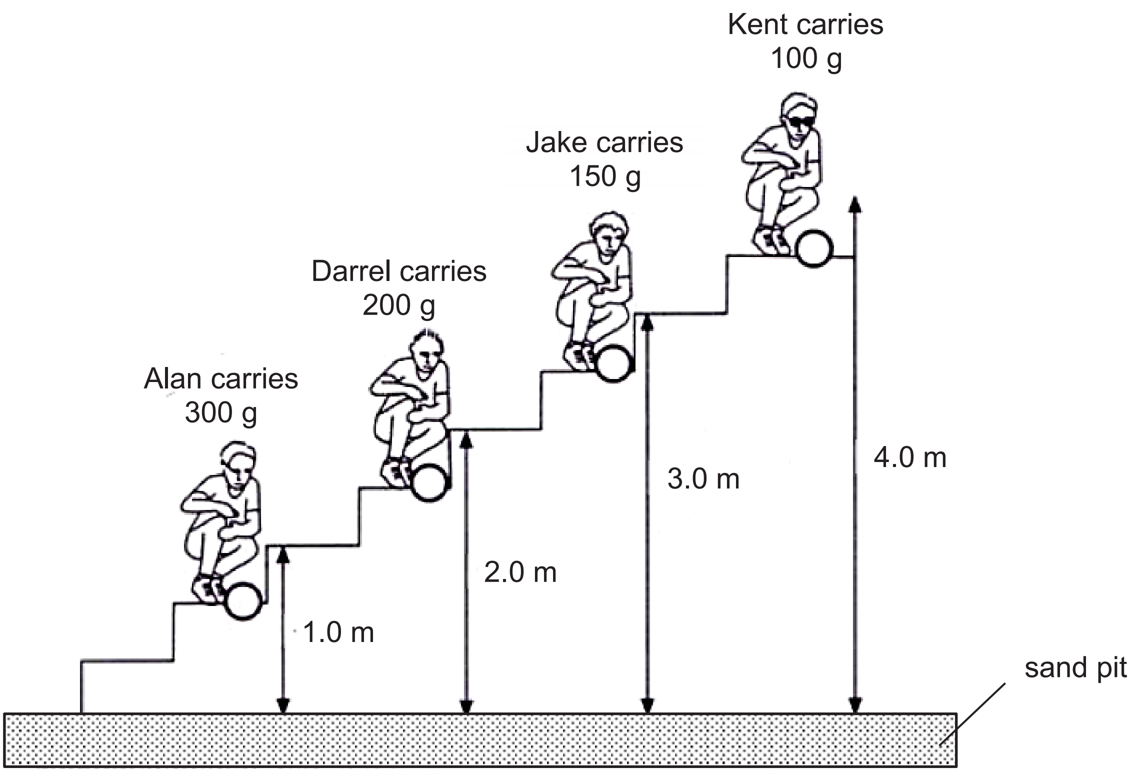
11 A block was pulled up along a slope.



What is the magnitude of *h*, the increase in vertical height of the block?

A 2.0 m **B** 6.0 m
C 8.0 m **D** 10 m

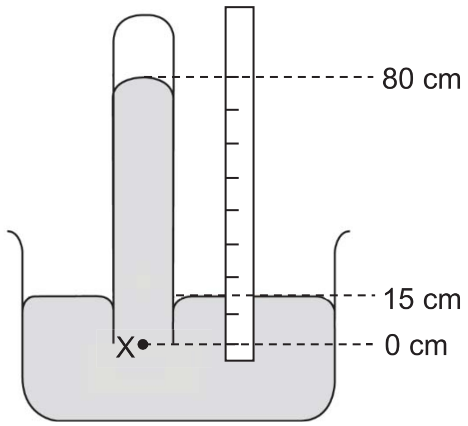
12 Alan, Darrel, Jake and Kent squat on concrete steps as shown. Each person carries a sphere which is of the same size but of different mass. They drop the spheres onto a smooth level sand pit.



Who carries the sphere which will sink the deepest in the sand?

A Alan
B Darrel
C Jake
D Kent

13 A simple mercury barometer is used to measure atmospheric pressure as shown below.



What is the pressure at X?

A 150 mm Hg

B 650 mm Hg

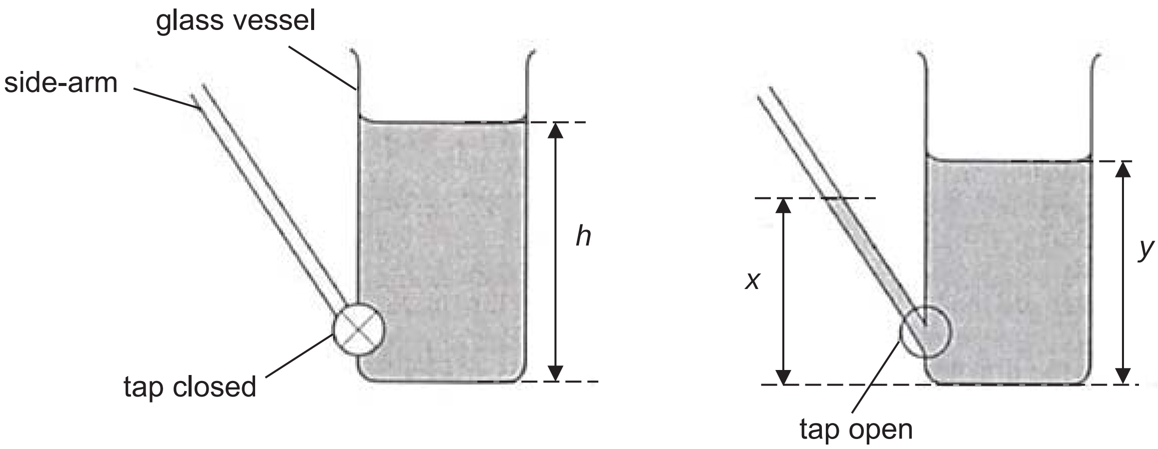
C 800 mm Hg

D 950 mm Hg

14 A glass vessel is connected to a side-arm through a tap.

With the tap closed, the depth of water in the vessel is *h*. When the tap is opened, water flows into the side-arm. The depth of water in the vessel falls.

The diagram on the right shows the water levels before they have settled.



When the levels have settled, which statement is true?

A $h = x$

B $y = x$

C $h = y + x$

D $h = y - x$

15 A fixed mass of gas is compressed while kept at constant temperature.

How will the properties of the molecules of the gas change?

	average distance between molecules	frequency of collisions between the molecules and the walls of the container	average speed of molecules
A	decreased	decreased	increased
B	decreased	increased	no change
C	increased	decreased	no change
D	no change	increased	decreased

16 A centimetre scale is fixed next to an unmarked mercury-in-glass thermometer. At ice point the length of the mercury thread is 1.5 cm. At 60 °C, the length of the mercury thread increases to 9.5 cm.

What is the length of the mercury thread at steam point?

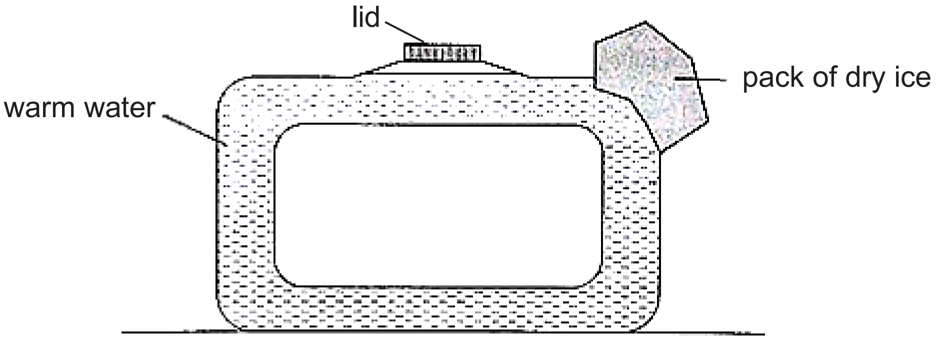
A 13.3 cm **B** 14.3 cm
C 14.8 cm **D** 15.8 cm

17 A Brownian motion experiment involving smoke particles in air was conducted.

What best explains why heavy particles settle down quickly but very small particles remain suspended for long period of time?

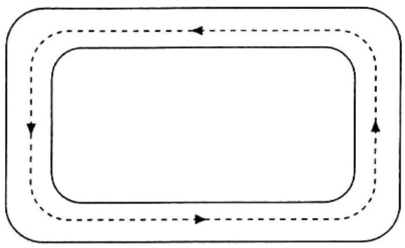
A Air pressure has a greater effect on smaller particles.
B Random molecular bombardment by air molecules keeps the small particles suspended.
C The earth's gravitational field does not act on very small particles.
D The small smoke particles have the same density as air.

18 A student filled an upright ring-shaped container completely with warm water. He then placed a pack of dry ice at a corner of the container.

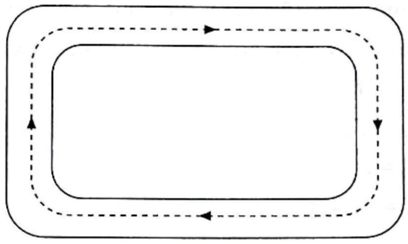


Which diagram correctly illustrates the convection current that was set up?

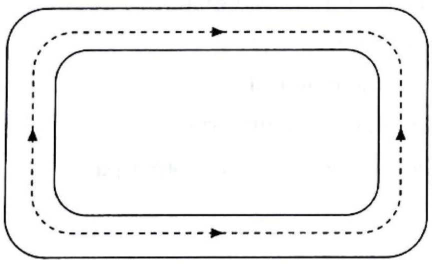
A



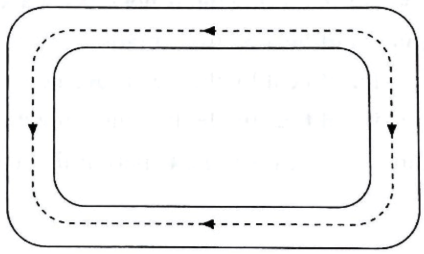
B



C

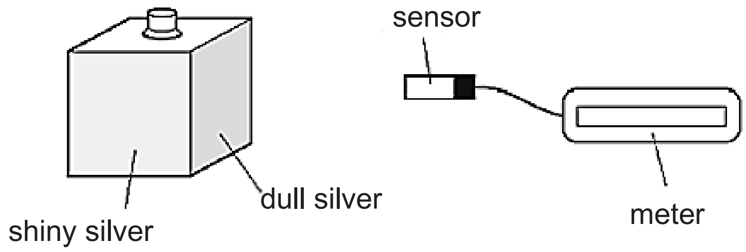


D



19 A metal box has four different surfaces of equal area: dull black, shiny black, dull silver and shiny silver.

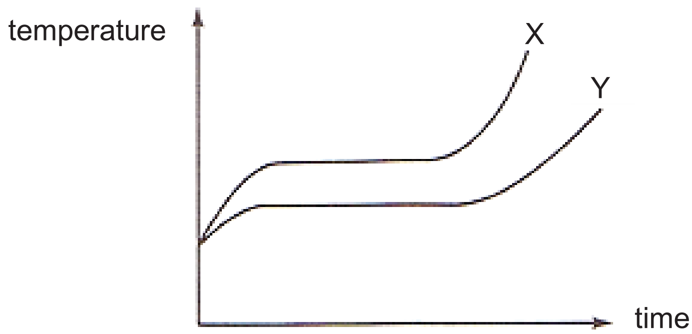
The box is filled with boiling water so that each surface is at the same temperature. A sensor measures the amount of radiation from each surface.



Which surface emits radiation at the slowest rate and which surface emits radiation at the fastest rate?

	emits radiation slowest	emits radiation fastest
A	dull black	shiny silver
B	dull silver	shiny black
C	shiny black	dull silver
D	shiny silver	dull black

20 Two liquids X and Y of equal weight are put in identical vessels, and thermal energy is supplied to them at the same rate. The temperature-time graphs are as shown.



Which statement(s) is(are) true?

I Y has a higher freezing point than X.

II Y at liquid state has a larger specific heat capacity compared to X at liquid state.

III Y has a larger specific latent heat of vaporisation than X.

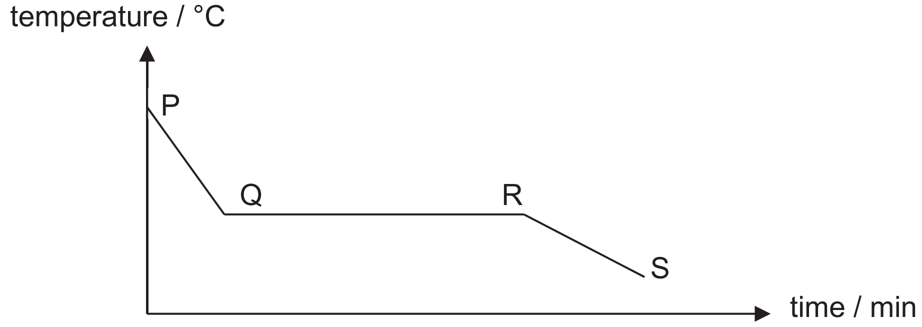
A II only

B III only

C I and II only

D II and III only

21 Some wax in a test tube was heated till it melted. It was then allowed to cool. The temperature-time graph during the cooling process is shown.



Which statement is correct?

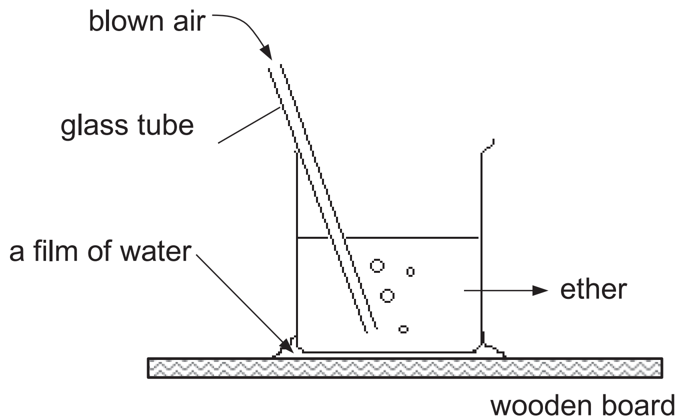
A Along PQ, the molecules gain internal energy.

B Along QR, the molecules lose kinetic energy.

C Along QR, the molecules lose potential energy.

D Along RS, the molecules gain potential energy.

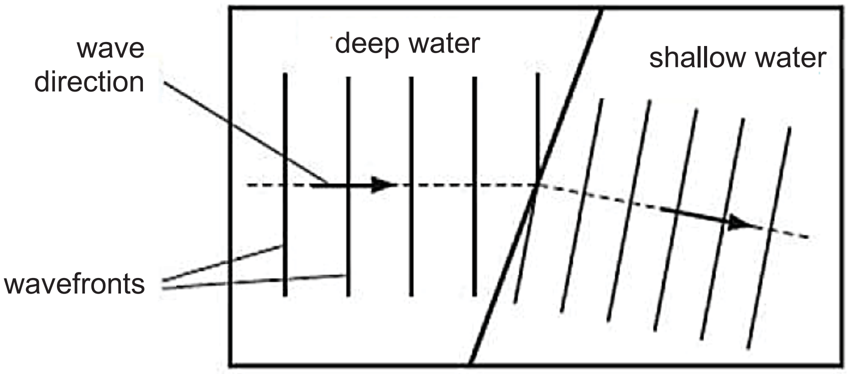
22 Air is blown into ether through the glass tube as shown in the diagram.
After some time, it is observed that the film of water freezes into ice.



Which option best describes the processes that result from blowing the air?

	rate of evaporation of ether	temperature of ether	heat transfer
A	decreases	falls	from ether to water
B	decreases	rises	from ether to water
C	increases	falls	from water to ether
D	increases	rises	from water to ether

23 Water waves can be used to demonstrate refraction by passing them in a trough of water of different depths.



Which statement describes why the water wave changes direction as it passes into shallow water?

A The frequency of the wave decreases.

B The frequency of the wave increases.

C The speed of the wave decreases.

D The speed of the wave increases.

24 Which statement about the components of the electromagnetic spectrum is **not** correct?

A Microwaves have shorter wavelengths compared to those of radio waves and they are used in airport security to detect metallic objects in passengers' baggage.

B Radio waves have lower frequencies compared to those of gamma rays and they are used in television broadcasts.

C Visible light have higher frequencies compared to those of microwaves and they are used in lasers to weld metals together.

D X-rays have shorter wavelengths compared to those of ultraviolet rays and they are used to check flaws in metal welds.

25 A student holds a sheet of paper with letters on it facing a plane mirror. The letters on the paper are shown below.

What does the student see in the mirror?

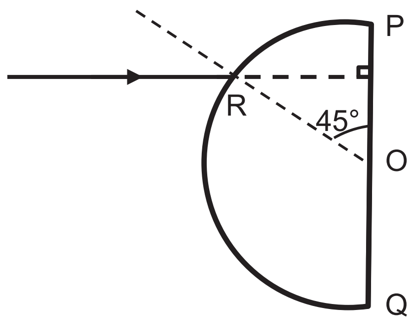
A

B

C

D

26 The figure shows a semi-circular glass slab with centre O. The glass has a critical angle of 45°.



What happens when a ray of light, perpendicular to the diameter POQ, is incident at R?

A The light ray emerges at O.

B The light ray emerges at some point between O and P.

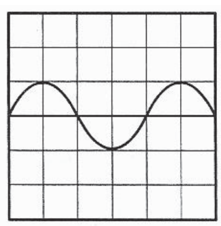
C Total internal reflection occurs at O.

D Total internal reflection occurs at some point between O and P.

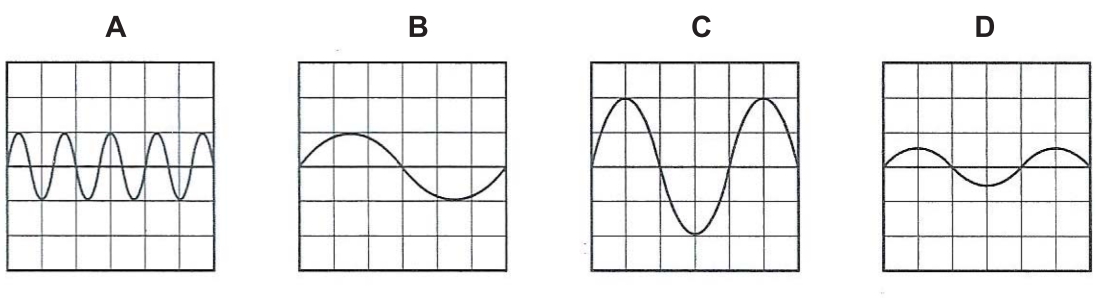
27 The converging lens in a camera is used to make an image on a film.

At which point could an object be placed so that it forms a diminished image?

28 The diagram shows the trace on a cathode-ray oscilloscope when a microphone which is connected to it picks up a sound.



Which trace is obtained when the sound wave is changed to one that has the same loudness but of higher pitch?



29 An attendant is filling up a car with petrol at a petrol station.

Which of the following describes how electrostatic charges becomes a hazard?

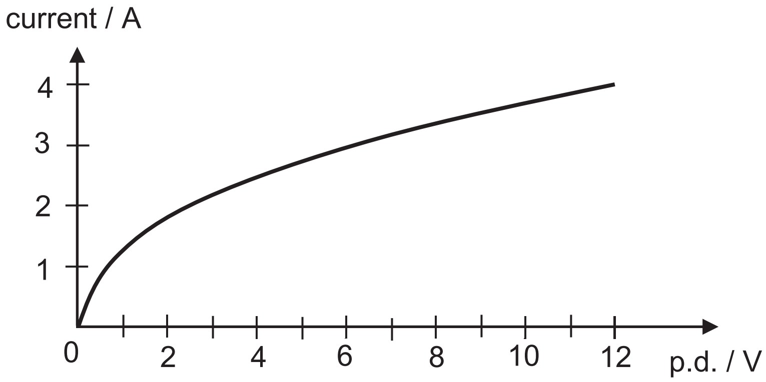
A As the car is filled with petrol, the petrol vapour gets ignited by the sparks between the attendant and the car when they discharge accidentally.

B As the car is not earthed, charges on the car ignite the fuel inside the car's petrol tank.

C Charges on the car flow through the hose to the underground petrol reservoir, causing the petrol to catch fire.

D The attendant gains charges due to friction of his clothes and he gets an electric shock when he touches the car.

30 The graph shows how the current flowing through a 12 V lamp varies with the potential difference (p.d.) across the lamp.



From the graph, which statement correctly describes the resistance of the lamp as the p.d. increases?

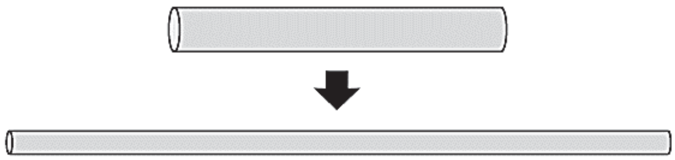
A The resistance of the lamp decreases throughout the voltage range.

B The resistance of the lamp increases at first and then decreases.

C The resistance of the lamp increases throughout the voltage range.

D The resistance of the lamp remains constant.

31 A piece of wire initially has a resistance of 48 Ω. This wire is then stretched evenly until it is twice its initial length as shown below. The volume of the wire remains unchanged.

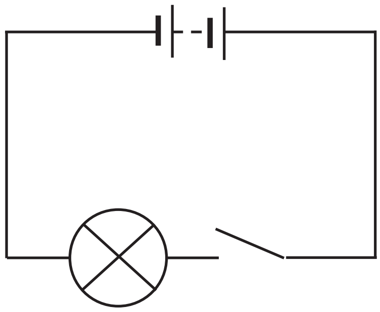


What is the new resistance of the wire?

A 48 Ω **B** 96 Ω

C 192 Ω **D** 384 Ω

32 A filament lamp is connected to a 12 V battery as shown.



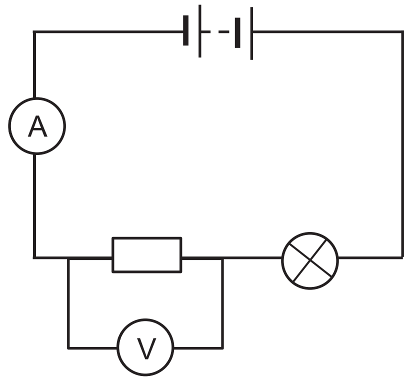
When the circuit is switched on for 2.0 minutes, 4.0 C of charges flow through the circuit.

What is the amount of electrical energy that is converted into light and thermal energy in the lamp?

A 6.0 J **B** 24 J

C 48 J **D** 96 J

33 A d.c. circuit is set up as shown. The *electromotive force* of the battery is 12 V.



What is meant by the *electromotive force* of the battery is 12 V?

A It takes 1.0 s to drive 12 C of charge around the circuit.

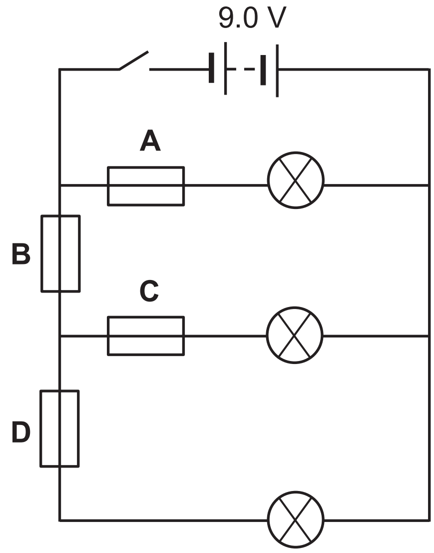
B It takes 12 s to drive 1.0 C of charge around the circuit.

C It takes 1.0 J of energy to drive 12 C of charge around the circuit.

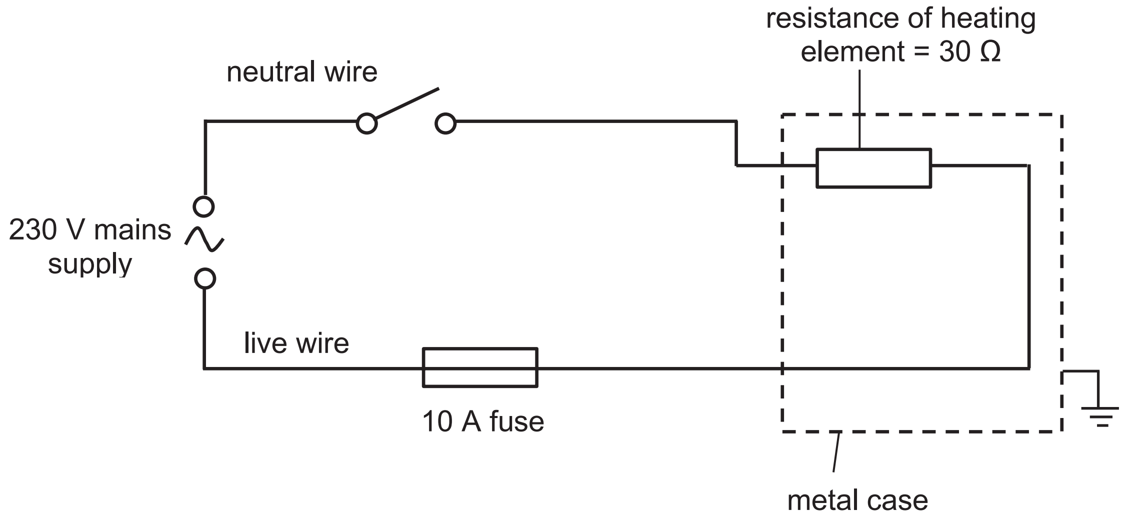
D It takes 12 J of energy to drive 1.0 C of charge around the circuit.

34 Each lamp in the circuit below is rated 9.0 V, 36 W. **A, B, C** and **D** are 6 A fuses.

Which fuse will blow when the switch is closed?



35 The diagram shows the circuit formed when a rice-cooker is plugged into a mains socket.



What is the fault in this circuit arrangement?

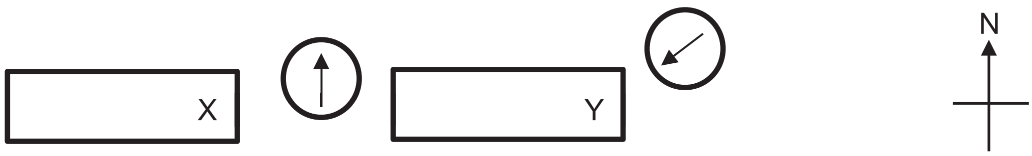
A The earth wire is connected wrongly.

B The fuse is connected to the wrong wire.

C The fuse rating is too low.

D The switch is connected to the wrong wire.

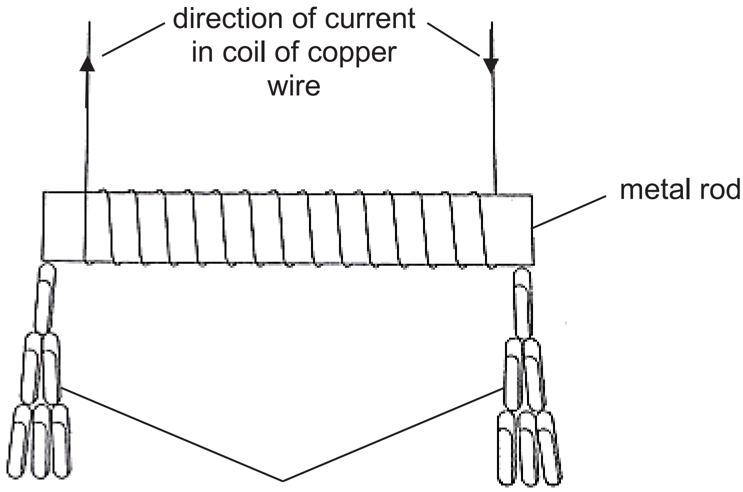
36 The diagram shows the direction of the compass needle when placed near two bar magnets.



What are the likely poles at X and Y?

	pole at X	pole at Y
A	North	South
B	North	North
C	South	North
D	South	South

37 Four metal rods are placed, one at a time, inside a coil of copper wire.



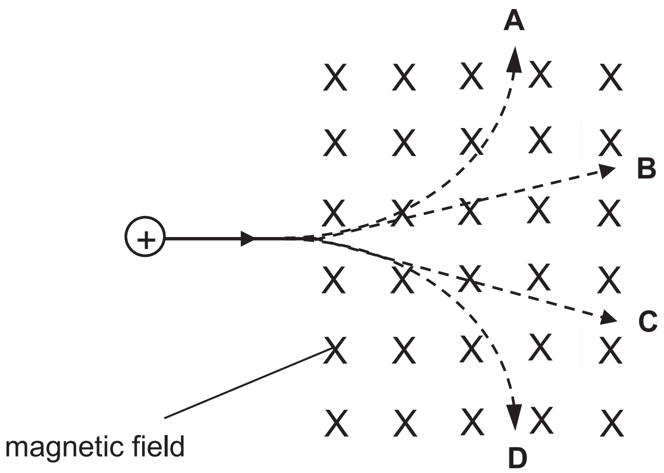
The table below gives the results of the experiment.

Which rod would be the most suitable to use for the core of a coil in a circuit breaker?

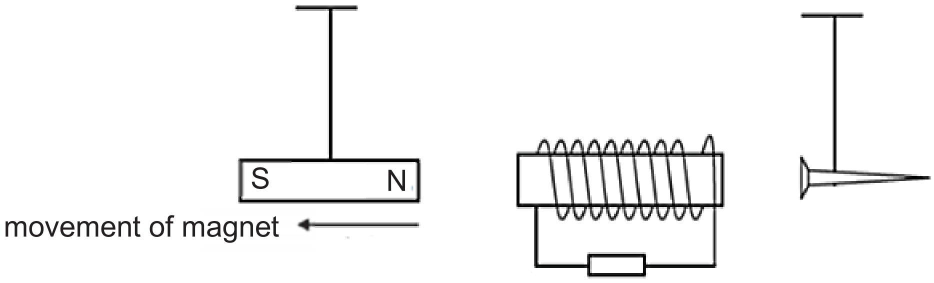
metal rod	number of paper clips picked up when there is current in the coil	number of paper clips still attracted when the current is switched off
A	1	0
B	20	2
C	35	0
D	35	30

38 The diagram below shows a positive charge entering a magnetic field directed into the paper.

Which path correctly illustrates the motion of the positive charge?



39 A solenoid is placed in between a magnet and an iron nail that are freely suspended from the ceiling. The magnet is then moved away from the solenoid as shown.



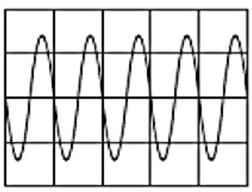
What is the direction of the current flowing through the fixed resistor and the direction that the iron nail moves?

	direction of current through the resistor	direction of movement of iron nail
A	to the left	away from solenoid
B	to the left	towards solenoid
C	to the right	away from solenoid
D	to the right	towards solenoid

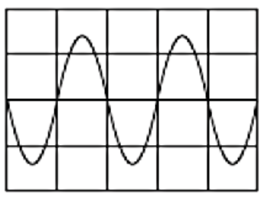
40 A supply of peak value 5.0 V and of frequency 50 Hz is connected to the Y-input terminals of a cathode ray oscilloscope. The Y-gain and time-base settings are set at 5.0 V per division and 10 ms per division respectively.

Which trace is obtained?

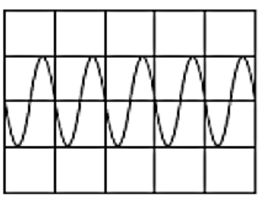
A



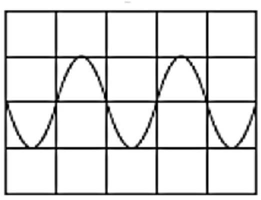
B



C



D



Q1	**Q2**	**Q3**	**Q4**	**Q5**	**Q6**	**Q7**	**Q8**	**Q9**	**Q10**
B	**B**	**A**	**D**	**C**	**C**	**D**	**B**	**B**	**C**
Q11	**Q12**	**Q13**	**Q14**	**Q15**	**Q16**	**Q17**	**Q18**	**Q19**	**Q20**
B	**C**	**C**	**B**	**B**	**C**	**B**	**B**	**D**	**D**
Q21	**Q22**	**Q23**	**Q24**	**Q25**	**Q26**	**Q27**	**Q28**	**Q29**	**Q30**
C	**C**	**C**	**A**	**B**	**B**	**A**	**A**	**A**	**C**
Q31	**Q32**	**Q33**	**Q34**	**Q35**	**Q36**	**Q37**	**Q38**	**Q39**	**Q40**
C	**C**	**D**	**B**	**D**	**A**	**C**	**A**	**B**	**D**

Class	Register Number	Name

BARTLEY SECONDARY SCHOOL

GCE O-LEVEL PRELIMINARY EXAMINATIONS

PHYSICS **6091/02**

Sec 4 Express

Paper 2 Theory **20 Sep 2019**

1 hours 45 minutes

Candidates answer on the Question Paper.
Additional Materials: NIL

READ THESE INSTRUCTIONS FIRST

Write your class, register number and name on all the work you hand in.
Write in dark blue or black pen on both sides of the paper.
You may use a soft pencil for any diagrams and graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Section A
Answer **all** questions.

Section B
Answer **all** questions. Question 12 has a choice of parts to answer.

Candidates are reminded that **all** quantitative answers should include appropriate units.
The use of an approved scientific calculator is expected, where appropriate.
Candidates are advised to show all their working in a clear and orderly manner, as more marks are awarded for sound use of Physics than for correct answers.

At the end of the examination, submit this question paper.
The number of marks is given in brackets [ ] at the end of each question or part question.

For Examiner's Use	
Section A	
Section B	
Total	

This document consists of **21** printed pages and **1** blank page.

Set by: **LHL** **[Turn over**

Section A

Answer **all** the questions in the spaces provided.

1 When out in the open sea, ship X and ship Y use a steel cable to transfer cargo from one to the other. Fig. 1.1 shows how the steel cable looks like when a cargo of mass 130 kg is exactly in between the two ships. The ends of the cable connected to each ship are positioned at the same height above the surface of the sea. The gravitational field strength is 10 N/kg.

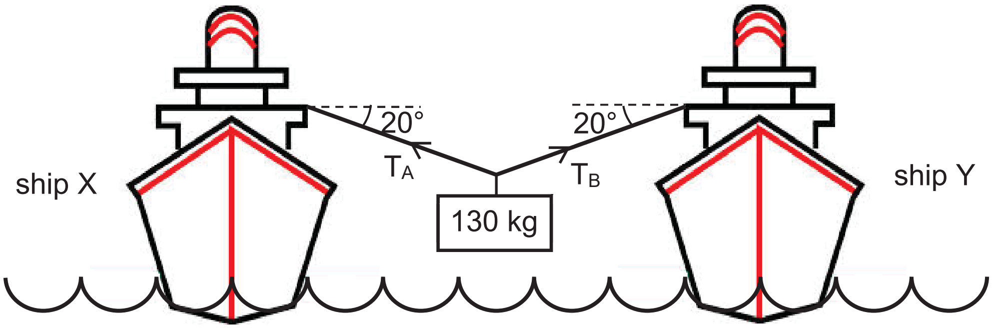


Fig. 1.1

(a) Calculate the weight exerted by the cargo.

weight of cargo = ... [1]

(b) By means of a scaled drawing, find the tension in the steel cable.

tension in the cable = ... [3]

2 **(a)** State the *principle of moments*.

....

....

....

....[2]

(b) Fig. 2.1 shows part of the boiler of a steam engine. Thermal energy is transferred to the water in the boiler by conduction.

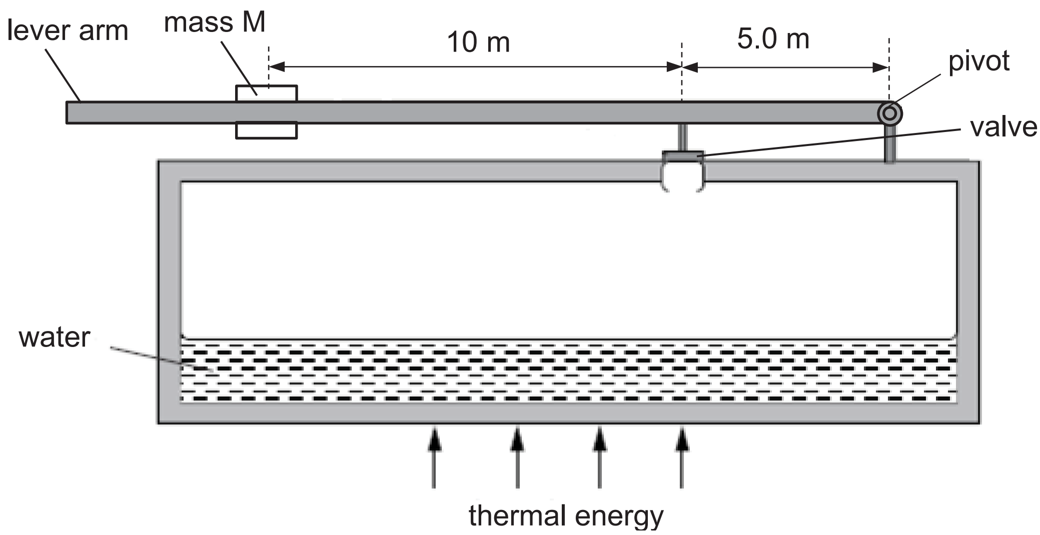


Fig. 2.1

The boiler has a valve which allows steam to escape if the pressure inside the boiler is too high. The pressure in the boiler is controlled by the valve connected to a pivoted lever arm. The uniform lever arm has a movable mass M which is used to adjust the pressure at which the valve opens.

(i) The surface area of the valve in contact with the steam is 4.0×10^{-2} m^2.

Calculate the upward force on the valve when the pressure in the boiler is 20 kPa.

force = ...[2]

(ii) The length of the uniform lever arm is 20 m and the weight of the lever arm is 100 N. By placing mass M 10 m away from the valve, the valve opens when the pressure in the boiler is 20 kPa.

Calculate the weight of M.

weight = ...[2]

(iii) State how the mass M should be moved so that the valve of the boiler is opened at a pressure higher than 20 kPa. Explain your answer.

....

....

....

....

....[2]

3 **(a)** Fig. 3.1 shows a soccer ball on the ground being stepped on by a foot.

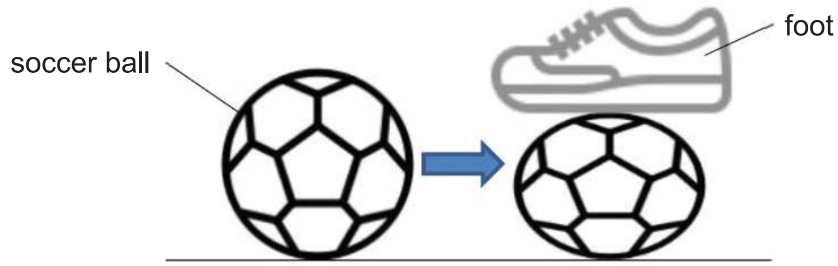


Fig. 3.1

It is observed that the volume of the soccer ball decreases while the temperature of the air in the ball remains the same.

Using the kinetic model of matter, state and explain how pressure of the air in the ball changes.

....

....

....

....

....

.... [3]

(b) Fig. 3.2 shows a mercury manometer that is being used to measure the pressure in a chamber. The pressure due to the air trapped in the chamber is found to be 810 mm Hg. The density of mercury is 13 600 kg/m^3.

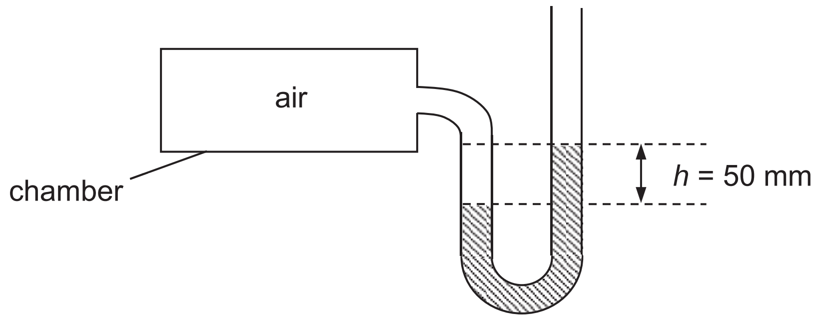


Fig. 3.2

Determine the atmospheric pressure, leaving your answer in Pa.

pressure = ... Pa [2]

4 Fig. 4.1 shows an igloo, which is a small dome-shaped house built by Eskimos from blocks of hard snow. The Eskimos live in very cold regions near to the North pole.

The entrance is dug lower than the sleeping area to create a cold sink where cold air flows to. The cross-section of an igloo is shown in Fig. 4.2.

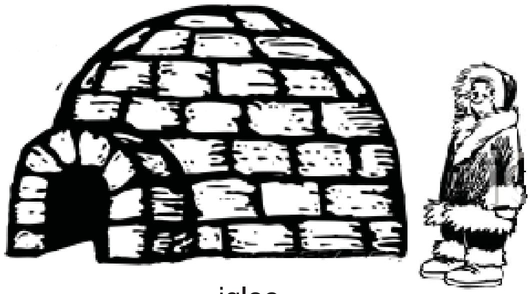


Fig. 4.1

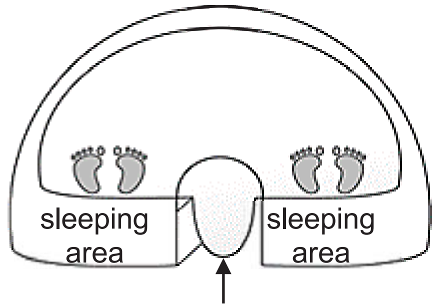


Fig. 4.2

(a) State one thermal property of the hard snow blocks that makes them suitable for building igloos.

....

....[1]

(b) Suggest one way by which the Eskimos can reduce their rate of heat loss by radiation when they sleep. Explain your answer.

....

....

....

....[2]

(c) Explain the process of how the heat from the Eskimos keep the igloo warm inside even if it is cold outside.

....

....

....

....

....[2]

5 Geothermal energy makes use of heat from the Earth's interior to generate power. Fig. 5.1 shows 1 200 kg of cold water at a temperature of 25 °C is pumped down to the hot rocks of the Earth's interior. 750 kg of it returns as hot water and the rest returns as steam, both at a temperature of 100 °C.

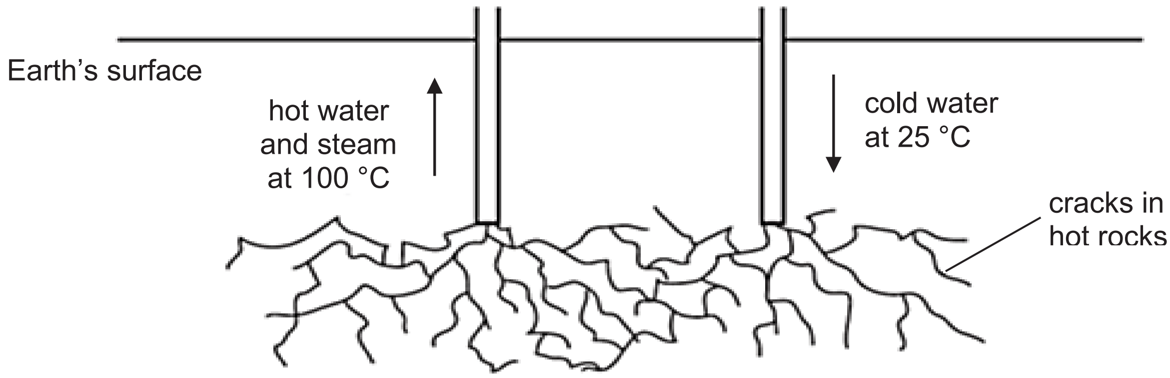


Fig. 5.1

The *specific heat capacity* of water is 4 200 J / (kg °C) and the *specific latent heat of vaporisation* of water is 2.3×10^6 J / kg.

(a) Distinguish between the *specific heat capacity* of water and the *specific latent heat of vaporisation* of water.

....

....

....

....[2]

(b) Calculate the energy needed to heat 1 200 kg of water from 25 °C to 100 °C.

energy = ... [2]

(c) Calculate the energy needed to produce steam at 100 °C.

energy = ... [2]

6 **(a)** State what is meant by *critical angle*.

....

....

....[1]

(b) Fig. 6.1 shows the cross-section of an optical fibre. The optical fibre has a very thin glass core with a diameter of 14 μm. The refractive index of the glass core is 1.65.

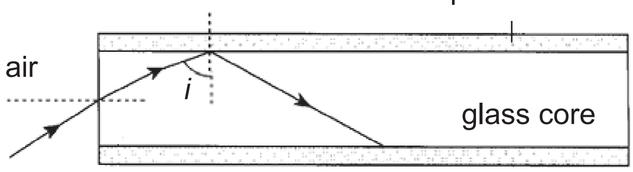


Fig. 6.1

(i) The glass core is surrounded by a plastic cladding.

State and explain which material has a higher refractive index and explain your answer.

....

....

....

....[2]

(ii) The light ray enters the air-glass interface at 45°.

Calculate the angle of refraction in the glass core.

angle of refraction = ...[2]

(iii) Prove that the minimum value for *i* is 37.3°.

[2]

7 Fig. 7.1 shows a potential divider made from a thermistor and a 6.0 kΩ fixed resistor. The potential divider is connected in series with a 12 V d.c. power supply. A voltmeter is connected across the 6.0 kΩ resistor.

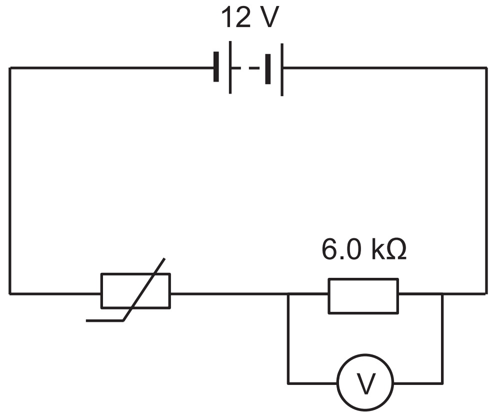


Fig. 7.1

(a) At the current room temperature of 30 °C, the resistance of the thermistor is 1.0 kΩ.

Calculate the reading on the voltmeter.

voltmeter reading = ... [2]

(b) The temperature of the room is gradually decreased.

State and explain what happens to the reading on the voltmeter.

....

....

....

.... [2]

8 Fig. 8.1 shows an electric heater used in a shower.

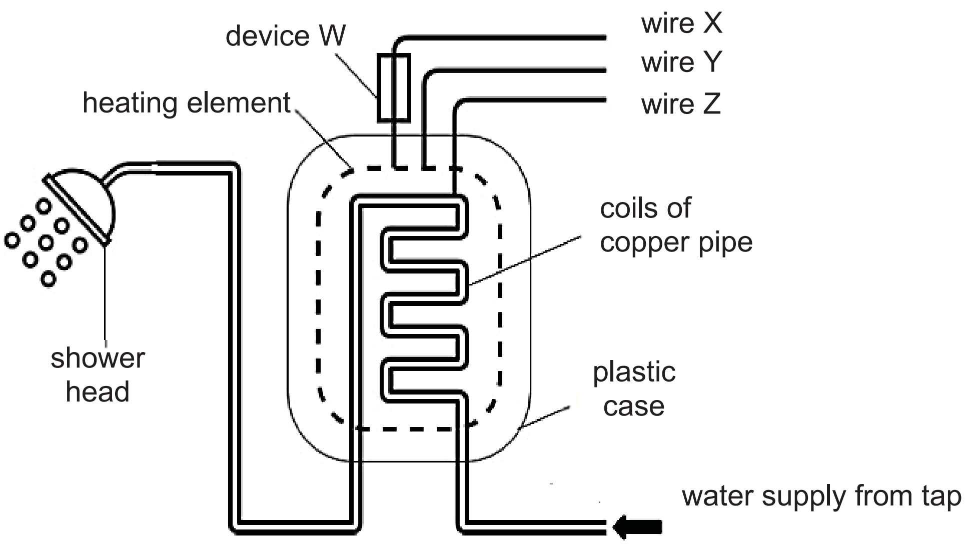


Fig. 8.1

(a) Wires X, Y and Z are connected to the mains power supply. Identify these wires and device W.

wire X: ....

wire Y: ....

wire Z: ....

device W: .... [2]

(b) In a faulty water heater, an electric current flows from the heating element to the copper pipe and the water that flows inside. This puts the user at risk of electric shock when the shower is used.

(i) Explain how wire Z protects the user from electric shock.

....

....

....

....

....

.... [2]

(ii) State the colour of the insulation for wire Z.

.... [1]

(c) The water heater consumes 3.0 kW of power as it operates on 240 V a.c. Assume that the efficiency of the water heater is 100%.

The cost of electricity supplied is $0.30 per kWh.

Calculate the total cost of using the water heater for 30 minutes a day for 30 days.

total cost = ... [2]

9 Fig. 9.1 shows a type of electric door lock.

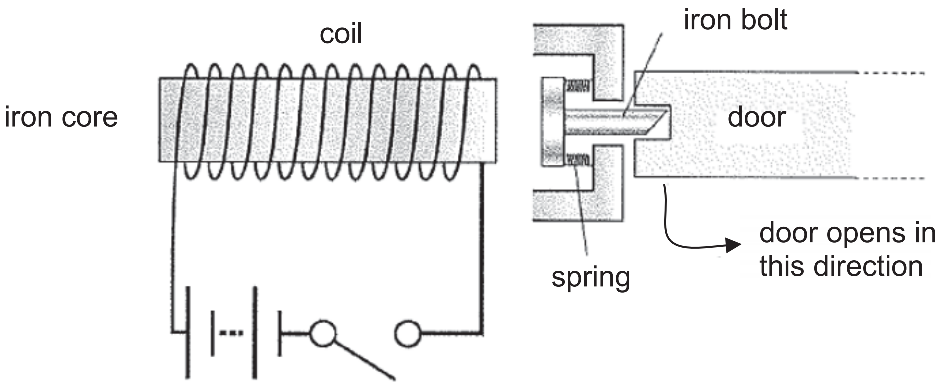


Fig. 9.1

The lock is closed when the position of the iron bolt is as shown in Fig. 9.1.

(a) Explain how closing the switch in the circuit allows the door to be opened.

....

....

....

.... [2]

(b) The door's iron bolt is changed to a thicker piece of iron. When the switch is closed, the lock remains closed.

Without doing further changes to the bolt, suggest **two** other changes that could be made in order to open the lock.

....

....

....

.... [2]

Section B (30 marks)

Answer **all** the questions in this section.

Answer only one of the two alternative questions in **Question 12**.

10 An engineer designs a device that can be used to monitor the thickness of pipes as shown in Fig. 10.1.

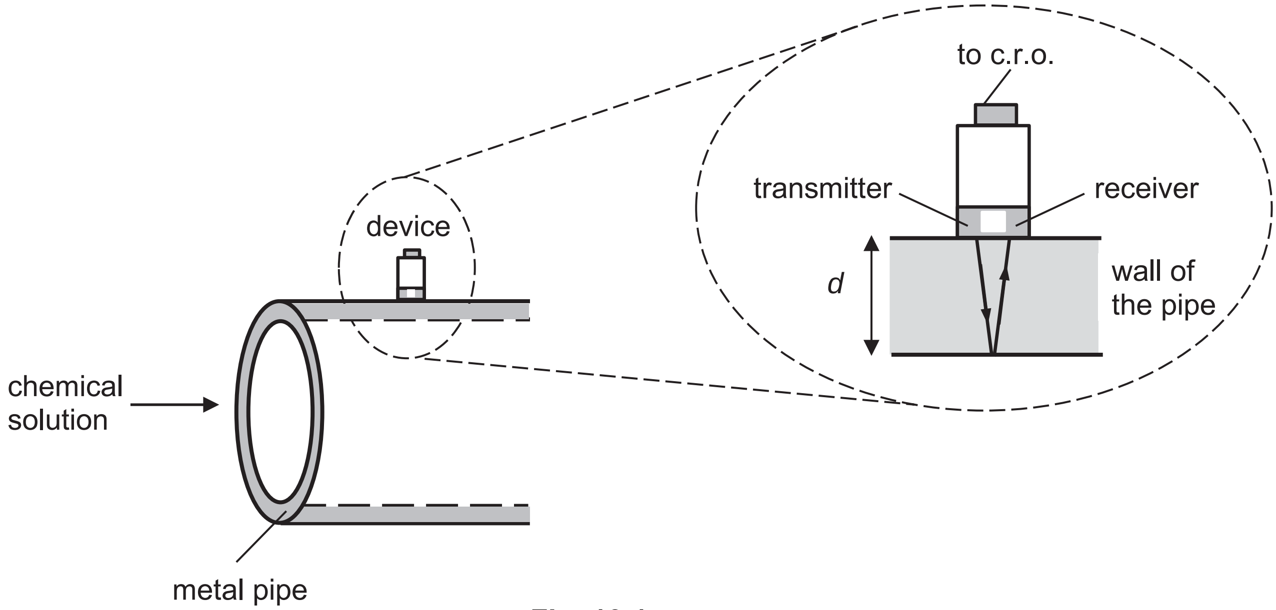


Fig. 10.1

The device emits an ultrasound pulse of frequency 4.0×10^6 Hz. The pulse travels through the wall of the metal pipe and is reflected by the inner wall back to the device. The returning pulse is picked up by the receiver. Both the transmitter and the receiver are connected to a cathode-ray oscilloscope (c.r.o.)

The metal pipe is made of steel. Table 10.1 shows the speed of sound in different media.

Table 10.1

medium	speed of sound / ms^{-1}
air	340
glass	4 000
steel	6 100
water	1 400

(a) (i) Determine the wavelength of the ultrasound pulse in the wall of the pipe.

wavelength = ...[2]

(ii) At one point of time, the series of compressions and rarefactions of the ultrasound wave in the wall of the pipe is as shown in Fig. 10.2. Points A, B, C and D are at the centres of regions of compression.

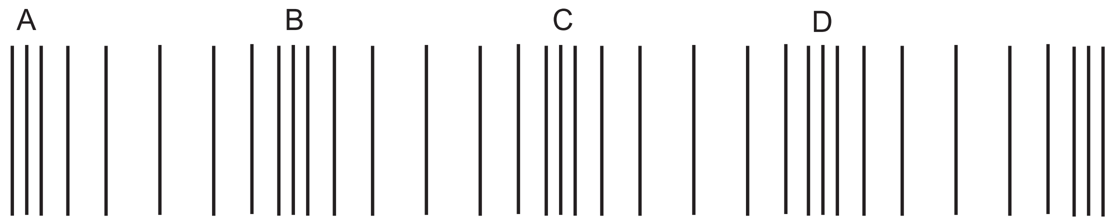


Fig. 10.2 (not to scale)

Determine the distance between points A and D.

distance = ...[1]

(b) The thickness of the pipe is 4.0 mm.

(i) Determine the time interval, in μs, between the emitted pulse and the reflected pulse.

time interval = ... μs [2]

(ii) The c.r.o. has a time base setting of 100 ns / div. Fig. 10.3 shows the emitted pulse on the c.r.o. On Fig. 10.3, draw the reflected pulse.

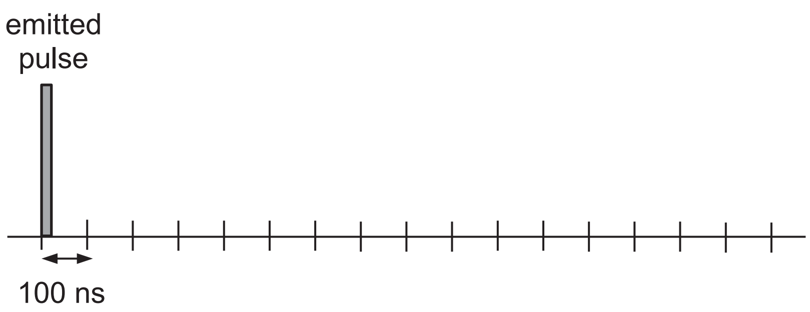


Fig. 10.3

[1]

(c) Suggest and explain how your answer in **(b)(ii)** will change if the chemical solution corrodes the metal pipe.

....

....

....

.... [2]

(d) The engineer's colleague suggests that the device should be placed at the bottom of the pipe in order to better monitor the thickness of the pipe. Explain how this can better monitor the thickness of the pipe.

....

....

....

.... [2]

11 (a) Fig. 11.1 shows a simple setup that can be used to detect seismic waves from earthquakes. The setup consists of a bar magnet suspended from a spring hanging from a metal rod. The metal rod transmits vibrations from the earth and the magnet moves in and out of the coil when there is an earthquake. The coil is connected to a cathode-ray oscilloscope (c.r.o.) that monitors the e.m.f across the coil.

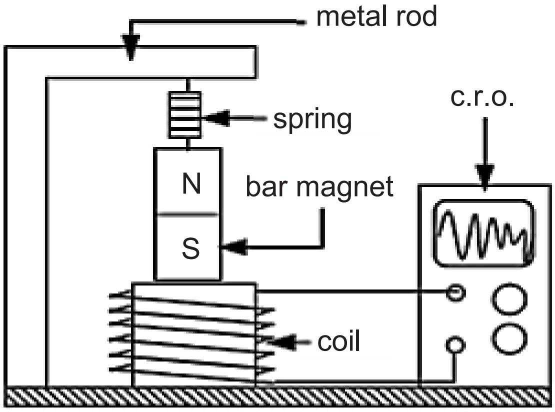


Fig. 11.1

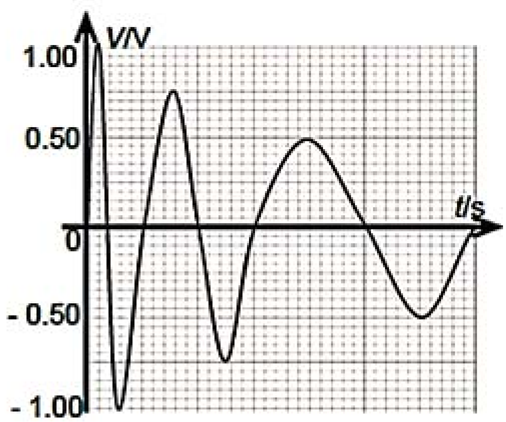


Fig. 11.2

Fig. 11.2 shows the trace that was displayed on the c.r.o. during a particular earthquake. Each complete oscillation of the same magnitude represents one tremor.

(i) Describe and explain how a trace shown on the c.r.o. in Fig. 11.2 is obtained when there is an earthquake.

....

....

....

....

....

....

....

....

....[4]

(ii) On Fig. 11.1, indicate the direction of the current in the coil when the south pole of the magnet is moving into the coil. [1]

(b) An output voltage of 2.0 V from a generator is connected to the primary coil of a step-up transformer with a turns ratio of 50 : 1. The current in the secondary coil is 2.4 mA. The transformer is 75% efficient.

(i) State the metal used for the core of a transformer.

....[1]

(ii) Calculate the current in the primary coil.

current = ...[2]

(iii) State two reasons why a typical transformer is not 100% efficient.

....

....

....

....[2]

12 EITHER

A car travelled along a smooth and straight road with a uniform speed of 20 ms^{-1} for 4.0 s. It then experienced *uniform deceleration* until it came to a stop 5.0 s later. It remained stationary for 2.0 s before it started to travel in the opposite direction. Its speed increased at a decreasing rate to reach 25 ms^{-1} after 8.0 s. After that it travelled at a uniform speed for another 6.0 s.

(a) (i) In the space below, sketch the velocity-time graph of the car.

[3]

(ii) State what is meant by *uniform deceleration*.

....

....[1]

(iii) Calculate the deceleration of the car.

deceleration = ...[2]

(b) Given that the mass of the car was 1 500 kg, determine the retarding force that was acting on the car from 4.0 s to 9.0 s.

retarding force = ...[2]

(c) When the car was accelerating in the opposite direction, the driving force produced by the car engine was constant throughout its journey.

Explain, in terms of forces acting on the car, why the velocity was increasing at a decreasing rate, even though the driving force was constant.

....

....

....

....[2]

12 OR

A golf club hits a stationary golf ball. Fig. 12.1 shows three stages in the process.

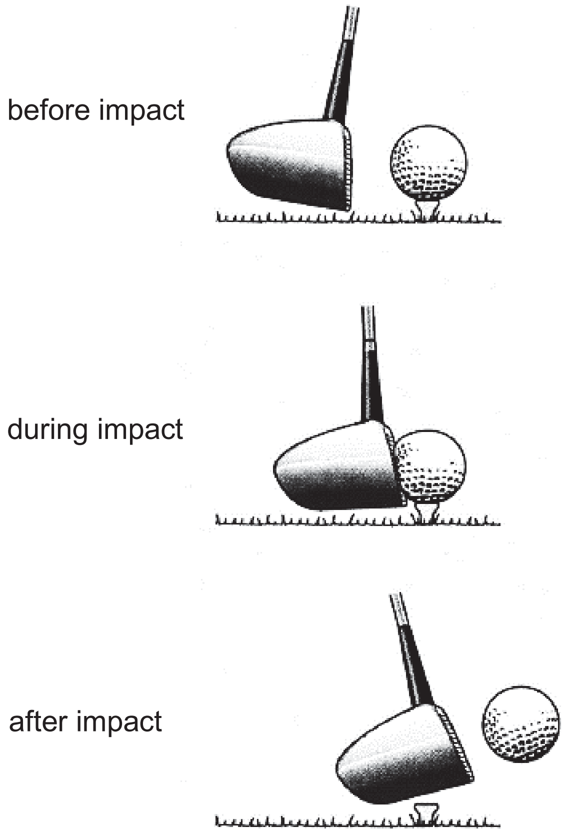


Fig. 12.1

(a) Explain how the principle of conservation of energy applies during the impact.

....

....

....

....

....

....[3]

(b) Using ideas about energy, explain why the speed of the golf ball does not depend on its mass.

....

....

....

....[2]

(c) The golf ball rises from the ground at A to a vertical height of 16 m at B before landing on the ground at C, as shown in Fig. 12.2. You may assume that there is no air resistance as the ball travels from A to B to C.

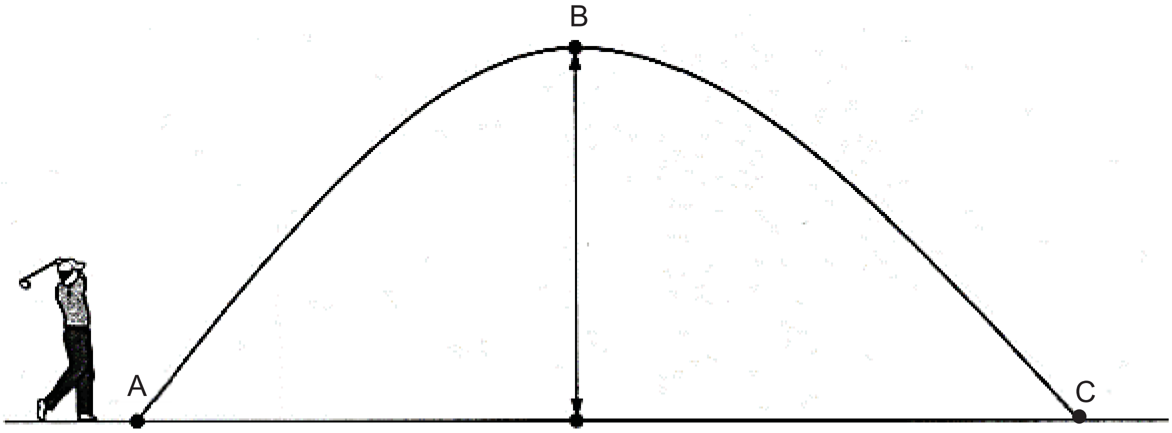


Fig. 12.2 (not to scale)

The mass of the ball is 0.045 kg. The gravitational field strength g is 10 N / kg.

(i) Calculate the increase in gravitational potential energy of the ball between A and B.

increase in potential energy = ...[2]

(ii) At B, the kinetic energy of the ball is 2.5 J.

Calculate the kinetic energy of the ball at A.

kinetic energy = ...[1]

(iii) Calculate the speed of the golf ball just before it lands at C.

speed = ...[2]

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Paper 1 [40 marks]

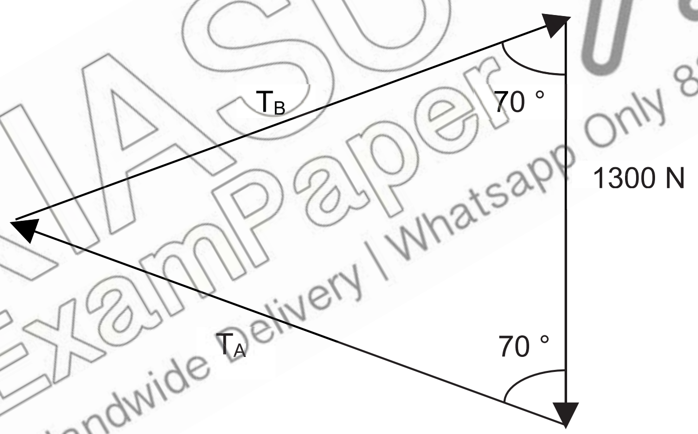
Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
B	B	A	D	C	C	D	B	B	C
Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20
B	C	C	B	B	C	B	B	D	D
Q21	Q22	Q23	Q24	Q25	Q26	Q27	Q28	Q29	Q30
C	C	C	A	B	B	A	A	A	C
Q31	Q32	Q33	Q34	Q35	Q36	Q37	Q38	Q39	Q40
C	C	D	B	D	A	C	A	B	D

Paper 2 Section A [50 marks]

1)(a) Weight of cargo = 130 x 10 = 1 300 N A1

(b) Using a **min. scale** of 1 cm: 200 N B1

Diagram correctly drawn (either parallelogram method or tip-to-tail method) B1



Allow ECF for weight of cargo from (a)

T_A = T_B = 1 900 N (accept values from 1 800 to 2 000 N) A1

2(a) For any system to be in equilibrium, B½

total clockwise moments is equal to total anticlockwise moments B1

about the same pivot B½

(b)(i) F = P × A

= $20000 \times 4.0 \times 10^{-2}$ m^2 C1

= 800 N A1

(b)(ii) By Principle of Moments, Clockwise moments = anticlockwise moments

800 × 5 = 100 × 10 + W × 15 Allow ECF from **(b)(i)** C1

W = 200 N A1

(b)(iii) Mass M should be moved further from the pivot. B1

With a larger release pressure, a larger force is produced at the valve, which means the clockwise moment is increased. Hence a larger anticlockwise moment is needed to balance this increased clockwise moment. B1

3(a) As the volume of the ball decreases, the number of air particles per unit volume increases. B1

Air particles in the ball collide more frequently with the inner walls of the ball. B1

The air particles then exert a larger force on the inner walls of the ball. Since pressure is the force per unit area, the pressure exerted increases. B1

(b) P_{atm} = 810 – 50 = 760 mm Hg C1

= 0.76 x 10 x 13 600

= 103 360 Pa ≈ 103 000 PA (3 s.f.) A1

4(a) They are poor heat conductors / poor emitter of radiation / poor absorber of radiation hence heat transfer into and out of igloo is slower. B1

(b) Any one of the following sets of answers:

- The Eskimos can curl their legs close to the body to reduce their surface area (B1) exposed to the surroundings, so heat loss by radiation from their bodies is slower. B1
- The Eskimos can wear silver / white coloured clothes, as such clothes are (B1) poorer emitters of radiation so that heat loss from their bodies is slower B1

(c) When air around the eskimos is warmed, it becomes less dense and rises B½

Hot air is trapped at the top of the igloo. B½

The cold air which is denser sinks into the cold sink and flows out of the igloo. B1

5(a) Specific heat capacity is the amount of thermal energy required to raise the temperature of 1.0 kg of water by 1.0 °C. B1

Specific latent heat of vaporisation is the amount of thermal energy required to change 1.0 kg of water into steam without a change of temperature. B1

(b) Heat needed = $mc\Delta T$

= 1 200 x 4200 x (100 – 25) C1

= 3.78×10^8 J A1

(c) Heat needed = ml_v

= $450 \times 2.3 \times 10^6$ C1

= 1.04×10^9 J A1

6(a) Critical angle is the <u>angle of incidence in the optically denser medium for which the angle of refraction in the optically less dense medium is 90°</u>. B1

(b)(i) In order for <u>total internal reflection to occur</u>, light ray must travel from an optically denser medium to an optically less dense medium. B1

Therefore, <u>glass core has a higher refractive index than plastic cladding</u>. B1

(b)(ii) $\dfrac{\sin 45^\circ}{\sin r} = 1.65$ C1

$r = 25.4°$ A1

(b)(iii) $\dfrac{1}{\sin c} = 1.65$ M1

$c = 37.3°$ A1

7(a) voltmeter reading $= \frac{6}{7} \times 12$ C1

$= 10.3$ V (3 s.f.) A1

(b) The **potential difference across the 6.0 kΩ resistor is given by $\frac{6}{6 + R_{TH}} \times 12$** where R_{TH} is the resistance of the thermistor. B1

As the <u>resistance of the thermistor increases, the potential difference across the 6.0 kΩ resistor will decrease</u> and <u>voltmeter shows a smaller reading</u>. B1

<u>Alternative explanation</u>

As the <u>resistance of the thermistor increases,</u> the <u>total resistance of the circuit increases</u> and the <u>current in the circuit decreases.</u> B1

Since <u>potential difference across the 6.0 kΩ resistor is given by V = IR</u>, if current decreases, potential difference decreases and <u>voltmeter shows a smaller reading</u>. B1

8(a) Wire X: Live wire

Wire Y: Neutral wire

Wire Z: Earth wire

Device W: fuse

} 1 mark for every two correct answers B2

(b)(i) The large current flows through the <u>earth wire to the ground</u>. B½

The <u>fuse will melt (or circuit breaker will trip) and break the circuit</u>. B½

Thus the <u>high voltage source is disconnected</u> from the water heater and the water inside will no longer be live, preventing electric shock. B1

(b)(ii) green and yellow B1

(c) Total kWh used per month = 3.0 x 0.5 x 30
= 45 C1
Total cost = 45 x \$0.30
= \$13.50 A1

9(a) When the switch is closed, current flows through the coil and the iron core becomes an electromagnet. B1
The electromagnet attracts the iron bolt, causing it to move to the left, allowing the door to be opened. B1

(b) Any two of the following answers: B2

- Increase the number of turns of the coil of wire
- Increase the current flowing through the coil of wire.
- Move the iron core closer to the iron bolt.

10(a)(i) $\lambda = \frac{v}{f}$

$= \frac{6\ 100}{4.0 \times 10^6}$ C1

$= 0.00153$ m (3 s.f.) or 1.53 mm A1

(a)(ii) distance = 3 x 0.01525 = 0.00458 m (3 s.f.) A1

(b)(i) $s = \frac{2d}{t}$

$6100 = \frac{2 \times 0.004}{t}$ C1

t = 0.000001311
= 1.31 μs A1

(b)(ii) A **shorter pulse 13 spaces after the reflected pulse**. B1

(c) Either the emitted and transmitted pulses will be closer
OR the time interval between emitted and refelcted pulses will be shorter B1
The ultrasound travels a shorter distance at the same speed before it is reflected. B1

(d) The chemical solution will always be in contact with the bottom wall. B1
Any corrosion of the wall will be detected at the bottom wall first. B1

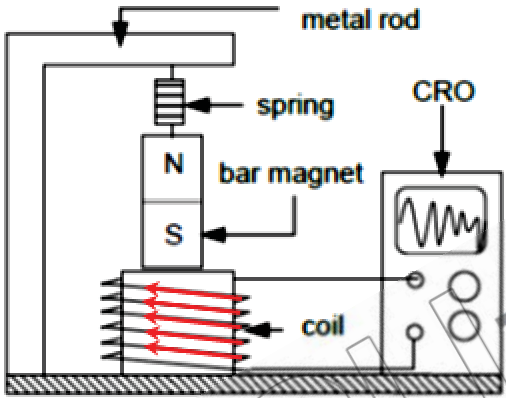
11 (a)(i) During an earthquake, the magnet moves in and out of coil, producing a change in magnetic flux linking (in) the coil, thus inducing an electromotive force (e.m.f.) at the solenoid. B1

The direction of the e.m.f. changes when the magnet moves in and out of the coil, hence an alternating trace is produced. B1

The magnitude of the induced emf is proportional to the rate of change of magnetic flux linkage, B1

hence a larger tremor will produce a trace with a higher amplitude. B1

(a)(ii)



(b)(i) Soft iron B1

(ii) $V_s = 50 \times 2.0 = 100$ V

$0.75 \times V_p I_p = V_s I_s$

$0.75 \times 2.0 \times I_p = 100 \times 0.0024$ C1

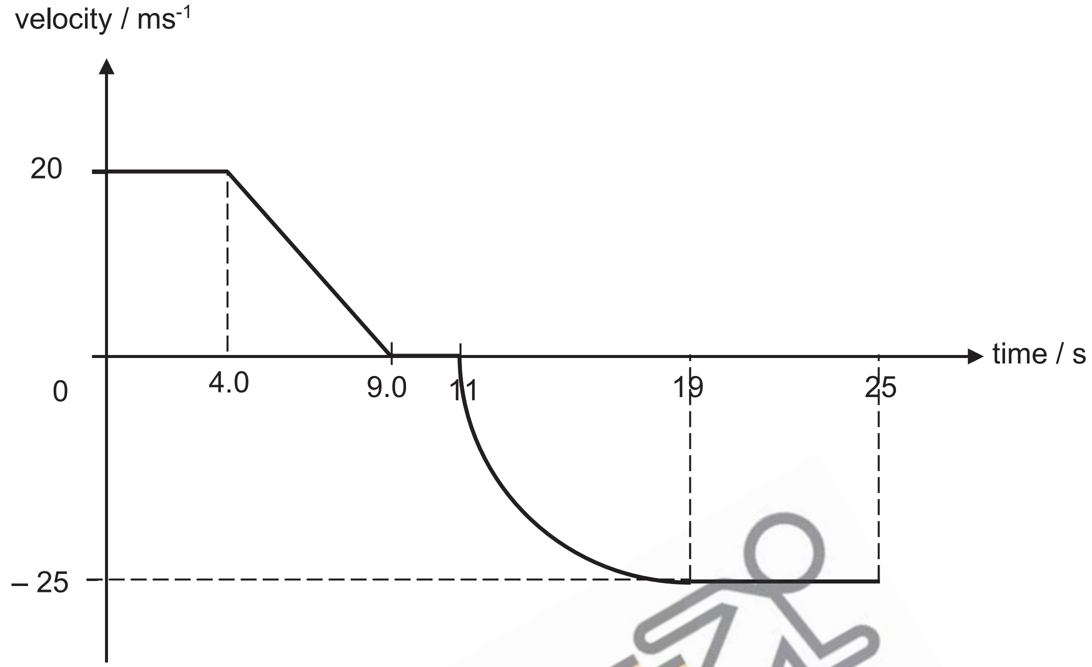
I_p = 0.16 A A1

(iii) Any two answers from the following: B2

- There is energy loss due to eddy currents formed in the core of the transformer.
- There is heat loss due to the resistance in the primary / secondary coils.
- There is magnetic flux leakage between the primary and secondary coil.

12 EITHER

(a)(i)



- B1 mark for correct timings
- B1 mark for all correct shapes
- B1 mark for axes correctly labelled.

(a)(ii) The velocity of the car decreases at a constant rate. B1

(iii) $a = \frac{v - u}{t}$

$= \frac{0 - 20}{5.0}$ C1

$= -4.0$

deceleration = 4.0 m/s^2 A1

(b) F = ma

= 1 500 x 4.0 — Allow ECF from **(a)(iii)** C1

= 6 000 N — **Do not accept – 6 000 N** A1

(c) The opposing force such as air resistance acting on the car increases as velocity of the car increases. B1

This causes the resultant force acting on the car to decrease, resulting in a decrease in its acceleration. B1

12 OR

(a) During impact, part of the kinetic energy of the golf club is converted into kinetic energy of the ball and sound and thermal energy as the club hits the ball. B1

The golf club continues moving with a smaller amount of kinetic energy. B1

The amount of total energy remains constant before and during impact. B1

(b) As the golf ball travels, its gravitational potential energy is changed into kinetic energy and vice-versa. B1

This means that mgh = $\frac{1}{2}mv^2$ or $v^2 = 2gh$ or speed is independent of mass. B1

(c)(i) Increase in GPE = mgh

= 0.045 x 10 x 16 C1

= 7.2 J A1

(ii) KE at A + GPE at A = KE at B and GPE at B

= 2.5 + 7.2 **Allow ECF from (c)(i)**

= 9.7 J A1

(iii) KE at C = KE at B and GPE at B

$\frac{1}{2} \times 0.045 \times v^2$ = 9.7 **Allow ECF from (c)(ii)** C1

v = 20.8 m/s A1

Register No.	Class

Name ______________________

BENDEMEER SECONDARY SCHOOL
2019 PRELIMINARY EXAMINATION
SECONDARY 4 EXPRESS
PHYSICS PAPER 1
6091/01

DATE : **3 Sep 2019**
DURATION : **1 hour**

READ THESE INSTRUCTIONS FIRST

Write in 2B pencil.
Do not use paper clips, glue or correction fluid.
Write your name, class and register number on the question paper and OTAS sheet in the spaces provided.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in **2B pencil** on the OTAS sheet.

Read the instructions on the OTAS sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
The use of an approved scientific calculator is expected, where appropriate.

/ 40

This document consists of **17** printed pages.

[Turn over

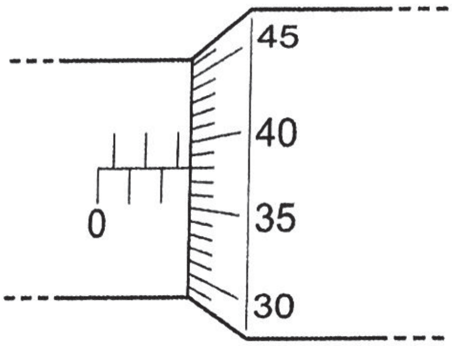
1 A pipe has an approximate length of 60 cm and an approximate internal diameter of 3 cm.

Which instruments are the most suitable for measuring accurately the internal diameter and the length?

A calipers and micrometer
B calipers and rule
C rule and micrometer
D rule and tape

2 A student measures the thickness of 20 sheets of paper with a micrometer.

The diagram shows the reading on the micrometer.



What is the average thickness of one sheet of paper?

A 0.119 mm **B** 0.144 mm **C** 0.169 mm **D** 0.171 mm

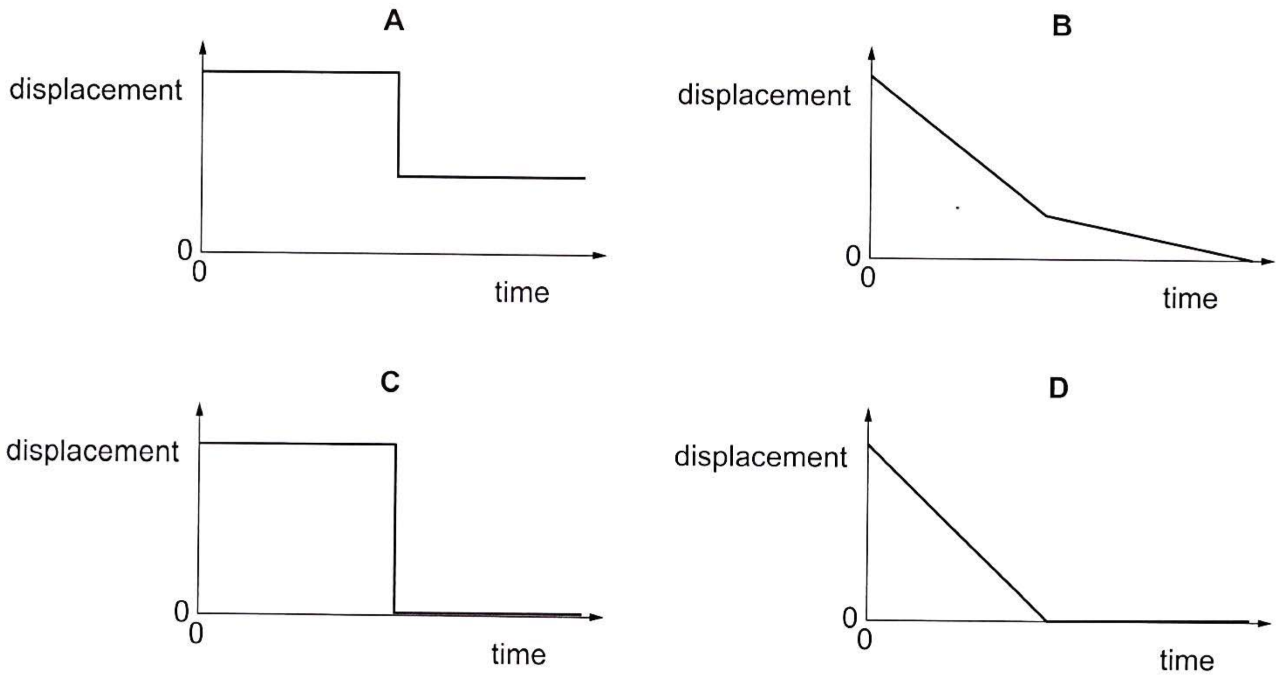
3 A body accelerates from rest at 4 m/s^2 for 5 s.

What is its **average** speed?

A 0.8 m/s **B** 2.0 m/s **C** 10.0 m/s **D** 20.0 m/s

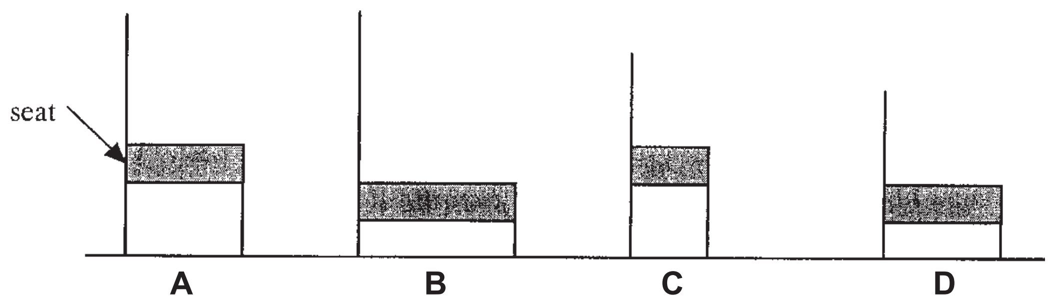
4 A free-fall parachutist falls at a constant speed. He then opens his parachute and continues to fall to Earth at a lower, constant speed.

Which diagram shows how the displacement of the parachutist varies with time?



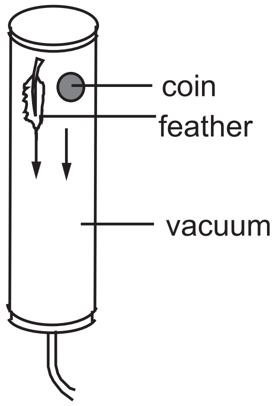
5 The following chairs are drawn to the same scale.

Which one is the most stable?



[Turn over

6 A coin and a feather are released from rest in vacuum as shown in the diagram. It is observed that both the coin and the feather reach the bottom of the cylinder at the same time.



Which of the following is/are correct deduction(s) from this experiment?

I The masses of the coin and the feather are identical in vacuum.
II The coin and the feather fall with the same acceleration in vacuum.
III The gravitational forces acting on the coin and the feather in vacuum are identical.

A I only **B** II only **C** II and III **D** III only

7 Two balls are dropped one after another from the same height. Assuming that the air resistance is negligible, which of the following statements is true?

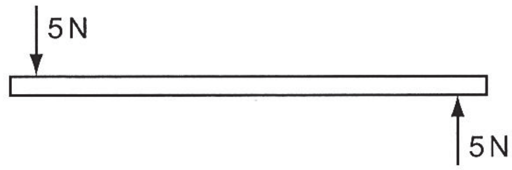
A The two balls drop with a constant distance between them.
B The two balls drop with a constant speed.
C The two balls get closer as they descend.
D The two balls get further away as they descend.

8 5000 kg of iron is melted and mixed with 2.0 m^3 of molten copper.

If the density of molten iron and molten copper are 7500 kg/m^3 and 9000 kg/m^3 respectively, what is the approximate density of the mixture?

A 7.5 g/cm^3 **B** 8.3 kg/m^3 **C** 8300 kg/m^3 **D** 8600 kg/m^3

9 Two forces act on a rod as shown in the diagram.



Which effect will be produced by these two forces?

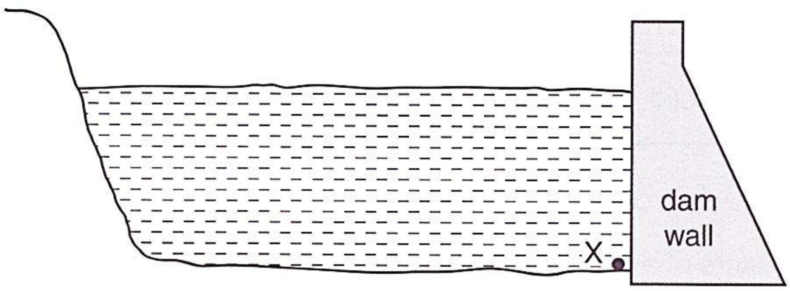
A both rotation and movement in a straight line
B movement in a straight line only
C no effect, because the forces are balanced
D rotation only

10 An object is experiencing a pressure of 800 mmHg.

Express this pressure in Pa, given that the density of mercury is 13,600 kg/m^3.

A 108,800 Pa
B 170,000 Pa
C 170,000,000 Pa
D 108,800,000 Pa

11 An engineer designs a dam wall for a reservoir.



Which factor determines the pressure at X?

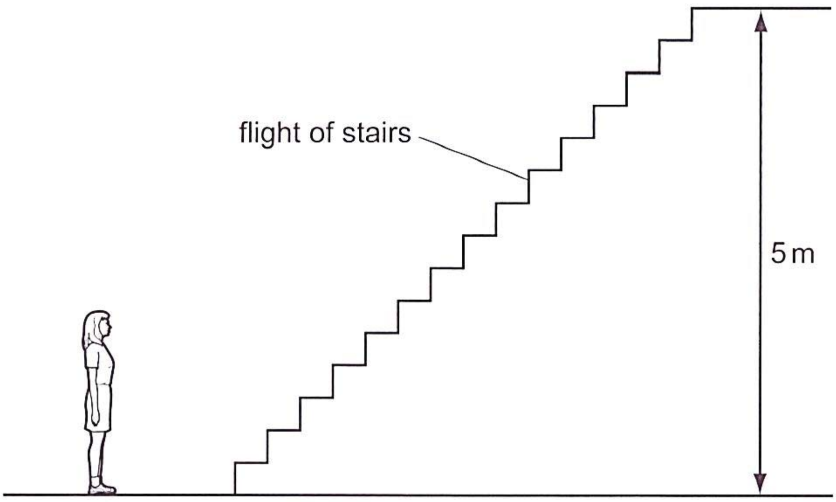
A the depth of the water in the reservoir
B the length of the reservoir
C the surface area of the reservoir
D the thickness of the dam wall

12 A parachutist opens his parachute and falls to Earth at constant speed.

What is the principal energy conversion taking place as he falls?

A kinetic energy ➔ potential energy
B kinetic energy ➔ thermal energy (heat)
C potential energy ➔ kinetic energy
D potential energy ➔ thermal energy (heat)

13 A girl of weight 500 N runs up a flight of stairs in 10 seconds. The vertical height of the stairs is 5 m.



What is the average useful power developed by the girl?

A 50 W **B** 100 W **C** 250 W **D** 1000 W

14 Which change is condensation?

15 A fixed mass of gas is trapped in a cylinder with a movable piston. The piston is pushed inward slowly to decrease the volume and yet maintain a constant temperature in the cylinder.

Which of the following about the gas molecules is correct?

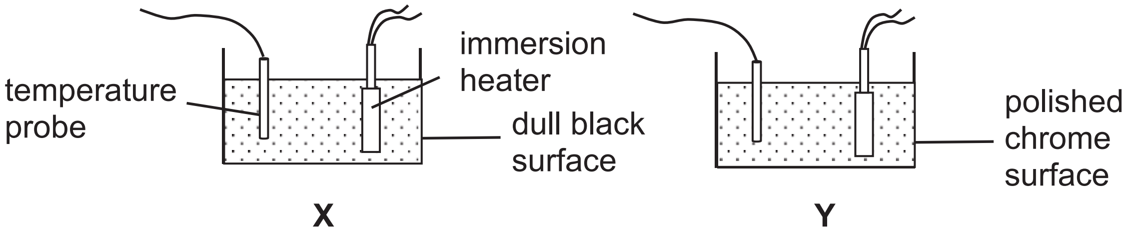
	average speed	average distance apart
A	increase	decrease
B	increase	no change
C	no change	decrease
D	no change	no change

16 How is heat transferred from the Sun to Earth?

I conduction
II convection
III radiation

A I only **B** III only **C** I and II **D** I and III

17 In the diagram, two copper cans **X** and **Y** with outer surface of different colours and textures are filled with the same amount of water at room temperature and heated by heaters of the same power.



Which of the following statements is correct?

A Water in both cans take the same amount of time to boil because the texture of the outer surface will not affect the rate of energy absorbed by the water.
B Water in **X** boils faster because the dull black surface is a good absorber of radiant heat.
C Water in **Y** boils faster because the polished chrome surface is a poor absorber of radiant heat.
D Water in **Y** boils faster because the polished chrome surface is a poor radiator.

18 An electric kettle contains 1500 g of liquid and is powered by a 0.5 kW electric element. If the temperature rises at 5°C every minute, what is the specific heat capacity of the liquid?

A 6.7 μJ/(kg°C) **B** 4 mJ/(kg°C) **C** 4000 J/(kg°C) **D** 4200 J/(kg°C)

19 According to the kinetic theory, matter is made up of very small particles in a constant state of motion.

Which row best describes the particle behaviour in the liquid state?

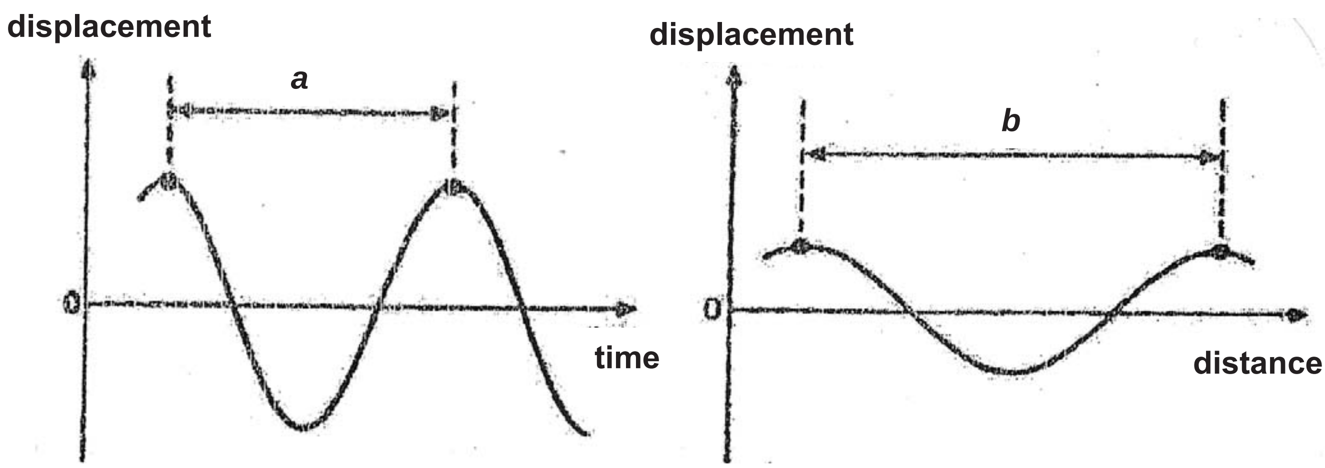
	forces between particles	motion of particles
A	strong	move randomly at high speeds
B	strong	vibrate but can move freely
C	strong	vibrate to and from around a fixed position
D	weak	move randomly at high speed

20 A liquid evaporates rapidly.

Why does this cause it to cool?

A Air molecules remove heat by contact with the liquid surface.
B Energy is lost by convection currents.
C Some of the most energetic molecules leave the liquid.
D The molecules have less room to move around.

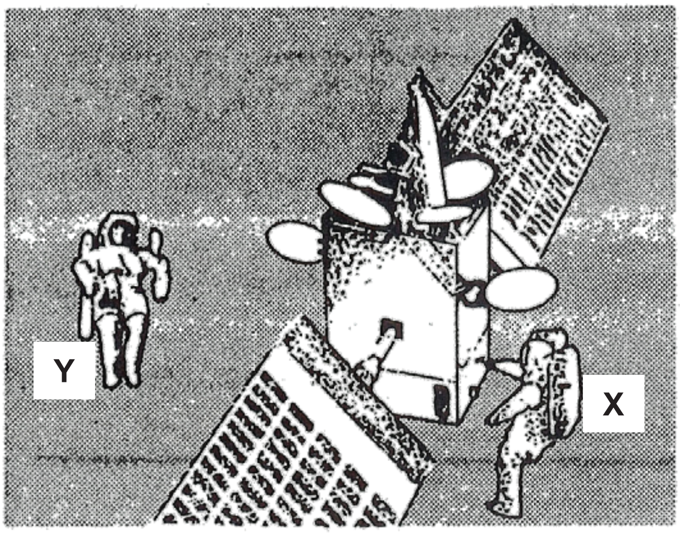
21 The same transverse wave is represented by the following graphs.



Which of the following gives the speed of the wave?

A ab **B** $\frac{a}{b}$ **C** $\frac{b}{a}$ **D** $\frac{1}{ab}$

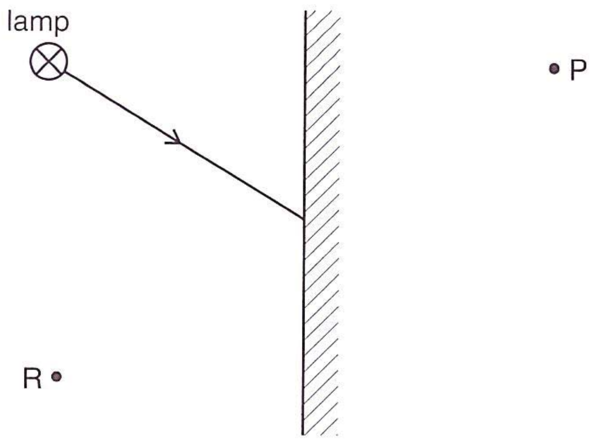
22 Astronaut X is hammering on one side of a satellite.



Astronaut Y on the other side of the satellite will not hear the hammering because

A the satellite is blocking the sound travel.
B the sound is refracted away from him.
C the sound cannot be produced in space.
D the sound cannot travel in space.

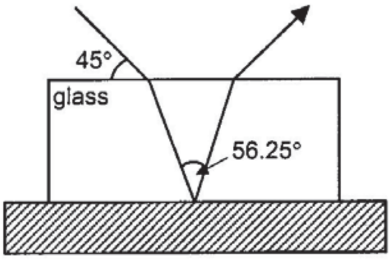
23 The diagram shows a ray of light from one point on a lamp striking a plane mirror.



The image of the point on the lamp formed by the mirror is

A at P and is real.
B at P and is virtual.
C at R and is real.
D at R and is virtual.

24 A piece of glass was placed on top of a polished mirrored surface as shown in the diagram below.



What is the critical angle of the glass?

A 28.1° **B** 41.8° **C** 45.0° **D** 56.3°

25 Which of the following uses microwaves?

I oven
II mobile phone
III metal detector

A I and II **B** I and III **C** II and III **D** I, II and III

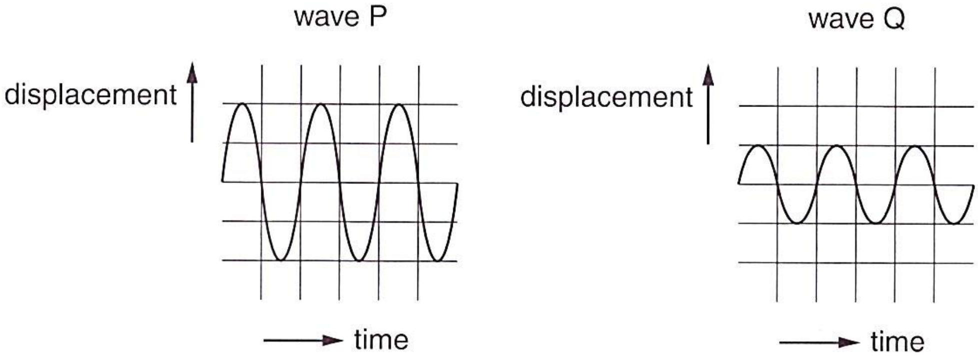
26 A student stands 50 m from a wall and knocks two wooden blocks together. When the frequency of knocking is 3 knocks per second, the echo of a knock is heard at the instant of the next one.

What is the speed of sound in air?

A 150 m/s **B** 200 m/s **C** 300 m/s **D** 350 m/s

[Turn over

27 The diagrams represent two different sound waves.



How do the frequency and pitch of P compare with the frequency and pitch of Q?

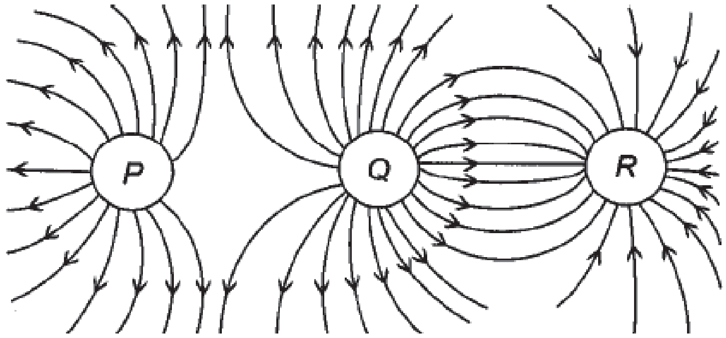
	frequency of P	pitch of P
A	greater than Q	higher than Q
B	greater than Q	same as Q
C	same as Q	higher than Q
D	same as Q	same as Q

28 A piece of polythene is rubbed with a cloth duster. The polythene becomes negatively charged and the cloth becomes positively charged.

What happens to the polythene and to the cloth to cause this?

	polythene	cloth
A	gains electrons	gains protons
B	gains electrons	loses electrons
C	loses protons	gains protons
D	loses protons	loses electrons

29 The diagram below shows the pattern of an electric field produced by three charged spheres.



Which of the following correctly shows the charge on each sphere?

	P	Q	R
A	–	–	+
B	+	–	+
C	–	+	–
D	+	+	–

30 60 C of charge passes through a resistor in 120 seconds.

The energy converted in the resistor is 5 J every second.

What is the potential difference across the resistor?

A 5 V **B** 10 V **C** 12 V **D** 24 V

31 Three wires X, Y and Z are made from the same metal. Their dimensions are listed below.

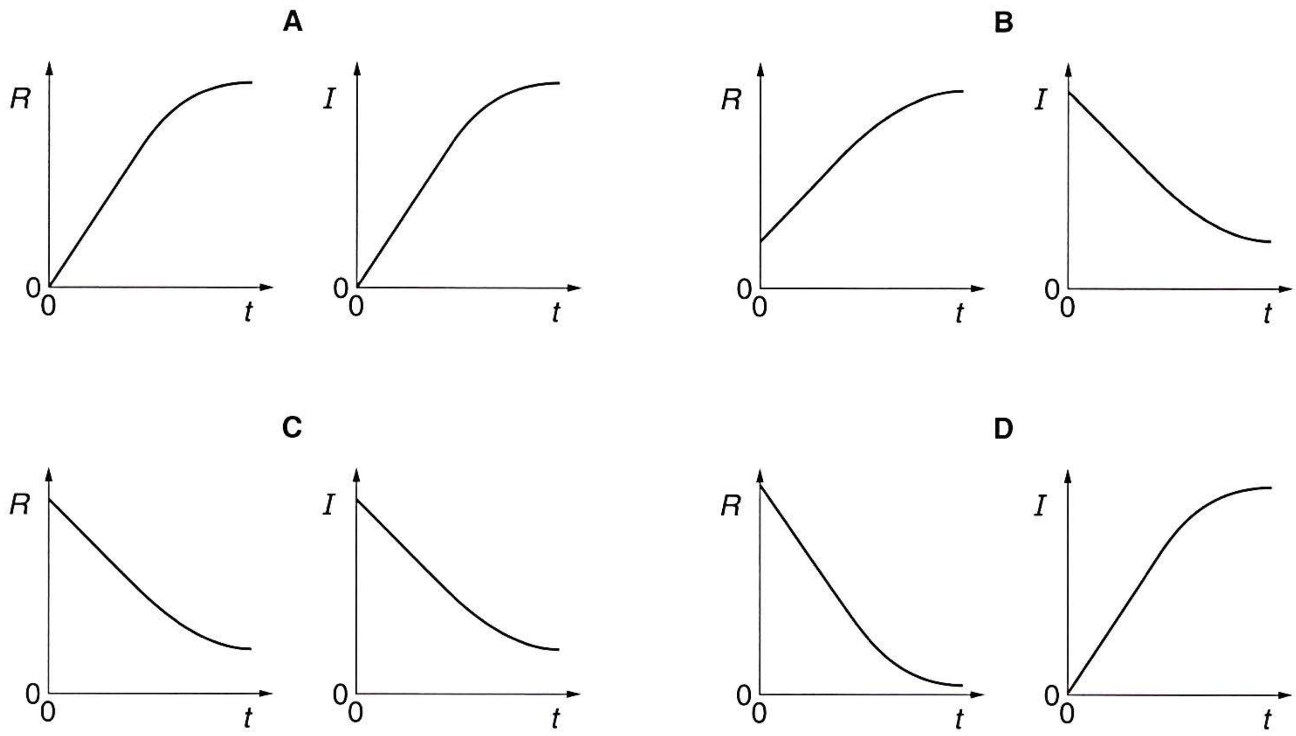
	length / m	cross-sectional area / mm^2
X	4	2
Y	5	1
Z	8	6

Arrange them in ascending order of their resistances.

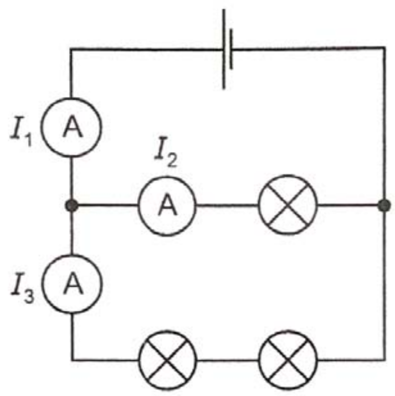
A X, Y, Z **B** X, Z, Y **C** Y, X, Z **D** Z, X, Y

32 When a filament lamp is switched on, there is a current in the lamp. As the temperature of the filament rises, its resistance changes.

Which pair of graphs shows how the resistance R of the filament and the current I vary with time after the lamp is switched on?



33 Three identical lamps and three identical ammeters are connected as shown.



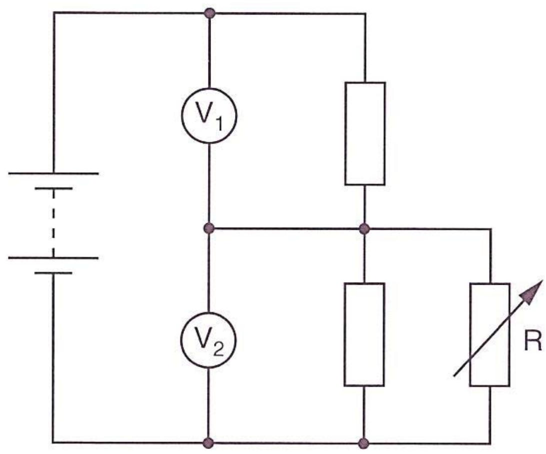
The readings on the ammeters are I_1, I_2 and I_3.

How are the readings related?

A $I_1 = I_2 = I_3$
B $I_1 > I_2$ and $I_2 = I_3$
C $I_1 > I_3 > I_2$
D $I_1 > I_2 > I_3$

[Turn over

34 The circuit diagram shows a variable resistor R connected in parallel to the lower half of a potential divider.



The resistance of R increases.

What happens to the voltmeter readings?

	reading on V_1	reading on V_2
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

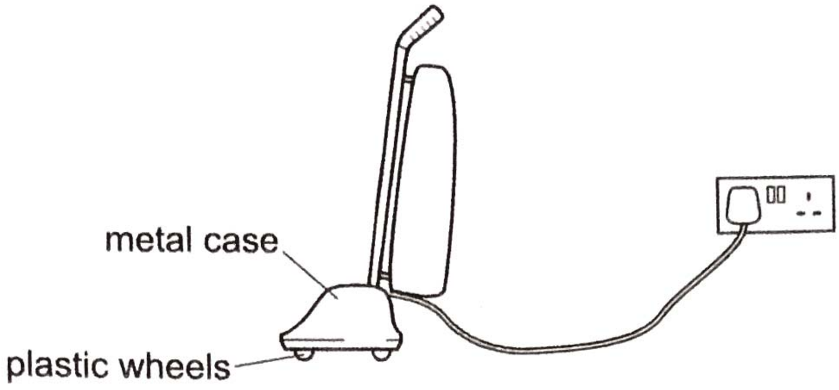
35 The table below shows the typical daily electrical usage in an office.

Appliance	Quantity	Number of hours used per day
40 W lamp	10	15
3 kW air-conditioner	2	12

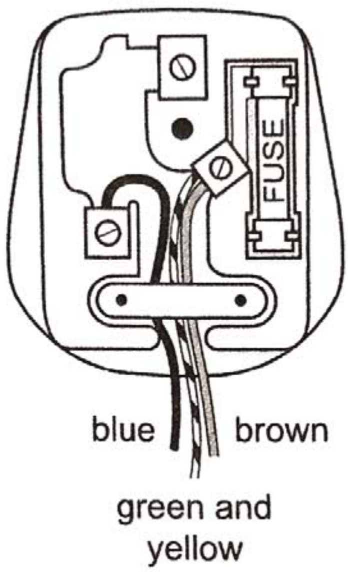
If the cost of electricity is $0.20 per kWh, calculate the total electrical bill per day.

A $12.14 **B** $15.60 **C** $1214.40 **D** $15 600

36 The diagram shows an old vacuum cleaner with plastic wheels and a metal case.



The plug of the vacuum cleaner is wrongly wired as shown.



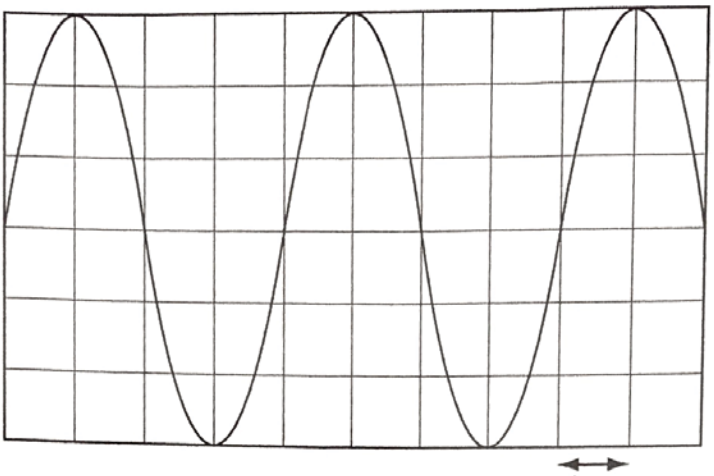
What is the effect of using the plug wired this way?

A The fuse in the plug blows.
B The metal case becomes live.
C The vacuum cleaner catches fire.
D The vacuum cleaner does not work.

37 Which material is used for the needle of a plotting compass?

A aluminium **B** brass **C** iron **D** steel

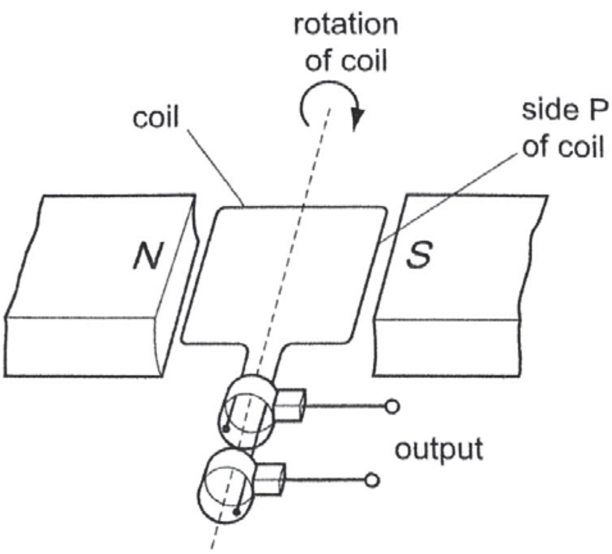
38 An alternating supply with a period of 0.020 s is connected to a cathode-ray oscilloscope (c.r.o.).



What is the time-base setting of the c.r.o.?

A 0.2 ms/cm **B** 0.5 ms/cm **C** 2 ms/cm **D** 5 ms/cm

39 An output voltage is produced as the coil in the diagram rotates.



One side of the coil is labelled P.

During the rotation, when is the output voltage zero?

	orientation of coil	position of P
A	horizontal	near the N-pole only
B	horizontal	near the N-pole or near the S-pole
C	vertical	at the top only
D	vertical	at the top or bottom

40 Which statement about a transformer is correct?

A The core of the transformer is made of iron because iron is a good electrical conductor.
B The direction of the induced e.m.f. in the secondary coil opposes the change that produces it.
C The transformer converts alternating current to direct current.
D The transformer converts direct current to alternating current.

END OF PAPER

Register No.	Class

Name ____________________

BENDEMEER SECONDARY SCHOOL
2019 PRELIMINARY EXAMINATION
SECONDARY 4 EXPRESS
PHYSICS PAPER 2
6091/02

DATE : 2 Sep 2019
DURATION : 1 hour 45 minutes

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number on the work you hand in.
Write in dark blue or black pen.
You may use a 2B pencil for any diagrams or graphs.
Do not use paper clips, glue or correction fluid.

Section A
Answer **all** questions.

Section B
Answer **all** questions. Question 11 has a choice of parts to answer.

Candidates are reminded that **all** quantitative answers should include appropriate units.
The use of an approved scientific calculator is expected, where appropriate.
Candidates are advised to show all their working in a clear and orderly manner, as more marks are awarded for sound use of Physics than for correct answers.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

/ 80

This document consists of **21** printed pages.

[Turn over

Section A

Answer **all** the questions in this section.

1 The contractor of the school's upgrading project often uses a crane to lift construction materials from the ground to a higher-level floor.

On one occasion, the crane is used to lift a long and heavy metal bar. Fig. 1.1 shows part of the lifting mechanism comprising a main cable **AB**, two other cables **BC** and **BD**, and the metal bar. **BC** and **BD** make an angle of 100°.

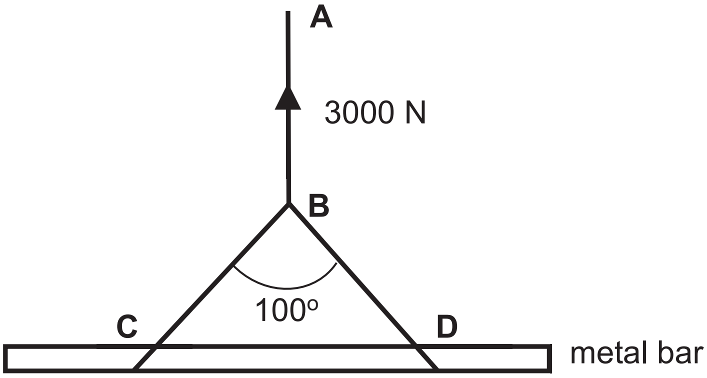


Fig. 1.1

When the metal bar is being lifted vertically at a constant speed, the tension in the main cable **AB** is 3000 N. Take gravitational field strength g to be 10 N/kg.

(a) Given that the tension of cables **BC** and **BD** are equal, use a scaled drawing to determine the tension in each of these two cables.

Scale: ……………………………………

tension = ………………………………………….. [4]

(b) Calculate the total mass of the three cables and metal bar.

total mass = ………………………………………….. [2]

2 An MRT train took 7 minutes to travel from Sembawang station to Admiralty station. During this time, the train was travelling in a straight line and it reached a top speed of 80 km/h.

Fig 2.1 shows the velocity-time graph of the train.

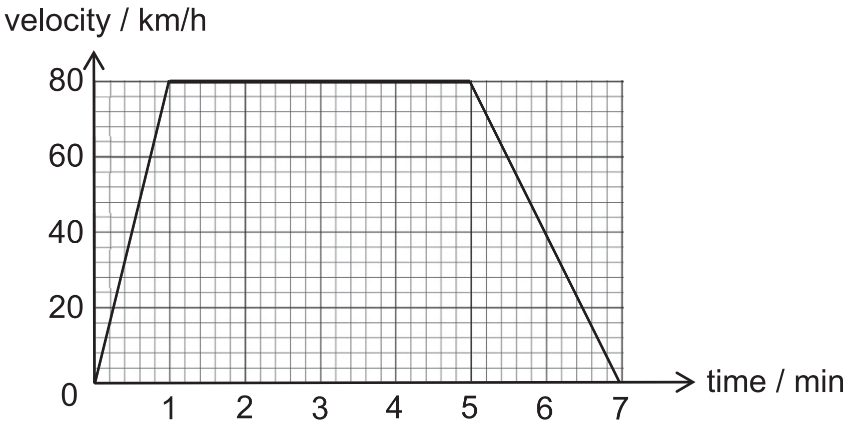


Fig. 2.1

(a) Calculate the average speed of the train (in km/h) from 0 to 7 minutes.

average speed = ………………………………………… km/h [2]

[Turn over

(b) Calculate the deceleration of the train (in km/h^2) from 5 to 7 minutes.

deceleration = ……………………………… km/h^2 [2]

(c) During the time interval of 1 to 5 minutes, a passenger in the train stood without holding onto the rails or leaning on anything.

What are the forces acting on the passenger during this time interval?

…………………………………………………………………………………………

…………………………………………………………………………………………

………………………………………………………………………………………… [2]

3 Fig. 3.1 shows an optical fibre cable probe used in medical procedures.

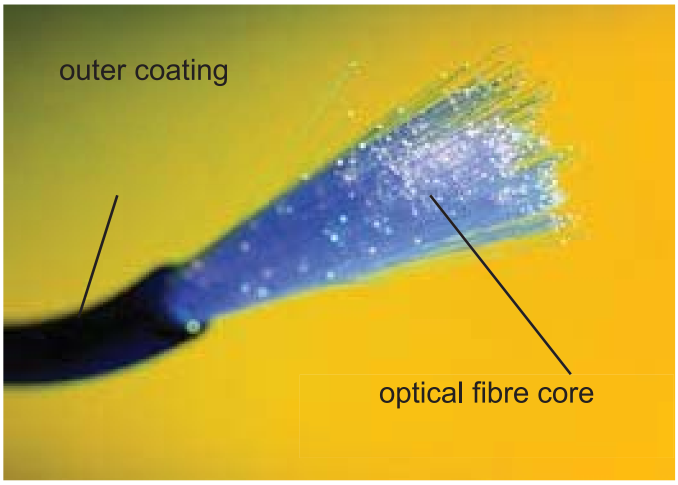


Fig. 3.1

[Turn over

Fig. 3.2 shows the cross-section of one part of the cable probe with a ray of light entering the fibre core at point **X**.

optical fibre cable probe

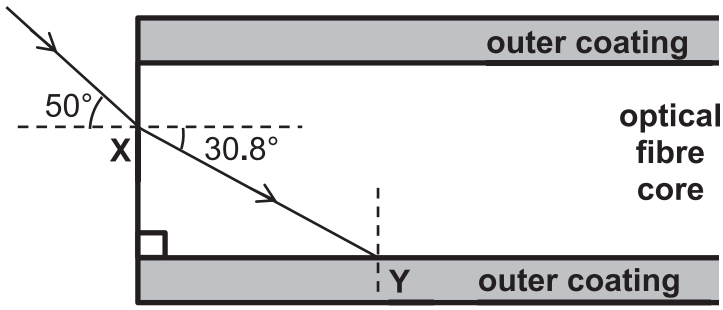


Fig. 3.2

(a) Calculate the refractive index of the optical fibre.

refractive index = ………………………………………….. [2]

(b) Calculate the critical angle *c* for this optical fibre.

critical angle *c* = ………………………………………….. [2]

(c) State and explain what will happen to the ray at point **Y**.

……………………………………………………………………………………

……………………………………………………………………………………

…………………………………………………………………………………… [2]

4 Fig. 4.1 shows an incorrect electromagnetic spectrum drawn by a student. The parts of the spectrum and the wavelengths are in the wrong order. The values of the wavelengths do not match the correct parts of the spectrum.

short wavelength						long wavelength
microwaves	radio waves	ultraviolet	infra-red	gamma rays	X-rays	visible
10^3 m	10^{-14} m	10^{-10} m	10^{-8} m	10^{-2} m	10^{-6} m	10^{-5} m

Fig. 4.1

(a) On Fig. 4.2, complete the table of the electromagnetic spectrum. Radio waves and their correct wavelength have been inserted for you.

short wavelength						long wavelength
						radio waves
						10^3 m

Fig. 4.2

[3]

(b) State the speed of all electromagnetic waves in vacuum.

.... [1]

(c) State two uses of infra-red radiation.

1. ....

2. .... [2]

5 Fig. 5.1 shows a student touching the metal dome of a Van de Graaff generator. When the generator is switched on, the metal dome becomes negatively charged.

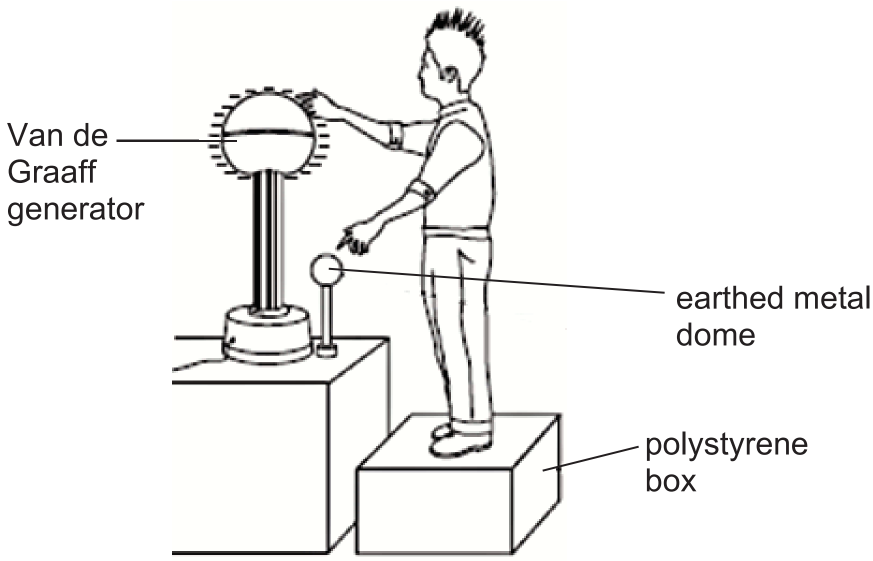


Fig. 5.1

(a) Explain why the student's hair stands on end when the generator is switched on.

…………………………………………………………………………………………

…………………………………………………………………………………………

………………………………………………………………………………………… [2]

(b) **(i)** When the potential difference between the student and a nearby earthed metal dome reaches 15 kV, a spark jumps between the student and the earthed dome. The spark transforms 0.3 J of energy into heat, light and sound.

Calculate the charge carried by the spark.

charge = ……………………………………….. [2]

(ii) State the physical quantity that represents the rate of transfer of charge.

………………………………………………………………………………………… [1]

6 Fig. 6.1 shows a piece of video tape passing under the recording head of a video recorder. An alternating current is passed through the coil. The video tape is coated with a magnetic material which becomes magnetised.

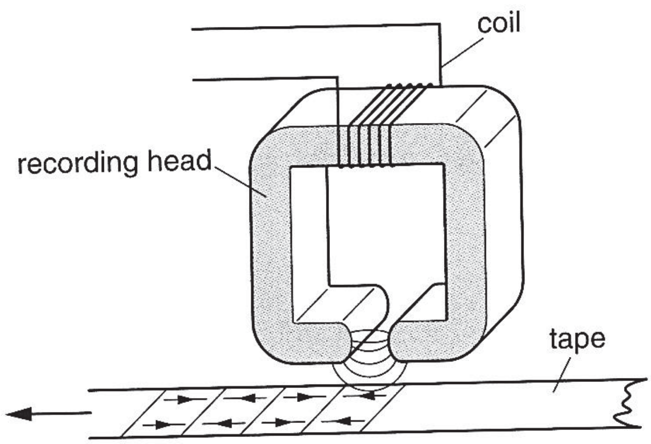


Fig. 6.1

(a) **(i)** Explain why the tape becomes magnetised.

....

....

.... [1]

(ii) Fig. 6.1 shows that the sections of the video tape are magnetised in opposite directions. Explain the cause of this occurrence.

....

.... [1]

(iii) The tape is moved faster past the recording head. State how this changes the pattern on the tape.

....

.... [1]

(b) **(i)** Explain why the coating must be of a permanent magnetic material.

....

.... [1]

(ii) State the name of a permanent magnetic material.

.... [1]

7 Fig. 7.1 shows a circuit in which all switches S1, S2 and S3 are open.

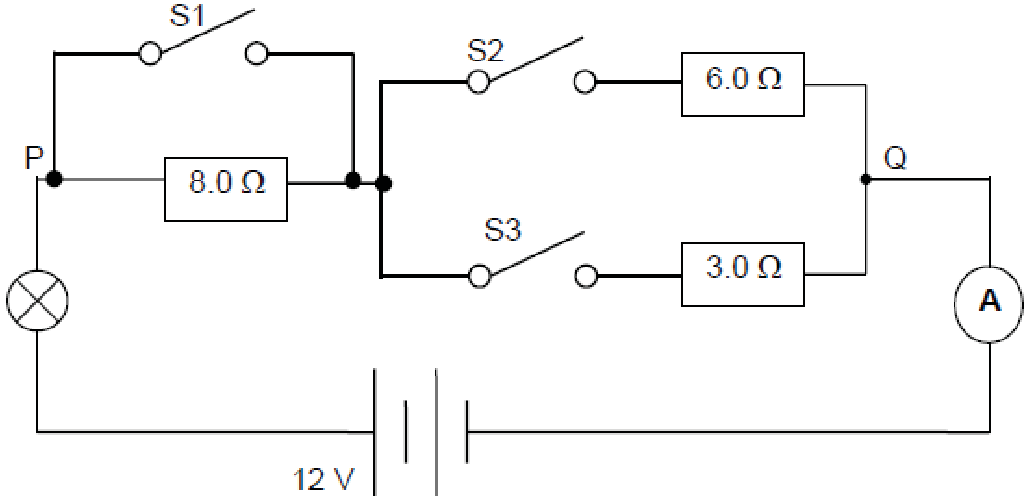


Fig. 7.1

(a) Calculate the effective resistance between points P and Q when S1, S2 and S3 are closed.

effective resistance = ... [2]

(b) Calculate the resistance of the lamp when S1, S2 and S3 are closed and the ammeter reads 2.0 A

resistance = ... [2]

[Turn over

(c) Calculate the energy dissipated by the lamp in 2 min when S1, S2 and S3 are closed.

energy dissipated = ………………………………………….. [2]

8 Fig. 8.1 shows two coils wound on an iron ring. One coil is connected in series to a switch and a d.c. supply, and the other is connected to a very sensitive centre-zero voltmeter.

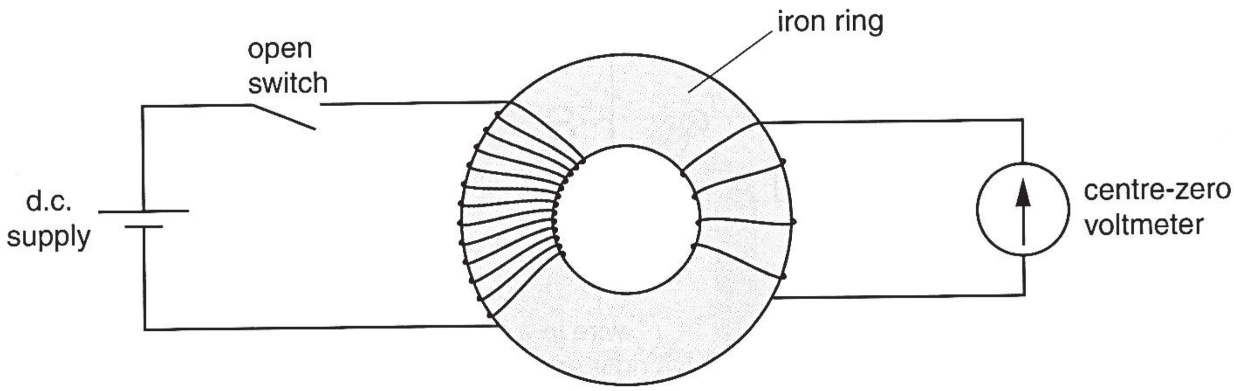


Fig. 8.1

At first the switch is open, as shown in Fig. 8.1.

(a) The following actions are taken in turn.

Describe and explain what happens to the reading on the voltmeter in each case.

(i) The switch is closed.

…………………………………………………………………………………….

…………………………………………………………………………………….

…………………………………………………………………………………….

……………………………………………………………………………………. [4]

[Turn over

(ii) The switch is left closed for a long time.

……………………………………………………………………………………

…………………………………………………………………………………… [1]

(iii) The switch is opened.

……………………………………………………………………………………

……………………………………………………………………………………

…………………………………………………………………………………… [2]

(b) State why an a.c. supply, rather than a d.c. supply, is used for a transformer.

……………………………………………………………………………………

…………………………………………………………………………………… [1]

(c) State two ways how the turning effect on a current-carrying coil in a d.c. motor can be increased.

1. ……………………………………………………………………………………

2. …………………………………………………………………………………… [2]

Section B

Answer **all** the questions from this section.
Answer only one of the two alternative questions in **Question 11**.

9 In an experiment, different sized metal pellets are fired from an air rifle towards an 8.0 kg block of plastic suspended from the top of a ceiling. The initial position of the block is shown in Fig. 9.1, and when the pellet hits the plastic block, the block is displaced as shown in Fig. 9.2.

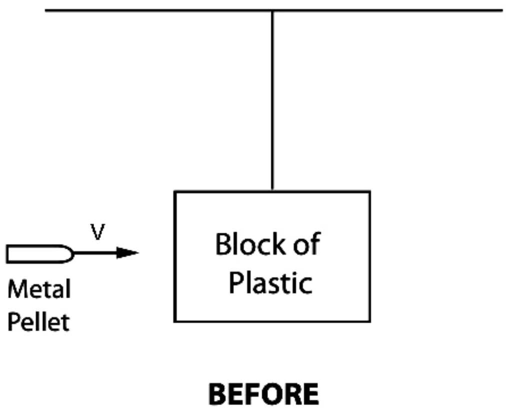


Fig. 9.1

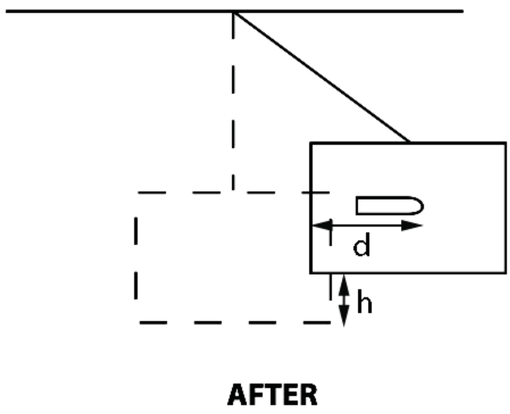


Fig. 9.2

The information obtained from the experiment is shown in Fig. 9.3.

mass of pellet, m	speed of pellet just before it hits plastic block, v	depth of penetration by pellet, d	time taken for pellet to come to a stop, t	maximum increase in height of plastic block, h
0.050 kg	40 m/s	0.15 m	0.025 s	0.348 m
0.025 kg	56 m/s	0.12 m	0.020 s	0.292 m
0.020 kg	62 m/s	0.11 m	0.018 s	0.274 m

Fig. 9.3

(a) Calculate the kinetic energy of the 0.025 kg pellet just before it hits the block of plastic.

kinetic energy = ………………………………………….. [2]

[Turn over

(b) Calculate the deceleration and hence the resistive force acting on the 0.025 kg pellet.

deceleration = ……………………………………….. [2]

resistive force = ……………………………………….. [2]

(c) Calculate the work done by the 0.025 kg pellet against friction.

work done = ……………………………………….. [2]

(d) Show that there is a discrepancy between the experimental and theoretical values for the increase in height of the plastic block.

[2]

10 Fig. 10.1 shows a refrigerator. The refrigerator walls are made of smooth white metal with a layer of polystyrene foam between the inside and outside walls.

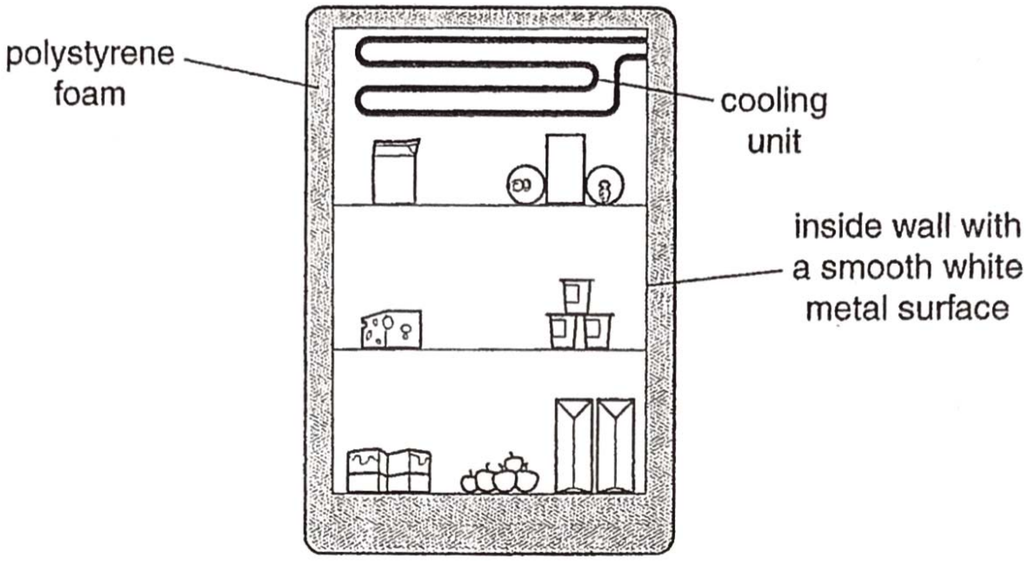


Fig. 10.1

(a) **(i)** Describe how the polystyrene foam insulates the refrigerator.

....

....

....

.... [2]

(ii) Explain how the cooling unit at the top cools all the contents of the refrigerator.

....

....

....

....

....

.... [2]

(iii) The inside wall radiates a small amount of thermal energy (infra-red radiation). State how the colours of the surface affects the amount of energy radiated.

……………………………………………………………………………………

…………………………………………………………………………………… [1]

(b) A beaker contains 100 g of water at temperature of 50°C. An ice cube is removed from a refrigerator and dropped into the water. The ice cube is initially all solid at 0°C and has a mass of 3.0 g.

When the ice has melted, the water is stirred and has a temperature of 46°C.

The specific heat capacity of water is 4.2 J/(g°C).

In this question, ignore heat loss to the beaker and surroundings.

(i) Calculate the energy lost by the water as it cools from 50°C to 46°C.

energy = ………………………………………….. [2]

(ii) The melted ice (water) from the ice cube gains energy as it warms from 0°C to 46°C. Calculate the thermal energy needed for this rise in temperature.

energy = ………………………………………….. [1]

[Turn over

(iii) Use your answers to **(i)** and **(ii)** to determine the latent heat needed to melt the ice cube.

energy = ……………………………………….. [1]

(iv) Determine the specific latent heat of fusion of water.

specific latent heat of fusion = ……………………………………….. [1]

11 **EITHER**

Fig. 11.1 shows a man using an exercise machine.

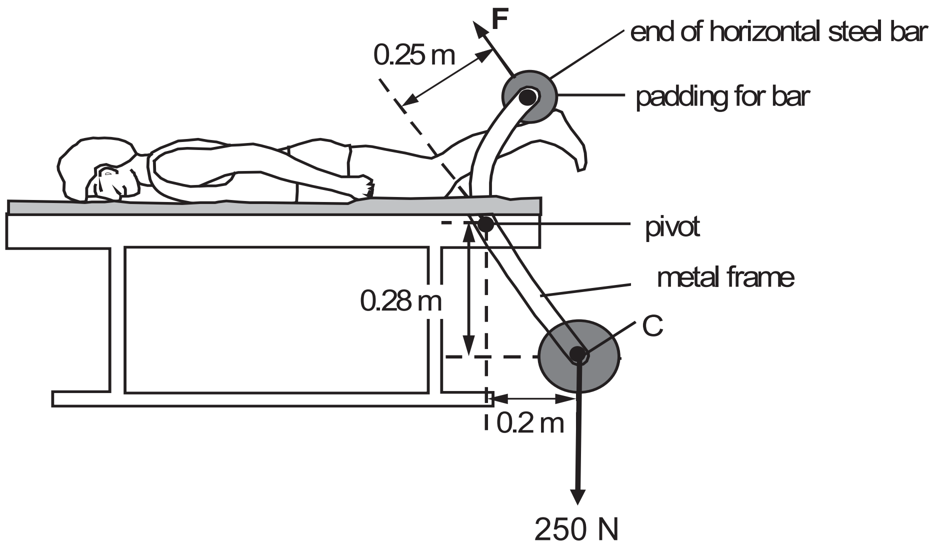


Fig. 11.1

(a) State the *Principle of Moments*.

....

....

....

.... [2]

(b) Define the *moment* of a force and state its SI unit.

....

....

....

.... [2]

[Turn over

(c) The heels press against the pad with a force **F** and cause a turning effect about the pivot. The weight of the 250 N weights acts through the centre of gravity C.

Calculate the

(i) number of weights supported at C if each piece has a mass of 5 kg;

number of weights = ……………………………………….. [2]

(ii) moment due to the 250 N weights about the pivot;

moment = ……………………………………….. [2]

(iii) force **F**.

F = ……………………………………….. [2]

[Turn over

OR

An appliance is connected to the live, neutral and earth conductors of the mains supply.

The current in the circuit is 4.0 A and the rating of the fuse is 5 A.

(a) Explain what is meant by

(i) *live*;

....

.... [1]

(ii) *neutral*.

....

.... [1]

(b) When a fault occurs in the appliance, no damage or injury is caused provided that the correct fuse is used and the metal case is connected to earth.

(i) The 5 A fuse is replaced by a 30 A fuse.

Explain why this presents a risk of damage or injury.

....

....

....

....

.... [2]

(ii) The earth conductor is **not** connected to the metal case.

Explain why this presents a risk of damage or injury.

....

....

....

....

.... [2]

(c) State one advantage of using a circuit breaker rather than a fuse to protect the appliance.

....

.... [1]

(d) Fig. 11.2 shows a circuit connected to a mains voltage of 220 V.

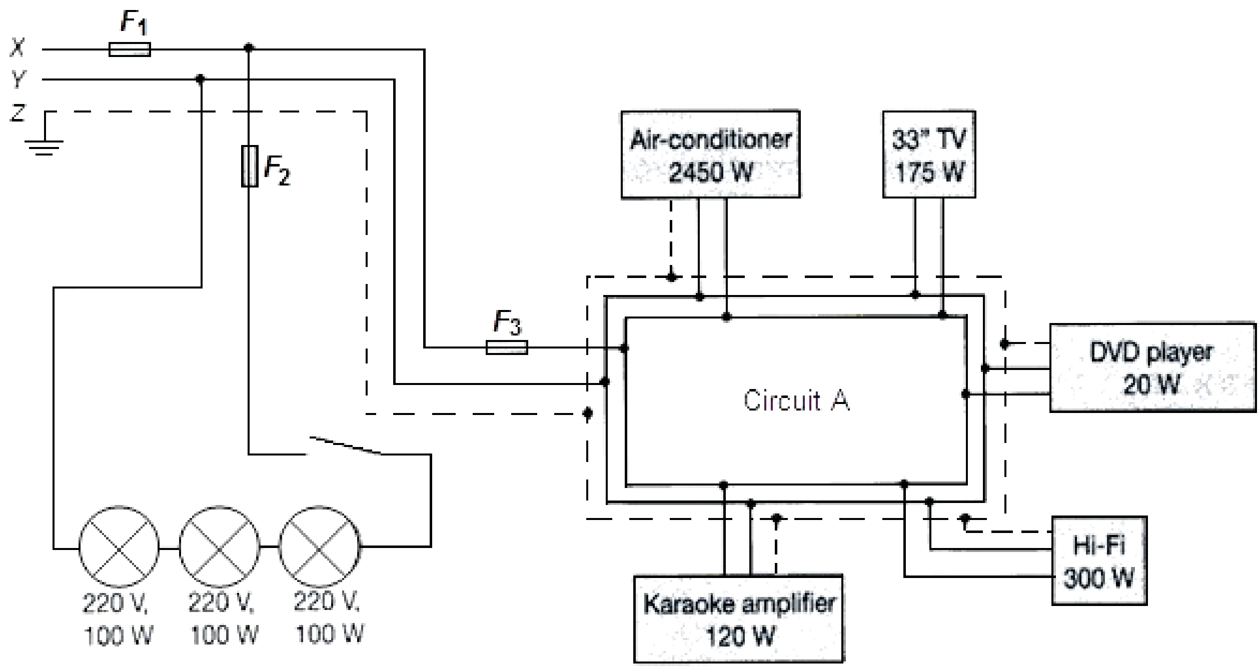


Fig. 11.2

Name the wires *X*, *Y*, and *Z*.

Wire *X* ……………………………………………

Wire *Y* ……………………………………………

Wire *Z* …………………………………………… [3]

END OF PAPER

Answer Key

2019 Prelim Examination
Sec 4 Express
Physics
Paper 1

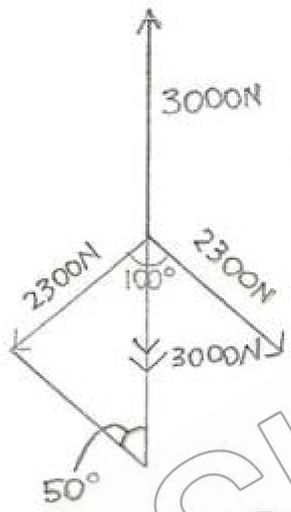
1	B	11	A	21	C	31	D
2	B	12	D	22	D	32	B
3	C	13	C	23	B	33	D
4	B	14	D	24	B	34	B
5	B	15	C	25	A	35	B
6	B	16	B	26	C	36	B
7	D	17	D	27	D	37	D
8	D	18	C	28	B	38	D
9	D	19	B	29	D	39	D
10	A	20	C	30	B	40	B

Answer Key

2019 Preliminary Examination
Sec 4 Express
Physics
Paper 2

Section A

1 (a)



[1] for scale (1 cm : 1000 N)
[1] for correct drawing of forces
[1] for correct labelling
[1] Tension – accept 2200 N to 2400 N

(b) W = mg
3000 = m x 10 [1]
m = 300 kg [1]

2 (a) Total distance = area under speed-time graph
= 0.5 x (7+4) x 80 / 60
= 7.333 km [1]
average speed = 7.333 / (7/60)
= 62.9 km/h [1]

(b) a = (v – u)/t
= (0 – 80) / (2/60) [1]
= –2400 km/h^2

Deceleration = 2400 km/h^2 [1]

(c) Weight and [1]
normal reaction force / contact force [1]

3 (a) $\eta = \frac{\sin i}{\sin r}$

$= \frac{\sin 50°}{\sin 30.8°}$ [1]

= 1.50 (3sf) [1]

(b) $\eta = \frac{1}{\sin c}$

$\sin c = \frac{1}{1.50}$ [1]

c = 41.8° (3sf) [1]

(c) Total internal reflection will take place at point Y. [1]

Angle of incidence at point Y = 180° – 90° – 30.8° = 59.2°

Explanation: angle of incidence at point Y is greater than the critical angle [1]

4 (a) correct order of powers of ten [1]
correct order of spectrum [2]
(exchanging two parts or moving one part produces correct order [1])

short wavelength						long wavelength
gamma rays	X-rays	ultraviolet	visible	infra-red	microwaves	radio waves
10^{-14} m	10^{-10} m	10^{-8} m	10^{-6} m	10^{-5} m	10^{-2} m	10^{3} m

(b) 3×10^{8} m/s [1]

(c) any TWO from cooking, intruder (accept burglar, motion, security) alarms, [2]
any **specific** sensor or medical use, remote controls, night vision, heating (e.g. just heating or heating a greenhouse, heating a solar panel),
detect temp., see in fog,
detect hot bodies, IR astronomy, distance measurement

5 (a) Excess electrons from the negatively charged Van de Graaff generator flows to the student, causing his whole body to be negatively charged. [1]
As his hair strands attain a negative charge, they are repelled from the body as like charges repel, thus making the hair stand on ends. [1]

(b) (i) V = W / Q
15,000 = 0.3 / Q [1]
Q = 2 x 10^{-5} C [1]

(ii) Current [1]

6 (a) (i) When current is flowing in the coil, it generates a magnetic field in and around the coil.
Hence the recording head is magnetised as an electromagnet, which in turn magnetises the tape. [1]

(ii) magnetism / magnetic field or current or poles on head reverses / changes direction [1]

(iii) each direction / one cycle longer (on tape) [1]

(b) (i) need to keep record / tape stored [1]

(ii) steel etc. [1]

7 (a) $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$

$= \frac{1}{6} + \frac{1}{3}$ [1]

R = 2 Ω [1]

(b) V = IR
12 = 2 x R
Total R = 6 Ω [1]

Resistance of lamp = 6 – 2 = 4 Ω [1]

(c) E = Pt = I^2R x t
= 2^2 x 4 x (2 x 60) [1]
= 1920 J [1]

8 (a) (i) meter deflects one way then returns to zero [1]
(current in left coil creates a) magnetic field [1]
magnetic field / flux cuts right-hand coil or changes (and induces a voltage) [1]
meter returns to zero because no more change in flux [1]

(ii) meter remains at / returns to zero **and** no change in flux / no flux cuts coil [1]

(iii) meter deflects in opposite direction [1]
field change in opposite direction **or** field / flux cuts in opposite direction [1]

(b) direction of current / magnetic field constantly changes [1]

(c) inserting a soft iron core into the coil
increasing the number of turns in the coil
increasing the current in the coil
any two [2]

Section B

9 (a) KE = ½ mv^2
= 0.5 x 0.025 x 56^2 [1]
= 39.2 J [1]

(b) a = (v-u)/t
= (0 – 56)/0.02 [1]
= –2800 m/s^2
Deceleration = 2800 m/s^2 [1]

F = ma
= 0.025 x 2800 [1]
= 70 N [1]

(c) work done = F x d
= 70 x 0.12 [1]
= 8.4 J [1]

(d) By the Principle of Conservation of Energy
KE = W + GPE
39.2 = 8.4 + GPE [1]
GPE = 30.8 J = mgh
h = (30.8) / (0.025+8.0)(10)
= 0.384 m (theoretical value) [1]

10 (a) (i) The polystyrene foam which traps air is a good heat insulator. [1]
It is a good insulator and it prevents heat conduction. [1]

(ii) The cooling unit cools the air at the top.
As the cool air contracts and sinks, the warm air rises. [1]
This movement of air sets up a convention current.
This convection current cools all the contents of the refrigerator. [1]

(iii) Shiny and smooth surfaces are poorer emitters compared to black and dull surfaces.
Hence only a small amount of energy is radiated by the inside wall. [1]

(b) (i) $E = mc\Delta\theta$
$= 100 \times 4.2 \times (50 - 46)$ [1]
$= 1680$ J [1]

(ii) $E = mc\Delta\theta$
$= 3.0 \times 4.2 \times (46 - 0)$
$= 580$ J (3sf) [1]

(iii) Latent heat required = 1680 – 580
= 1100 J [1]

(iv) specific latent heat of fusion $l_f = L_f / m$
$= 1100 / 3.0$
$= 367$ J/g [1]

EITHER

11 (a) The Principle of Moments states that when a body is in equilibrium, the sum of the clockwise moments about a pivot is [1] equal to the sum of the anticlockwise moments about the same pivot. [1]

(b) The moment of a force is the product of the force and the perpendicular distance from the pivot to the line of action of the force. [1]

SI unit: Nm [1]

(c) (i) Weight of each piece W = m x g
= 5 x 10
= 50 N [1]

No. of weights at C = 250 / 50
= 5 [1]

(ii) moment = F x d
= 250 x 0.2 [1]
= 50 Nm [1]

(iii) By the Principle of Moments
sum of clockwise moments = sum of the anticlockwise moments
50 = F x 0.25 [1]
F = 200 N [1]

OR

11 (a) (i) Live conductors allow current to flow through and reach the appliance. [1]

(ii) Neutral conductors allow the current to flow back to the source and hence complete the circuit. [1]

(b) (i) The fuse rating is much higher than the amount of current flowing through the circuit. [1]
When excessive current flows through the appliance, the fuse may not melt and disconnect the circuit. As a result, it may cause harm to the user or damage to the appliance. [1]

(ii) The metal case becomes live when the live wire is damaged and touches the metal case. [1] [1]
As a result it may cause harm to the user or damage to the appliance.

(c) The circuit breaker works faster in disconnecting all the switches in the house. Any one
The circuit breaker only needs to be reset after activated whereas the fuse needs to be replaced after melting. [1]

(d) Wire X: Live [1]

Wire Y: Neutral [1]

Wire Z: Earth [1]

Name: ____________________________ (   )   Class: ______________

PRELIMINARY EXAMINATION

GENERAL CERTIFICATE OF EDUCATION ORDINARY LEVEL

PHYSICS **6091/01**

Paper 1 Multiple Choice **Tuesday 3 September 2019**

1 hour

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, highlighters, glue or correction fluid.
Write your name, index number and class on the Answer Sheet in the spaces provided.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.

Choose the one you consider correct and record your choice in soft pencil on the separate Answer Sheet.

Read instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer. Any rough working should be done on this booklet.

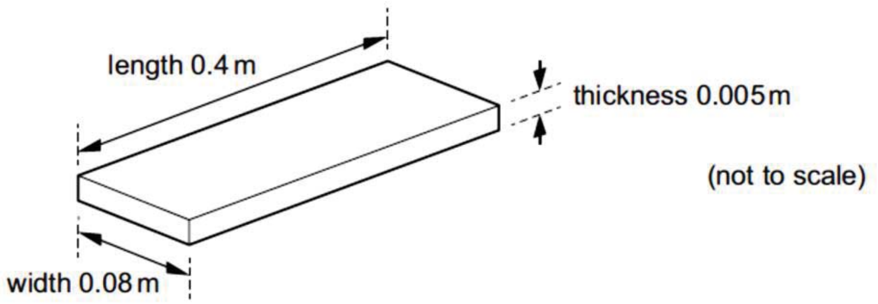
The use of an approved scientific calculator is expected, where appropriate.

This document consists of **19** printed pages and **1** blank page.

圣尼各拉女校
CHIJ ST. NICHOLAS GIRLS' SCHOOL
Girls of Grace ● Women of Strength ● Leaders with Heart

[Turn over

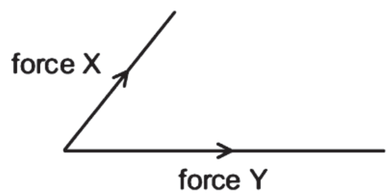
1 A manufacturer measures the three dimensions of a floor tile using three different instruments. The approximate dimensions of the tile are shown.



Which instruments are used to measure accurately each of these dimensions?

	length	width	thickness
A	calipers	micrometer	metre rule
B	metre rule	micrometer	calipers
C	metre rule	calipers	micrometer
D	micrometer	metre rule	calipers

2 Two forces, X and Y, act on an object and produce a resultant force. The diagram represents the sizes and directions of forces X and Y.

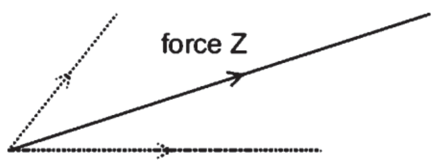


(not to scale)

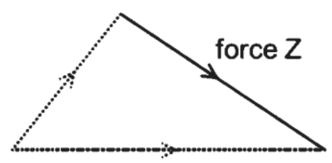
Force Z balances the resultant force due to X and Y and keeps the object stationary.

Which arrow represents force Z?

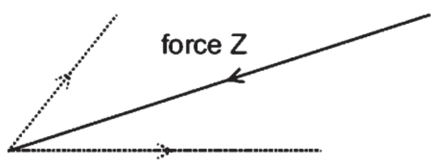
A



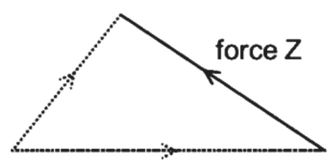
B



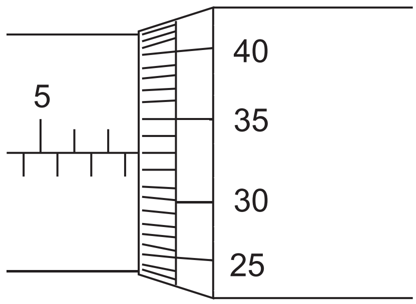
C



D



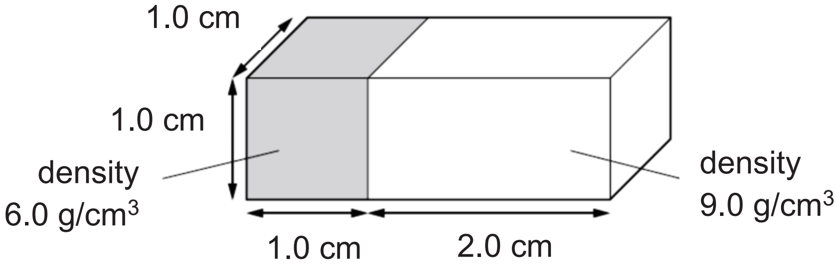
3 A student used a micrometer screw gauge to measure the thickness of a metal sheet.



What is the thickness of the metal sheet?

A 5.83 mm **B** 7.33 mm **C** 7.83 mm **D** 10.33 mm

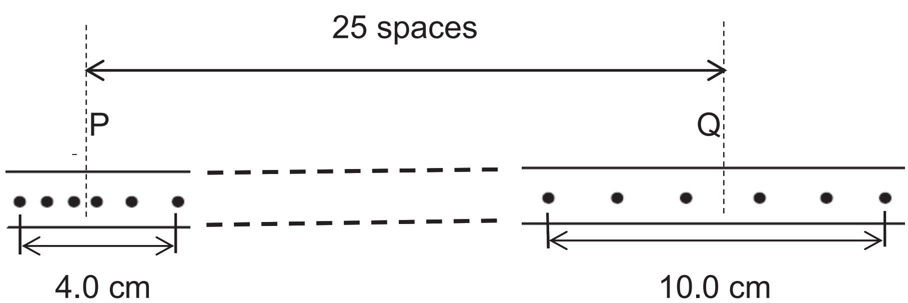
4 Two blocks are joined together as shown below.



One block has a density of 6.0 g/cm^3 and the other has a density of 9.0 g/cm^3.
What is the overall density of the two blocks joined together?

A 7.0 g/cm^3
B 7.5 g/cm^3
C 8.0 g/cm^3
D 15 g/cm^3

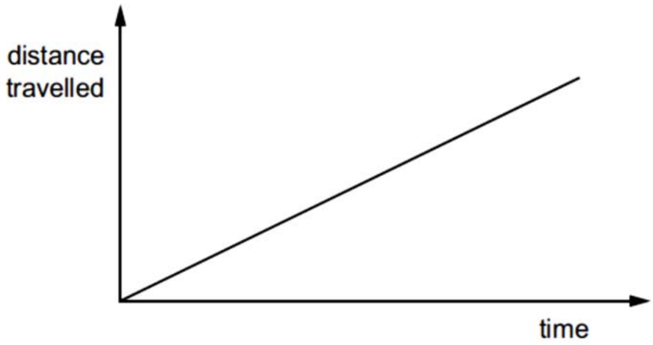
5 A trolley with a ticker-tape attached to it, moves down a runway. The ticker-tape timer operates at a frequency of 50 Hz on the tape. The diagram below shows two sections from tape P and Q, separated by 25 spaces.



Calculate the average acceleration of the trolley.

A 0.4 m/s^2
B 0.6 m/s^2
C 0.8 m/s^2
D 1.2 m/s^2

6 The distance travelled by a car is increasing uniformly as it is driven along a straight road up a hill.



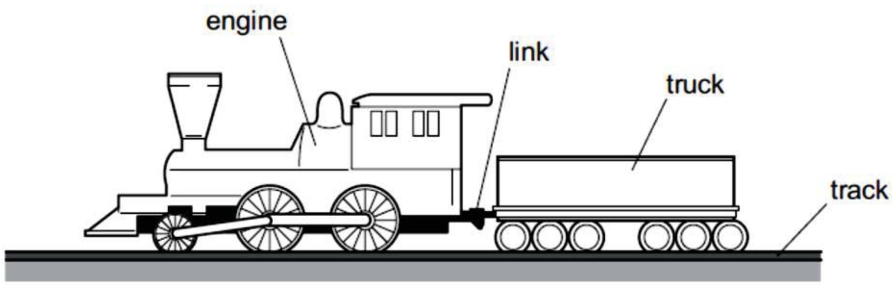
Which quantity of the car is constant but not zero?

A acceleration
B displacement
C gravitational potential energy
D kinetic energy

7 Which moving body has a resultant force acting on it?

A a parachutist descending vertically at terminal velocity
B a diver rising vertically through water at constant speed
C an aircraft circling an airport at constant speed
D a train going up a straight incline at constant speed

8 An engine pulls a truck at constant speed on a level track.



The link between the engine and the truck breaks. The driving force on the engine remains constant.

What effect does this have on the engine and the truck?

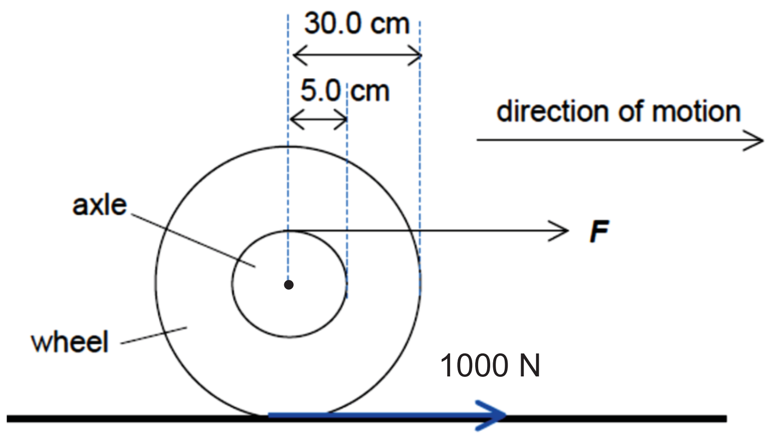
	engine	truck
A	speed stays constant	slows down
B	speeds up	slows down
C	speed stays constant	stops immediately
D	speeds up	stops immediately

9 A free-fall skydiver jumps from a plane. As he falls, there is a force acting upwards and a force acting downwards on his body. These produce a resultant force.

Before he reaches terminal velocity, how do the sizes of the forces change?

	downward force	upward force	resultant force
A	decreases	decreases	stays the same
B	increases	stays the same	decreases
C	stays the same	increases	decreases
D	stays the same	increases	increases

10 The diagram shows an axle fixed to a wheel. The axle of radius 5.0 cm is pulled by a force *F* so that the wheel of radius 30.0 cm turns clockwise. The wheel moves forward at constant speed and experience a frictional force of 1000 N between the wheel and the floor. The mass of the wheel and axle is 200 kg.

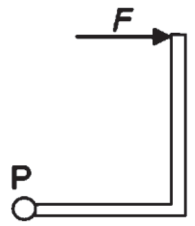


What is the force *F* acting on the axle?

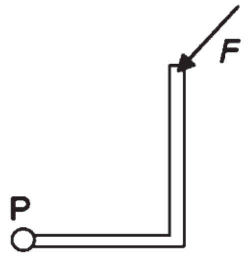
A 167 N
B 1 000 N
C 6 000 N
D 8 000 N

11 A force F acts on an L-shaped object pivoted at point P. Which of the following will produce the largest turning moment about pivot P?

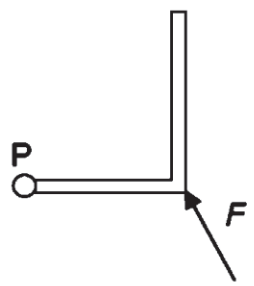
A



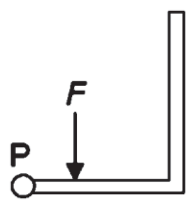
B



C



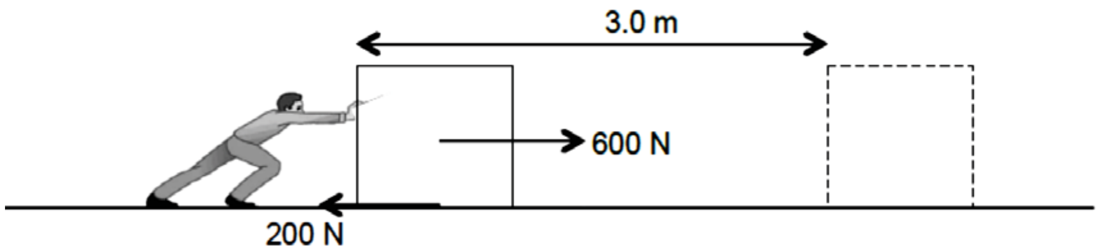
D



12 A car of mass 1500 kg has a speed of 20 m/s. It accelerates until its speed is 25 m/s. What is the increase in the kinetic energy of the car?

A 19 kJ
B 38 kJ
C 170 kJ
D 340 kJ

13 A man exerts a horizontal force of 600 N on a box as shown in the diagram. A frictional force of 200 N acts in the opposite direction. The box moves 3.0 m in 5.0 s.



What is the useful power in pushing the box forward?

A 120 W
B 240 W
C 360 W
D 480 W

14 The energy supplied to an electric motor is E, and, in the same time, the energy wasted by the motor is W.

What is the efficiency of the motor?

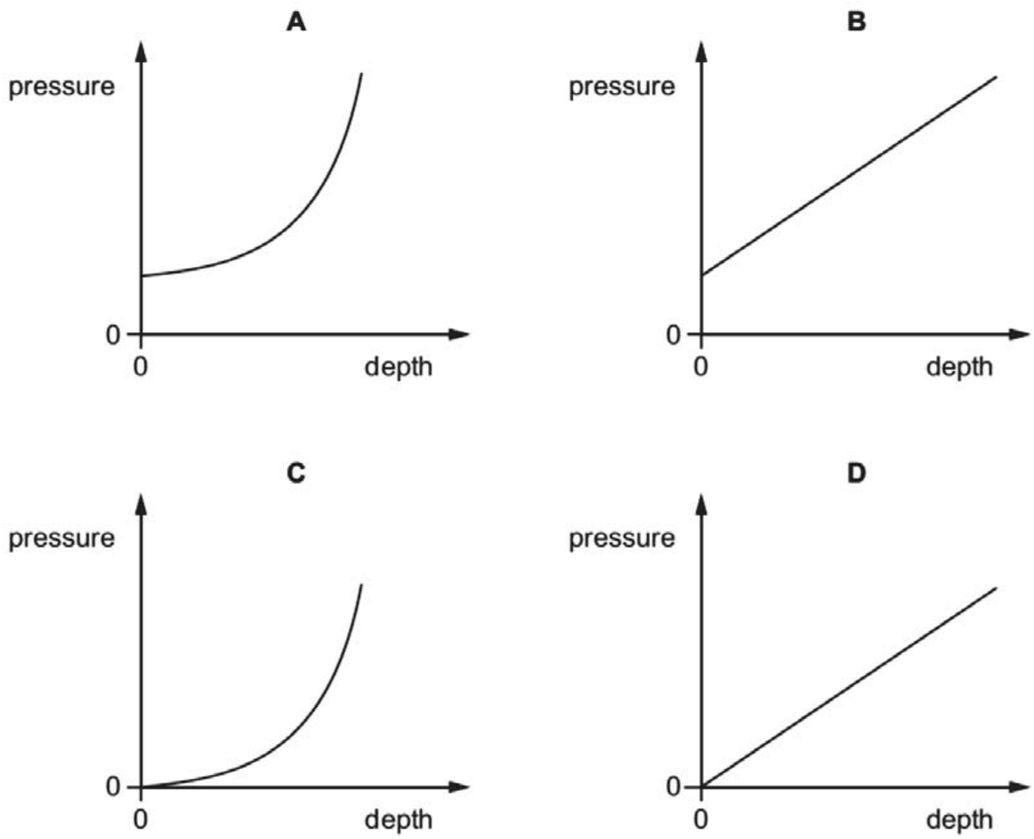
A $\frac{E}{W}$

B $\frac{W}{E}$

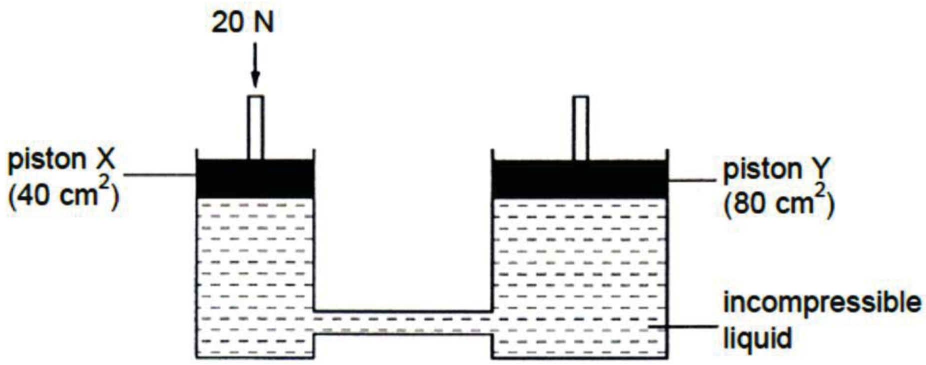
C $\frac{(E-W)}{W}$

D $\frac{(E-W)}{E}$

15 Which graph shows the total external pressure acting on a submarine at different depths below the surface of the sea? Assume the change in density of sea water is negligible.



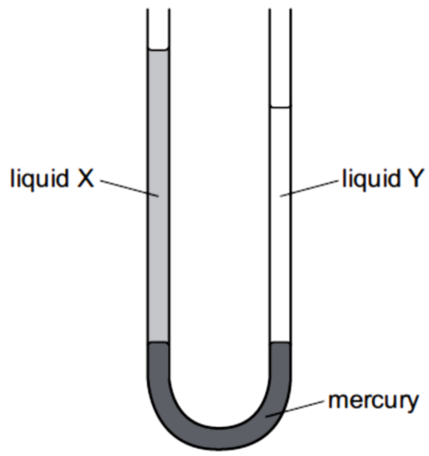
16 The diagram shows a simple hydraulic jack. A downward force of 20 N is exerted on piston X, causing it to move down by 30 cm.



What is the upward force on piston Y and the distance moved by piston Y raised?

	upward force on piston Y	distance moved by piston Y
A	40 N	15 cm
B	40 N	20 cm
C	80 N	10 cm
D	80 N	15 cm

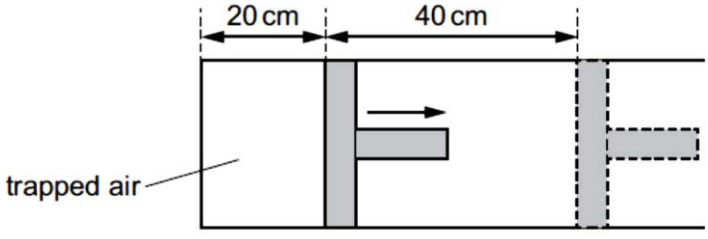
17 The diagram shows a U-tube manometer containing three liquids: mercury, liquid *X* and liquid *Y*. Neither liquid *X* or liquid *Y* mixes with mercury.



Which correctly describes the densities of X and Y, and the pressures they exert on the mercury?

	pressure exerted on the mercury	densities of *X* and *Y*
A	pressure of *X* is greater than Y	density of *X* is greater than *Y*
B	pressure of *Y* is greater than X	density of *Y* is greater than *X*
C	pressure of *X* and of *Y* are the same	density of *X* is greater than *Y*
D	pressure of *X* and of *Y* are the same	density of *Y* is greater than *X*

18 Air is trapped in a cylinder by a piston. The pressure of the air is p and the length of the air column is 20 cm. The piston is moved outwards until the length of the air column has increased by 40 cm. The temperature of the air remains constant.



What is the new air pressure?

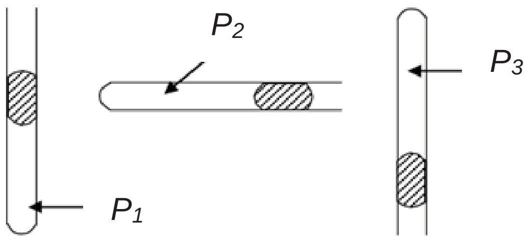
A $p/2$
B $p/3$
C $2p$
D $3p$

19 Some gas is trapped in a closed container. The gas is cooled and the volume of the container is kept constant.

What happens to the gas molecules?

A They collide with the walls more often.
B They contract.
C They get closer together.
D They move more slowly.

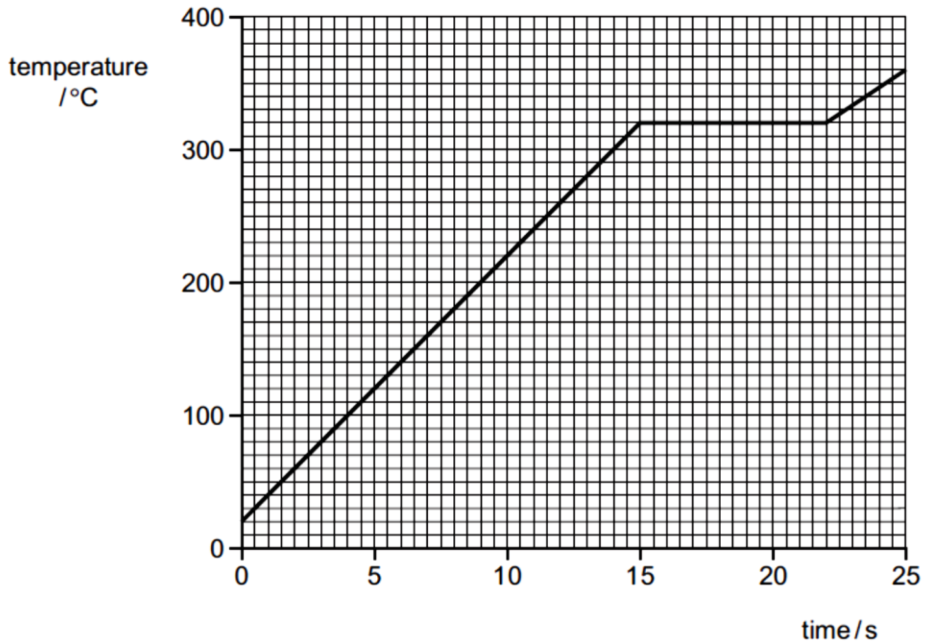
20 A column of dry air is trapped by a pellet of mercury in a capillary tube. The capillary tube is held in different positions as shown in the diagrams.



Compare the air pressures P_1, P_2 and P_3.

A $P_1 > P_2 > P_3$
B $P_3 > P_2 > P_1$
C $P_1 > P_3 > P_2$
D $P_1 = P_2 = P_3$

21 A 125 g piece of solid lead at room temperature is heated. It completely melted after 22 s. The graph shows how its temperature varies with time.



The power of the heater is 400 W. What is the specific latent heat of fusion of lead, in J/kg?

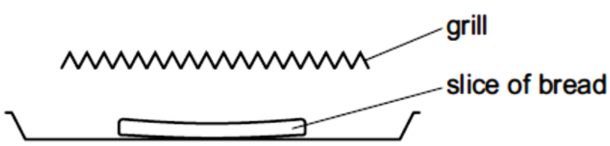
A $\dfrac{7.0 \times 400}{0.125 \times 300}$

B $\dfrac{22 \times 400}{0.125 \times 300}$

C $\dfrac{7.0 \times 400}{0.125}$

D $\dfrac{22 \times 400}{0.125}$

22 A slice of bread is placed under a red-hot electric grill to make toast.

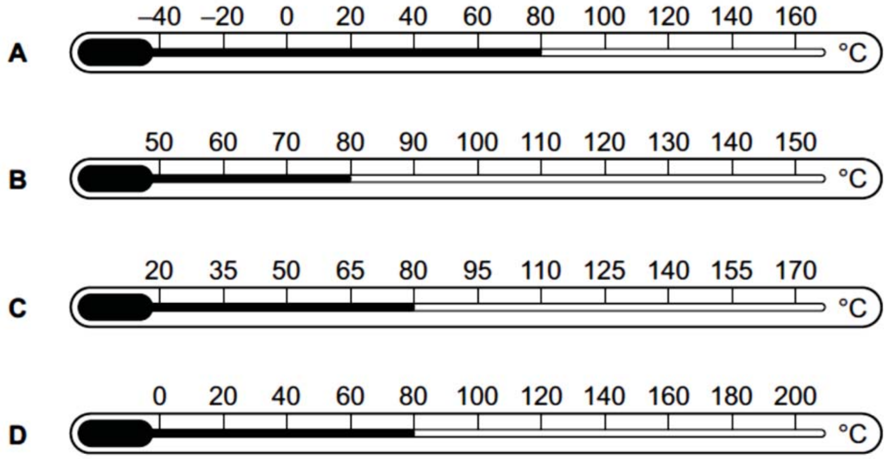


How does heat reach the bread?

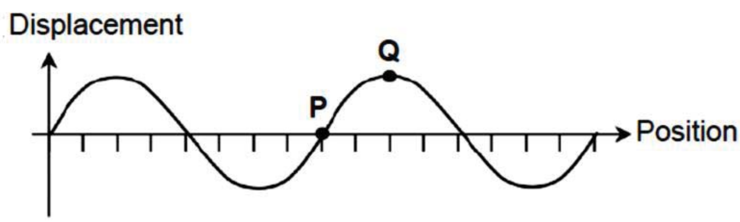
A conduction and convection
B conduction and radiation
C convection and radiation
D radiation only

23 A thermometer is used to measure a temperature of 80 °C.

Which thermometer is the most sensitive?



24 The graph shows a water wave with frequency 10 Hz traveling from left to right. The displacement of particle *P* on the wave at this instant is zero.



How long later would particle *Q* be at zero displacement?

A 0.025 s
B 0.050 s
C 0.10 s
D 2.5 s

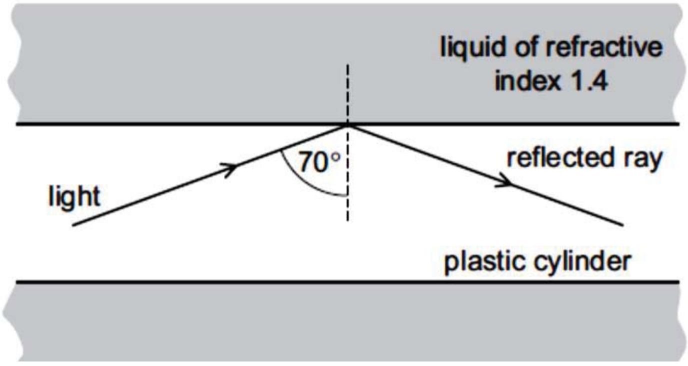
25 Which device uses ultrasound?

A an optical fibre
B a pre-natal scanner
C a steriliser
D a sunbed

26 Which statement about microwaves is correct?

A Microwaves are longitudinal waves.
B In vacuum, the speed of microwaves is equal to speed of visible light.
C The frequencies of microwaves are greater than the frequencies of visible light
D The wavelengths of microwaves are smaller than the wavelengths of infra-red.

27 A solid plastic cylinder is immersed in a liquid of refractive index 1.4. Light travelling in the plastic cylinder strikes the inside surface at an angle of incidence of 70°. The light undergoes total internal reflection.



What are the values of the critical angle in the plastic and the refractive index of the plastic?

	critical angle in the plastic	refractive index of the plastic
A	greater than 70°	greater than 1.4
B	greater than 70°	less than 1.4
C	less than 70°	greater than 1.4
D	less than 70°	less than 1.4

28 The ray diagrams 1 and 2 show two ways in which a thin converging lens produces an image that is larger than the object.

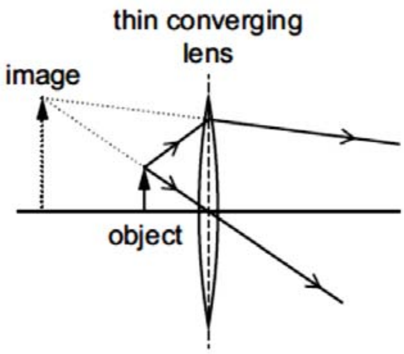


diagram 1

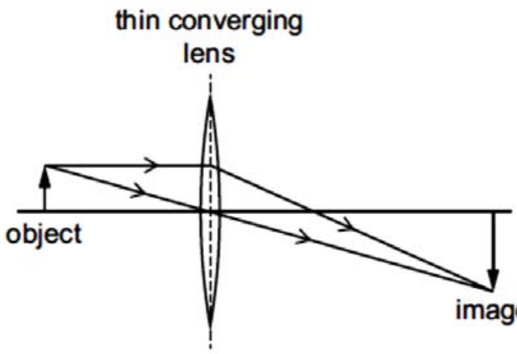
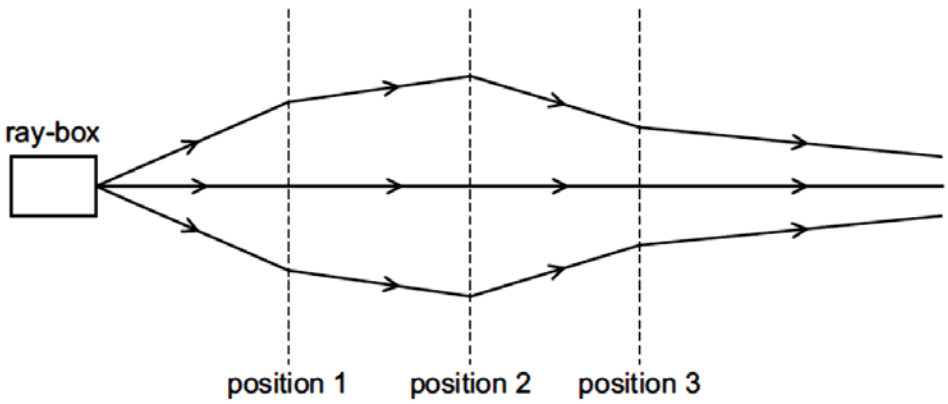


diagram 2

Which devices use lenses in the ways as shown in diagrams 1 and 2?

	diagram 1	diagram 2
A	camera	magnifying glass
B	magnifying glass	projector
C	photographic enlarger	camera
D	photographic enlarger	projector

29 The diagram shows rays of light from a ray-box passing through three lenses placed at positions 1, 2 and 3.



What type of lens is used at each position?

	position 1	position 2	position 3
A	converging	converging	converging
B	converging	converging	diverging
C	diverging	converging	diverging
D	diverging	diverging	converging

30 A positively charged metal sphere is placed midway between two previously uncharged metal rods, one of which is connected to earth.

Which diagram shows the charges on the rods?

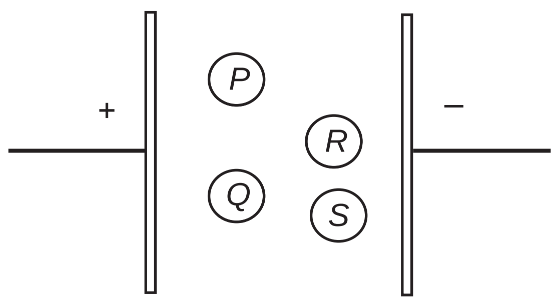
A

B

C

D

31 The diagram shows two charged parallel plates. Four negatively charged identical particles, *P, Q, R* and *S* are placed in between the plates.



Which particles experienced the same force due to electric field?

A *P* and *Q*
B *R* and *S*
C All of them
D None of them

32 A piece of wire has a resistance of 16 Ω. The wire is 20 cm long and has a cross-sectional area of 2.0 mm^2.

Which wire of the same material has a resistance of 8.0 Ω?

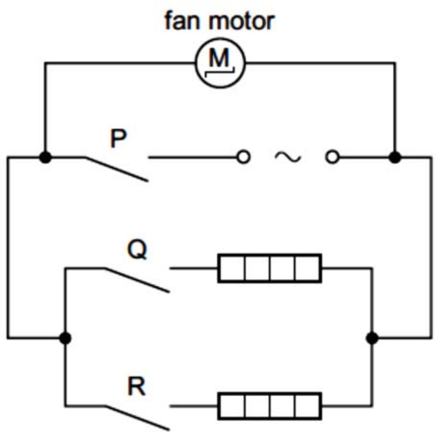
	length	cross-sectional area
A	10 cm	0.5 mm^2
B	10 cm	1.0 mm^2
C	20 cm	0.5 mm^2
D	20 cm	4.0 mm^2

33 A defibrillator is a device that is used to give an electric shock to a patient's heart. It supplies an electric shock of energy 300 J at an average voltage of 2000 V for 10 ms.

What is the average current it supplies?

A 0.015 A
B 0.67 A
C 6.7 A
D 15 A

34 The diagram shows the circuit for a hair-dryer.



The fan motor has a power rating of 0.10 kW and the heaters each have a rating of 0.40 kW. The cost of electricity is 18 cents per kWh.

What is the cost of running the hair-dryer for two hours with switches P and Q closed and switch R open?

A 9 cents
B 18 cents
C 24 cents
D 32 cents

35 The current in a kettle is 10 A and the kettle is protected by a 13 A fuse. The owner of the kettle replaces the 13 A fuse with a 3 A fuse.

What happens when the kettle is switched on?

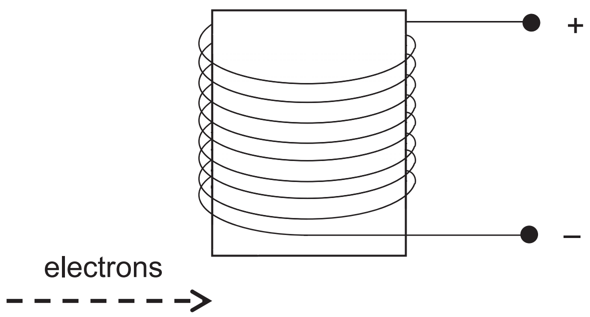
A The fuse does not melt and the kettle works correctly.
B The fuse does not melt but the kettle fails to work.
C The fuse melts and the kettle is undamaged.
D The fuse melts and the kettle might be damaged.

36 An old lamp is found and a new filament bulb with a power rating of 500 W is inserted. When the lamp is plugged into the mains and switched on, it does not light up.

What is a possible cause of this?

A The earth wire in the plug is disconnected.
B The fuse in the circuit has too high a rating.
C The neutral wire in the plug is disconnected.
D The lamp is doubly insulated.

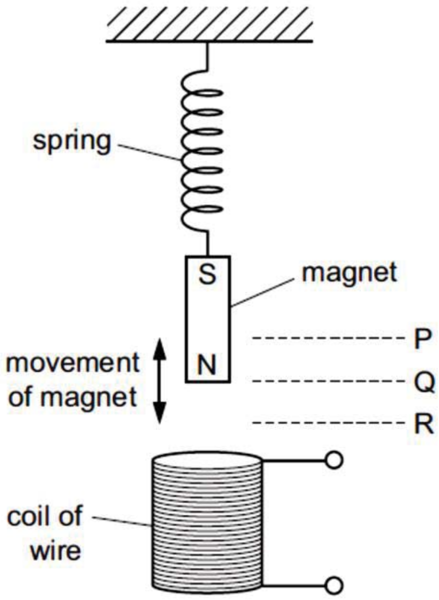
37 A beam of electrons is travelling towards the right. The electrons subsequently move past a solenoid connected to a d.c. source.



Assuming that the electrons have negligible mass, in which direction will the beam of electrons be deflected?

A downwards
B into the page
C out of the page
D upwards

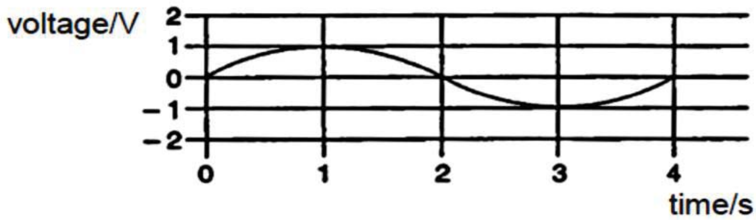
38 A magnet moves up and down above a coil of wire. The bottom of the magnet moves up and down between P and R.



Where is the bottom of the magnet when the induced electromotive force (e.m.f.) in the coil is maximum?

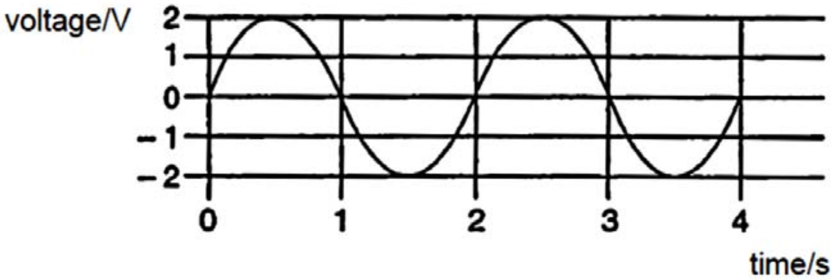
A P
B Q
C R
D P and R

39 The graph shows the voltage induced by an a.c. generator that varies with time.

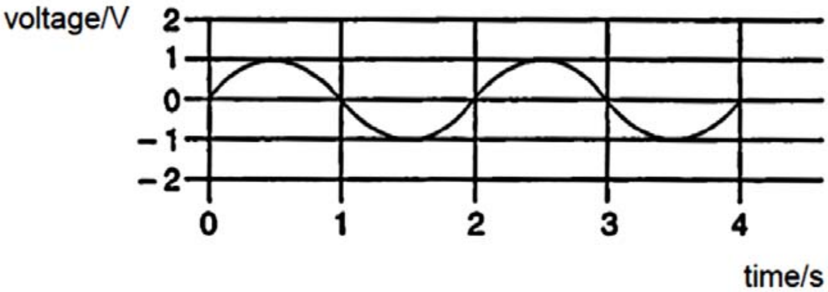


If the number of turns in the coil is increased four times and the speed of the rotation of the coil is halved, what will be the new waveform shown on the CRO?

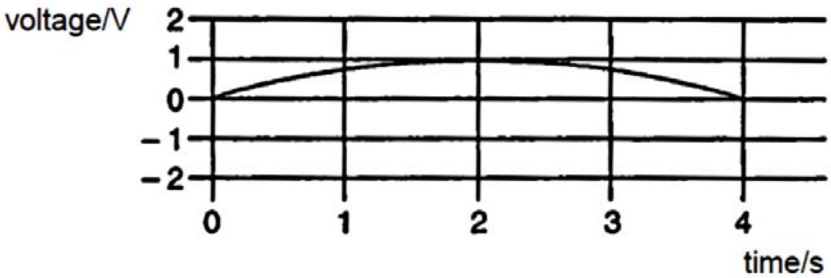
A



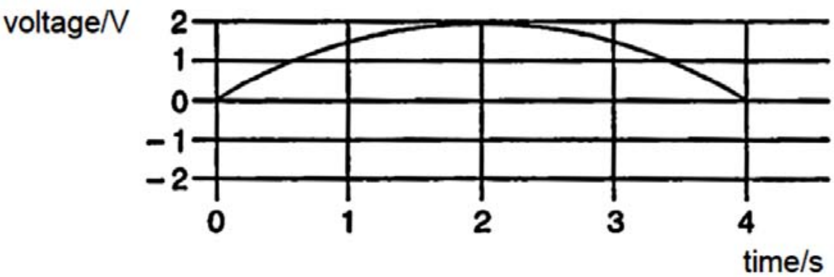
B



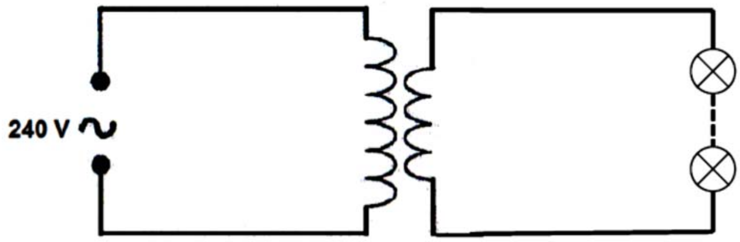
C



D



40 The diagram shows many small identical bulbs connected to an ideal transformer of turns ratio 1:4. The bulbs are rated at 2.0 V, 2.0 W.



To operate the bulbs at normal brightness, how many bulbs can be connected to the secondary side of the transformer and what is the primary current?

	number of bulbs	primary current / A
A	30	0.25
B	30	0.50
C	60	0.50
D	120	4.00

Name ______________________________ (   )   Class ______________

PRELIMINARY EXAMINATION
GENERAL CERTIFICATE OF EDUCATION ORDINARY LEVEL

PHYSICS **6091/02**
Paper 2 **20 August 2019**
1 hour 45 minutes

READ THESE INSTRUCTIONS

Write your name and index number on all the work you hand in. Write in dark blue or black pen in the spaces provided on the Question Paper. You may use a soft pencil for any diagrams or graphs. You may use geometrical instruments and electronic calculators. Do not use highlighters, correction fluid or correction tape.

Section A [50 marks]
Answer **ALL** questions.

Section B [30 marks]
Answer **ALL** questions. Question 11 has a choice of parts to answer.

<u>Information for students</u>:

Students are reminded that all quantitative answers should include appropriate units and should be given to a sensible number of significant figures. Errors in units and numbers of significant figures will be penalised. If working is needed for any question, it must be shown in the space provided. Omission of essential working will result in loss of marks.

The number of marks is given in brackets [ ] at the end of each question or part question.

For Examiner's Use	
Section A (50 Marks)	
Section B (30 Marks)	
Total (80 Marks)	

This document consists of **<u>21</u>** printed pages and **<u>1</u>** blank page.

圣尼各拉女校
CHIJ ST NICHOLAS GIRLS' SCHOOL
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[Turn over]

Section A (50 marks)

Answer **all** the questions in this section in the spaces provided.

1 Fig 1.1 shows a crane, with a "wing" attachment on its side, lifting a load.

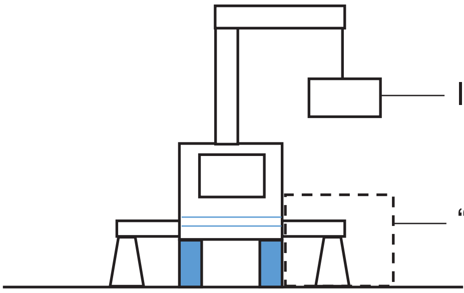


Fig 1.1

(a) Explain the purpose of this "wing" attachment.

…………………………………………………………………………………..

…………………………………………………………………………………..

………………………………………………………………………………….. [2]

(b) On a windy day, the 25 kN load experiences a force of 50 kN to the east, as shown in Fig 1.2.

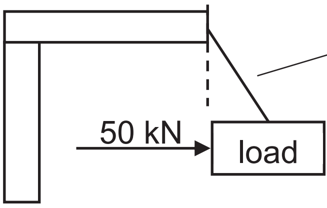


Fig 1.2

Using a scaled vector diagram, determine the tension in the steel cable.

tension = …………………….. [3]

2 A piece of ice, with a mass of 22 g, at a temperature of -12.0 °C is placed in a container containing water at 22.0 °C.

(a) Given that the specific heat capacity of ice is 2100 J/(kgK) and the latent heat of fusion of ice is 3.3 x 10^5 J/kg, calculate the heat needed

(i) to raise the temperature of ice from -12.0 °C to 0 °C.

heat = …………………... [2]

(ii) to change the ice at 0 °C to water at 0 °C.

heat = …………………… [2]

(b) The temperature of the water in the container falls after ice has been added.

(i) Given that the specific heat capacity of water = 4200 J/(kgK), calculate the initial mass of water in the container if the final temperature of the mixture is 8.0 °C.

initial mass of water = …………………... [2]

(ii) State an assumption you have made in **(b)(i)**.

..…………………………………………………………………...………

…………………………………………………………………………… [1]

3 A light dependent resistor (LDR) is used to turn on a lamp in another circuit when it gets dark. Part of the circuit is shown in Fig 3.1.

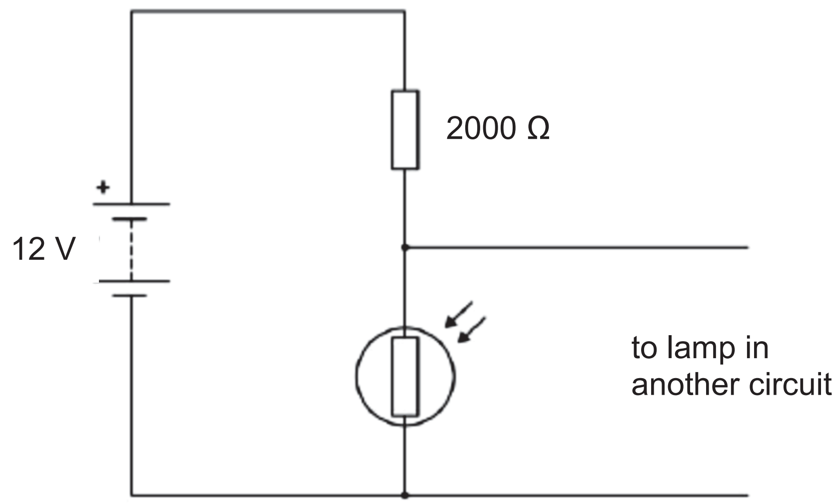


Fig 3.1

(a) The light intensity decreases. State and explain what happens to the potential difference across the LDR.

…………………………………………………………………………………

…………………………………………………………………………………

………………………………………………………………………………… [2]

(b) Calculate the resistance of the LDR when the current flowing through it is 4.0 mA.

resistance = ……………………. [2]

(c) The electrical circuit in Fig 3.1 is now altered such that the LDR is removed and 3 other resistors are added, as shown in Fig 3.2.

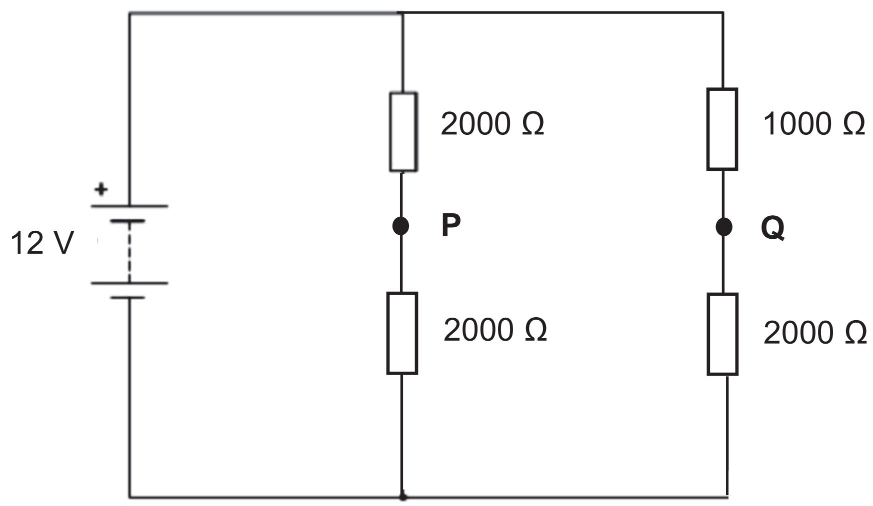


Fig 3.2

(i) Calculate the effective resistance of the circuit in Fig 3.2.

effective resistance = ……………………. [2]

(ii) Compare the current flowing through point P and point Q. Explain your answer.

………………………………………………………………………

………………………………………………………………………

………………………………………………………………………

……………………………………………………………………… [2]

4 Jamie bought a tea kettle with a dull black external surface, as shown in Fig 4.1. The tea kettle uses an electric element to heat water and its power output is 2.8 kW.

Fig 4.1

(a) State the energy change that takes place when the tea kettle is used to heat up the water.

………………………………………………………………………………….. [1]

(b) Suggest a modification which can be made to the tea kettle such that the water in the kettle can remain hot for a longer period of time.

…………………………………………………………………………………..

………………………………………………………………………………….. [1]

(c) An electricity retailer passes the cost due to transmission loss to the consumers. The transmission loss factor for the current year is 1.03.

Given that the tea kettle is used for 10 minutes daily and the cost per unit of electricity charged by this electricity retailer is 18 cents, calculate the cost of using this tea kettle daily for one week.

cost = …………………… [2]

(d) The mains voltage supply for the tea kettle is 230 V. Suggest a suitable fuse rating for the tea kettle.

fuse rating = …………………… [2]

5 Fig. 5.1 shows a method to paint a metal panel using electrostatic charges. The nozzle of the spray gun is connected to a high voltage electrode which applies positive charges to the paint droplets. The metal panel is connected to earth.

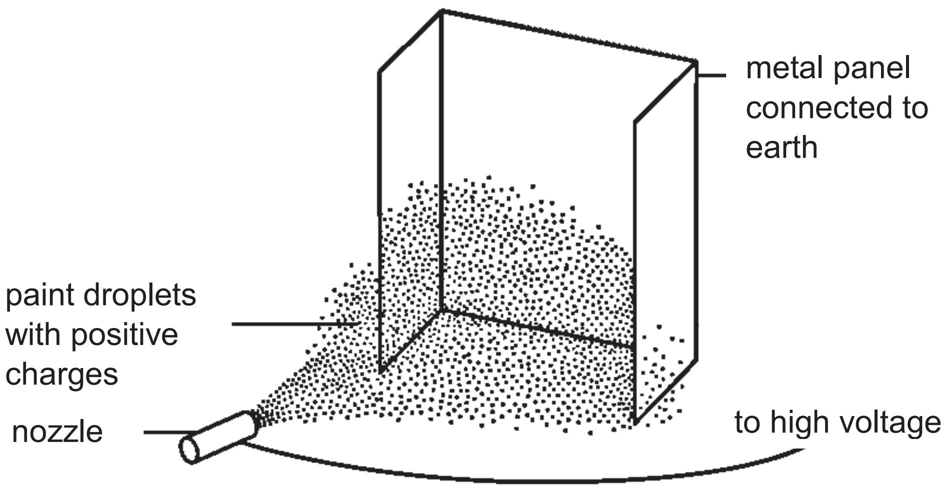


Fig 5.1

(a) Explain why the paint droplets spread out as they leave the nozzle.

………………………………………………………………………………

……………………………………………………………………………… [1]

(b) Explain why this method of painting reduces the amount of paint lost.

………………………………………………………………………………

………………………………………………………………………………

………………………………………………………………………………

……………………………………………………………………………… [2]

(c) Another type of spray gun does not make use of electrical voltage to charge the paint. However, the paint droplets are still charged positively as they leave the nozzle. Suggest how the paint droplets become positively charged as they leave the nozzle.

....

....

.... [2]

6 **(a)** Fig 6.1 shows a series of lines representing a longitudinal wave set up in a long spring (slinky).

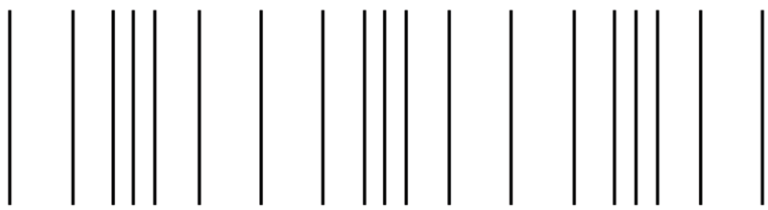


Fig 6.1

(i) Describe how a longitudinal wave could be set up in the spring.

....

.... [1]

(ii) On Fig 6.1, mark

1. a position of compression and rarefaction with the letter "C" and "R" respectively and [1]
2. a distance to represent the wavelength of the wave with an arrow. [1]

(b) Fig 6.2 represents a cross-section of the water waves.

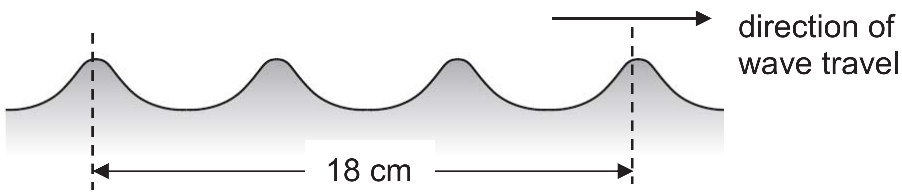


Fig 6.2

The water waves has a frequency of 5.0 Hz.

(i) Calculate the speed of the water waves in cm/s.

speed = …………………… [2]

(ii) The wave as shown in Fig 6.2 travels into a shallow region.
State and explain what happens to
1. frequency and
2. wavelength of the wave in the shallow region.

1. ……………………………………………………………………

……………………………………………………………….............. [1]

2. ……………………………………………………………………

……………………………………………………………………

…………………………………………………………………… [1]

7 Fig 7.1 shows white light incident on the top face of a diamond. The white light is dispersed into its various rays. Only the red (R) and blue (B) light rays are shown in Fig 7.1.

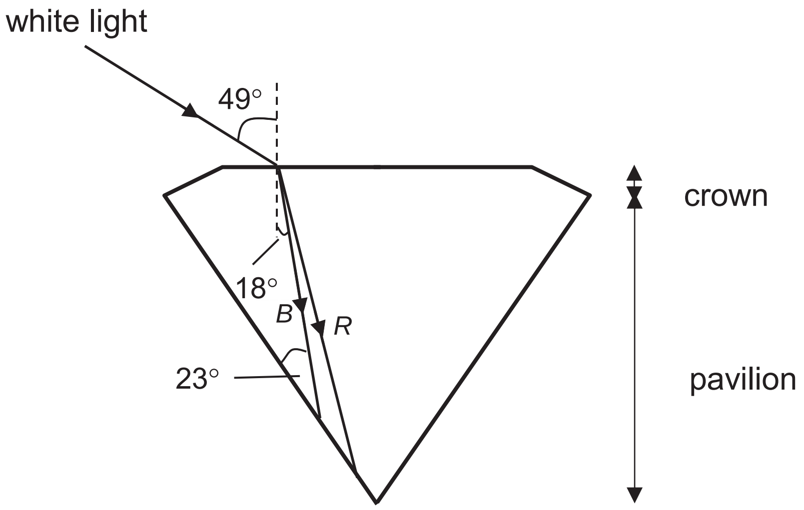


Fig 7.1 (not to scale)

(a) Explain why white light disperses in diamond, as shown in Fig 7.1.

....

....

.... [2]

(b) **(i)** Calculate the refractive index of diamond for blue light.

refractive index = …………………… [2]

(ii) Given that the speed of light in air is 3.0×10^8 m/s, calculate the speed of blue light in the diamond.

speed of blue light in diamond = …………………… [1]

(c) The diamond is now submerged in water. If the white light is still incident on the top face of the diamond at the same angle, explain what happens to the path of the blue light ray in the diamond.

....

....

....

.... [2]

8 **(a)** A student has 3 identical metal bars. Two of the metal bars are magnets and one is not. Explain, with the aid of a diagram, how the student can identify the two magnets without using any other apparatus.

....

....

....

.... [2]

(b) State a type of metal that can be used to make a permanent magnet.

.... [1]

(c) **(i)** Fig 8.1 shows a vertical wire passing through a horizontal piece of card.

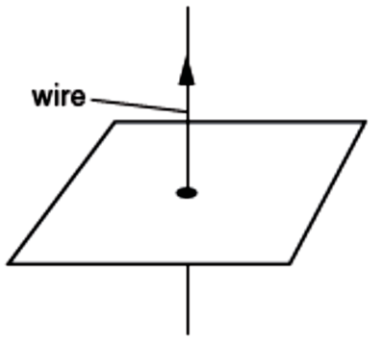


Fig 8.1

There is a direct current (d.c.) in the wire, which produces a magnetic field around it. Suggest how the magnetic field produced by the current-carrying wire can be investigated.

....

.... [1]

(ii) Fig 8.2 shows the wire and the card viewed from above.

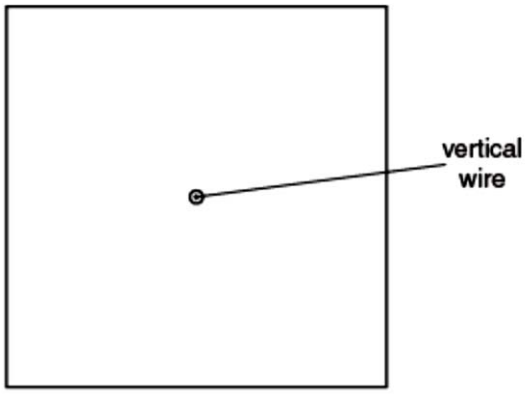


Fig 8.2

On Fig 8.2, draw three complete field lines produced by the current-carrying wire. [1]

Section B (30 marks)

Answer **all** the questions in the spaces provided.

Answer only one of the two alternative questions in **Q11.**

9 Fig 9.1 shows a rollercoaster train being pulled horizontally to the right by a cable.

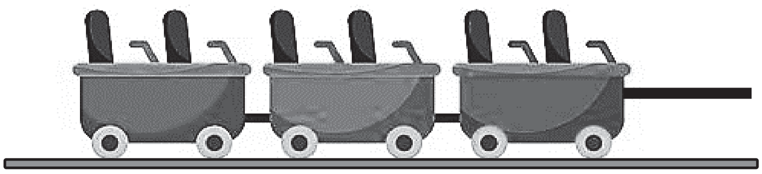


Fig 9.1

Fig 9.2 shows information on the train.

speed / m/s	8.3	8.3	8.3	16.6	24.9	33.2	41.5
time / s	0.0	0.5	1.0	1.5	2.0	2.5	3.0

Mass of empty train: 1500 kg
Mass of fully loaded train : 1800 kg
Total length: 10.5 m
Number of wheels: 16

Fig 9.2

(a) Describe the motion of the train from t = 0.0 s to t = 3.0 s.

....

....

....

.... [2]

(b) **(i)** Determine the average tension in the cable pulling a fully loaded train during t = 1.0 s to t = 3.0 s.

average tension = …………………… [3]

(ii) Is the actual average tension higher, lower or the same compared to your answer in **(b)(i)?** Explain your answer.

……………………………………………………………………………

……………………………………………………………………………

……………………………………………………………………………

…………………………………………………………………………… [2]

(c) Calculate the distance the train travelled from t = 0.0 s to t = 3.0 s.

distance = …………………… [2]

(d) One of the passenger claims that if the tension in the cable remains constant and the number of passengers is halved, the acceleration of the train will be doubled. Explain whether the claim is true.

……………………………………………………………………………

…………………………………………………………………………… [1]

10 **(a)** Fig 10.1 shows the structure of a simple a.c. generator.

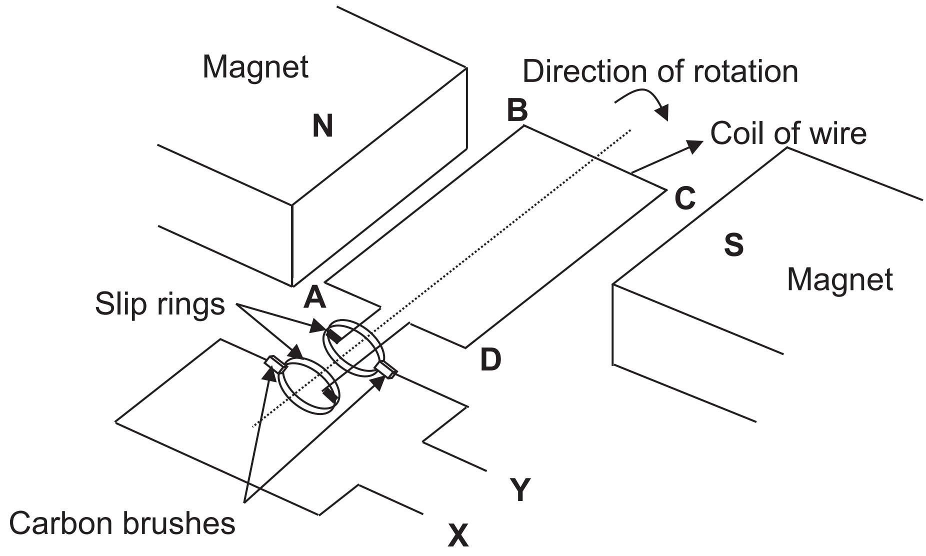
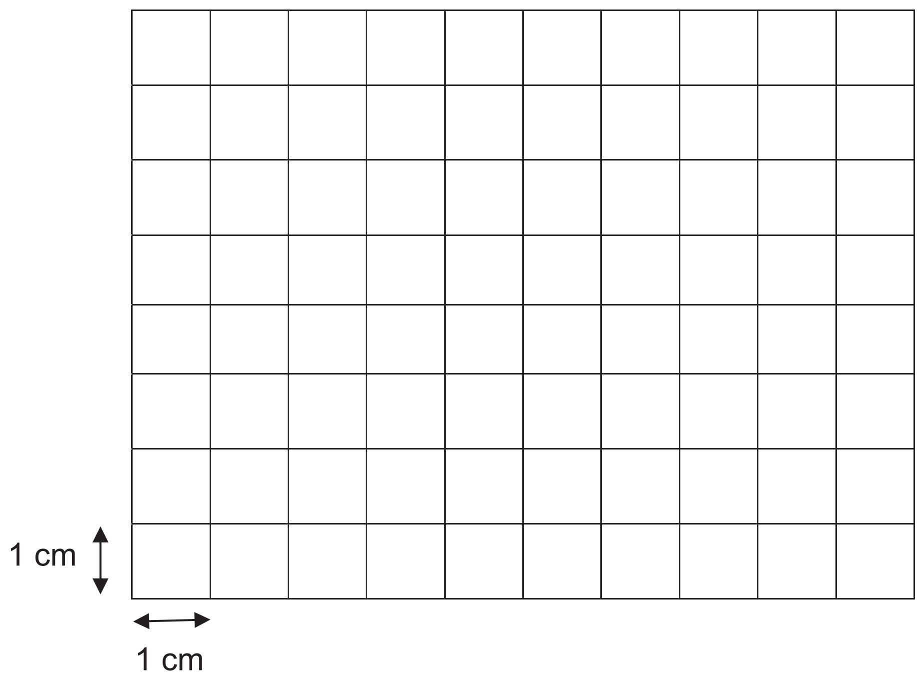


Fig 10.1

The two ends of the wires, X and Y are the output terminals which are connected to a cathode ray oscilloscope (CRO). The coil is turned by a water wheel at 50 Hz. The peak voltage of the output is 9.0 V.

The time base of CRO is switched on at 10 ms/cm and Y-gain is set at 3 V/cm.

(i) Sketch the trace of the output from the generator on CRO.



[2]

(ii) Explain how the generator gives the output in **(a)(i).**

…………………………………………………………………………………

…………………………………………………………………………………

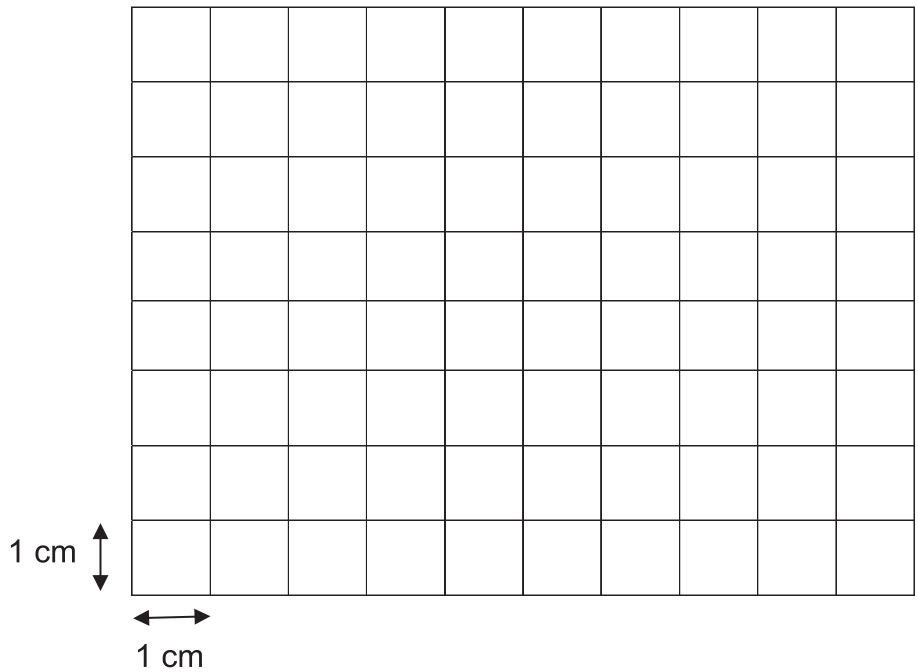
…………………………………………………………………………………

…………………………………………………………………………………

…………………………………………………………………………………

………………………………………………………………………………… [3]

(iii) Sketch the new trace of the output display when the slip rings are replaced by a split-ring commutator.



[1]

(b) Fig 10.2 shows an electric guitar, with strings that are already magnetised. A coil is placed near each string. Fig 10.3 shows that the coil is connected to a loudspeaker, which produces the sound of the guitar.

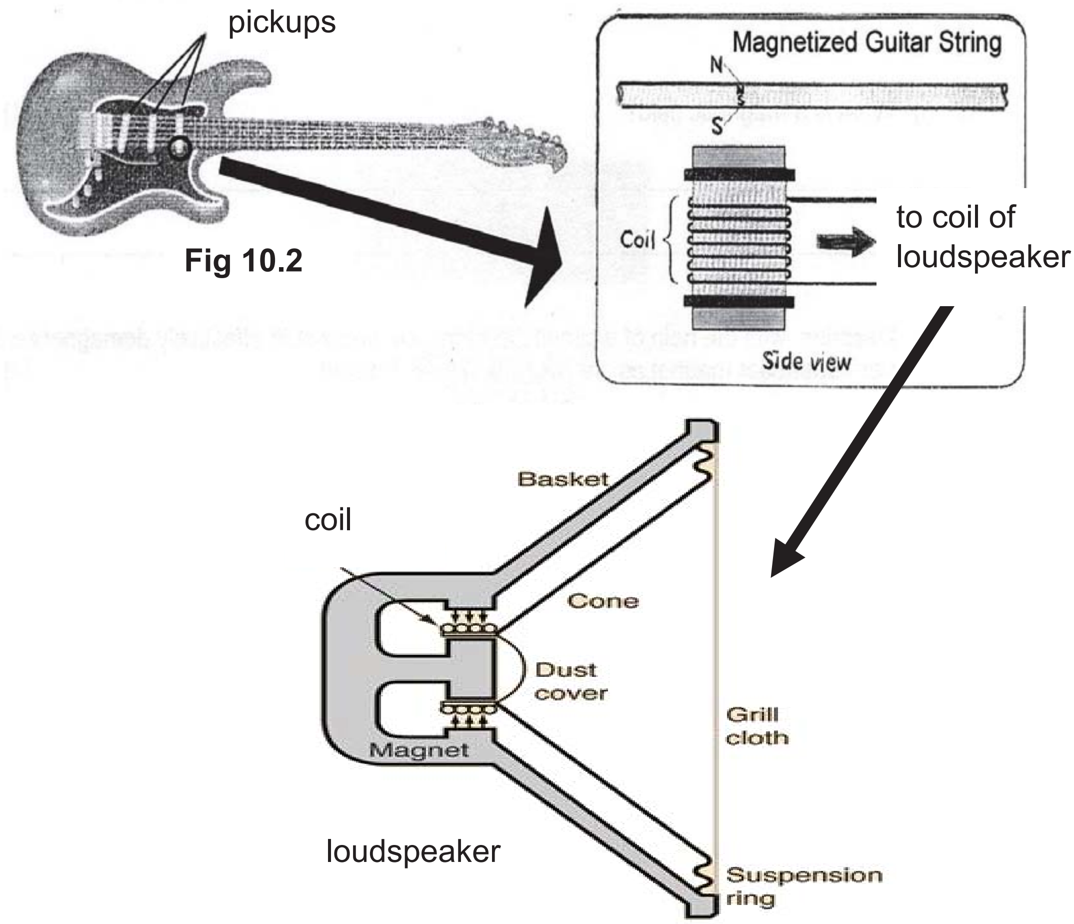


Fig 10.2

Fig 10.3

(i) Explain how the coil in Fig 10.2 can detect the vibration in the magnetised string when it is plucked.

……………………………………………………………………………………

……………………………………………………………………………………

…………………………………………………………………………………… [2]

(ii) Explain how the loudspeaker, a moving-coil device, produces the sound of the electric guitar.

……………………………………………………………………………………

……………………………………………………………………………………

…………………………………………………………………………………… [2]

11 EITHER

(a) Fig 11.1 shows a simple d.c. motor. The ends of the single loop coil ABCD are soldered to the split-ring commutators. Two batteries are connected in the external circuit.

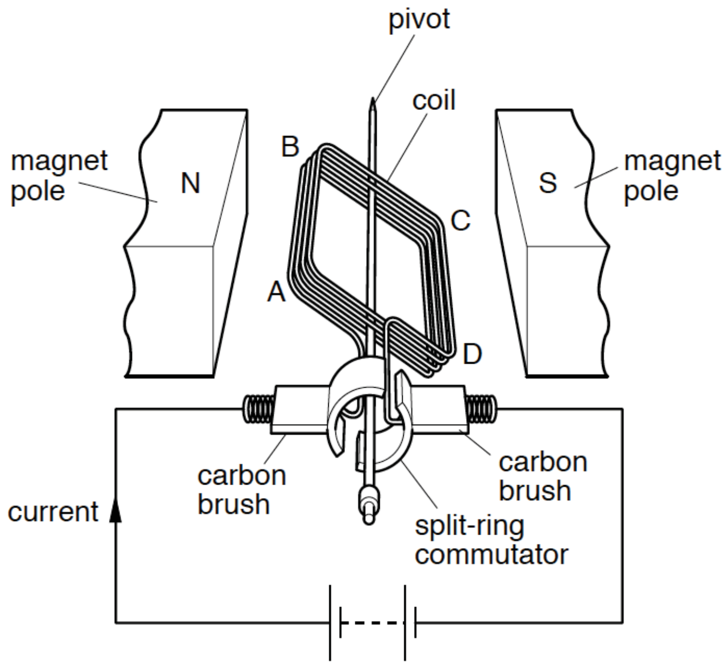


Fig 11.1

(i) State the direction of rotation of the coil when viewed from the commutator.

…………………………………………………………………………………… [1]

(ii) Explain how this d.c. motor works and the purpose of the split-ring commutator.

……………………………………………………………………………………

……………………………………………………………………………………

……………………………………………………………………………………

……………………………………………………………………………………

……………………………………………………………………………………

…………………………………………………………………………………… [3]

(b) Jamie designs a simple doorbell using materials found in the Physics laboratory, as shown in Fig 11.2. When switch S is pressed and then released, two sound notes of identical frequency are produced.

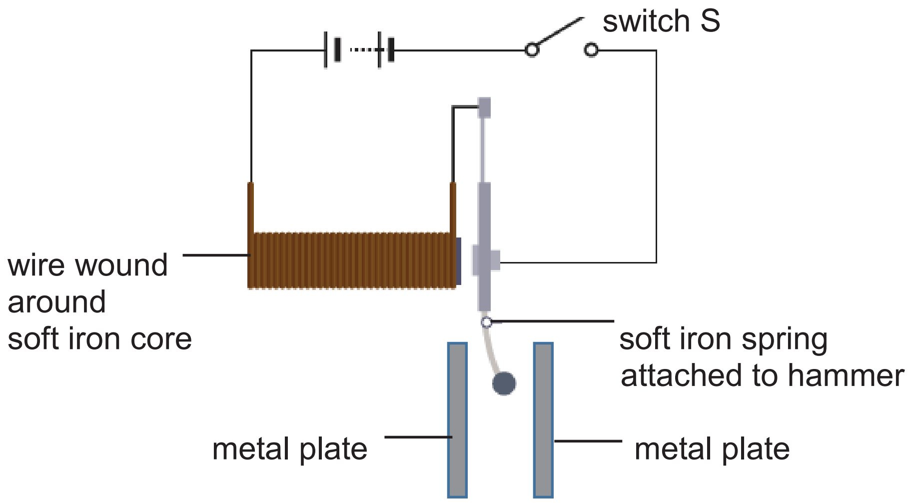


Fig 11.2

(i) Explain how the two sound notes are produced.

……………………………………………………………………………………

……………………………………………………………………………………

……………………………………………………………………………………

…………………………………………………………………………………… [2]

(ii) Jamie makes the following comment: "The bell will still work if the battery is replaced with an a.c. source."
Do you agree? Explain your answer.

……………………………………………………………………………………

……………………………………………………………………………………

……………………………………………………………………………………

…………………………………………………………………………………… [2]

(iii) Suggest two ways to increase the loudness of the bell.

……………………………………………………………………………………

…………………………………………………………………………………… [2]

11 OR

Fig 11.3 shows a diving bell with a hatch of outer surface area 0.50 m^2. While the bell is on the surface of the sea, the hatch is closed and sealed.

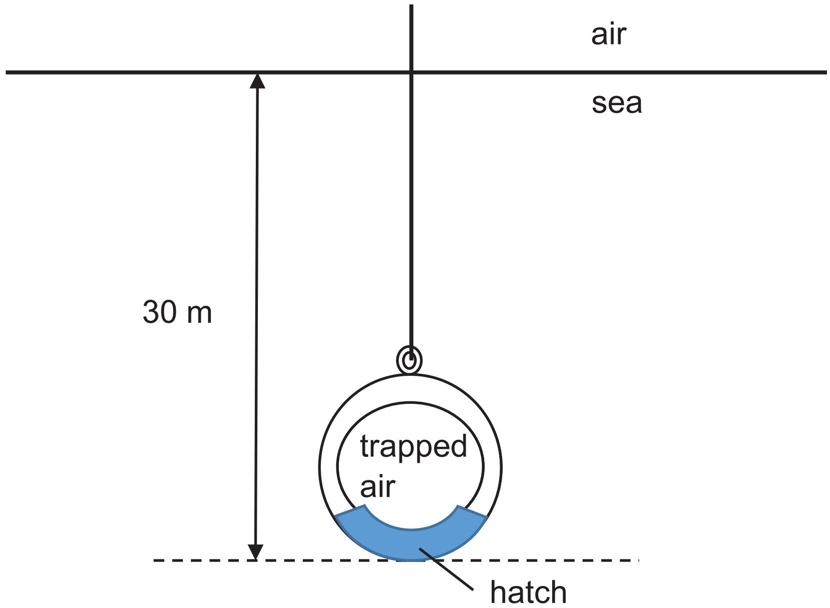


Fig 11.3 (not to scale)

(a) The bell is lowered from the surface of the sea to a depth of 30 m. The pressure of the atmosphere is 100 000 Pa and the density of the seawater is 1100 kg/m^3. The gravitational field strength *g* is 10 N/kg.

(i) Define *pressure.*

……………………………………………………………………………….

………………………………………………………………………………. [1]

(ii) Calculate the pressure exerted on hatch by the water when it is at a depth of 30 m.

pressure = ……………………. [2]

(iii) Hence, calculate the force acting on the hatch.

force = ……………………. [1]

(iv) Explain what happens to the volume of the trapped air when the hatch is opened at 30 m below the surface of the sea. Assume that the trapped air in the bell is at atmospheric pressure before the hatch is opened.

…………………………………………………………………………………

…………………………………………………………………………………

………………………………………………………………………………… [2]

(b) The same diving bell is lowered to the same depth of 30 m in another region of the sea. It was observed that the volume of trapped air is more than the volume in **(a)(iv)** when the hatch opens. Suggest a possible reason for the observation.

…………………………………………………………………………………...

………………………………………………………………………………… [1]

(c) Using kinetic theory of matter, explain why the pressure of the trapped air in the bell rises when its temperature increases.

…………………………………………………………………………………...

…………………………………………………………………………………...

…………………………………………………………………………………...

…………………………………………………………………………………...

…………………………………………………………………………………

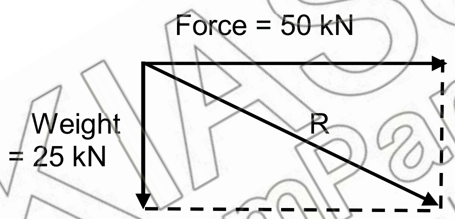
………………………………………………………………………………… [3]

--- END OF PAPER ---

2019 Physics Prelim Paper 1

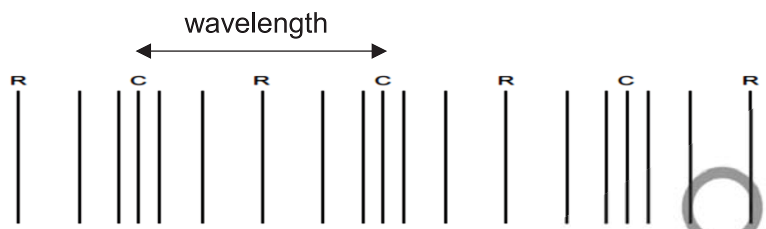
1	2	3	4	5	6	7	8	9	10
C	**C**	**C**	**C**	**D**	**D**	**C**	**B**	**C**	**C**
11	12	13	14	15	16	17	18	19	20
A	**C**	**B**	**D**	**B**	**A**	**D**	**B**	**D**	**A**
21	22	23	24	25	26	27	28	29	30
C	**B**	**B**	**A**	**B**	**B**	**C**	**B**	**B**	**B**
31	32	33	34	35	36	37	38	39	40
C	**D**	**D**	**B**	**C**	**C**	**B**	**B**	**D**	**A**

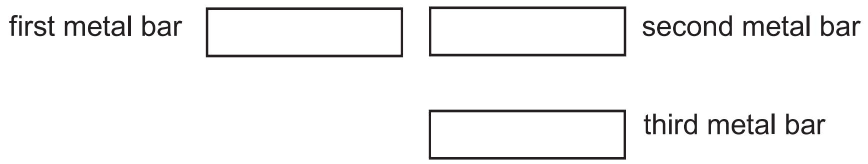
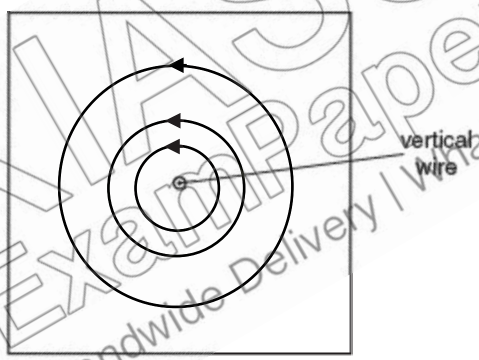
2019 Physics Prelim Paper 2

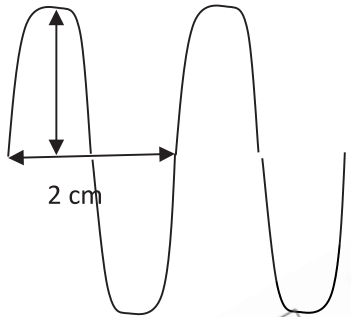
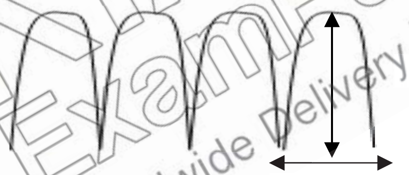
<table>
<tr><th>Qn</th><th>Answer</th></tr>
<tr><td>1(a)</td><td>The attachment is to provide the crane with better stability / make the crane more stable.
It increases the base area of the crane OR it lowers the centre of gravity of the crane.</td></tr>
<tr><td>1(b)</td><td>Scale: 1 cm rep 10 kN
Accurate drawing of vector diagram (incl. correct labelling of forces and direction of arrows):


Tension of the cable = 56 kN (accept 55 kN to 57 kN)</td></tr>
<tr><td>2(a)(i)</td><td>Q = mcΔT
= (22/1000) x 2100 x 12.0
= 554.4 J
= 550 J (2 sf)</td></tr>
<tr><td>2(a)(ii)</td><td>Q = ml
= (22/1000) x 3.3 x 10^5
= 7260 J
= 7300 J (2 sf)</td></tr>
<tr><td>2(b)(i)</td><td>Q = mcΔT
554.4 + 7260 + (22/1000 x 4200 x 8.0) = m x 4200 x (22.0 – 8.0) *the mark is for showing the concept of heat lost = heat gained
m = 0.15 kg (2 sf)</td></tr>
<tr><td>2(b)(ii)</td><td>No heat gain from the surroundings</td></tr>
</table>

Qn	Answer
3(a)	The resistance of the LDR increases as the light intensity decreases. The potential difference across LDR increases.
3(b)	V across fixed resistor = 2000 x 0.004 = 8.0 V $V_{output} = R_{output} / R_{total} \times V_{total}$ 8.0 V = 2000 / (R_{LDR} + 2000) x 12 V R_{LDR} = 1000 Ω **OR** V = IR 12 – 8 = (4/1000) x R R = 1000 Ω
3(c)(i)	Effective R = $(1/4000 + 1/3000)^{-1}$ = 1700 Ω (2s.f)
3(c)(ii)	The total resistance in the branch with point P is higher than that with point Q. Since potential difference across each branch is constant, current flowing through point P is lower than current flowing through point Q.
4(a)	Electrical energy → Heat
4(b)	The external surface of the tea kettle could be modified to one with a shiny silver surface which is a poor emitter of infrared radiation to the surroundings, so as to minimize heat lost to surroundings.
4(c)	Energy = Power x Time = 2.8 kW x 10/60 x 7 h = 3.27 kWh Cost = 3.27 kWh x \$0.18 x 1.03 = \$0.61
4(d)	I = P / V = 2800 / 230 = 12.2 A Suitable fuse rating = 13 A
5(a)	The paint droplets repel each other as they have the same charge / same charges repel.
5(b)	The positively charged paint droplets induced a negative charge on the surface of the metal panel. As opposite charges attract, most of the paint droplets are attracted to the metal panel, reducing the amount of paint loss.

Qn	Answer
5(c)	The paint droplets are <u>charged by friction</u>. The paint droplets <u>lose electrons to the nozzle</u> as they leave the nozzle.
6(a)(i)	The long spring can be <u>given a displacement</u> such that the movement of <u>each turn on the long spring is parallel to the direction of the wave motion</u> set up.
6(a)(ii)	
6(b)(i)	Wavelength = 6 cm v = fʎ = 5.0 x 6 = 30 cm/s
6(b)(ii)	1. frequency – remains unchanged as source of wave is the same 2. wavelength – becomes smaller as speed decreases in the shallow region
7(a)	Different colours of light travel at the same speed in air. However, <u>different colours of light travel at different speeds in diamond</u>. Therefore, there are <u>different angles of refraction</u> for different colours / different colours bend at different angles. OR There are <u>different refractive indices</u> for different colours, hence white light disperses into its various rays.
7(b)(i)	$n = \frac{sin49°}{sin18°}$ n = 2.4 (2 sf)
7(b)(ii)	v = 3 x 10^8 / ($\frac{sin49°}{sin18°}$) = 1.2 x 10^8 m/s (2 s.f.)
7(c)	Blue light would <u>bend towards the normal less</u> at the water-diamond boundary as compared to the air-diamond boundary. This is due to the <u>higher refractive index of water</u> compared to that of air.

Qn	Answer
8(a)	 Bring one end of the first metal bar near to both ends of the second metal bar, and then to both ends of the third metal bar. The repulsion between two metal bars will enable the student to identify them as the two magnets.
8(b)	Steel
8(c)(i)	Magnetic field can be investigated by placing a plotting compass on the piece of card and marking the positions of the needle of the compass. OR Use iron filings to investigate the pattern of magnetic field lines.
8(c)(ii)	 • The inner circles are closer to each other • Correct direction
9(a)	In the first second, the train travels at a constant speed of 8.3 m/s. In the next two seconds, the train accelerates uniformly.
9(b)(i)	Average acceleration = $(v - u) / t$ $= (41.5 - 8.3) / (3.0 - 1.0)$ $= 16.6$ m/s^2 (3 sf) Tension = m x a = 1800 x 16.6 = 29 880 N = 29 900 N (3 sf)

Qn	Answer
9(b)(ii)	The actual average tension is higher than the answer in (b)(i) as there is friction between the moving parts and air resistance in actual situation.
9(c)	Total distance travelled = (8.3 x 1) + ½ (8.3 + 41.5)(3-1) = 58.1 m
9(d)	The claim is false. The total mass is not halved as the mass of the empty train remains constant. Thus, the acceleration will not be doubled.
10(a)(i)	
10(a)(ii)	When the coil rotates, it cuts the magnetic flux which induces an emf across the two ends of the coil. When the coil changes position after half a revolution, the emf induced is reversed. When the coil is horizontal, emf induced is maximum, when the coil is vertical, emf induced is zero.
10(a)(iii)	
10(b)(i)	When the strings are plucked, their relative distances with the coil change (vibration), and the magnetic flux linking the coil changes as a result. The vibration thus causes an e.m.f. to be induced in the coil. Hence an induced emf in the coil means a detection of the vibration in the string.
10(b)(ii)	The changing induced current in the coil that causes the force/ vibration/ movement of coil in loudspeaker [Fleming's Left-hand Rule] is in sync with the variation of current. The vibration of coil will cause the cone in the loudspeaker and hence the air around it to vibrate and produces sound. (produces regions of compressions and rarefactions in the layer of air next to it)

5

Qn	Answer
11 EITHER	
11(a)(i)	Anti-clockwise direction from the front
11(a)(ii)	When current flows into the coil through the magnetic field of the magnet, it results in a force produced such that the coil will turn. The split-ring commutator reverses the current in the coil every half a cycle so that the coil can turn continuously in one direction.
11(b)(i)	When switch S is closed, the soft iron core becomes magnetised and attracts the soft iron spring attached to the hammer. The hammer strikes the metal plate and produces the first sound note. When the swtich is released, the circuit is broken and iron core loses magnetism and hammer swings to the other metal plate, producing the second sound note.
11(b)(ii)	Yes, the iron core will be magnetized and the spring will be attracted similarly, although there is a change of polarity.
11(b)(iii)	1. Increase the current flowing through the wire 2. Increase the number of turns around the soft iron core
11 OR	
11(a)(i)	Pressure is the force acting (on an object) per unit area.
11(a)(ii)	Pressure due to sea-water at depth 30 m = hρg =1100 x 10 x 30 = 330 kPa
11(a)(iii)	Total pressure = 330 k + 100 k = 430 k Pa Force = pressure x area = 430 000 x 0.50 = 215 kN
11(a)(iv)	The volume decreases so that the pressure of the trapped air becomes the same as the pressure at 30 m / there is higher pressure exerted.
11(b)	The density of the sea water in that region is lower resulting in lower pressure at depth of 30 m. Hence the volume of the trapped air increases to give a lower pressure that balances the external pressure.
11(c)	When temperature increases, the air molecules gain kinetic energy and have greater speed / average KE of molecules increases. The molecules will collide with the wall more often and hence increasing the force acting on the wall. Since pressure is due to the force acting on the wall per unit area, larger force acting on the wall results in a larger pressure (P = F/A).

Name		Index Number		Class	4 A

DUNMAN HIGH SCHOOL
PRELIMINARY EXAMINATION 2019
GCE O LEVEL PHYSICS

Paper 1 — 6091/1

Paper 1 Multiple Choice

03 September 2019
1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write your name and index number on all the work you hand in.
Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers, **A**, **B**, **C** and **D**.
Choose the **one** that you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
The use of an approved scientific calculator is expected, where appropriate.

For teacher's use:

Paper 1	**/40**
Paper 2	**/80**
Total	**/120**

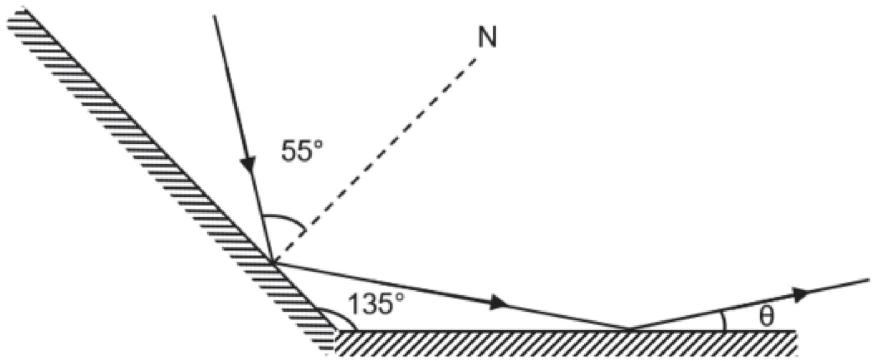
This document consists of **13** printed pages.

1 A car travels at a speed of 65 km/h.

What is the speed of the car in m/s?

A 18.1 m/s **B** 55.4 m/s **C** 181 m/s **D** 1080 m/s

2 A light ray is reflected off two mirrored surfaces.



(not to scale)

What is the value of θ?

A 5° **B** 10° **C** 15° **D** 20°

3 A name tag reads “SAM”.

What is the image of the name tag in a plane mirror?

A

B

C

D

4 The refractive index for germanium is 4.01.

What is the speed of light in germanium?

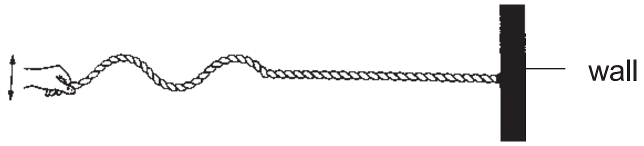
A 7.5×10^{7} m/s **B** 7.5×10^{8} m/s **C** 1.2×10^{8} m/s **D** 1.2×10^{9} m/s

5 A thin, converging lens of focal length *f*, is used to produce various types of images.

Which row is correct?

	location of object	type of image produced
A	less than *f*	inverted, virtual, diminished
B	between f and 2*f*	upright, real, enlarged
C	at *2f*	inverted, real, same size
D	beyond 2*f*	upright, real, diminished

6 A rope is fixed to a wall at one end with the other end moved up and down to produce a wave.



What is transferred along the rope due to this motion?

A mass
B energy
C frequency
D molecules

7 Which is not an application of microwaves?

A To detect structural flaws.
B To ionise biological molecules.
C To cook food in microwave ovens.
D To transmit communication signals.

8 The wavelength of an X-ray is 1.0 nm while the wavelength of a radio wave is 1.0 mm.

What is the ratio of the frequency of the X-ray to the frequency of radio wave?

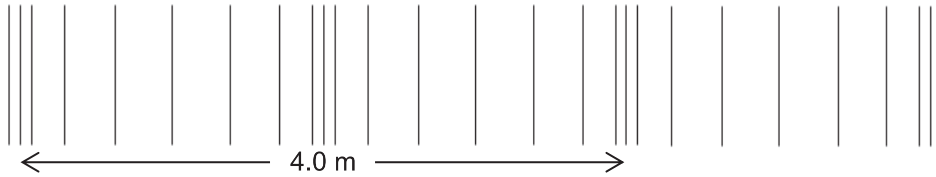
A 1 : 1 00 000
B 1 : 1 000 000
C 1 00 000 : 1
D 1 000 000 : 1

9 A sound travels through a solid copper tube and then enters air.

Which of the following correctly compares the sound in the solid copper tube to air?

	frequency	speed (in copper tube)
A	different	higher
B	different	same
C	same	higher
D	same	lower

10 A series of compressions and rarefactions of a sound wave are shown.



What is the wavelength of the sound wave?

A 2.0 m **B** 3.0 m **C** 4.0 m **D** 6.0 m

11 Which defines acceleration?

A $\frac{change\ in\ distance}{time\ taken}$

B $\frac{change\ in\ distance\ in\ a\ fixed\ direction}{time\ taken}$

C $\frac{change\ in\ speed}{time\ taken}$

D $\frac{change\ in\ velocity}{time\ taken}$

12 A stone falls freely from rest from the top of a building of height, 80 m.

The gravitational field strength g is 10 N/kg.

What is the speed of the stone when it hits the ground?

A 4.0 m/s **B** 8.0 m/s **C** 40 m/s **D** 80 m/s

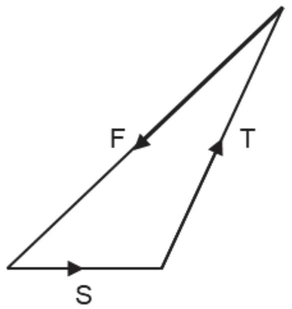
13 Which quantity is a scalar?

A displacement **B** force **C** weight **D** work done

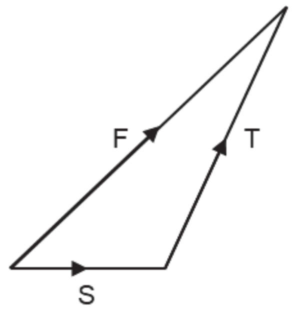
14 A body is acted on by two forces, *S* and *T*. A frictional force, *F* keeps the body in equilibrium.

Which vector diagram shows the relationship between these forces?

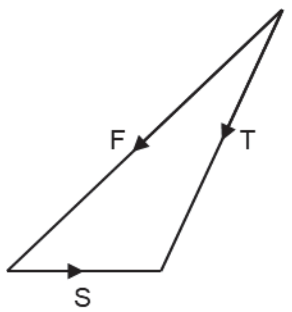
A



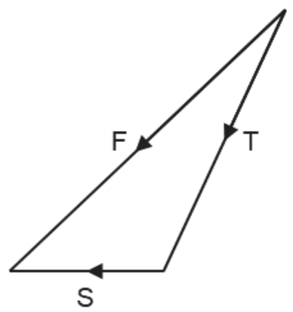
B



C



D



15 A helicopter of mass 3.0×10^3 kg rises vertically with a constant speed of 25 m/s.

The gravitational field strength *g* is 10 N/kg.

What is the resultant force acting on the helicopter?

A 0 N
B 3.0×10^4 N downwards
C 4.5×10^4 N upwards
D 7.5×10^4 N upwards

16 A parachutist is falling through air with terminal velocity.

Which quantity is changing?

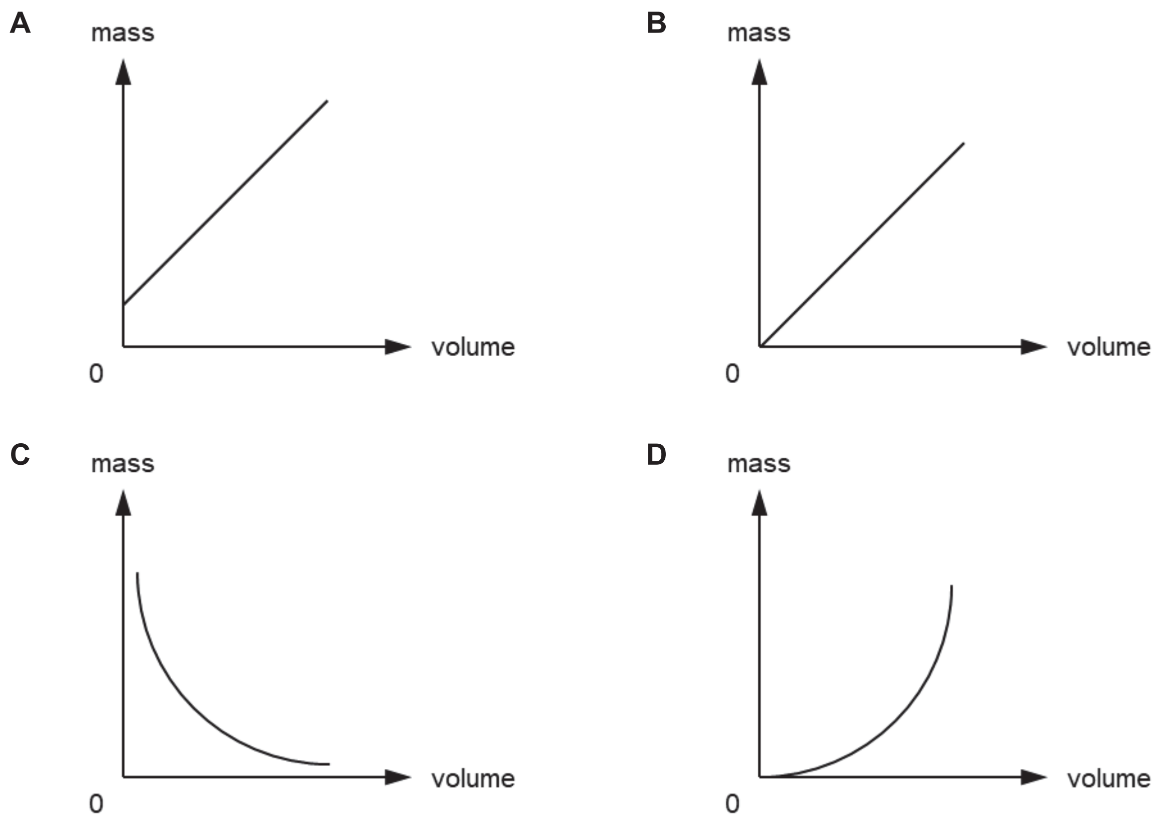
A acceleration
B gravitational potential energy
C kinetic energy
D mass

17 Which object has the largest inertia?

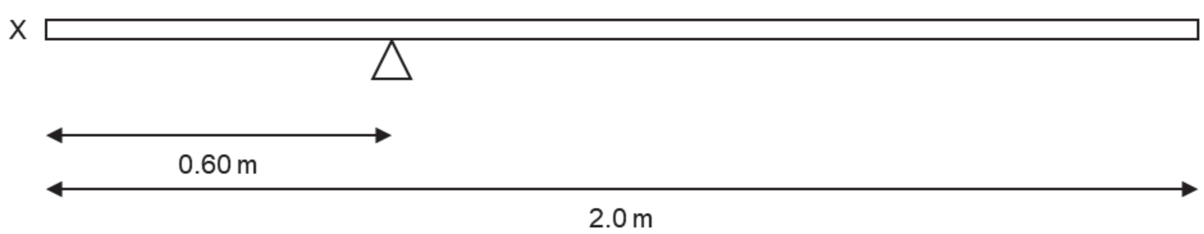
A a 1.5×10^{-1} kg baseball pitched at 170 km/h
B a 1.2×10^3 kg sports car travelling at 100 km/h
C a 5.0×10^3 kg stationary helicopter
D a 3.0×10^6 kg falling tree

18 The mass and volume of different sized samples of a newly discovered metal are measured.

Which graph shows how the mass varies with volume?



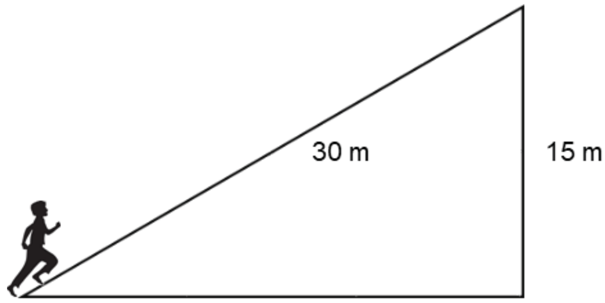
19 A uniform beam has a weight of 60 N and a length of 2.0 m. It is pivoted at a length of 0.60 m from the end X.



At what distance from the pivot should a 160 N weight be placed in order to balance the beam?

A 0.150 m **B** 0.225 m **C** 0.375 m **D** 0.450 m

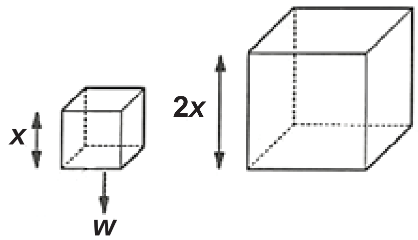
20 A student of weight 500 N runs up a slope of length 30 m and height 15 m in 25 s.



What is the power developed by the student?

A 30 W **B** 60 W **C** 300 W **D** 600 W

21 The two cubes shown below are made from the same material. The bigger cube has sides that are twice as long as the smaller cube. Standing on one face, the small cube exerts a pressure, *P* on the floor.

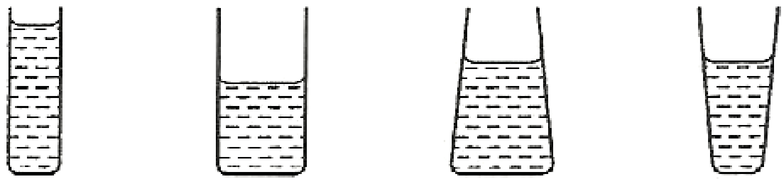


Given that the smaller cube has a weight, *w* and the bigger cube weighs eight times as much, what is the pressure exerted by the larger cube standing on one of its faces?

A ½ P **B** P **C** 2P **D** 4P

22 Equal masses of water are poured into four jars as shown.

Which jar has the least pressure exerted by the water on the base?



23 When fine pollen grains suspended in water are viewed under a microscope, they are seen to be making small, erratic movements.

Why is this?

A There are convection currents in the water.
B They are being hit by water molecules.
C They are moving and colliding with one another.
D They are living organisms so they move around.

24 Which physical property is not suitable for defining temperature scales?

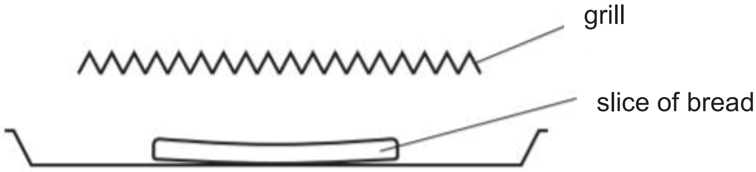
A e.m.f at the junction of two different metals
B mass of a solid object
C volume of a liquid column
D volume of trapped gas

25 A piece of wire has an electrical resistance of 980 Ω in ice of -10 °C, and 1750 Ω in boiling water at 100 °C.

What is the resistance of the piece of wire at 30 °C, assuming resistance changes uniformly with temperature?

A 280 Ω **B** 1190 Ω **C** 1260 Ω **D** 1370 Ω

26 A slice of bread is placed under a hot electric grill.

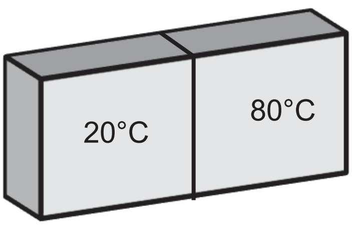


How does thermal energy reach the bread?

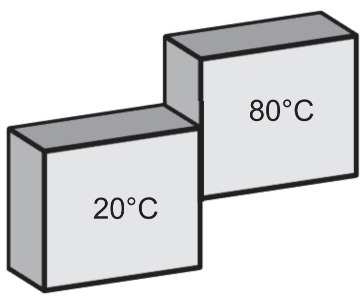
A conduction only
B radiation only
C conduction and convection
D convection and radiation

27 Two identical blocks of metal are heated to 20°C and 80°C and placed in a vacuum. In which scenario will thermal equilibrium between the two blocks be reached in the shortest time?

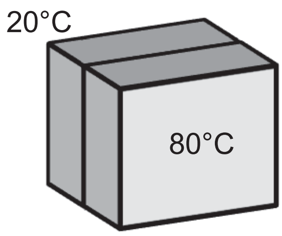
A



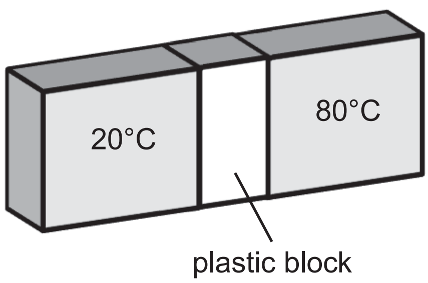
B



C



D



28 A piece of pure ice melts.

Which row describes the energy changes of the ice as it melts?

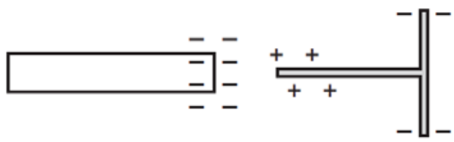
	internal potential energy	internal kinetic energy
A	increases	decreases
B	decreases	increases
C	increases	remains constant
D	remains constant	increases

29 A negatively charged rod is brought close to an isolated T-shaped piece of metal.

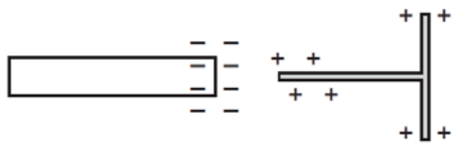
Initially, the metal is uncharged.

Which diagram shows the induced charge on the metal?

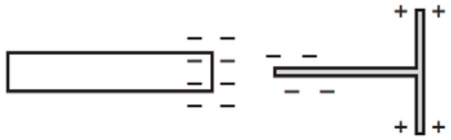
A



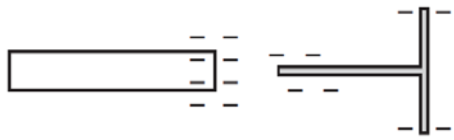
B



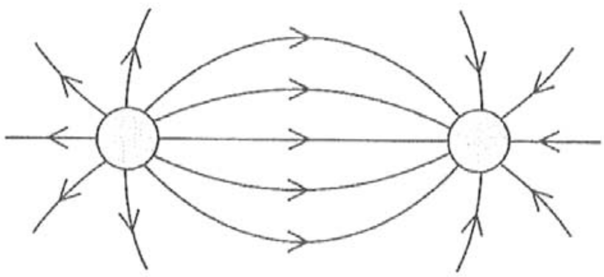
C



D



30 The diagram shows the electric field pattern between two isolated point charges.



Which two point charges produce this pattern?

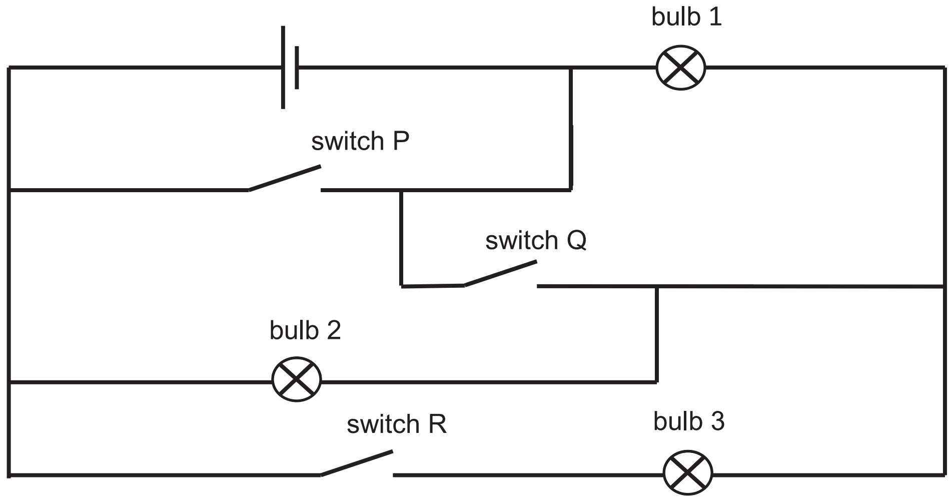
A

B

C

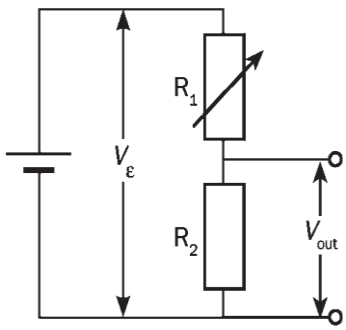
D

31 Identify the correct position of the switches such that all three bulbs are lit.



	switch P	switch Q	switch R
A	closed	closed	open
B	open	open	closed
C	open	closed	open
D	open	closed	closed

32 In the diagram below, the potential difference across the battery is denoted by V_ε and the potential difference across R_2 is denoted as V_{out}.

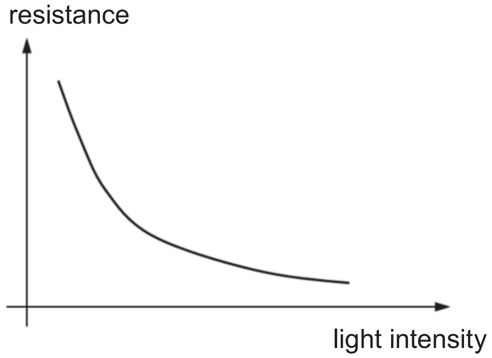


What is the ratio of $V_\varepsilon : V_{out}$?

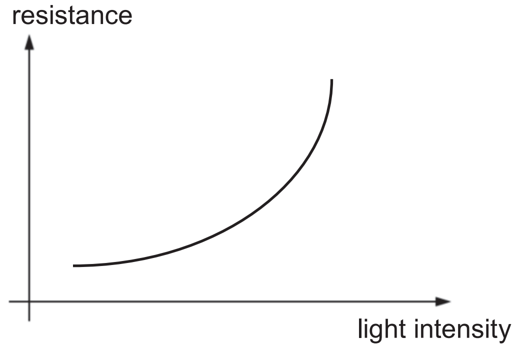
A $R_1 : R_2$
B $R_2 : (R_1 + R_2)$
C $(R_1 + R_2) : R_1$
D $(R_1 + R_2) : R_2$

33 Which graph shows the characteristics of a light dependent resistor?

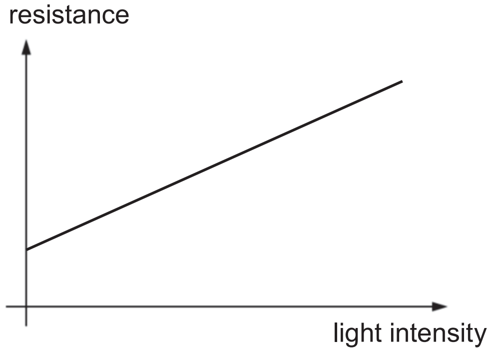
A



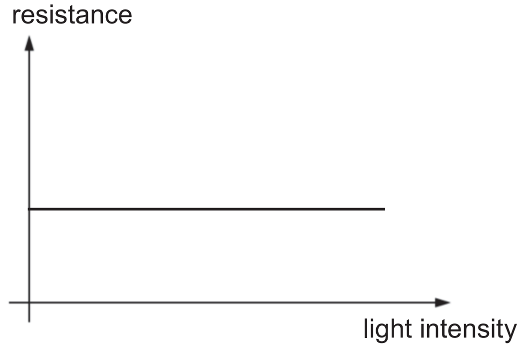
B



C



D



34 Which of the following is not a safety feature found in a typical household electrical circuit?

A fuse
B earth wires
C lightning rod
D main circuit breaker

35 An electric oven is rated at 10 A.

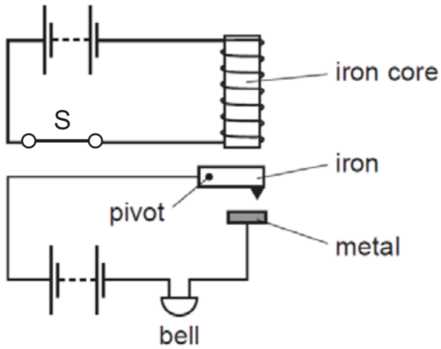
What is a suitable fuse for the oven?

A 5.0 A **B** 8.0 A **C** 10 A **D** 13 A

36 To determine whether a material is magnetic, you should find out if it

A is a metal or a non-metal.
B is a conductor or an insulator.
C can be given an electric charge.
D affects the direction in which a compass needle points.

37 The diagram shows an alarm system in which the switch S is shown closed.

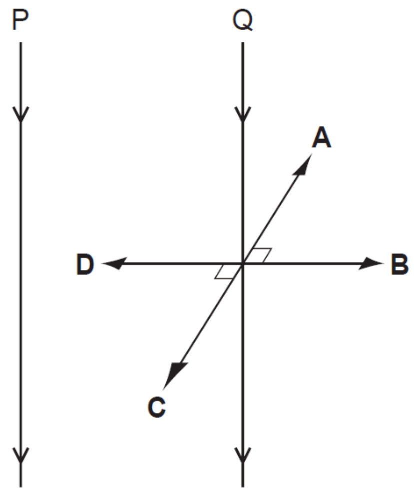


What happens when the switch S is opened?

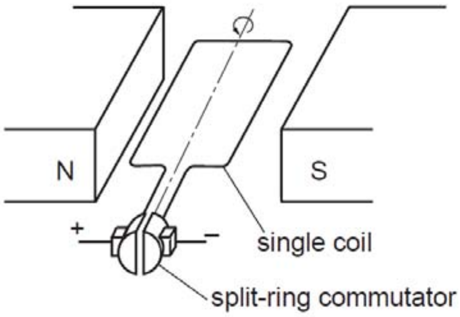
	iron	bell
A	drops	rings
B	drops	stops ringing
C	moves up	rings
D	moves up	stops ringing

38 Two parallel vertical wires P and Q are a small distance apart in air. There is a downwards electric current in both wires. A force acts on Q due to the current in P. This force is perpendicular to the wire Q.

What is the direction of the force on Q?



39 The diagram shows a single-coil electric motor.



The split-ring commutator reverses the current in the coil as it rotates.

How many times is the current reversed if the coil is rotated for one complete revolution?

A 1 **B** 2 **C** 3 **D** 4

40 Electric power cables transmit electrical energy over large distances using a high voltage, alternating current.

What are the advantages of using a high voltage and of using an alternating current?

	advantage of using a high voltage	advantage of using an alternating current
A	a higher current is produced in the cable	the resistance of the cable is reduced
B	a higher current is produced in the cable	the voltage can be changed using a transformer
C	less energy is wasted in the cable	the resistance of the cable is reduced
D	less energy is wasted in the cable	the voltage can be changed using a transformer

END OF PAPER

Name		Index Number		Class	4 A

DUNMAN HIGH SCHOOL
PRELIMINARY EXAMINATION 2019
GCE O LEVEL PHYSICS

Paper 2 — 6091/2

Theory

30 Aug 2019
1 hour 45 minutes

Candidates answer on the Question Paper.
No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your name and index number on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

Section A
Answer **all** questions.

Section B
Answer **all** questions. Question 17 has a choice of parts to answer.

Candidates are reminded that **all** quantitative answers should include appropriate units.
The use of an approved scientific calculator is expected, where appropriate.
Candidates are advised to show all their working in a clear and orderly manner, as more marks are awarded for sound use of Physics than for correct answers.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

For teacher's use:

Section A	**/50**
Section B	**/30**
Total	**/80**

This document consists of **24** printed pages and **1** blank page.

Section A

Answer **all** the questions in this section.

1 A student measures the diameter of a rod using a micrometer.

Fig. 1.1 shows the reading on the micrometer. Given that the micrometer has a zero error of -0.04 mm, determine the actual diameter of the rod.

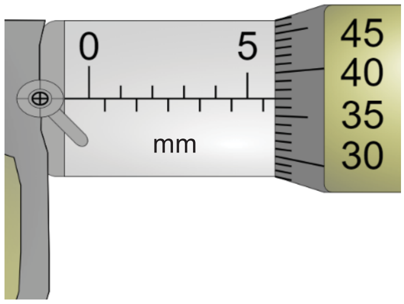


Fig. 1.1

diameter = ……………………… [2]

2 The critical angle of glass is 41.2°.

(a) Calculate the refractive index, η of glass.

η = ……………………… [1]

(b) Fig. 2.1 shows a light ray incident on a glass block. Calculate *r*, the angle of refraction.

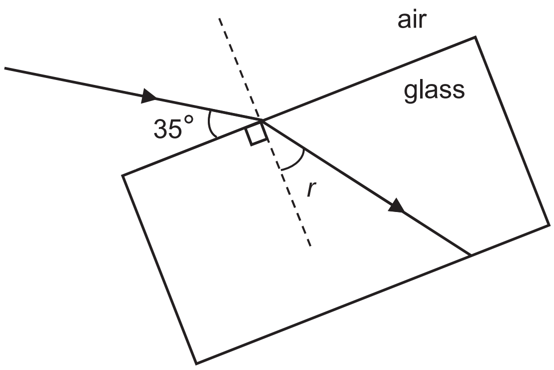


Fig. 2.1 (not to scale)

r = ……………………… [2]

3 Fig. 3.1 shows a thin converging lens that is used as a magnifying glass.

(a) On Fig. 3.1, draw two rays from the top of the object to locate the top of the image. Draw in the whole of the image. [3]

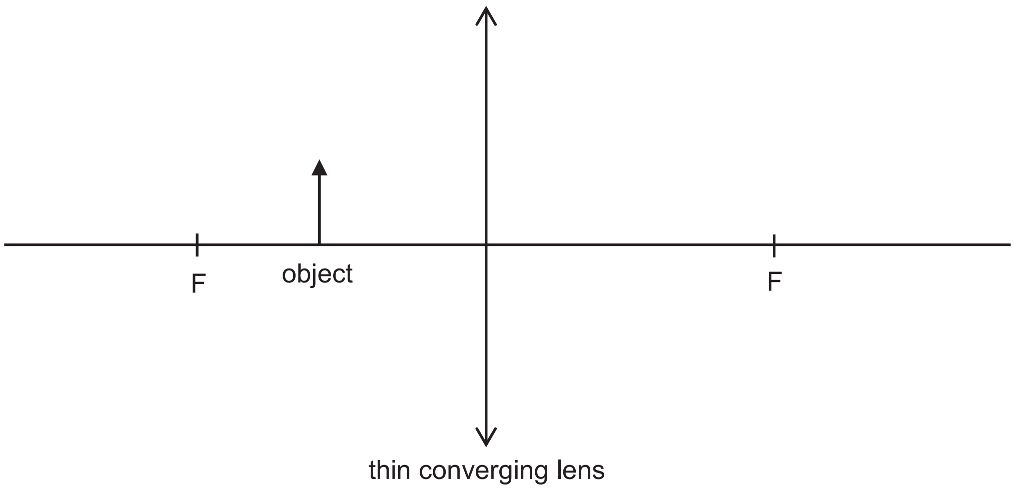


Fig. 3.1

(b) Other than the size of the image relative to the object, state another characteristic of the image.

……………………………………………………………………………………………..... [1]

4 Fig. 4.1 shows the displacement-distance graph of a transverse wave.

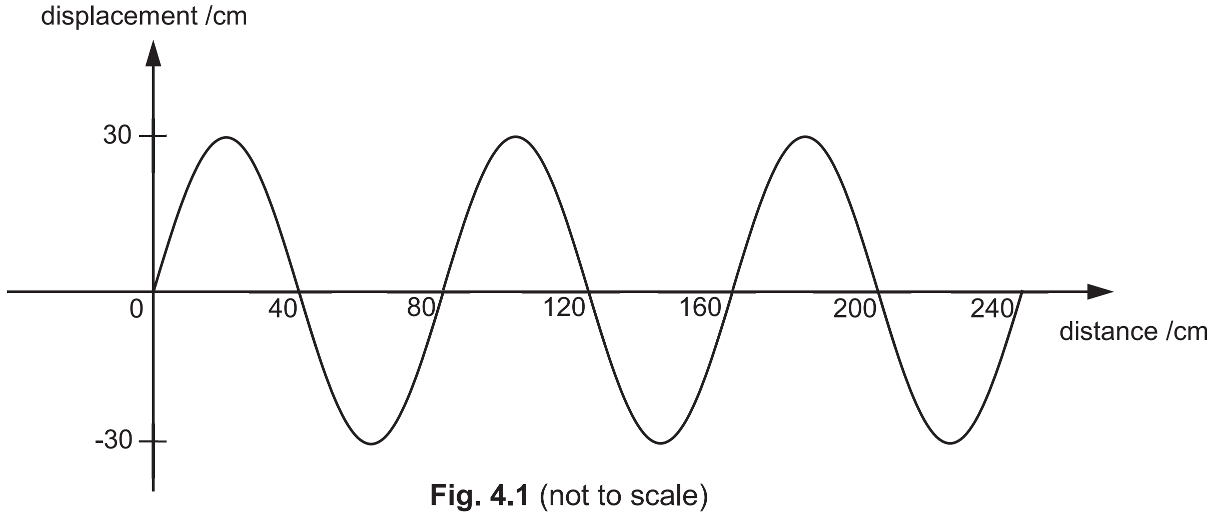


Fig. 4.1 (not to scale)

(a) Determine the amplitude of the wave.

amplitude = ……………………… [1]

(b) The wave propagates at a speed of 2.8 m/s.

Calculate the frequency of the wave.

frequency = ……………………… [2]

(c) Name a region of the electromagnetic spectrum that has a higher frequency than ultraviolet radiation.

……………………………………………………………………………………….. [1]

5 Fig. 5.1 shows a sound source integrated with a microphone placed in the middle of a rectangular room. The microphone is attached to an oscilloscope. A sound pulse is emitted and the oscilloscope starts recording immediately after the entire pulse has been emitted.

Fig. 5.2 shows the oscilloscope trace of the first two returning echoes.

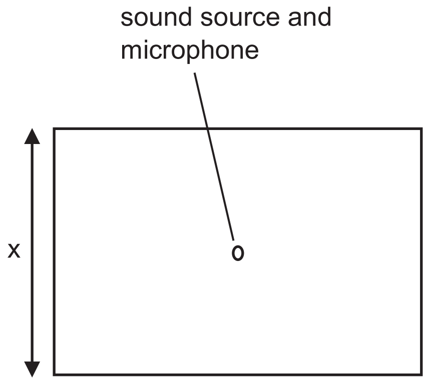


Fig. 5.1 (not to scale)

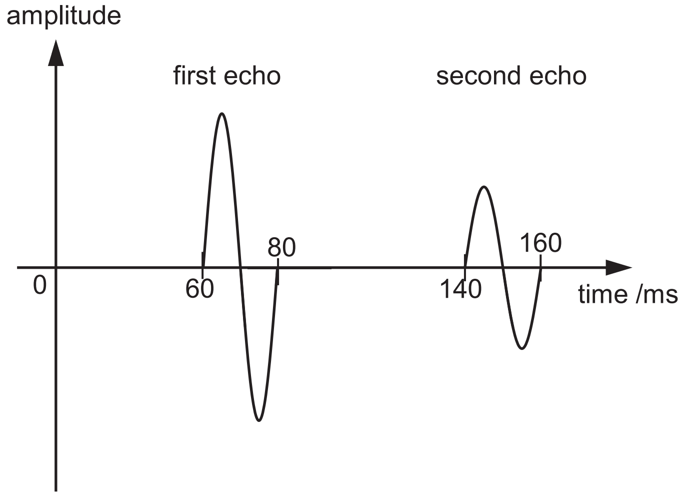


Fig. 5.2 (not to scale)

(a) Explain why the second echo is of a smaller amplitude than the first echo.

....

.... [1]

(b) The speed of sound in air is 330 m/s.

Calculate the distance x, leaving your answer in metres.

x = ... m [2]

6 Fig. 6.1 shows an empty double walled container of mass 235 g which can hold up to 235 cm^3 of fluids.

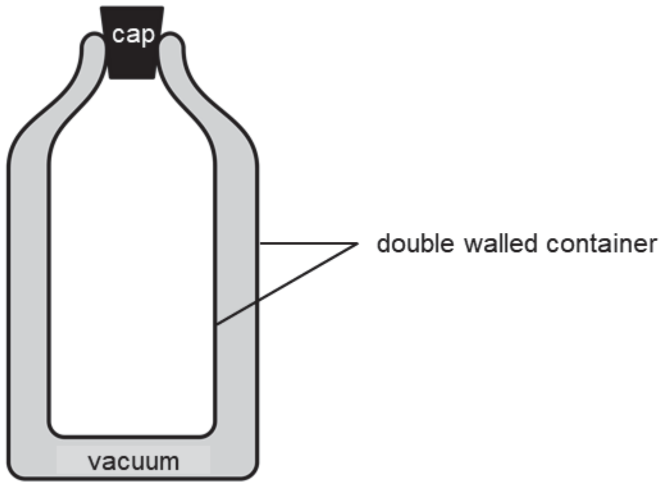


Fig. 6.1

State and explain whether the empty double walled container will float or sink in water. The density of water is 1.0 g/cm^3.

……………………………………………………………………………………………........

……………………………………………………………………………………………........

……………………………………………………………………………………………....... [2]

7 Fig. 7.1 shows a simple balancing toy balanced on the tip of a finger.

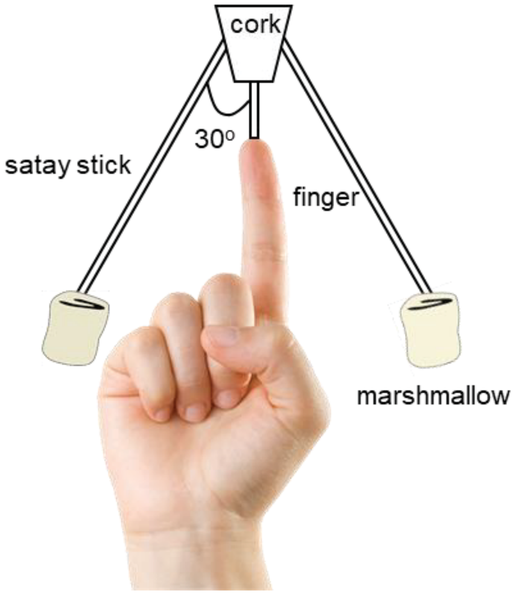


Fig. 7.1

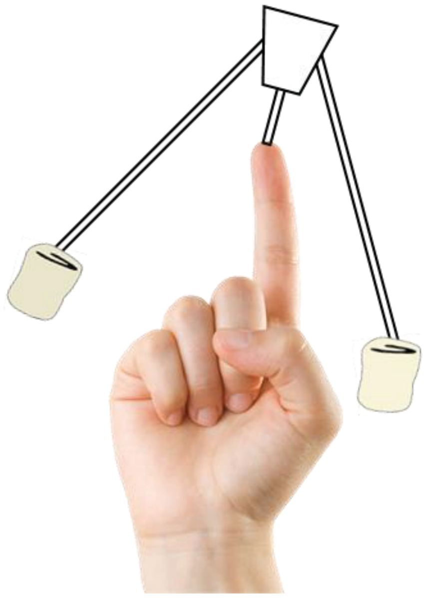


Fig. 7.2

(a) **(i)** Define the *centre of gravity* of an object.

………………………………………………………………………………………......

………………………………………………………………………………………...... [1]

(ii) On Fig. 7.1, mark the position of the centre of gravity of the simple balancing toy with an 'X'. [1]

(b) Fig. 7.2 shows the simple balancing toy displaced on the tip of the finger.
Explain how the simple balancing toy is able to return to its position in Fig. 7.1.

……………………………………………………………………………………………

……………………………………………………………………………………………

…………………………………………………………………………………………… [2]

(c) Without any changes to the materials used to construct the simple balancing toy, suggest a modification to make it more stable.

……………………………………………………………………………………………

…………………………………………………………………………………………… [1]

8 Fig. 8.1 shows a skier of mass 80 kg, ski down the slope from rest at X and reach a speed of 5.0 m/s at Y.

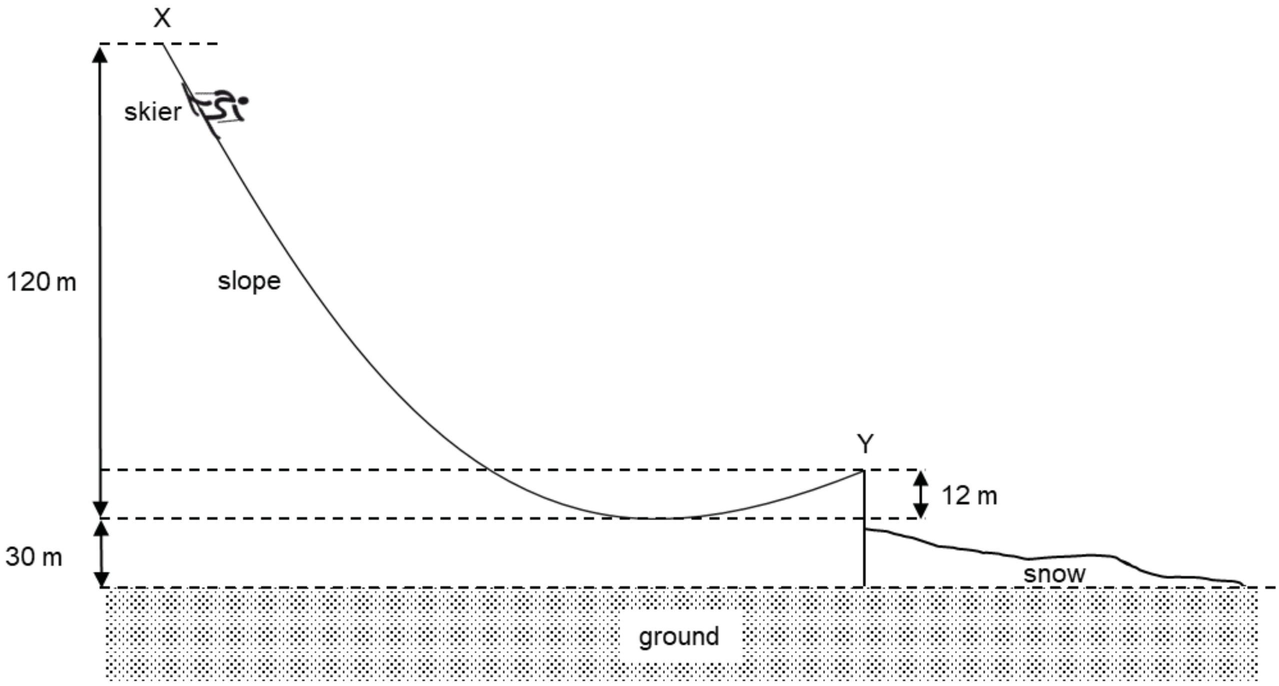


Fig. 8.1

(a) Define *work*.

………

……… [1]

(b) Calculate the work done against friction from X to Y.

The gravitational field strength g is 10 N/kg.

work done = ……………………… [3]

9 **(a)** Fig. 9.1 shows a gas in a sealed container at a pressure of 118 kPa connected to the left arm of a manometer. The right arm of the manometer is open to the atmosphere.

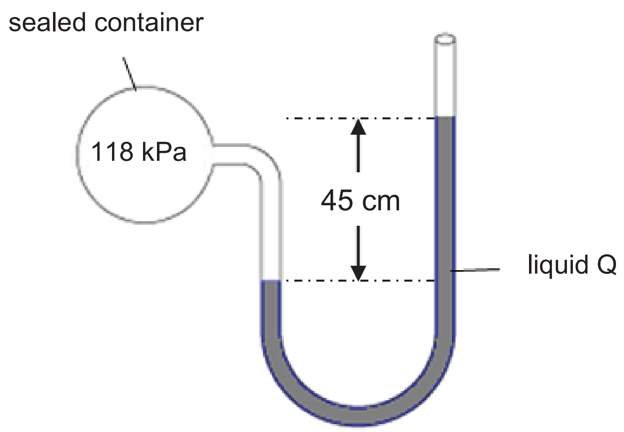


Fig. 9.1

Calculate the density of liquid Q.

The gravitational field strength *g* is 10 N/kg. The atmospheric pressure is 101 kPa.

density of liquid Q = ……………………… [2]

(b) Fig. 9.2 shows a mercury barometer placed under a pressure of one atmosphere. The density of mercury is 13 600 kg/m^3.

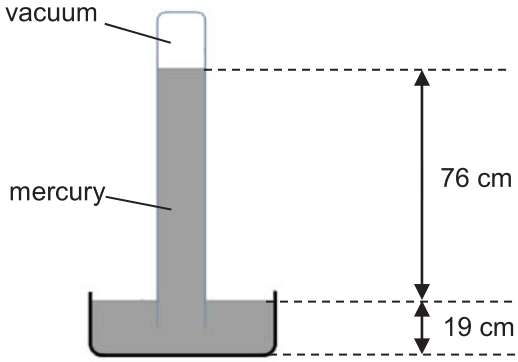


Fig. 9.2 (not to scale)

Liquid Q is used in place of mercury.

Calculate the height of the column of liquid Q when placed under a pressure of one atmosphere.

[1]

height of column of liquid Q = ……………………..

(c) **(i)** Define *pressure.*

…………………………………………………………………………………… [1]

(ii) Fig. 9.3 shows the caterpillar tracks found on excavators.

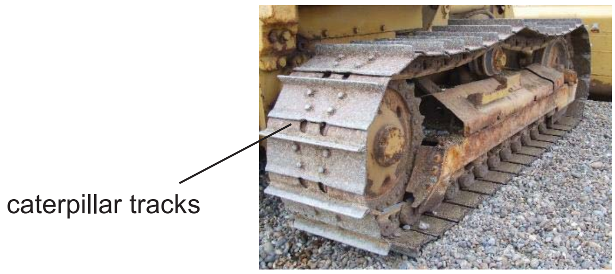


Fig. 9.3

Explain why caterpillar tracks, instead of wheels, are fitted on excavators on muddy ground.

……………………………………………………………………………………

…………………………………………………………………………………… [1]

10 Fig. 10.1 shows a flask filled with air and covered with a rubber bung.

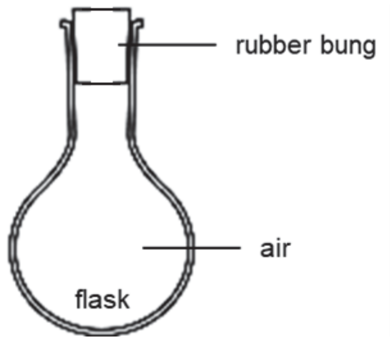


Fig. 10.1

When the flask is heated, the pressure of the air inside the flask increases and the rubber bung flies out.

(a) State the *kinetic theory of matter*.

……………………………………………………………………………………………………

…………………………………………………………………………………………………… [1]

(b) Explain, using the kinetic theory of matter, why heating the air inside the flask causes the air pressure to increase.

……………………………………………………………………………………………………

……………………………………………………………………………………………………

……………………………………………………………………………………………………

……………………………………………………………………………………………………

…………………………………………………………………………………………………… [3]

11 Fig. 11.1 shows petrol being pumped into a can. Electrostatic charges build up on the petrol and the pipe.

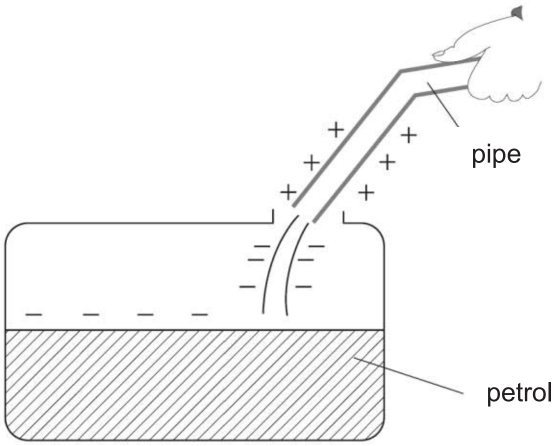


Fig. 11.1

(a) Explain why this is dangerous.

………………………………………………………………………………………………..

………………………………………………………………………………………………..

……………………………………………………………………………………………….. [2]

(b) Describe what can be done to stop the electrostatic charge building up in this way.

………………………………………………………………………………………………..

……………………………………………………………………………………………….. [1]

12 Fig. 12.1 shows a circuit with three identical resistors R_1, R_2 and R_3.

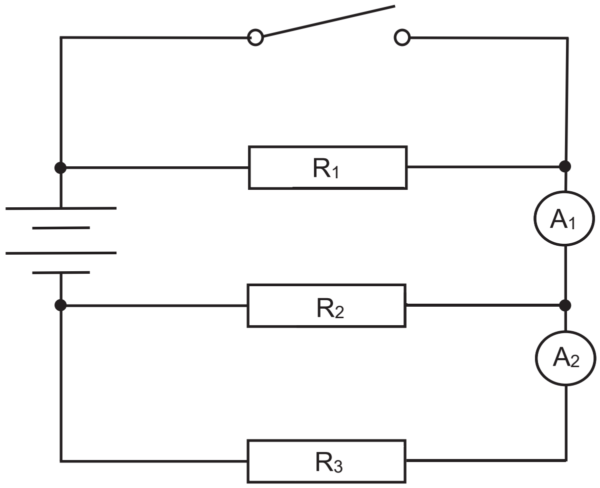


Fig. 12.1

(a) The switch is closed.

State and explain what happens to the reading of A_1 compared to when the switch is opened.

……………………………………………………………………………………………..

…………………………………………………………………………………………….. [1]

(b) R_2 is now replaced with a diode, , pointing to the right. The switch remains closed.

State the ratio of the reading of A_1 to the reading of A_2.

…………………………………………………………………………………………….. [1]

13 Fig. 13.1 shows the three wires P, Q and R of an electrical appliance and their corresponding wires on the mains socket.

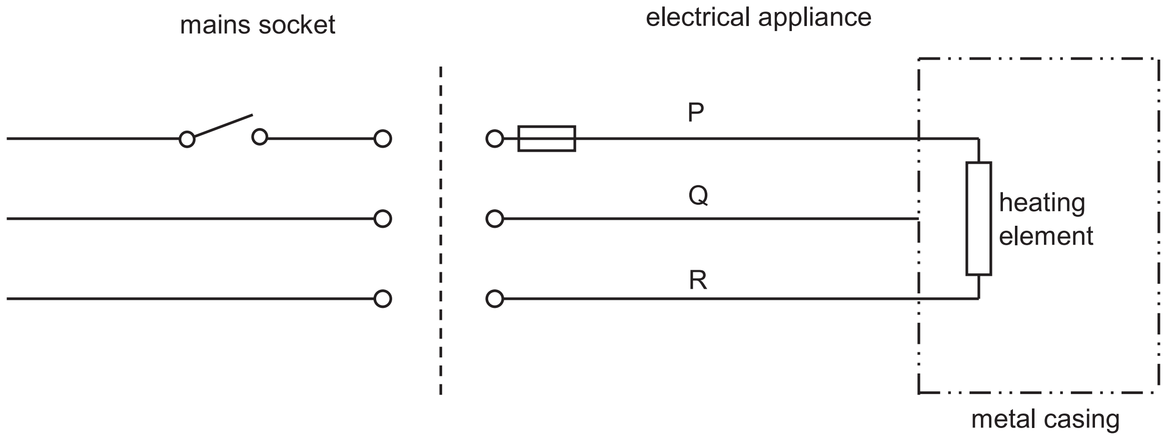


Fig. 13.1

(a) Name wire P.

…………………………………………………………………………………………….. [1]

(b) State the colour of wire R.

…………………………………………………………………………………………….. [1]

(c) Explain how wire Q serves as a safety feature.

……………………………………………………………………………………………..

…………………………………………………………………………………………….. [1]

(d) In some appliances, wire Q is not present.

State an additional safety feature that is present in place of wire Q.

…………………………………………………………………………………………….. [1]

14 **(a)** State two conditions required for a particle to experience a force in a magnetic field.

1. ………………………………………………………………………………………….

………………………………………………………………………………………….

2. ………………………………………………………………………………………….

…………………………………………………………………………………………. [2]

(b) Microwaves and a beam of fast-moving electrons enter a strong magnetic field, as shown in Fig. 14.1.

Fig. 14.1

The magnetic field acts only in the shaded region shown in Fig. 14.1. The direction of the magnetic field is out of the page.

On Fig. 14.1, sketch the paths of the microwaves and the electrons in the magnetic field. [3]

Section B

Answer **all** the questions in this section.
Answer only one of the two alternative questions in **Question 17**.

15 The marathon is a long-distance race of about 42 km. Water on the skin of a marathon runner evaporates as he runs.

Data relevant to the marathon is given in the box.

mass of marathon runner: 70 kg
time taken by runner to complete the marathon: 4.5 hours
average body temperature before starting the marathon: 37 °C
body temperature above which overheating may cause serious damage: 40 °C
average production of thermal energy in one hour by the runner: 3.3×10^6 J
average loss of energy in one hour by evaporation from the skin: 2.2×10^6 J
average specific heat capacity of the human body: 3400 J/(kg °C)
specific latent heat of vaporisation of water at body temperature: 2.4×10^6 J/kg

The level of dehydration of a human body is measured by the percentage loss of body mass caused by evaporation. The table below shows three levels of dehydration.

level of dehydration	percentage of body mass lost by evaporation of water
mild dehydration	<3%
moderate dehydration	3–5%
severe dehydration	>5%

(a) Calculate the mass of water lost by evaporation from the skin of the runner in one hour.

mass of water lost = ……………………… [2]

(b) Assume that the runner only loses energy by evaporation from his skin.

Calculate the rise in temperature of his body in one hour of the race.

rise in temperature = ……………………… [3]

(c) Using your answer to **(b)**, show that evaporation from his skin is not sufficient, on its own, to prevent overheating during the race.

……………………………………………………………………………………....

……………………………………………………………………………………....

…………………………………………………………………………………….... [1]

(d) One other mechanism for evaporation occurs in breathing. Water is vaporised in the lungs and is then exhaled.

Assume that there is no increase in the runner's body temperature during the race.

Calculate the mass of water vapour that the runner exhales during the **whole** race.

mass of water vapour = ……………………… [2]

(e) Assume that the runner does not drink any water during the race.

Using your answers to **(a)** and **(d)**, determine the level of dehydration of the runner at the end of the race.

…………………………………………………………………………………….... [2]

16 Fig. 16.1 shows a hovercraft which moves on a cushion of air trapped underneath it.

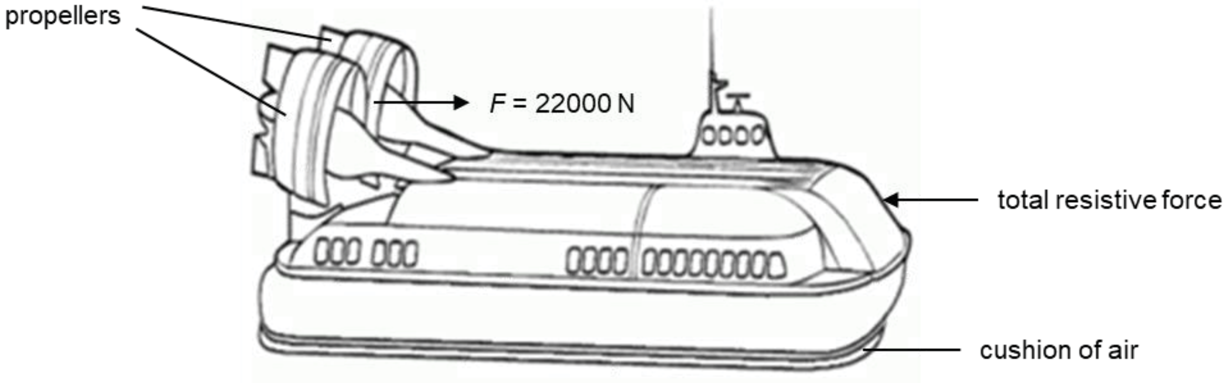


Fig. 16.1

(a) At an instant, the propellers produce a total forward force, *F* of 22000 N and experiences a total resistive force of 2000 N. The mass of the hovercraft is 25000 kg.

Calculate the acceleration of the hovercraft at this instant.

acceleration = ……………………… [2]

(b) After some time, the hovercraft reaches a steady speed, even though the force *F* is unchanged.

Explain, in terms of the forces acting on the hovercraft, why the hovercraft will reach steady speed.

…………………………………………………………………………………………………

…………………………………………………………………………………………………

………………………………………………………………………………………………… [2]

(c) Explain how the propeller is able to produce a forward force, *F*.

…………………………………………………………………………………………………

………………………………………………………………………………………………… [1]

(d) Fig. 16.2 shows how the speed, *v* of the hovercraft varies with time, *t* for part of its journey.

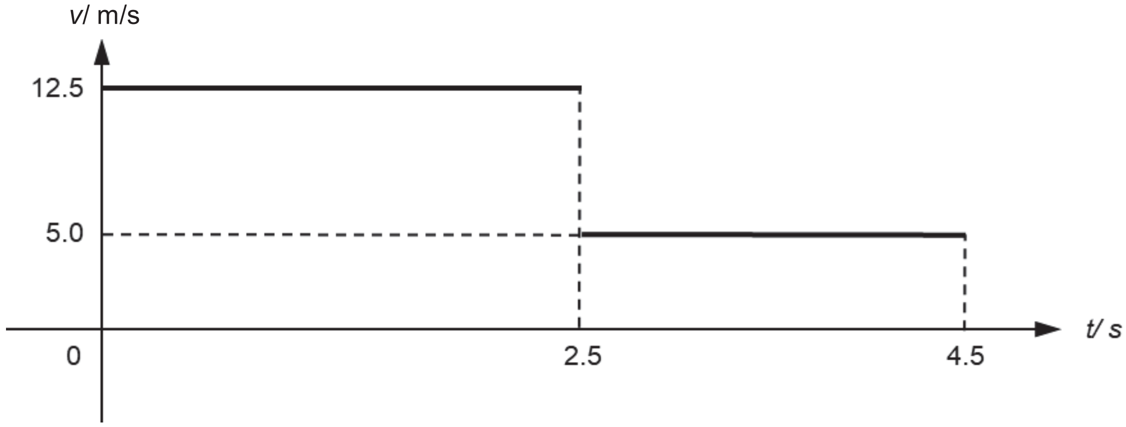


Fig. 16.2

(i) State the acceleration of the hovercraft between t = 0 s and t = 2.5 s.

……………………………………………………………………...………………… [1]

(ii) Calculate the total distance travelled by the hovercraft in 4.5 s.

distance = ……………………… [2]

(iii) On Fig. 16.3, sketch how the distance travelled, *d* of the hovercraft varies with time, *t*. You are **not** required to make any calculations.

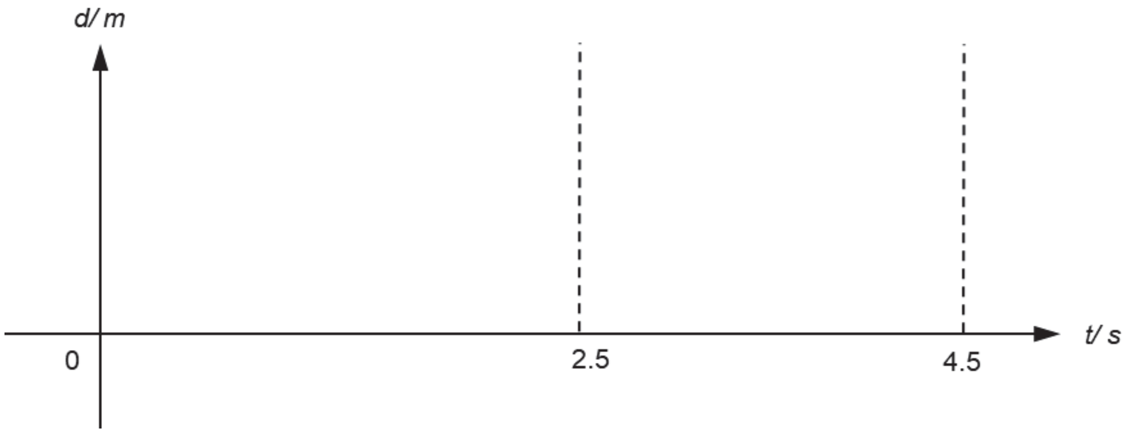


Fig. 16.3

[2]

17 **EITHER**

Fig. 17.1 shows an electrical circuit used to determine the resistance of an unknown fixed resistor, R_T. Three fixed resistors of 100 Ω, 150 Ω and 450 Ω are used to provide varying resistance values, simulating the rheostat shown in the circuit diagram.

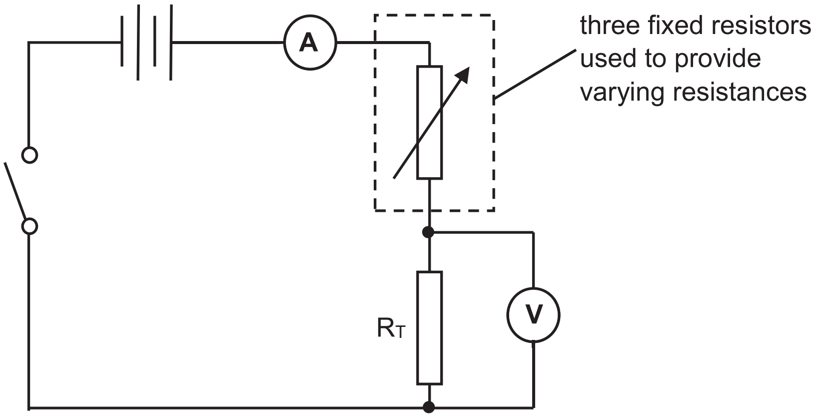


Fig. 17.1

To obtain each resistance value recorded in the first column of Fig. 17.2, **all** three fixed resistors are used. The resistance values are varied by placing the three resistors in different arrangements. The switch is then closed and the corresponding voltmeter and ammeter readings are recorded.

resistance / Ω	voltage / V	current / mA
P	5.64	120.1
213	2.14	46.4
232	1.99	43.2
510	0.97	21.6
Q	0.71	16.1

Fig. 17.2

(a) Given that P and Q respectively represent the smallest and largest possible resistance values obtainable,

(i) calculate P.

P = ……………………… Ω [2]

(ii) calculate Q.

Q = ……………………… Ω [1]

(iii) Explain why the voltage measured across R_T decreases as the resistance values in the first column of Fig. 17.2 increases.

……………………………………………………………………………………..

…………………………………………………………………………………….. [1]

(iv) A student uses the results obtained for resistance of 232 Ω from Fig. 17.2 to correctly estimate the value of the unknown resistor, R_T.

Calculate the resistance obtained by the student.

resistance of R_T = ……………………… [1]

(v) Using your answer in part **(iv)**, estimate the potential difference (p.d.) across the terminals of the batteries in the circuit.

p.d across terminals of batteries = ……………………… [2]

(b) Fig. 17.3 shows the *I*/*V* characteristic graph of two light emitting diodes (LED).

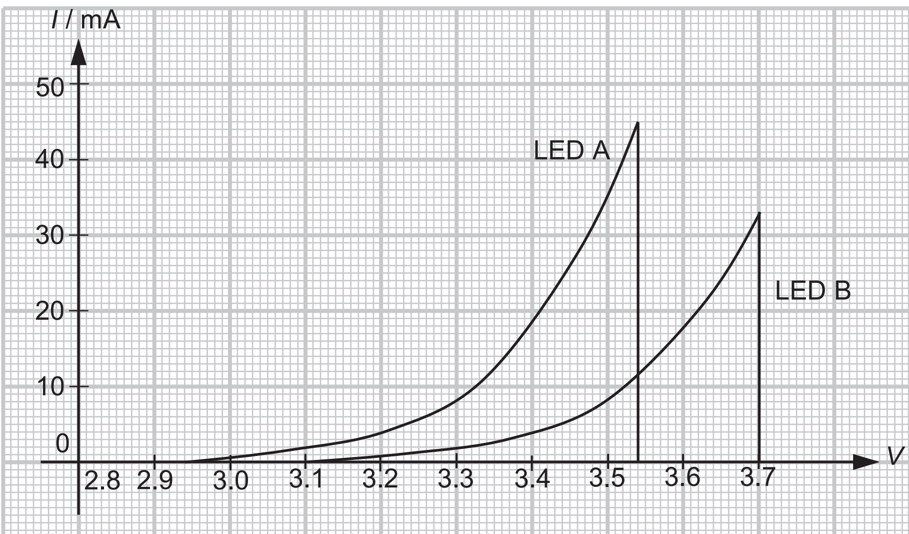


Fig. 17.3

(i) Describe how *I* varies with *V* for LED B.

……………………………………………………………………………………..

…………………………………………………………………………………….. [1]

(ii) Assume that all the power supplied is converted to light for both LED A and LED B.

Determine which LED will be brighter at its maximum power dissipation. Show your working clearly.

…………………………………………………………………………………….. [2]

OR

Fig. 17.4 represents the basic structure of a transformer.

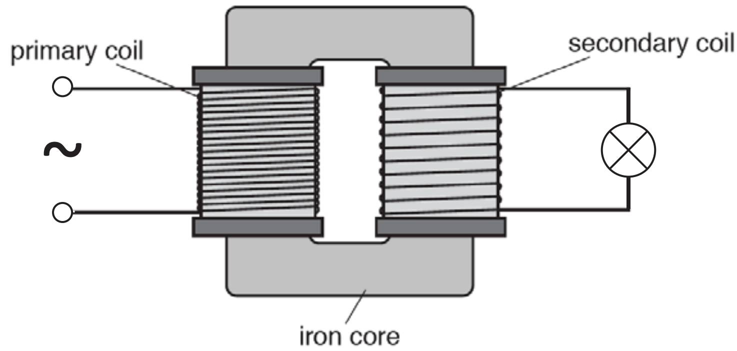


Fig. 17.4

(a) The secondary coil is connected to a lamp. When there is an alternating current in the primary coil, the lamp is lit.

When there is a direct current in the primary coil, the lamp is **not** lit.

(i) State **one** way in which an alternating current differs from a direct current.

……………………………………………………………………………………….......

………………………………………………………………………………………....... [1]

(ii) Explain why the lamp is **not** lit when there is a direct current in the primary coil.

……………………………………………………………………………………….......

……………………………………………………………………………………….......

………………………………………………………………………………………....... [2]

(b) An alternating voltage of 240 V is applied to the primary coil and a voltage is induced in the secondary coil. The primary coil has 560 turns.

Calculate the smallest number of complete turns in the secondary coil that would give an induced voltage of at least 8.0 V in the secondary coil.

number of turns = ……………………… [2]

(c) A student determines the input and output power of the transformer and calculates the efficiency of the transformer.

(i) The student uses voltmeters and ammeters that measure alternating voltages and currents.

On Fig. 17.4, draw two voltmeters and two ammeters that enable the input power and the output power of the transformer to be determined. [2]

(ii) State what is meant by *efficiency*.

………………………………………………………………………………………..........

………………………………………………………………………………………..........

……………………………………………………………………………………….......... [1]

(iii) The current in the primary coil is 0.033 A. The current in the secondary coil is 0.72 A and the output voltage of the transformer is 8.0 V.

Calculate the efficiency of the transformer.

efficiency = ……………………… [2]

END OF PAPER

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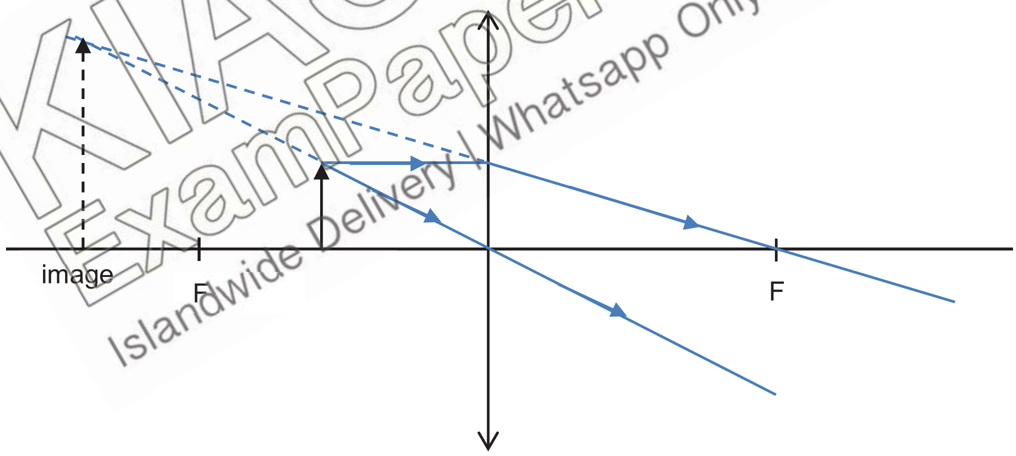
Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
A	B	D	A	C	B	B	D	C	A
Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20
D	C	D	A	A	B	D	B	A	C
Q21	Q22	Q23	Q24	Q25	Q26	Q27	Q28	Q29	Q30
C	B	B	B	C	B	C	C	A	D
Q31	Q32	Q33	Q34	Q35	Q36	Q37	Q38	Q39	Q40
B	D	A	C	D	D	A	D	B	D

1		5.5 mm + 0.37mm = 5.87mm 5.87mm – (-0.04mm) = 5.91mm	

2	a	$\eta_{glass} = \frac{1}{\sin C}$ $\eta_{glass} = 1.52$	
	b	Angle of incidence = 55° $\sin r = \frac{\sin 55°}{1.52}$ $r = 32.6°$	

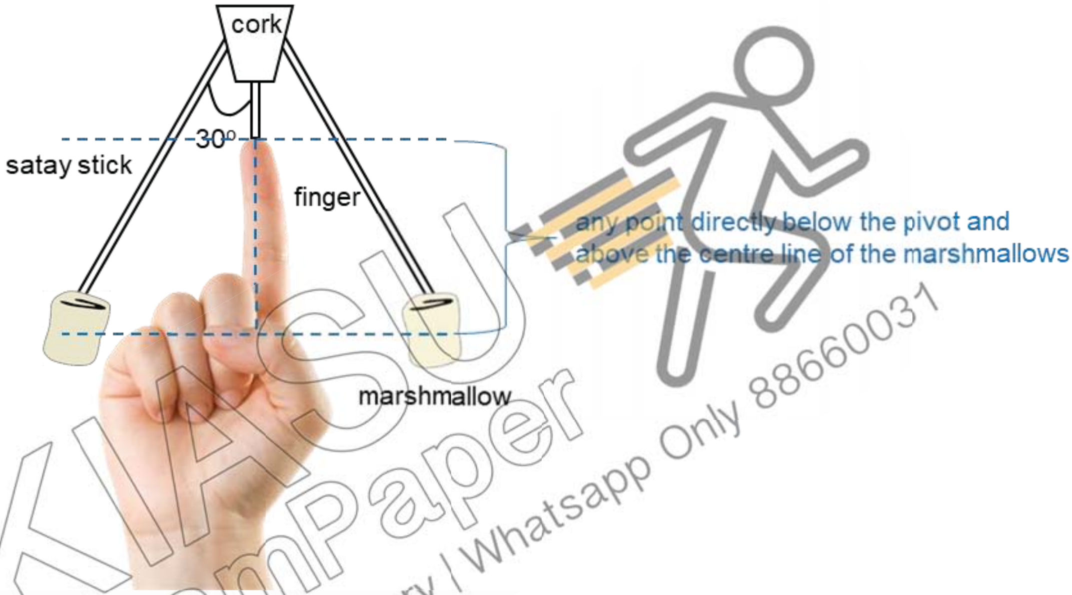
3	a		
	b	Image is upright / Image is virtual	

4	a	30 cm	
	b	$v = f\lambda$ 2.8 = f (0.8) f = 3.5 Hz	
	c	X-rays, Gamma rays	

5	a	The pulse spreads out in all directions as it propagates across the room, not all of the first echo will be picked up by the microphone when it returns as the second echo.	

		OR Some sound energy was absorbed by the medium as the pulse propagates and absorbed by the wall / microphone when the pulse hits.	
	b	$\text{distance} = \text{speed} \times \text{time}$ $= 330 \times 0.080$ $= 26.4$ m	

6		Float. The volume of the container is larger than 235 cm^3, hence the density is less than 1.0 g cm^{-3}.	

7	**ai**	The centre of gravity of any object is defined as the point through which its whole weight appears to act.	
	aii		
	b	When displaced, the line of action of weight produces an anti–clockwise moment about the pivot to return it to its original position.	
	c	Decrease the angle between the vertical and the satay stick.	

8	**a**	Work done is the product of the force applied and the distance moved by the object in the direction of the force.	
	b	Word done against friction = GPE – KE = mgh – ½ mv^2 = (80)(10)(108) – ½ (80)$(5.0)^2$ = 85400 J	

9	**ai**	118 kPa $= h\rho g + 101$ kPa 17 kPa = 4.5 × ρ $\rho = 3780$ kg m^{-3}	
	aii	$\frac{13600}{3777.8} \times 76 = 274$ cm	

	bi	Force acting per unit area.	
	bii	Increased surface area for the weight of the excavators will cause the pressure with the ground to decrease, prevent excavator from sinking in the mud.	

10	a	The kinetic theory of matter states that the tiny particles that make up matter are always in continuous, random motion.	
	b	Increase in average kinetic energy/ speed. Increase in collision frequency and average force per collision (against the walls of the container). Average force of collisions to increase.	

11	a	Sudden discharge may produce sparks, which can ignite the petrol.	
	b	Earth the can and/or pipe.	

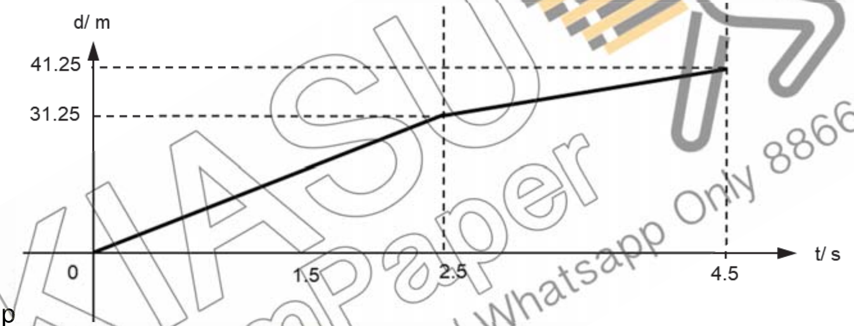
12	a	A_1 has increased. Current has bypassed R_1, effective resistance of circuit has decreased.	
	b	1 : 1	

13	a	Live	
	b	Blue	
	c	Provides a path of low resistance for current to flow through in the event the metal casing becomes live.	
	d	Double insulation / The casing is insulated	

14	a	The particle must have a charge. The charged particle must be moving.	
	b	Electrons deflected, upwards. No deflection to microwaves.	

15	a	$Q = m\,l_v$ $m = (2.2 \times 10^6) \div (2.4 \times 10^6)$ ≈ 0.91667 $= 0.92$ kg (2 sf) or 0.917 kg (3 sf)	
	b	amt. of thermal energy retained in body in one hour $= (3.3 - 2.2) \times 10^6$ $= 1.1 \times 10^6$ J $Q = m\,c\,\Delta\theta$ $\Delta\theta = (1.1 \times 10^6) \div (70 \times 3400)$ $= 4.6$ °C (2 sf) or 4.62 °C (3 sf)	
	c	The body temperature in one hour during the race is already 37 + 4.6 = 41.6 °C. This is higher than the 40 °C where overheating may cause serious damage.	
	d	$Q = m\,l_v$ in 1 hour, $m = (1.1 \times 10^6) \div (2.4 \times 10^6)$ $= 0.45833$ kg (5 sf) in 4.5 hours, $m = 4.5 \times 0.45833$ ≈ 2.0625 (5 sf) $= 2.1$ kg (2 sf) or 2.06 kg (3sf)	

	e	total amt. of water lost in 4.5 hours = (0.91667 x 4.5) + 2.0625 ≈ 6.1875 kg (5 sf) level of dehydration = (6.1875 ÷ 70) x 100% = 8.8% (2 sf) or 8.84% (3 sf) or = (6.1875 ÷ 63.8125) x 100% = 9.7% (2 sf) or 9.70% (3 sf) He will experience severe dehydration.	

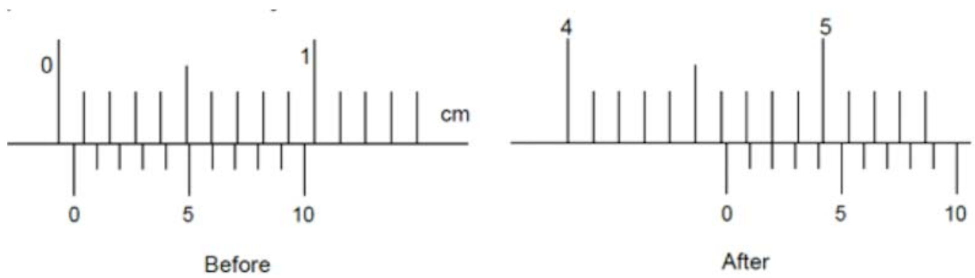
16	**a**	$F_{resultant} = ma$ a = (22000 – 2000) / 25000 = 0.80 m s^{-2}	
	b	As the speed of the hovercraft increases, the air resistance acting on it increases. When the air resistance equals the forward force, resultant force is zero.	
	c	The propellers exert a force on the air in the backward direction which results in a force by the air on the propellers in the forward direction.	
	di	Acceleration is zero or 0 m/s^2.	
	ii	Distance = Area under the speed – time graph = (12.5)(2.5) + (5.0)(2.0) = 41.25 m	
	iii	 p	

17 Either	**ai**	$\frac{1}{100}+\frac{1}{150}+\frac{1}{450}=\frac{1}{R_{eff}}$ P = 53 Ω	
	aii	Q = 700 Ω	
	aiii	As effective resistance increases, the current drawn decreases. For a fixed resistor R_T, the potential difference across the fixed resistor will decrease.	
	aiv	R_T = 1.99 ÷ (43.2 x 10^{-3}) = 46.1 Ω	
	av	Total resistance = 232 + 46.1 = 278.1 Ω p.d across batteries = 278.1 × 0.0432 = 12.0 V	
	bi	*I* = 0 A up till *V* = 2.9 V, thereafter, *I* increases non-proportionally with *V*.	
	bii)	LED A will be brighter. P_A = 45 x 3.54 = 159.3 mW; P_B = 33 x 3.7 = 122.1 mW	

Or	**ai**	a.c. changes direction or changes polarity / from positive to negative continually.	
	ii	There is no change in magnetic flux and hence, no induced voltage / current in the secondary coil.	

	b	$N_s = V_s / V_p \times N_p$ $= 8.0 / 240 \times 560$ = 19 (**whole no.**)	
	ci	Ammeters in series with each coil; Voltmeters in parallel with each coil	
	ii	It is the ratio (or percentage / proportion / fraction) of useful output power (or energy) to input power (or energy)	
	iii	Efficiency = (0.72 x 8.0) / (0.033 x 240) x 100% = 73% (2 sf) or 72.7% (3 sf)	

1 The following shows a set of Vernier caliper reading before and after a coin is placed between its jaws.



What is the zero error and the corrected radius of the coin, in cm?

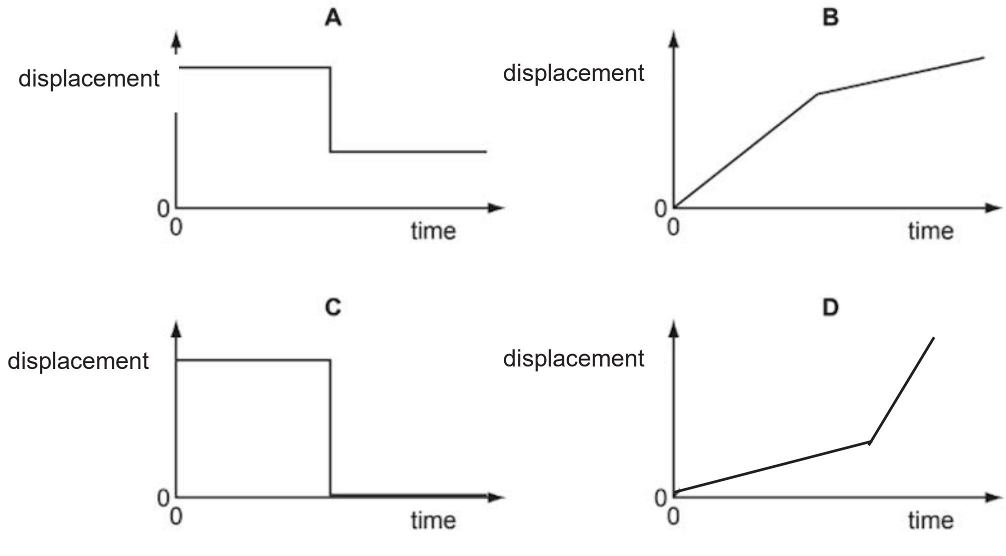
	zero error/cm	corrected radius/cm
A	-0.04	2.33
B	-0.04	2.44
C	0.06	2.28
D	0.06	2.38

2 Which line in the table correctly indicates the prefixes micro, nano and giga?

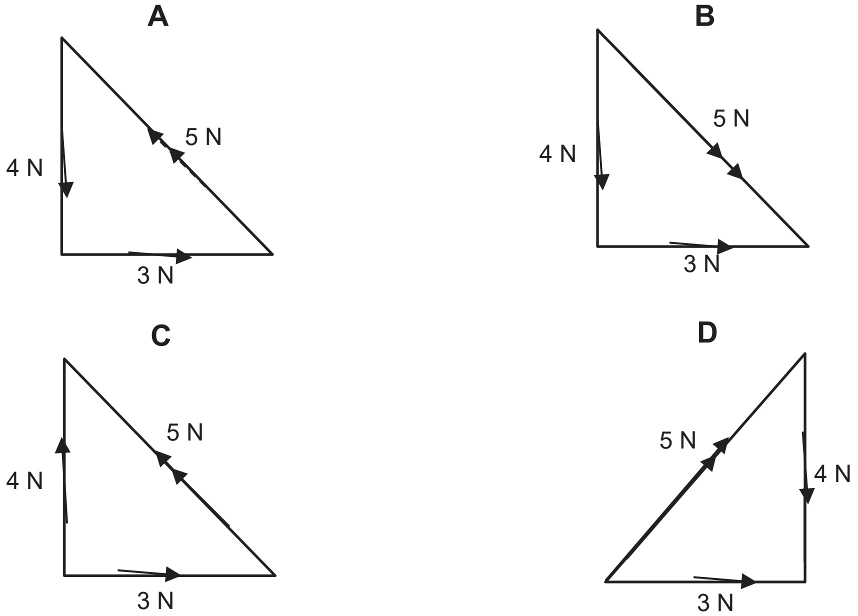
	$\times 10^{-6}$	$\times 10^{-9}$	$\times 10^{9}$
A	giga	micro	nano
B	giga	nano	micro
C	nano	micro	giga
D	micro	nano	giga

3 A car is traveling at constant speed. Brakes are applied for a short period of time and the car continues at a lower constant speed.

Which displacement-time graph shows the motion of the car?



4 Which diagram correctly shows the addition of a 3 N force and a 4 N force at right angles to each other?



5 Twenty-seven identical small cubes are arranged to form a big cube as shown in the diagram.

The cubes are made from the same material and the density of each cube is ρ. If one small cube is removed from the arrangement, what is the density of the remaining cubes?

A ρ

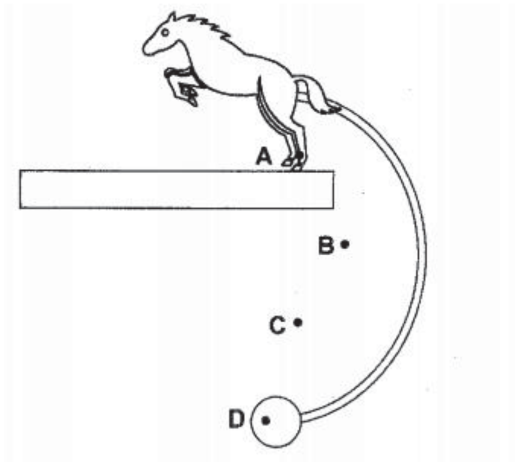
B $\frac{27}{26}$ ρ

C $\frac{26}{27}$ ρ

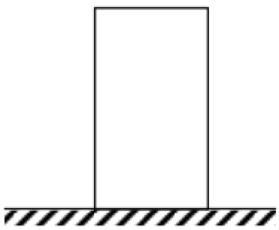
D $\frac{28}{27}$ ρ

6 The diagram shows the rest position of a balancing toy on the edge of a table.

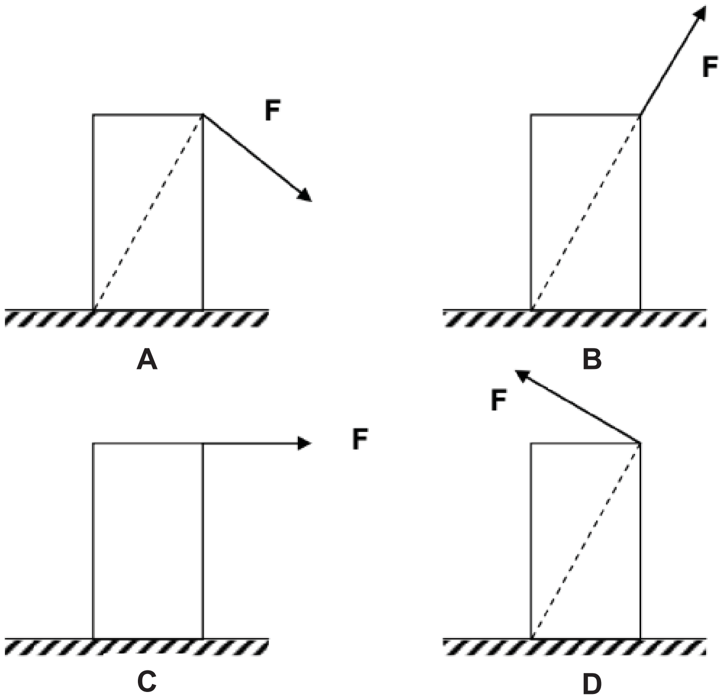
Which position is most likely to be the centre of mass of the toy?



7 A rectangular block of wood rests on the ground as shown in the diagram.



Which of the following is the easiest way for a force F to topple the block?



8 Car X is travelling at half the speed of car Y. Car X has twice the mass of car Y.

Which statement is correct?

A Car X has half the kinetic energy of car Y.

B Car X has one quarter of the kinetic energy of car Y.

C Car X has twice the kinetic energy of car Y.

D The two cars have the same kinetic energy.

9 A mass is raised vertically. In time t, the increase in its gravitational potential energy is E_p and the increase in its kinetic energy is E_k.

What is the average power input to the mass?

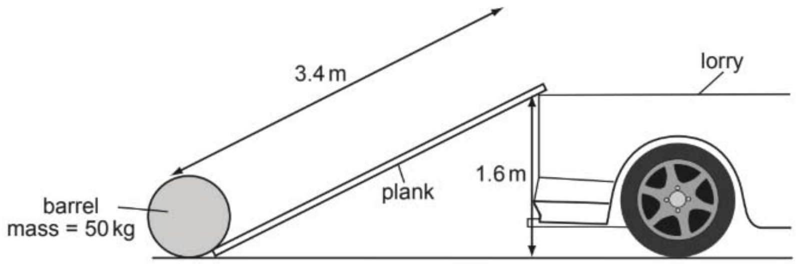
A $(E_p - E_k)t$

B $(E_p + E_k)t$

C $\left(\frac{E_p - E_k}{t}\right)$

D $\left(\frac{E_p + E_k}{t}\right)$

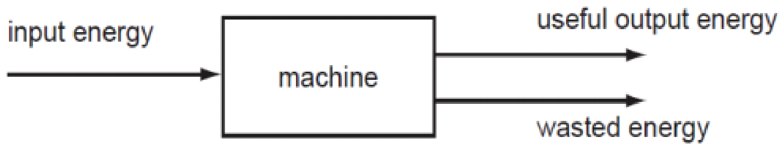
10 A barrel of mass 50 kg is loaded onto the back of a lorry 1.6 m high by pushing it up a smooth plank 3.4 m long. The gravitational field strength, g = 10 N/kg.



What is the minimum work done on the barrel?

A 80 J **B** 170 J **C** 800 J **D** 1700 J

11 The diagram shows the energy transfer of a machine.



The machine is 50% efficient.

Which of the following statements is correct?

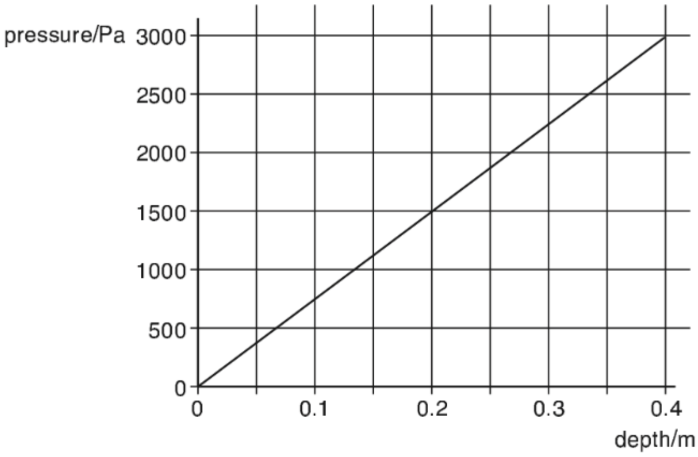
A input energy = useful output energy

B useful output energy = input energy + wasted energy

C wasted energy = input energy + useful output energy

D wasted energy = useful output energy

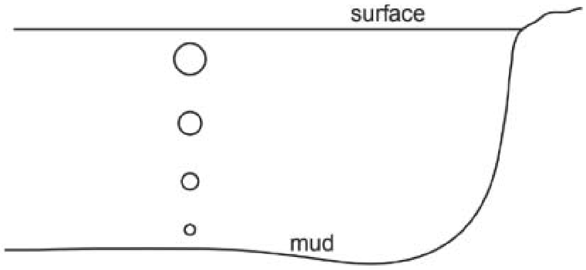
12 The graph shows how the pressure exerted by a liquid varies with depth below the surface. The gravitational field strength, g = 10 N/kg.



What is the density of the liquid?

A 600 kg/m^3 **B** 750 kg/m^3 **C** 6000 kg/m^3 **D** 7500 kg/m^3

13 Bubbles of gas, escaping from the mud at the bottom of a deep lake, rise to the surface.



As the bubbles rise, they get larger.

Why is this?

A Atmospheric pressure on the bubble decreases.

B Atmospheric pressure on the bubble increases.

C Water pressure on the bubbles decreases.

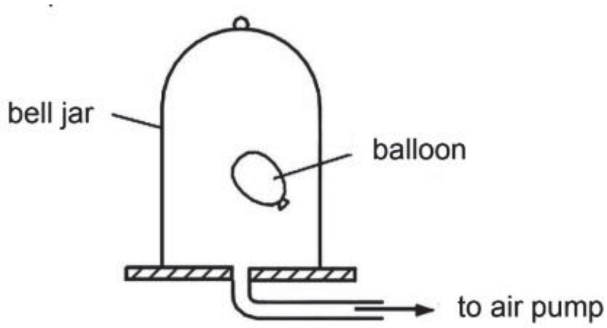
D Water pressure on the bubbles increases.

14 According to the kinetic theory of matter, matter is made up of very small particles in a constant state of motion.

Which of the following best describes the particle behaviour in the liquid state?

	forces between particles	motion of particles
A	strong	move randomly at high speed
B	strong	vibrate and are free to move position
C	weak	vibrate to and fro about a fixed position
D	weak	move randomly at high speed

15 A partially-inflated balloon is placed inside a bell jar. The bell jar is connected to an air pump. The air pump is switched on and air is slowly removed from the bell jar, keeping the temperature of the air constant.



What happens to the pressure and to the volume of the gas inside the balloon?

	pressure	volume
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

16 The lengths of the mercury thread in the stem of a mercury thermometer placed in three conditions are provided below:

- length in melting ice = 10 mm
- length in steam above boiling water = 160 mm
- length in liquid L = 70 mm

What is the temperature of liquid L?

A 37.5 °C
B 40.0 °C
C 43.8 °C
D 46.7 °C

17 Expanded polystyrene is often used to make containers for storing ice-cream. Air is trapped within the expanded polystyrene.

Which process(es) of thermal energy loss does the expanded polystyrene reduce?

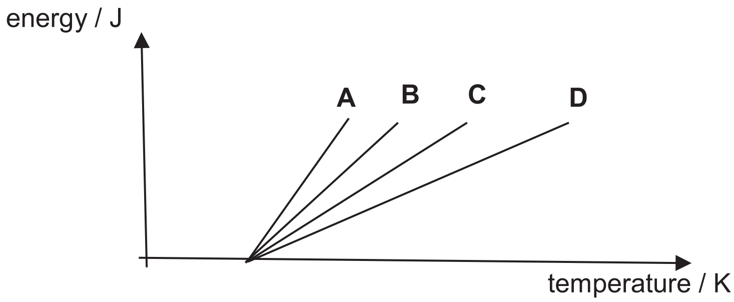
A conduction and convection only
B conduction and radiation only
C conduction only
D convection only

18 The table gives the specific heat capacities of four materials.

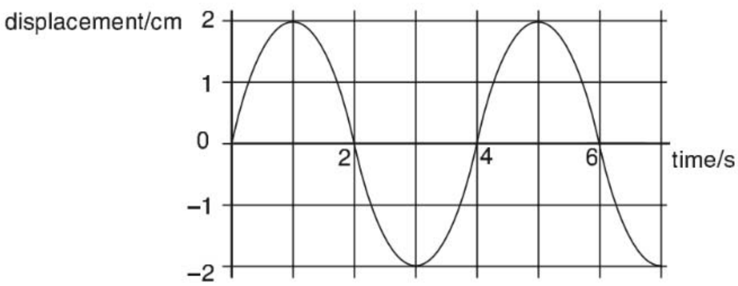
material	specific heat capacity / J/(kgK)
aluminium	913
lead	130
steel	420
water	4200

Four samples of the above materials, of equal masses were heated by an identical heat source. The graph below shows how the energy of the four samples varies with their temperature.

Which graph best represents the energy-temperature graph of aluminium?



19 The graph shows how the displacement of a particle in a wave varies with time.



Which of the following is correct?

A The wave has an amplitude of 2 cm and could be either transverse or longitudinal.

B The wave has an amplitude of 2 cm and must be transverse.

C The wave has an amplitude of 4 cm and could be either transverse or longitudinal.

D The wave has an amplitude of 4 cm and must be transverse.

20 Which list shows electromagnetic waves in order of increasing frequency?

A gamma rays, X rays, visible light
B visible light, X rays, gamma rays
C visible light, gamma rays, X rays
D X rays, gamma rays, visible light

21 The four statements shown are about the uses of electromagnetic radiation.

1. Gamma rays are used in medical treatment.
2. Infra-red waves are used in sunbeds.
3. Microwaves are used in satellite television
4. X rays are used in intruder alarms.

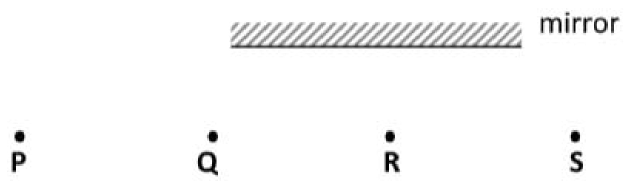
Which of these statements are correct?

A 1 and 2 **B** 1 and 3 **C** 2 and 3 **D** 2 and 4

22 What happens to light as it passes from glass into air?

A Its frequency decreases because its speed decreases.
B Its frequency increases because its speed increases.
C Its wavelength decreases because its speed decreases.
D Its wavelength increases because its speed increases.

23 Four people, P, Q, R and S, are standing in front of a plane mirror as shown.



How many people (including herself) can Q see in the mirror?

A 0
B 1
C 2
D 3

24 An object placed at 28 cm from a thin converging lens produces an image of the same size as the object.

When the object is moved to 12 cm from the same lens, the image produced will be

A real, inverted, diminished.

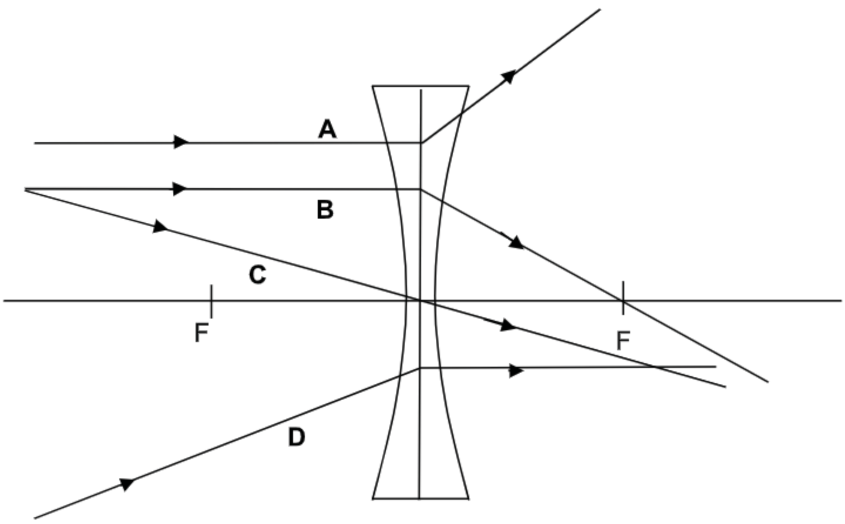
B real, inverted, magnified.

C virtual, upright, magnified.

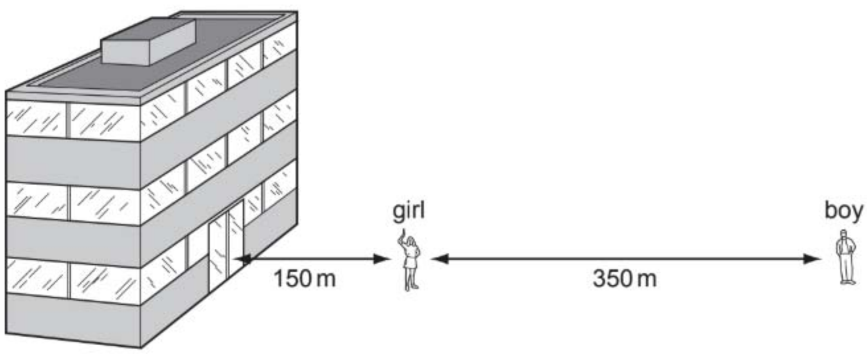
D virtual, upright, diminished.

25 Four different rays are passing through a diverging lens as shown in the figure.

Which ray does <u>not</u> represent the path after passing through the diverging lens?



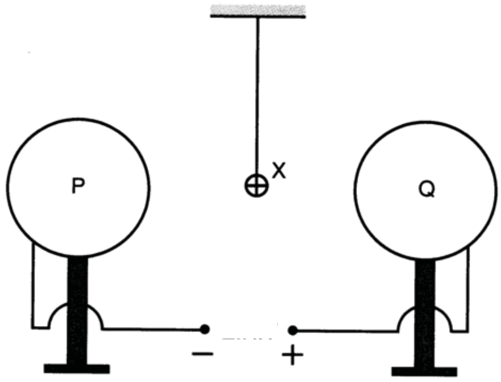
26 A girl, standing 150 m in front of a tall building, fires a shot using a starting pistol. A boy, standing 350 m from the girl, hears two bangs 1 s apart.



From this information, what is the speed of sound in air?

A 300 m/s **B** 350 m/s **C** 500 m/s **D** 650 m/s

27 The diagram shows a light spherical conductor X that is positively charged and suspended in between two insulated copper spheres, P and Q, which are connected to an power supply.



What will happen to conductor X when the switch is closed?

A move to P and stay attached to P

B move to P and then oscillate between P and Q

C move to Q and stay attached to Q

D move to Q and then oscillate between P and Q

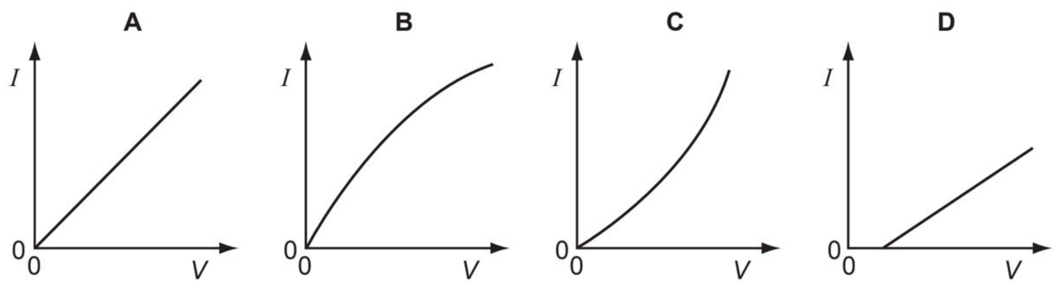
28 Two resistance wires made of the same material and of the same length are connected in parallel to the same voltage supply. Wire P has a diameter of 2 mm. Wire Q has a diameter of 1 mm.

What is the ratio of current in P to current in Q?

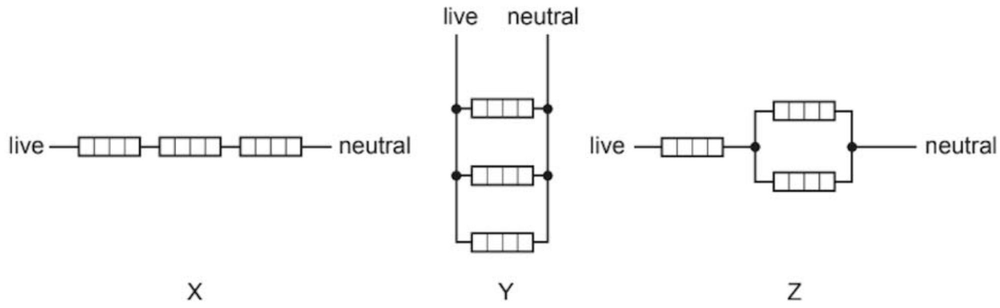
A 0.25 **B** 0.50 **C** 2.0 **D** 4.0

29 The resistance of a component in a circuit increases as the current through the component increases.

Which of the following graphs best represent the *I*-*V* characteristics of the component?



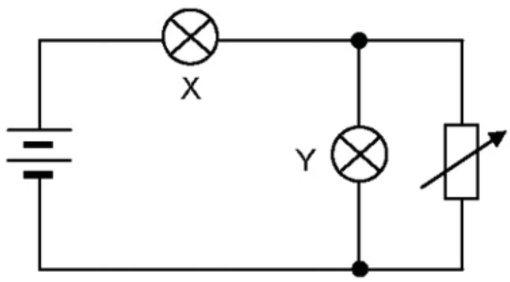
30 Three identical heating elements are wired up to the mains supply in the three arrangements shown.



In which arrangement is the current through the supply lowest and in which is the highest?

	lowest current	highest current
A	X	Z
B	X	Y
C	Y	X
D	Y	Z

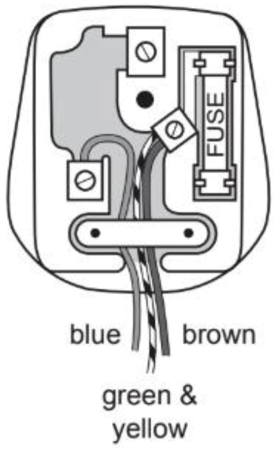
31 Two lamps, X and Y are connected to a battery and a rheostat as shown in the diagram.



What will happen to the brightness of the lamps if the resistance of the rheostat is decreased?

	X	Y
A	dimmer	dimmer
B	dimmer	brighter
C	brighter	dimmer
D	brighter	brighter

32 A plug is wrongly wired as shown. It is connected to an old vacuum cleaner, which has a metal case.



What is the effect of using the plug wired in this way?

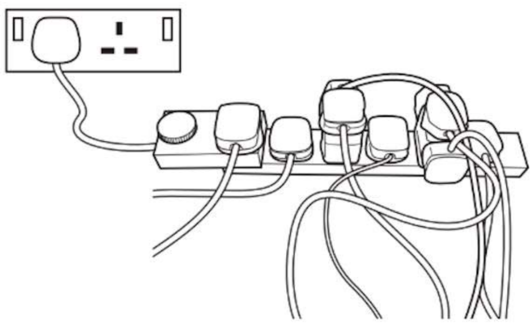
A The fuse in the plug blows.

B The metal case is live.

C The neutral wire melts.

D The vacuum cleaner catches fire.

33 The diagram shows an unsafe use of an extension cable.



What is the electrical hazard?

A the danger of burning out the appliances

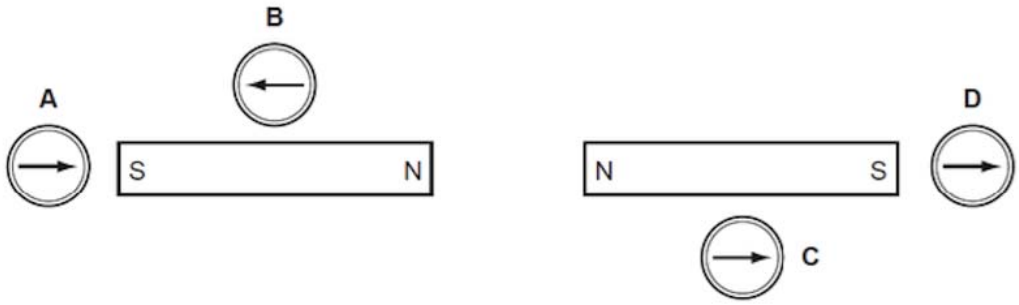
B the danger of melting the fuse

C the danger of overheating the cable

D the danger of the appliances not being earthed.

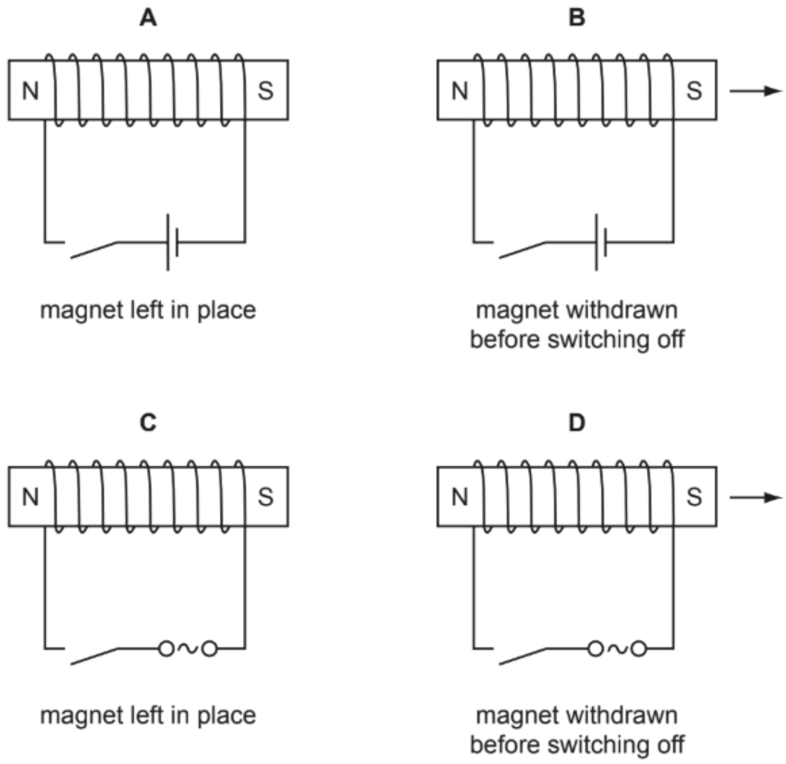
34 Four plotting compasses are placed in the magnetic field of two identical bar magnets as shown in the diagram.

Which compass is shown pointing in the wrong direction?



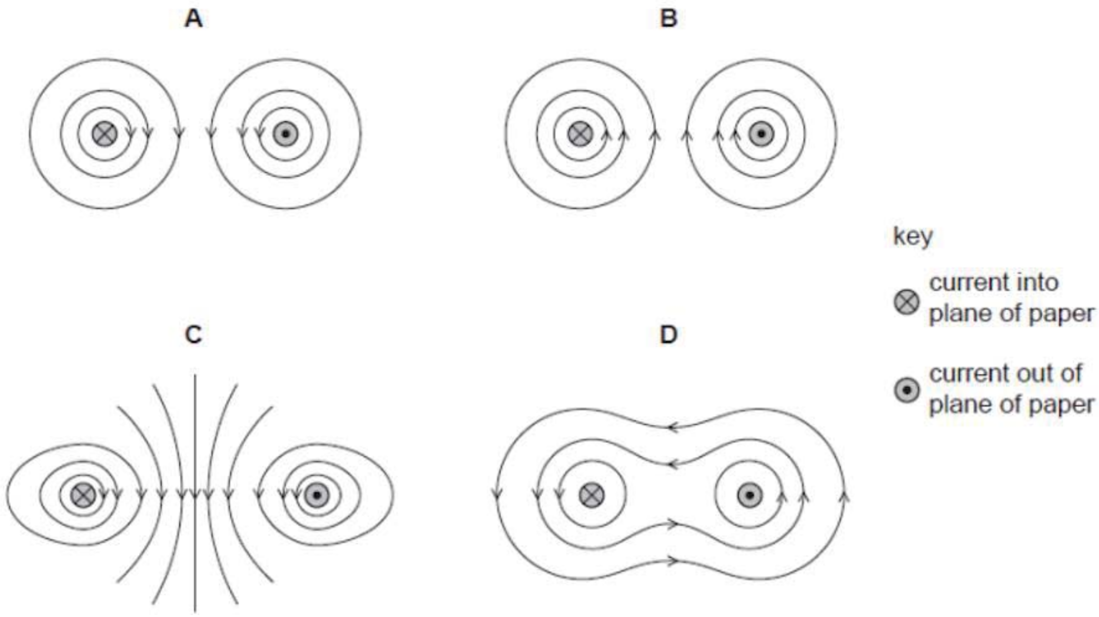
35 A permanent magnet can be demagnetised by using a solenoid and switching the current on then off.

Which diagram shows the most effective method of producing demagnetisation?

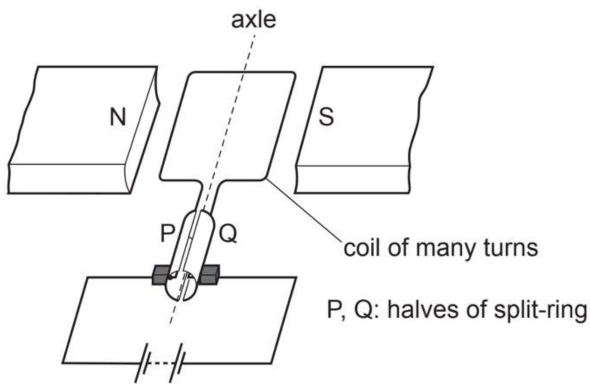


36 Two straight electrical conductors are parallel to one another. Each carries a current, one into the plane of the paper and one out of the plane of the paper.

Which diagram shows the magnetic field around the two wires?



37 A d.c. motor consists of a coil of many turns rotating in a fixed magnetic field. The coil is connected to a d.c. supply through a split-ring commutator.



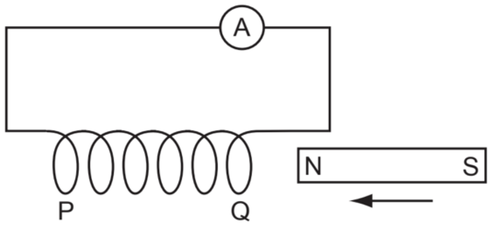
Each of these changes are made, one at a time and then compared to the above arrangement.

- The d.c. supply is reversed.
- The coil is rotated before switching on, so that P starts on the right and Q on the left.
- The poles of the magnet are reversed
- The turns on the coil are increased in number.

How many of these changes make the coil rotate in the opposite direction?

A 1 **B** 2 **C** 3 **D** 4

38 A student pushes the N-pole of a bar magnet into the end Q of a long solenoid and observes a deflection to the right on the sensitive ammeter.



What will produce a deflection in the same direction?

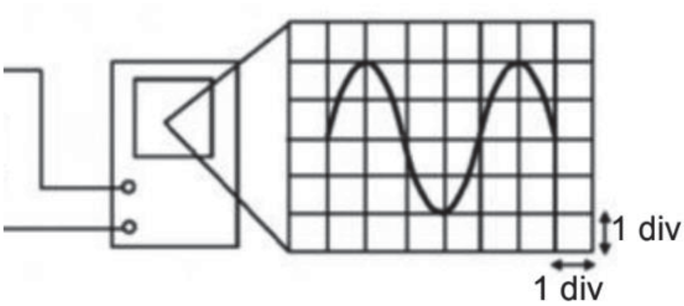
A pulling the N-pole out of end Q

B pulling the S-pole out of end P

C pushing the N-pole into end P

D pushing the S-pole into end P

39 A signal generator is connected to an oscilloscope (c.r.o) as shown the in the diagram.

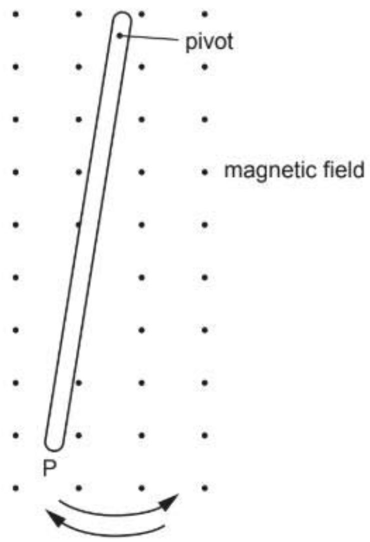


The Y-gain setting is 20 mV/div and time base setting is 5 ms/div.

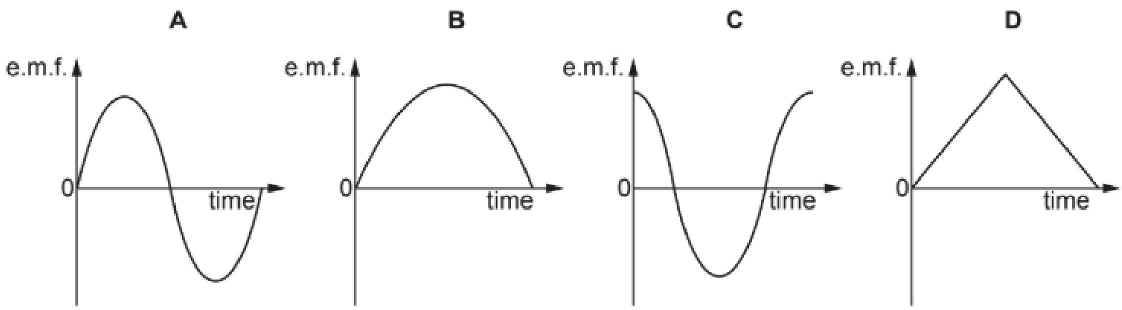
Which of the following indicates the correct amplitude and frequency of the actual signal?

	Amplitude / mV	frequency / Hz
A	40	50
B	40	100
C	400	50
D	400	100

40 The diagram shows a metal bar swinging like a pendulum across a uniform magnetic field. The motion induces an e.m.f. between the ends of the bar.



Which graph represents this e.m.f. during one complete oscillation of the bar, starting and finishing at P?



End of Paper

Section A [50 marks]

Answer **all** the questions in this section in spaces provided.

1 Fig. 1.1 shows a large tank containing water. The tank leaks and drops of water fall from the tank at A to the ground at B.

The drops hit the ground at a regular rate.

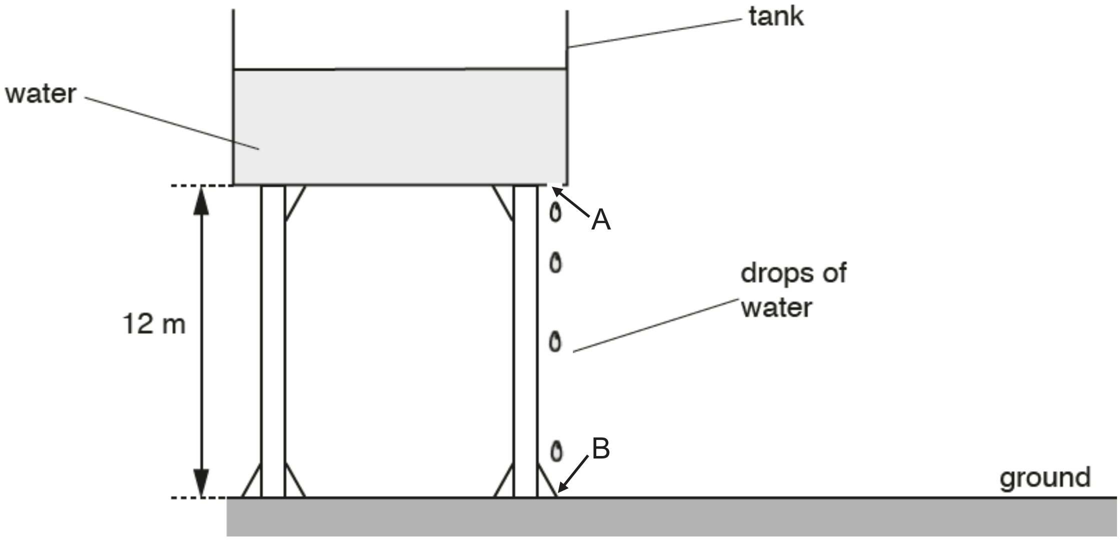


Fig. 1.1

(a) A student measures the time interval between two drops of water hitting the ground. She uses a stopwatch and repeats the procedure three times. She recorded the readings as shown.

1.24 s 1.14 s 1.16 s

(i) Calculate the average time interval between two drops of water hitting the ground.

average time = ... [1]

(ii) The average time interval calculated in **(a)(i)** is not accurate due to human reaction time error.

Describe a modification to the above procedure to obtain a more accurate value of the average time interval.

……………………………………………………………………………………..……

……………………………………………………………………………………..……

……………………………………………………………………………………..……

…………………………………………………………………..…………………… [2]

(b) The mass of one drop of water is 1.0×10^{-3} kg.

The gravitational field strength g is 10 N/kg.

(i) Calculate the change in gravitational potential energy of one drop of water as it falls from the tank at A to the ground at B.

change in gravitational potential energy = ... [2]

(ii) Determine the velocity of the drop of water just before it hits the ground at B. The effects of air resistance is negligible.

velocity = ... [2]

(iii) When the hole on the tank at A is enlarged, every drop of water falling from the tank will be of a much greater mass.

State and explain how the velocity of the drop of water will differ from that calculated in **(b)(ii).**

………………………………………………………………………………………..…..

………………………………………………………………………………………..…..

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…………………………………………………………………..…………………… [2]

2 A car accelerates from rest in a straight line. During the first 14 s, the acceleration is uniform and the car reaches a velocity of 25 m/s.

(a) **(i)** Calculate the acceleration of the car.

acceleration = ... [2]

(ii) After the first 14 s, the velocity of the car continues to increase but the acceleration decreases gradually. From 70 s to 80 s after the start, the car moves at a constant velocity of 55 m/s.

On Fig. 2.1, sketch a possible velocity-time graph for the car.

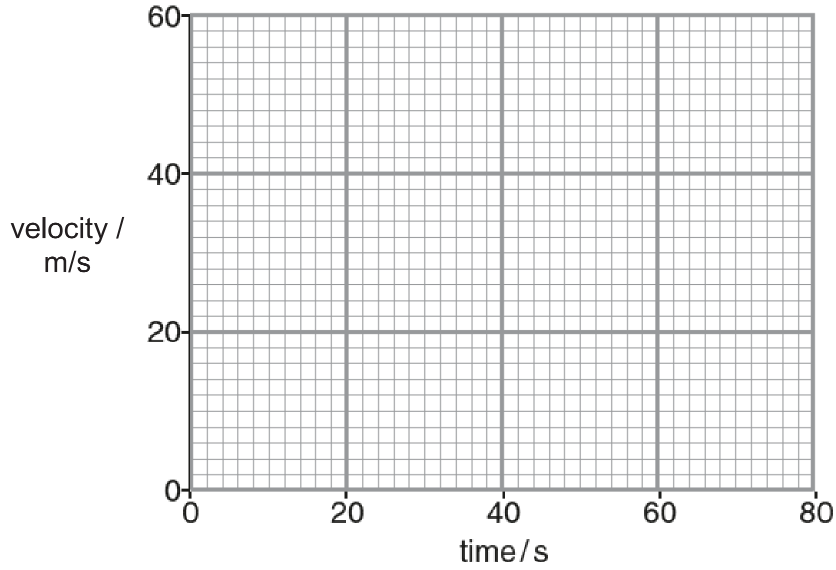


Fig. 2.1

[2]

(b) At a later time, the driver applies the brakes to stop. As he is wearing a seat belt, his body slows down in his seat. However, a bag on the seat next to him slides forwards, across the seat towards the front of the car.

Using ideas about the forces acting, explain why

(i) the driver slows down,

....

.... [1]

(ii) the bag slides forwards.

....

.... [1]

3 Fig. 3.1 shows a rocket as it takes off with an initial acceleration of 1.25 m/s^2. The total mass of the rocket and fuel is 40 000 kg. The gravitational field strength g is 10 N/kg.

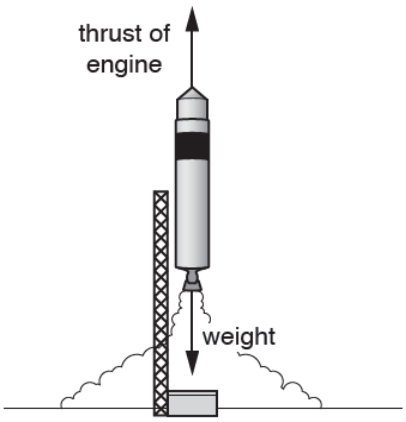


Fig. 3.1

(a) Determine the total weight of the rocket and fuel.

weight = ………………………….. [1]

(b) Calculate the magnitude of

(i) the resultant force acting on the rocket as it rises,

magnitude of resultant force = ………………………….. [2]

(ii) the upward thrust of the engine on the rocket as it rises.

magnitude of thrust = ………………………….. [2]

(c) As the rocket rises, the fuel will be used up.

Explain how this affects the acceleration of the rocket as it rises.

…………………………………………………………………………………………...

…………………………………………………………………………………………...

…………………………………………………………………………………………...

…………………………………………………………………………..………….. [2]

4 Fig. 4.1 shows a Galilean thermometer. This thermometer is used to measure the approximate temperature of the surrounding air in an air-conditioned room.

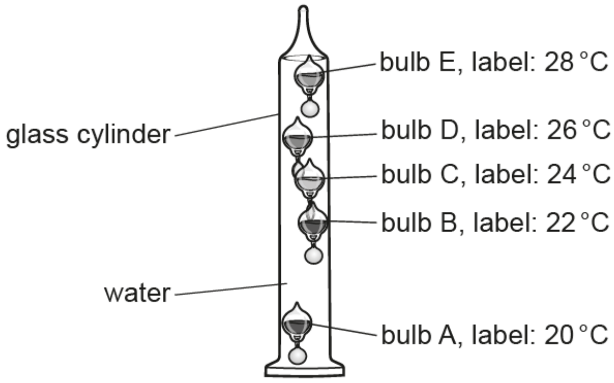


Fig. 4.1

The glass cylinder contains water. When the temperature of the water changes, so does its density.

Each bulb has a label printed with a temperature, as shown in Fig. 4.1. The bulbs have different densities. At 22 °C, only bulb A is at the bottom of the cylinder.

(a) Explain, in terms of density, why bulb A is at the bottom of the cylinder while bulb E is at the top.

……………………………………………………………………………………………...

……………………………………………………………………………..………….. [1]

(b) The temperature of the surrounding air increases to a temperature above 23°C.

(i) Suggest **one** reason why there is a delay before the temperature of the water increases to 23 °C.

……………………………………………………………………………………..…..

…………………………………………………………….……………………. [1]

(ii) Explain why, after this delay, bulb B sinks. Assume that the density of the bulbs remains the same.

……………………………………………………………………………………..…..

……………………………………………………………………………………..…..

……………………………………………………………………………………..…..

…………………………………………………………….……………………. [2]

5 **(a)** State the principle of moments.

………………………………………………………………………………………………...

………………………………………………………………………………………………...

……………………………………………………………………………..…………... [2]

(b) Fig. 5.1 shows a device for punching holes in a piece of paper. A person applies a force *F* at the end of the arm. Just before the hole is made in the paper, the arm is at rest.

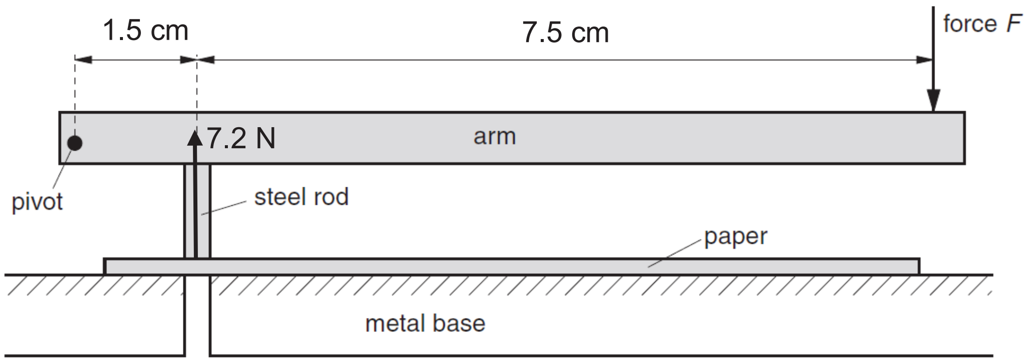


Fig. 5.1

Just before the hole is made, the upward force acting on the steel rod by the paper is 7.2 N.

Calculate

(i) the moment of the upward force acting on the steel rod by the paper about the pivot,

moment = ………………………….. [2]

(ii) the magnitude of the applied force *F*.

F = ………………………….. [2]

6 Fig. 6.1 shows part of a hydraulic jack used to lift the front of a car.

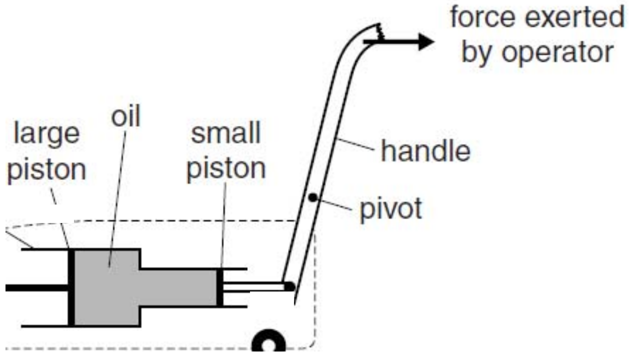


Fig. 6.1

The operator pulls the handle and causes a force of 50 N to act on the small piston. A force F is then exerted by the oil on the large piston.

The cross-sectional area of the small piston is 1.5 cm^2.
The cross-sectional area of the large piston is 5.0 cm^2.

(a) Calculate

(i) the pressure in the oil caused by the force on the small piston,

pressure = ………………………….. [2]

(ii) the magnitude of F.

F = ………………………….. [2]

(b) Explain why the large piston moves through a shorter distance than the small piston.

…………………………………………………………………………………………………...

……………………………………………………………………….………..…………….. [1]

7 Fig. 7.1 shows the relay connected in a circuit to a 12 V battery. A relay is an electrical circuit used to open and close contacts in another circuit.

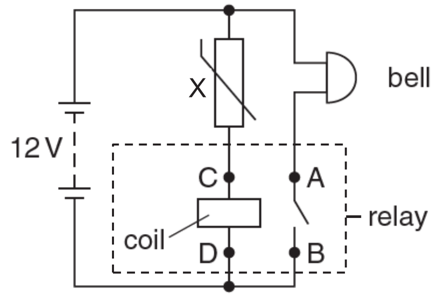


Fig. 7.1

(a) Explain why the bell rings when the temperature of X rises.

……………………………………………………………………………………………...

……………………………………………………………………………………………...

……………………………………………………………………………………………...

……………………………………………………………………………..………….. [2]

(b) At a particular temperature, the resistance of X is 2000 Ω and the current in the coil is 1.5 mA. This causes the switch AB in the relay to close. The resistance of the bell is 200 Ω.

Calculate

(i) the potential difference across X,

potential difference = ………………………….. [2]

(ii) the potential difference across the coil,

potential difference = ………………………….. [1]

(iii) the current through the battery.

current = ………………………….. [2]

8 Fig. 8.1 shows an electrical cooker hood used in some kitchens. The hood removes cooking fumes from the kitchen.

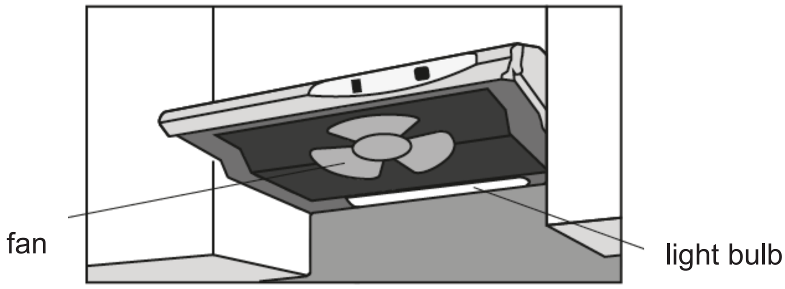


Fig. 8.1

The hood has a fan and a light bulb. Fig. 8.2 shows a simplified circuit diagram for the cooker hood.

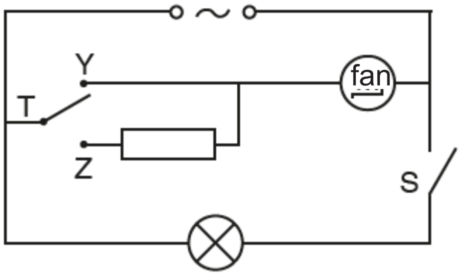


Fig. 8.2

(a) Switch S is closed. Switch T is moved to position Y.
State all the components that are switched on.

………………………………………………………………………………………….………….. [1]

(b) Switch T is moved from position Y to position Z.
Suggest how this change affects the fan.

……………………………………………………………………………………………………...

………………………………………………………………………………………….………….. [1]

(c) Electrical appliances with metal cases can become dangerous if there is a fault.
Suggest a hazard and describe a safety feature to reduce the danger due to this hazard.

hazard ..…………………………………………………………………………………………...

……………………………………………………………………………………………………...

safety feature ………………………………..…………………………………………………...

………………………………………………………………………………………….………….. [2]

9 When a magnet is placed near a small cardboard box, paper clips on the other side of the box are picked up as shown in Fig. 9.1.

When a small piece of soft iron is placed inside the box as shown in Fig. 9.2 the paper clips fall off.

Magnetic field lines in each diagram are shown as thin lines.

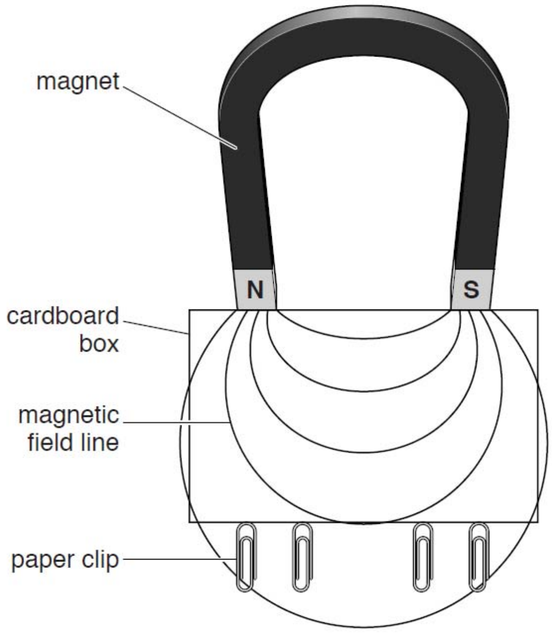


Fig. 9.1

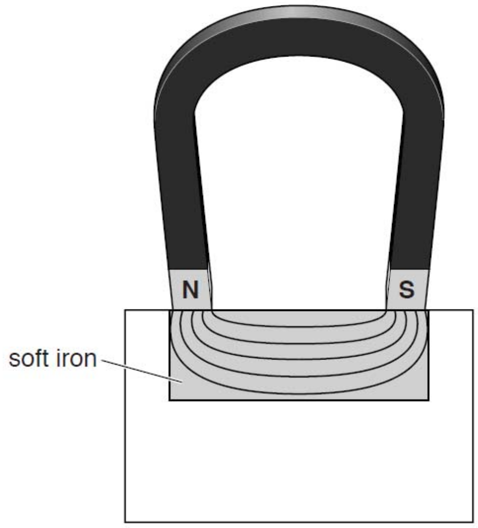


Fig. 9.2

(a) The lines in Fig. 9.1 are further apart compared to the lines in Fig.9.2.

State what this shows about the magnetic field in Fig. 9.1 compared to that in Fig. 9.2.

…………………………………………………………………………………..………….. [1]

(b) Explain why placing the soft iron inside the box causes the paper clips to fall off.

………………………………………………………………………………………………...

………………………………………………………………………………………………...

…………………………………………………………………………………..………….. [1]

Section B [30 marks]

Answer **all** the questions in this section in spaces provided.

10 An explosion is triggered on the surface of the earth to investigate a layer of rock underground.

Fig 10.1 shows the paths of how the sound waves propagate after an explosion.

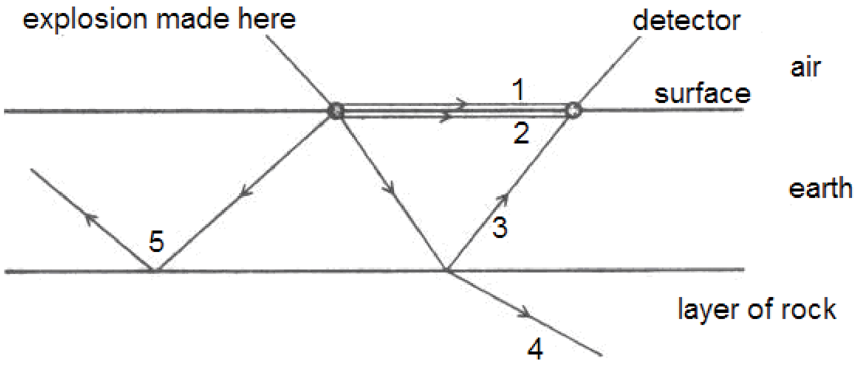


Fig. 10.1

Sound waves from the explosion travel to the detector through air (path 1) and through earth (path 2).

Some waves are transmitted through earth into the layer of rock by path 4 with part of wave being reflected at the boundary between the earth and the layer of rock as indicated by path 3.

Some waves also travelled along path 5 undergoing total internal reflection.

The time taken for the sound to reach the detector is shown in Fig. 10.2.

	path 1	**path 2**	**path 3**
Time taken (in seconds) for sound to travel from the source to the detector	0.10	0.02	0.30

Fig. 10.2

(a) Sound is a longitudinal wave.
Describe how the particles in earth move as the sound passes.

……………………………………………………………………………………………...

……………………………………………………………………………..…………... [1]

(b) Suggest a reason why sound wave takes the shortest time to reach the detector along path 2.

……………………………………………………………………………………………...

……………………………………………………………………………..…………... [1]

(c) **(i)** Given that the speed of sound in air is 330 m/s, calculate the distance between the source of sound and the detector.

distance = ………………………….. [2]

(ii) Using your answer in part **(c)(i)**, calculate the speed of sound in earth.

speed = ………………………….. [1]

(d) State and explain how the speed of sound changes when it travels from earth to the layer of rock along path 4.

………………………………………………………………………………………………...

………………………………………………………………………………..…………... [2]

(e) State two conditions that allows total internal reflection to occur along path 5.

………………………………………………………………………………………………...

………………………………………………………………………………………………...

………………………………………………………………………………………………...

………………………………………………………………………………..…………... [2]

(f) There are small bubbles of gas in the earth.

Explain why the volume of the bubbles fluctuates as the sound passes through the earth and the bubbles.

………………………………………………………………………………………………...

………………………………………………………………………………..…………... [1]

11 **(a)** Fig. 11.1 shows an open tray for storing water.

It is noticed that the level of water inside the tray slowly decreases as water evaporates.

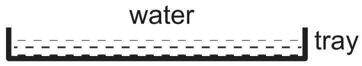


Fig. 11.1

(i) Using ideas about molecules, explain how the temperature of the water is affected when it evaporates.

....

....

....

.... [3]

(ii) Fig 11.2 shows a sheet of plastic used to cover half the surface of the water.

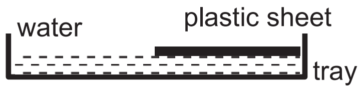


Fig. 11.2

State how this affects the rate of evaporation.

....

.... [1]

(b) Liquid air contains a mixture of oxygen and nitrogen. The boiling point of nitrogen is lower than oxygen. A sample of liquid air in a beaker is allowed to warm up slowly.

Fig. 11.2 shows how the reading of a thermometer in the beaker varies with time *t*.

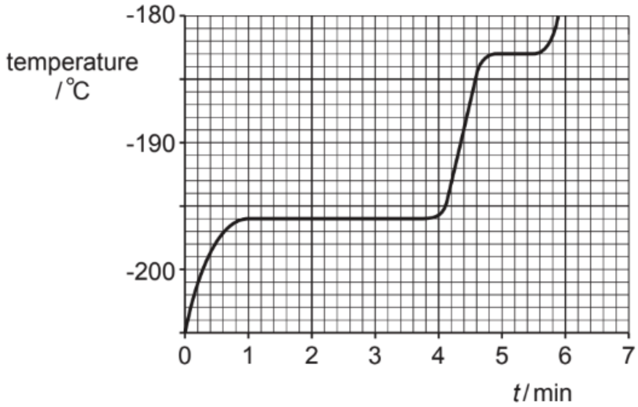


Fig. 11.2

(i) On Fig 11.2, label the boiling point of nitrogen, N on the temperature axis. [1]

(ii) The liquid air contains 200 g of liquid oxygen and 800 g of liquid nitrogen. Table 11.3 shows the table of specific heat capacity and specific latent heat of both gases.

	specific heat capacity J/(g°C)	specific latent heat of vaporisation J/g
oxygen	1.7	213
nitrogen	2.0	199

Table 11.3

Determine

(1) the thermal energy absorbed by the combined liquid air to reach the temperature at the 1 min mark.

thermal energy = ……………………..[2]

(2) the total thermal energy absorbed by the combined liquid air to reach the 4 min mark.

thermal energy = …………………...[3]

EITHER

12 Fig. 12.1 shows an electrical "wind-up" torchlight that operates through cranking a mechanical handle. The crank is turned in one direction and energy is stored in the spring internally. The torchlight then uses the energy stored in the wound-up spring to light the light bulb.

Fig 12.2 shows the simplified diagram of the mechanism within the torchlight. The spring is unwinding and N pole is moving away from the solenoid.

Fig. 12.1

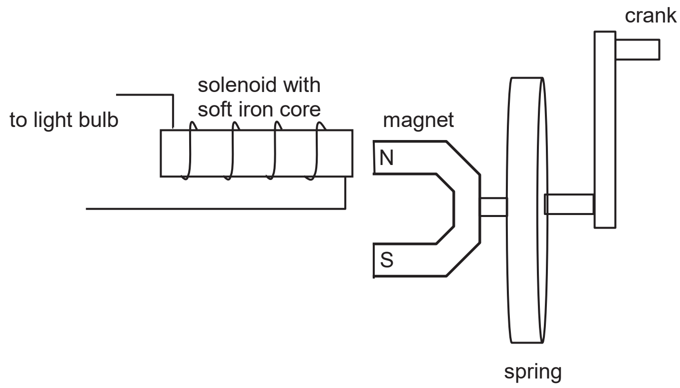


Fig. 12.2

(a) **(i)** On Fig 12.2, draw the current induced on the solenoid. [1]

(ii) Explain how the direction of the induced current in **(a)(i)** is determined.

....

.... [1]

(b) As the spring is unwound, the magnet rotates together with the spring.

(i) Explain why electromotive force is induced in the solenoid.

....

....

.... [2]

(ii) Describe the various stages of how energy is converted when the spring is unwound to the light bulb.

....

....

.... [1]

(iii) Explain why the induced current is an alternating current (A.C.).

....

....

.... [1]

(c) When the spring is tightly wound, the electrical signal from the wires is applied to the input terminals of an oscilloscope. Fig 12.3 shows the trace obtained on the screen of an oscilloscope of e.m.f. vs time.

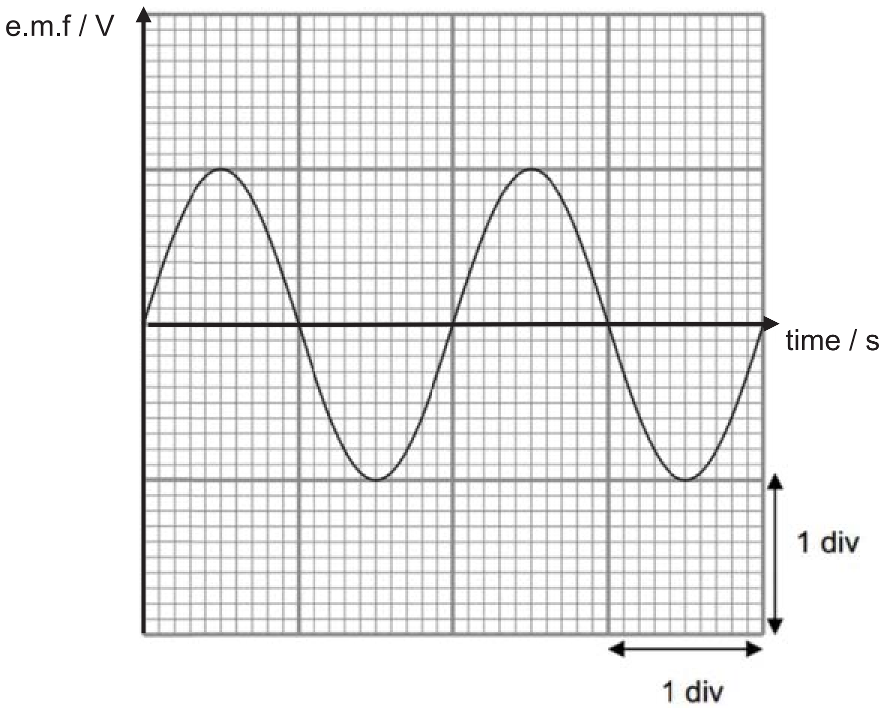


Fig 12.3

(i) The position between the magnet and the solenoid affects the strength of the e.m.f. induced in the coil.

On Fig. 12.3, indicate the position of the magnet poles by labelling N and S to the corresponding trace on the oscilloscope.

[2]

(ii) After a period of time, the rotation of the unwinding spring slows down to half.

On Fig. 12.3, sketch the new electrical signal trace produced by the spring.

[2]

OR

12 **(a)** Fig 12.1 shows a simple transformer.

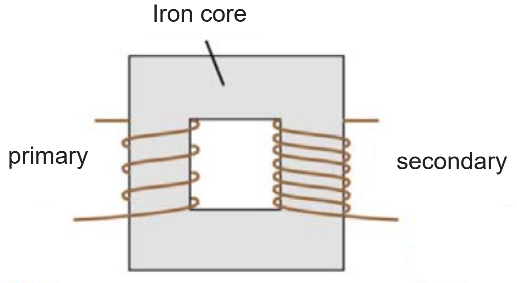


Fig. 12.1

(i) Explain how an alternating e.m.f. in the primary coil induces an e.m.f. in the secondary coil.

....

....

....

.... [2]

(ii) State and explain one method to improve the efficiency of the transformer.

....

....

.... [2]

(b) Fig. 12.2 shows a consumer connected to a main electrical supply some distance away. The electrical supplier generates electrical supply at 25 kV and transmits it to the consumer that uses 20 kV. Transformer X steps up the output voltage to 275 kV.

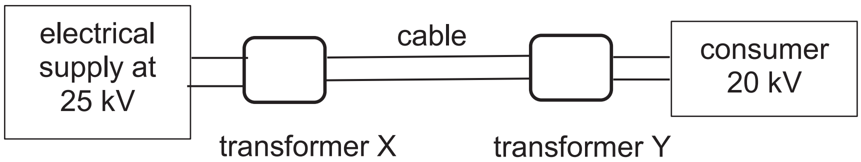


Fig. 12.2

(i) Explain why voltage is stepped up from the electrical supply and transmitted at high voltage.

....

....

....[1]

(ii) Determine the turns ratio for transformer X.

turns ratio = …………………[2]

(iii) 10 MW of power is transmitted through the cable of resistance 1 Ω/km at 275 kV.

Determine the power loss per kilometre as internal energy in the cable.

power loss per km = …………………[3]

End of Paper

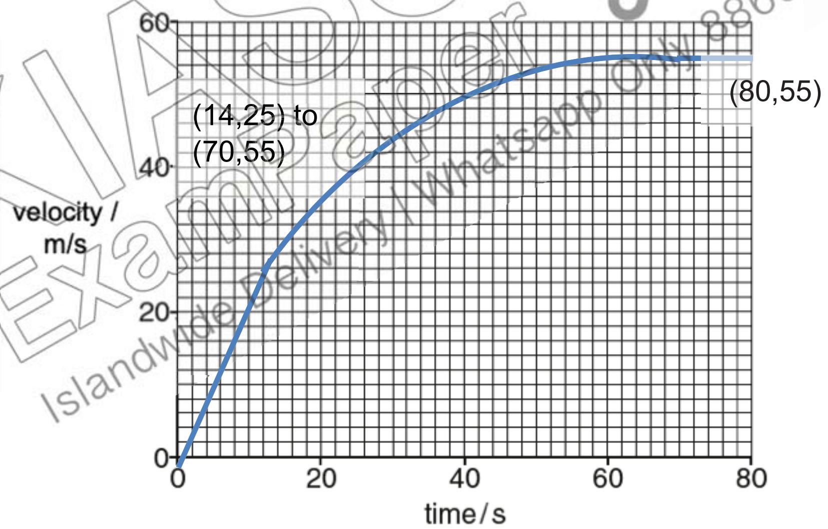
Answers:

1	2	3	4	5	6	7	8	9	10
C	D	B	B	A	C	D	A	D	C
11	12	13	14	15	16	17	18	19	20
D	B	C	B	B	B	C	B	A	B
21	22	23	24	25	26	27	28	29	30
B	D	C	C	B	A	B	D	B	B
31	32	33	34	35	36	37	38	39	40
C	B	C	D	D	C	B	D	A	A

Methodist Girls' School
Physics Sec 4 Preliminary Examination 2019
Marking Scheme

Section A

1(a)(i)	(1.24 + 1.14 + 1.16) ÷ 3 = **1.18 s**	A1
1(a)(ii)	- find time interval between 21 (appropriate no.) drops of water hitting the ground, t	B1
	- find the average timing for the time interval between two drops using T_1 = t/20 = t / (no.of drops - 1)	B1
1(b)(i)	GPE = mgh = 0.001 x 10 x 12	C1
	= **0.12 J**	A1
1(b)(ii)	KE = GPE	
	½ mv^2 = 0.12	
	½ (0.001) v^2 = 0.12	C1
	v = **15.5 m/s** OR **15 m/s** e.c.f.	A1
1(b)(iii)	Velocity will **remain unchanged.**	B1
	As ½ mv^2 = mgh, m will be cancelled in this equation. As, height and g remain unchanged, v calculated will be the same.	B1
	OR Acceleration due to free fall is constant, therefore, all masses falls with the same velocity.	
2(a)(i)	a = v–u / t = 25 / 14	C1
	= **1.79 m/s²** OR **1.8 m/s²**	A1
2(a)(ii)	B1 – shape from 14 to 80 s	
	B1 – correct coordinates	



2(b)(i)	force backwards on driver / car	B1
	OR force produced by seat belt	
2(b)(ii)	mass of bag resists change from state of motion	B1
	OR bag has inertia	
3(a)	weight = mg = 40 000 x 10 = **400 000 N**	A1
3(b)(i)	F = ma = 40 000 x 1.25	C1
	= **50 000 N**	A1
3(b)(ii)	resultant F = Thrust – weight	
	50 000 = Thrust – 400 000	C1
	Thrust = **450 000 N** e.c.f.	A1
3(c)	As the fuel is used up, the **total mass (weight) of the rocket and fuel decreases**,	

thrust remains the same, resulting in an **increase in resultant force**. B1
Hence, **resultant force and acceleration will increase**. B1

4(a) Density of bulb A greater than the density of the water (and sinks)
AND Density of bulb E less than the density of water (and float) B1

4(b)(i) Water / Glass is a poor conductor of heat
OR water / glass conducts heat at a slow rate
OR water / glass has a high (specific) heat capacity B1

4(b)(ii) The **water expands and becomes less dense** when temp increase. B1
Bulb B now has a greater density than the water (and sinks)
OR Weight of bulb B more than buoyancy forces / upthrust B1

5(a) The principle of moment states that **for an object in equilibrium**, B1
the **sum of clockwise moments about a point** is equal to
the **sum of anti-clockwise moments about the same point**. B1

5(b)(i) Moment = 7.2 x 1.5 C1
= **10.8 Ncm (0.108 Nm)** A1
5(b)(ii) F = 10.8 / 9.0 e.c.f. C1
= **1.2 N** A1

6(a)(i) Pressure = Force / Area
= 50 / 1.5 C1
= **33.3 N/cm^2** OR **3.33 x 10^5 N/m^2 (Pa)** OR **333 kPa** A1
6(a)(ii) F = Pressure x area
= 33.3 x 5.0 e.c.f. C1
= **167 N** OR **170 N** A1
6(b) the displaced volume of oil remains the same, as the larger piston with larger cross-sectional area results in a smaller d B1
OR Work done = Fd and when work done is constant, distance is small when force is large

7(a) resistance (of X) decreases B1
current (in coil) increases or more voltage across coil and either relay switch closes or circuit (to bell) complete B1

7(b)(i) V = $1.5 \times 10^{-3} \times 2000$ C1
= **3.0 V** A1
7(b)(ii) 12 – 3 = **9.0 V** e.c.f. B1
7(b)(iii) I flowing through bell = 12 / 200 = 0.06 A or 60 mA C1
I in battery = 1.5 + 60 mA or 0.0015 +0.06 A
= **61.5 mA or 62 mA**
= **0.0615 A or 0.062 A** A1

8(a) motor / fan AND lamp B1
8(b) motor / fan speed decreases / slows down B1
8(c) hazard: live wire touching case **AND**
user gets electric shock / burns
OR electrical fire due overheating / wire gets hot B1
safety feature: case is earthed OR connect earth wire to the metal case B1

9(a) lines that are further apart shows **weaker** magnetic field strength
OR lines that are closer shows **stronger** magnetic field strength B1

9(b) magnetic field goes through soft iron OR no field through paper clips
paper clips lose their (induced) magnetism / cannot be magnetised B1

Section B

10(a)	vibrate / oscillate in the same direction or parallel to transfer of energy or wave		B1
10(b)	sound travels faster in solid (earth) compared to air		B1
10(c)(i)	Distance	= 330 x 0.10	C1
		= **33 m**	A1
10(c)(ii)	Speed	= 33/0.02	
		=**1650 m/s**	A1

10(d) As the sound wave <u>bends away from the normal</u> as it travels from earth to rock, B1
its speed in rock is **faster** than earth. B1

10(e) Wave must travel from a region of lower speed to a region of higher speed. B1
Angle of incidence is larger than critical angle from a region of lower speed to a region of higher speed. B1

10(f) pressure increases and decreases B1

11 **(a)** Fig. 11.1 shows an open tray for storing water.

It is noticed that the level of water inside the tray slowly decreases as water evaporates.

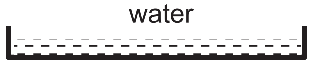


Fig. 11.1

(i) Using ideas about molecules, explain how the temperature of the water is affected when it evaporates.

11	**a**	**i**	Faster moving molecules escape from the attraction of their neighbours and leave <u>surface</u> of the liq. Leaving behind slower moving molecules Avg KE dec and temp dec	**B1** **B1** **B1**

....

....

....

.... [3]

(ii) Fig 11.2 shows a sheet of plastic used to cover half the surface of the water.

Fig. 11.2

State how this affects the rate of evaporation.

....

.... [1]

		ii	Rate of evaporation dec	**B1**

(b) Liquid air contains a mixture of oxygen and nitrogen. The boiling point of nitrogen is lower than oxygen. A sample of liquid air in a beaker is allowed to warm up slowly.

Fig. 11.2 shows how the reading of a thermometer in the beaker varies with time *t*.

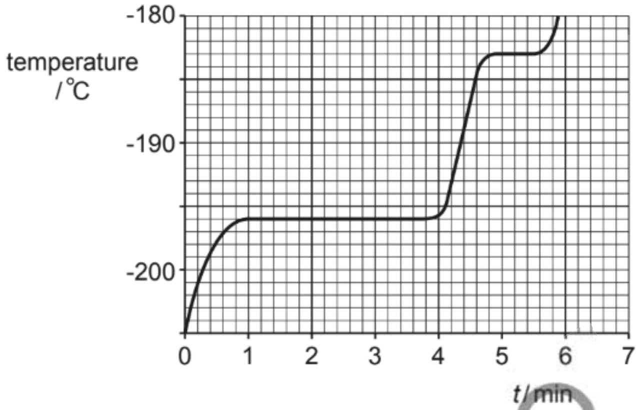
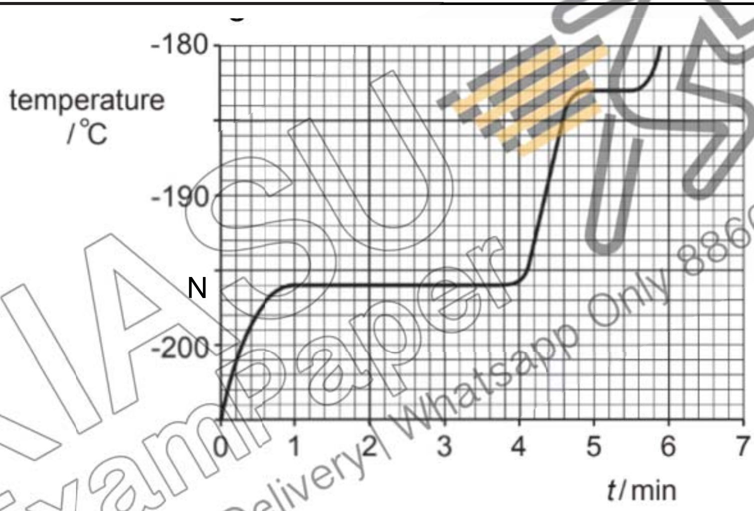


Fig. 11.2

	b	i		B1

(i) On Fig 11.2, label the boiling point of nitrogen, N on the temperature axis. [1]

(ii) The liquid air contains 200 g of liquid oxygen and 800 g of liquid nitrogen. Table 11.3 shows the table of specific heat capacity and specific latent heat of both gases.

	specific heat capacity J/(g°C)	specific latent heat of vaporisation J/g
oxygen	1.7	213
nitrogen	2.0	199

Table 11.3

Determine

(1) the thermal energy absorbed by the combined liquid air to reach the temperature at the 1 min mark.

thermal energy = …………………….[2]

(2) the total thermal energy absorbed by the combined liquid air to reach the 4 min mark.

thermal energy = …………………...[3]

		ii	(1)Q=mc x theta =200 x 1.7 x 9 + 800 x 2 x 9 =17.5 x 10^3 J (2) Q=ml = 800 x 199 = 159 x 10^3 J Total Q = 159 + 17.5 = 177 x 10^3 J (ecf)	 **C1** **A1** **B1** **A1** **A1**

EITHER

12 Fig. 12.1 shows an electrical "wind-up" torchlight that operates through cranking a mechanical handle. The crank is turned in one direction and energy is stored in the spring internally. The torchlight then uses the energy stored in the wound-up spring to light the light bulb.

Fig 12.2 shows the simplified diagram of the mechanism within the torchlight. The spring is unwinding and N pole is moving away from the solenoid.

Fig. 12.1

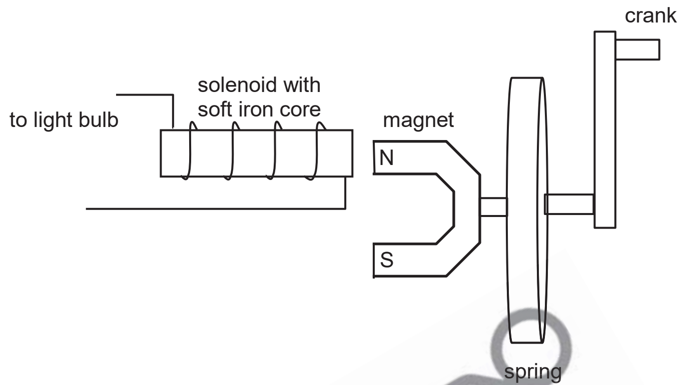
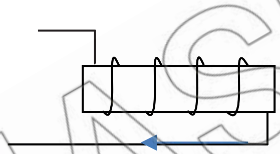


Fig. 12.2

(a) **(i)** On Fig 12.2, draw the current induced on the solenoid.

[1]

	a	i		B1

(ii) Explain how the direction of the induced current in **(a)(i)** is determined.

....

....[1]

		ii	Induced current is in direction to oppose the change causing it. OR S polarity induced in coil facing N pole of magnet to attract it.	B1

(b) As the spring is unwound, the magnet rotates together with the spring.

(i) Explain why electromotive force is induced in the solenoid.

....

....

....[2]

	b	i	When magnet rotates, there is a changing magnetic field. This induces an emf when magnetic field lines are "cut" by coil/magnetic flux linkage	B1 B1

(ii) Describe the various stages of how energy is converted when the spring is unwound to the light bulb.

....

....

....[1]

		ii	KE of unwinding spring to electrical energy to light energy (bulb)	B1

(iii) Explain why the induced current is an alternating current (A.C.).

....

....

....[1]

		iii	Everytime the magnet rotates 180 deg, the current induced reverses its direction to the light bulb OR magnet moves away then moves towards coil, the current reverses its direction	B1

(c) When the spring is tightly wound, the electrical signal from the wires is applied to the input terminals of an oscilloscope. Fig 12.3 shows the trace obtained on the screen of an oscilloscope of e.m.f. vs time.

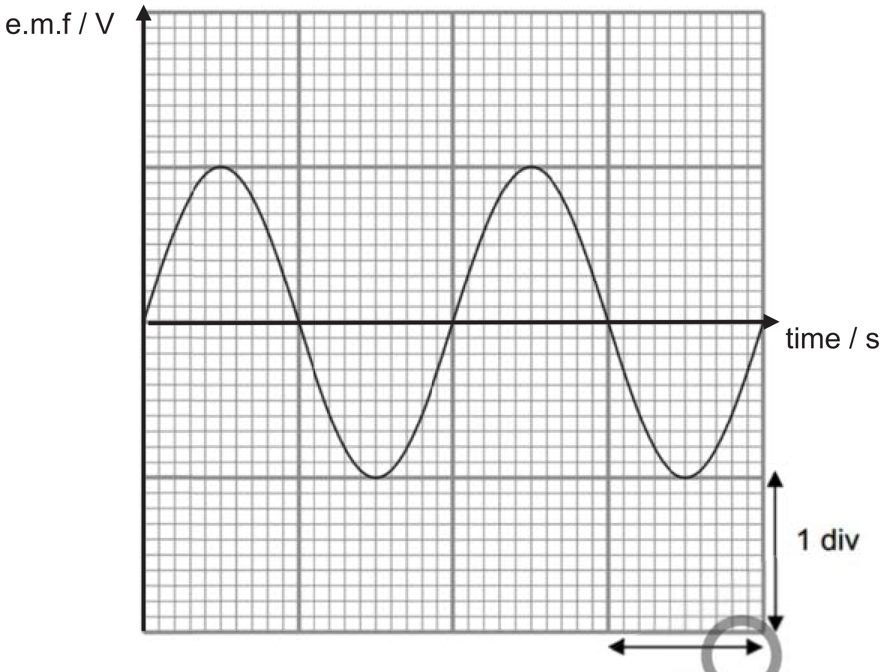


Fig 12.3

(i) The position between the magnet and the solenoid affects the strength of the e.m.f. induced in the coil.

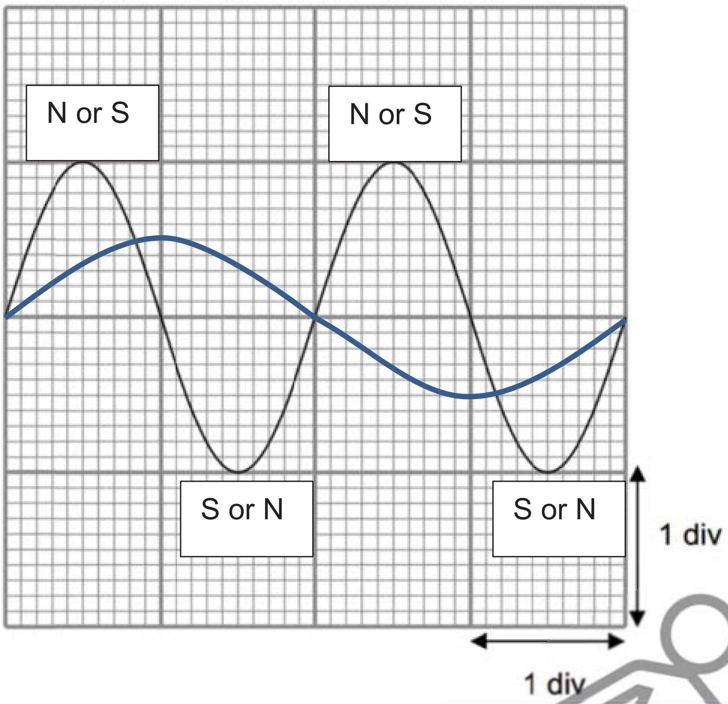
On Fig. 12.3, indicate the position of the magnet poles by labelling N and S to the corresponding trace on the oscilloscope.

[2]

(ii) After a period of time, the rotation of the unwinding spring slows down to half.

On Fig. 12.3, sketch the new electrical signal trace produced by the spring.

[2]

	b	I & ii	 B1 correct location of N B1 correct location of S B1 correct amplitude of graph B1 correct freq/shape of graph	

OR

12 (a) Fig 12.1 shows a simple transformer.

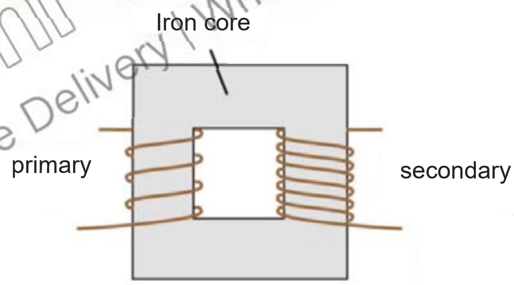


Fig. 12.1

(i) Explain how an alternating e.m.f. in the primary coil induces an e.m.f. in the secondary coil.

....

....

....

....

....

....[2]

	a	i	AC in pri coil produces a changing magnetic field in the soft iron core magnetic field line "cut" at sec coil induces a changing emf in sec coil	 **B1** **B1**

(ii) State and explain one method to improve the efficiency of the transformer.

....

....

....[2]

		ii	Laminated core - reduce eddy currents, reduce thermal energy loss OR Methods described in textbook and substantiated with correct effects.	**B1** **B1**

(b) Fig. 12.2 shows a consumer connected to a main electrical supply some distance away. The electrical supplier generates electrical supply at 25 kV and transmits it to the consumer that uses 20 kV. Transformer X steps up the output voltage to 275 kV.

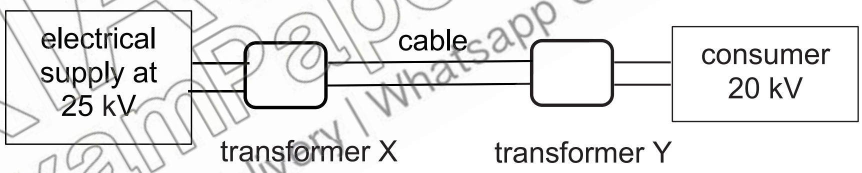


Fig. 12.2

(i) Explain why voltage is stepped up from the electrical supply and transmitted at high voltage.

....

....

....[1]

	b	i	To reduce power loss as thermal energy	**B1**

(ii) Determine the turns ratio for transformer X.

turns ratio = …………………[2]

		ii	Ns/Np = Vs/Vp =275k/25k =11	 **B1** **A1**

(iii) 10 MW of power is transmitted through the cable of resistance 1 Ω/km at 275 kV.

Determine the power loss per kilometre as internal energy in the cable.

power loss per km = …………………[3]

		iii	P loss = I^2R = (P/V)^2 x R = (10 x 10^6/275x10^3)^2 x 1 = 1320 W/km	 **B1** **B1** **A1**

End of Paper

NORTH VISTA SECONDARY SCHOOL

PRELIMINARY EXAMINATION 2019

40

NAME: ________________________________( ) **CLASS:** _________

SUBJECT: PHYSICS **DATE: 18 SEP 2019**

LEVEL / STREAM: SECONDARY 4 EXPRESS **TIME: 1 HR**

CODE : 6091/1

INSTRUCTIONS TO CANDIDATES

Write in soft pencil.
Do not use staples, paper clips, highlighters, glue or correction fluid.
Write your full name, index number and class on the Answer Sheet in the spaces provided.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.
Choose the one you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
The use of an approved scientific calculator is expected, where appropriate.

This question paper consists of 15 printed pages.

[Turn over

1 What is the correct order of magnitude for the diameter of Earth and diameter of a strand of human hair?

	diameter of Earth	diameter of human hair
A	10Gm	0.1mm
B	10Gm	0.1nm
C	10Mm	0.1mm
D	10Mm	0.1nm

2 Which is **not** a unit of a base quantity?

A ampere
B Kelvin
C kilogram
D Pascal

3 A vernier calipers is used to measure the diameter of a glass ball.

With the jaws closed and no glass ball, the vernier calipers reading is shown in Fig. 2.1.

With the jaws closed around the glass ball, the vernier calipers reading is shown in Fig. 2.2.

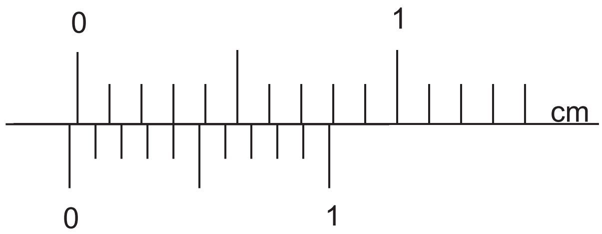


Fig. 2.1

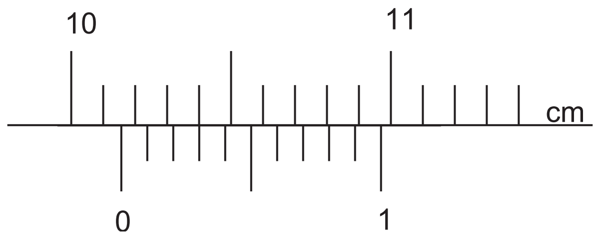
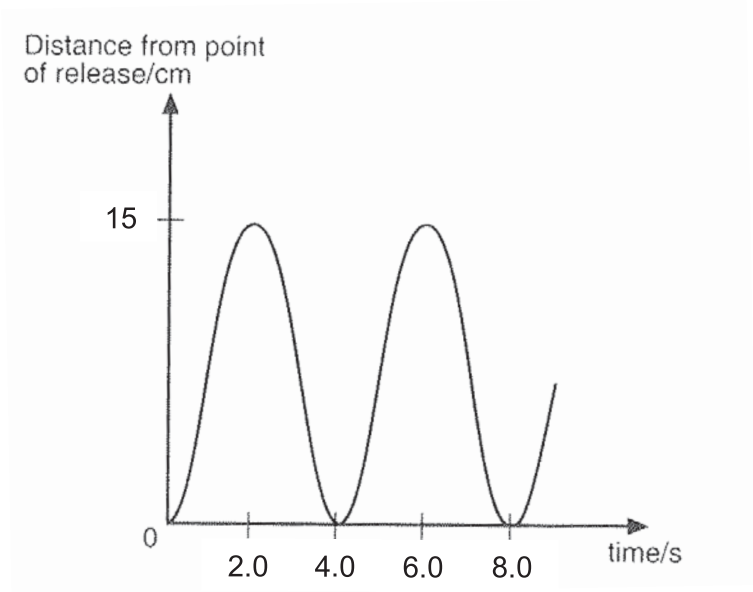


Fig. 2.2

What is the diameter of the glass ball?

A 10.07cm **B** 10.17cm **C** 10.19cm **D** 11.36cm

4 The bob of a simple pendulum is pulled to one side and released. The motion during its swing is shown on the graph.



What is the period of the pendulum?

A 2.0s **B** 4.0s **C** 6.0s **D** 8.0s

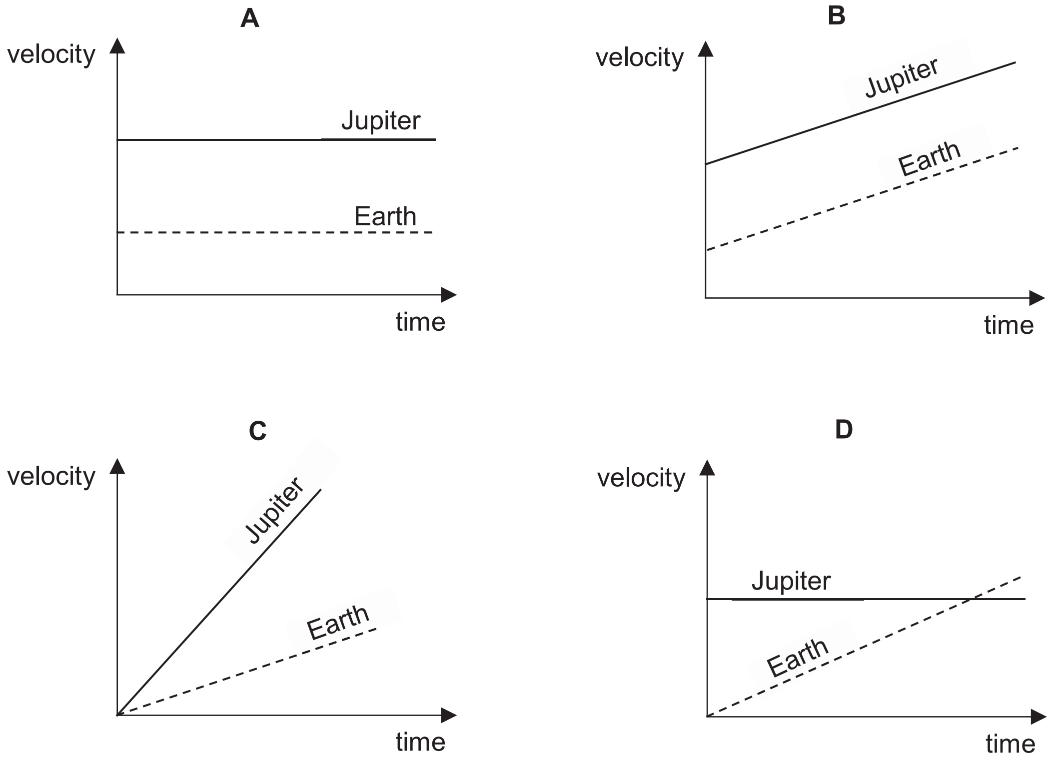
5 A ball is falling at terminal velocity.

Which row best describes the acceleration of the ball and the velocity of the ball?

	acceleration of ball	velocity of ball
A	downwards	constant
B	downwards	zero
C	zero	constant
D	zero	zero

6 A rock was dropped on Earth and it accelerates at about $10 m/s^2$. When the rock is dropped on Jupiter, it accelerates at about $24.5 m/s^2$.

Which graphs are the corresponding graphs of velocity against time for the rock?



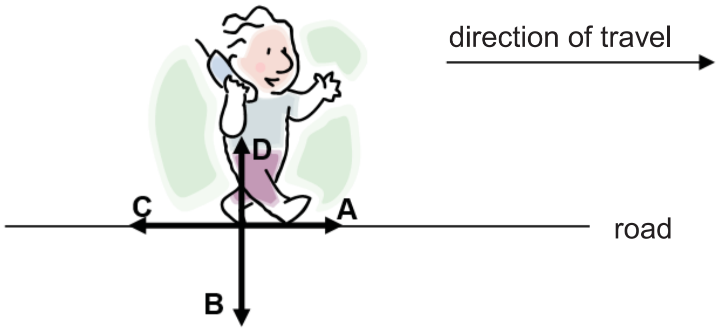
7 A ball is released from the bottom of a pond. After a short time, it rises at a constant speed.

Which statement best describes the resultant force then acting on the ball?

A Upwards and equal to the ball's weight
B Upwards and greater than the ball's weight
C Upwards and less than the ball's weight
D Zero

8 The diagram below shows a man walking along a road in the direction shown.

In which direction is the force of friction exerted by the road on the foot of the man?



9 What **must** change when a body is accelerating?

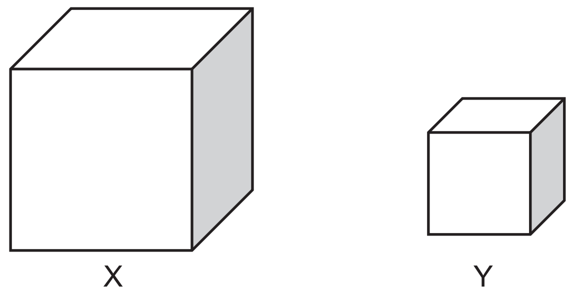
A the mass of the body
B the resultant force of the body
C the speed of the body
D the velocity of the body

10 The diagram shows a container filled with a liquid. There is a bubble in the liquid. The container is moved forward with a constant velocity as shown.

What will be the motion of the air bubble if the container suddenly decelerates?

A Air bubble will move in the backward direction.
B Air bubble will move in the forward direction.
C Air bubble will remain at the original position.
D Motion of air bubble cannot be determined as the total mass of the liquid is unknown.

11 Two cubes X and Y are made of iron.



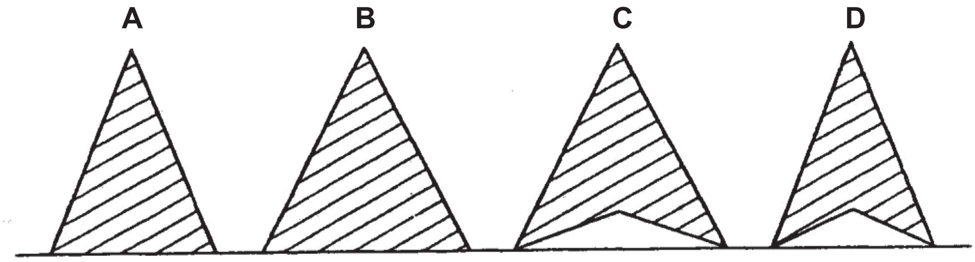
Cube X has sides that are twice as long as cube Y.

Which statement is correct?

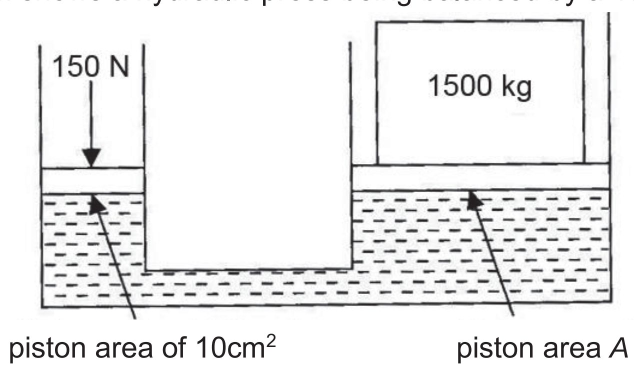
A The density of cube X is eight times that of cube Y.
B The density of cube X is four times that of cube Y.
C The density of cube X is two times that of cube Y.
D The density of cube X is equal to that of cube Y.

12 The diagrams show the cross-section of four solid objects.

Which object is the least stable?



13 The diagram shows a hydraulic press being balanced by a 150N force and a 1500kg mass.

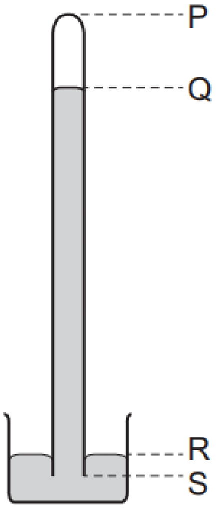


The area of the smaller piston is $10cm^2$ and the area of the larger piston is *A*.

What is the value of *A*?

A $1.0cm^2$ **B** $10cm^2$ **C** $100cm^2$ **D** $1000cm^2$

14 A long tube, full of mercury, is inverted in a small dish of mercury.



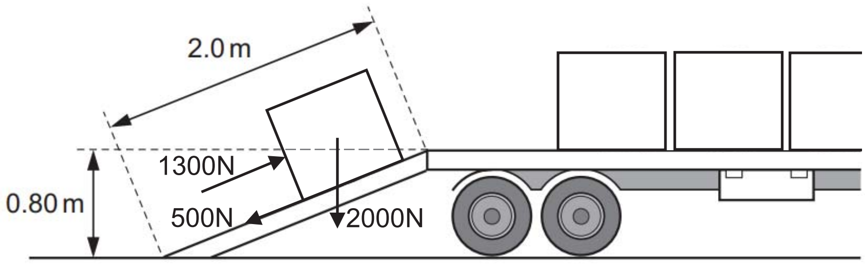
The mercury level in the tube falls, leaving a vacuum at the top.

When the atmospheric pressure decreases, which length increases?

A QR **B** PQ **C** PR **D** PS

15 A workman exerts a force of 1300N to move a box of weight 2000N up a plank and onto a lorry. The plank is 2.0m long and the back of the lorry is 0.80m above the horizontal surface of the road.

The box also experiences a friction force of 500N.



What is the useful work done on the box?

A 1600J **B** 2600J **C** 3000J **D** 4000J

16 A rocket of total mass *M* is travelling at a speed *v*. The engine of the rocket is fired and fuel is used up. The mass of the rocket decreases to ½*M* and its speed increases to 2*v*.

What happens to the kinetic energy of the rocket?

A It doubles.
B It halves.
C It increases by a factor of 4.
D It remains the same.

17 Smoke particles are introduced into a glass container.

When they are viewed under a microscope, the smoke particles are seen to be moving in a continuous and random motion.

Which row explains the motion of the smoke particles?

A collisions by air particles
B collisions with other smoke particles
C collisions against the walls of the glass container by the smoke particles
D motion due to high internal kinetic energy of the smoke particles

18 Hot water rises and cold water sinks due to changes in density.

Which statement explains the change in density?

A The water particles contract when heated.
B The water particles expand when heated.
C The water particles move further apart from each other when heated.
D The water particles have a smaller mass when heated.

19 The pressure of a gas in a container is the same at all points in the container.

Which statement explains this?

A The gas particles have the same size.
B The gas particles make the same number of collisions with the internal walls of the container per unit time.
C The gas particles move at the same speed.
D The gas particles are all moving in a continuous and random motion.

20 Oxygen can be supplied to a fish tank by bubbling air into the water.

What row describes the changes in the pressure and volume of the air bubbles when they rise to the surface of the water?

	volume	pressure
A	increases	increases
B	increases	decreases
C	decreases	increases
D	decreases	decreases

21 A pot is used to boil water.

How is thermal energy transferred from the base of a pot to the water?

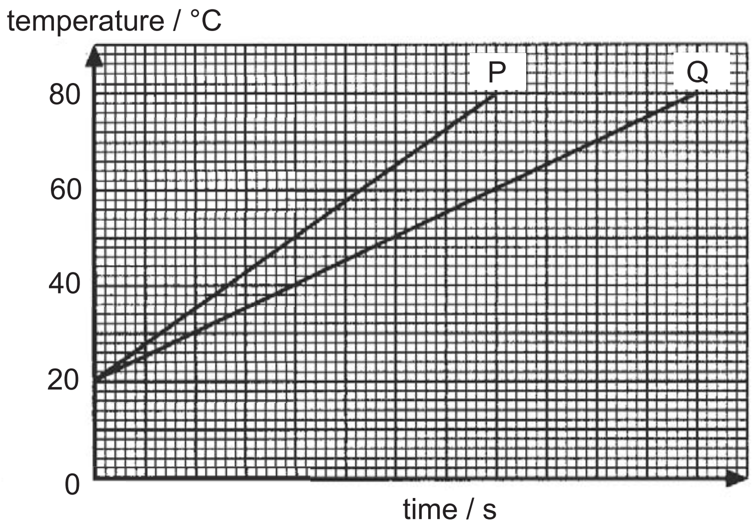
A by conduction only
B by convection only
C by conduction and convection only
D by convection and radiation only

22 A piece of wire has a resistance of 0.50Ω in melting ice and 2.50Ω in steam above boiling water.

What is the resistance of the wire at 40°C assuming that the resistance changes uniformly with temperature?

A 0.40Ω **B** 0.80Ω **C** 1.30Ω **D** 1.50Ω

23 Two well-insulated copper blocks P and Q are heated at the same power. The diagram shows the variation of temperature with time of the two blocks.



What is the ratio of the specific heat capacity of P to Q?

A 0.67 **B** 1.00 **C** 1.33 **D** 1.50

24 An ice pack is used to cool 0.20kg of water from 25°C to 0°C. The specific heat capacity of water is 4.20kJ/kg°C and the specific latent heat of fusion of ice is 334kJ/kg.

How much energy is removed from the water?

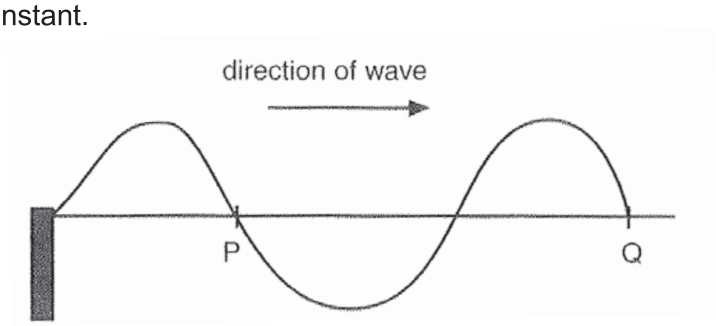
A 21kJ **B** 66.8kJ **C** 87.8kJ **D** 1670J

25 Water waves are travelling from deep region to shallow region.

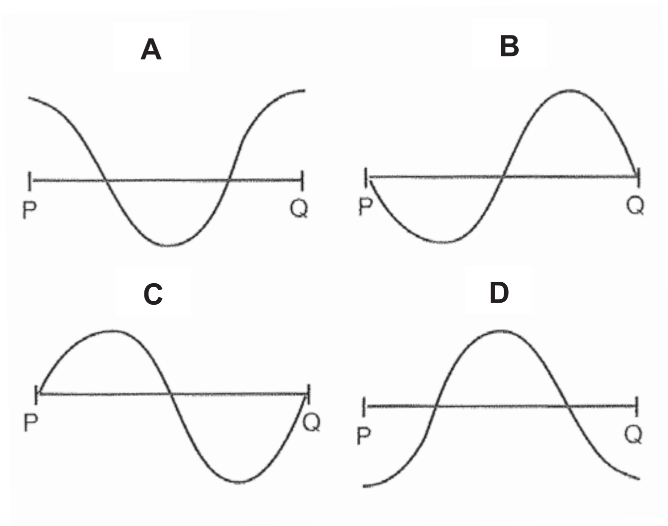
Which statement is true?

A The frequency in shallow region is lower.
B The speed of the waves in both regions is the same.
C The speed of the waves in shallow region is higher.
D The wavelength in shallow region is shorter.

26 A vibrator generates a travelling wave on a string. The diagram shows the shape of the string at a certain instant.



Which diagram shows the shape of the string between P and Q after half a period?

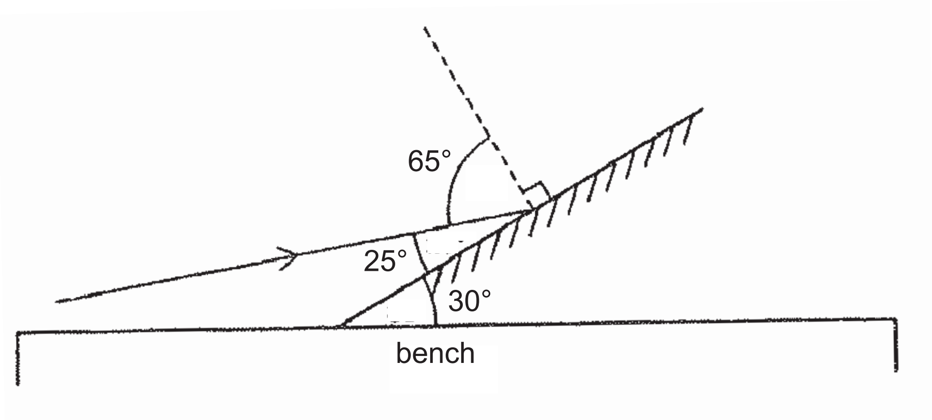


27 A ray of light passes from glass to air. In glass, the speed of light is 1.8×10^8m/s.

What is the critical angle for light passing from glass to air?

A 18.0° **B** 30.0° **C** 36.9° **D** 41.8°

28 The diagram shows a single ray of light being directed at a plane mirror.



What is the angle of reflection?

A 25° **B** 30° **C** 55° **D** 65°

29 An object is placed in front of a converging lens. The lens forms a magnified image of the object on a screen.

Which statement is correct?

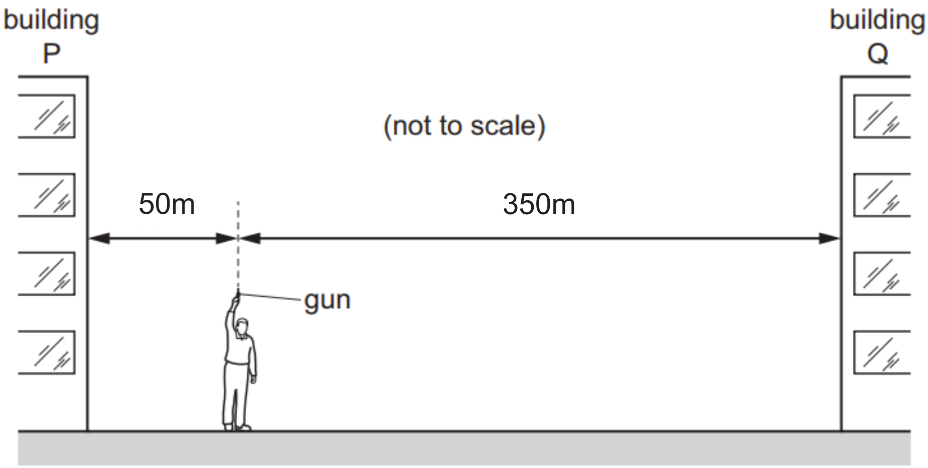
A The distance between the object and the lens is greater than the focal length.
B The image formed is a virtual image.
C The lens is acting as a magnifying glass.
D The image is upright.

30 Which statement about speed of sound is correct?

A Sound travels fastest in a vacuum.
B Sound travels fastest in gases.
C Sound travels fastest in liquids.
D Sound travels fastest in solids.

31 A man stands between two tall buildings, P and Q. The diagram is not drawn to scale.

The man is 50 m from P and 350 m from Q.



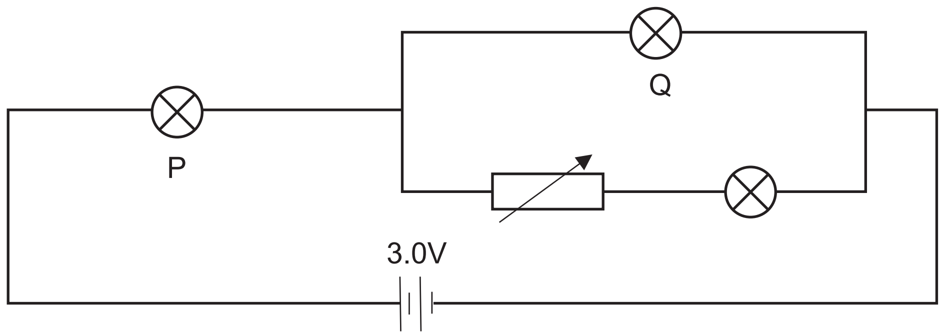
He fires a gun and the first two echoes he hears are 2.0 second apart.

What is the speed of sound calculated from this observation?

A 150m/s **B** 200m/s **C** 300m/s **D** 400m/s

Please refer to the diagram below for question 32 and 33.

The diagram shows a simple circuit consisting of three identical bulbs and a variable resistor. The e.m.f. of the battery is 3.0V.



32 When the variable resistor is adjusted to 0Ω, the current through the battery is 0.50A.

What is the resistance of each bulb?

A 2.0Ω **B** 4.0Ω **C** 6.0Ω **D** 18.0Ω

33 The resistance of the variable resistor is increased.

What happens to the brightness of bulb P and Q?

	bulb P	bulb Q
A	decrease	decrease
B	decrease	increase
C	increase	remains the same
D	remains the same	increase

Please refer to the following information for question 34 and 35.

A lighting system consists of 10 bulbs operating at their normal brightness. 5 bulbs are rated 230V 100W and the remaining 5 bulbs are rated 230V 120W.

34 What is the suitable fuse rating for the lighting system?

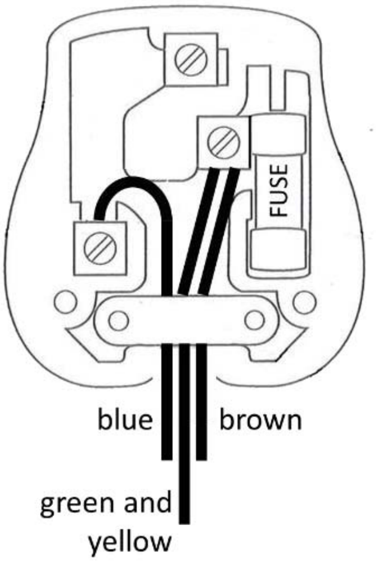
A 1A **B** 3A **C** 5A **D** 10A

35 The lighting system is switched on continuously for 1 week.

What is the total cost of using the lighting system if one unit of electrical energy cost \$0.22?

A \$1.69 **B** \$5.81 **C** \$8.13 **D** \$40.66

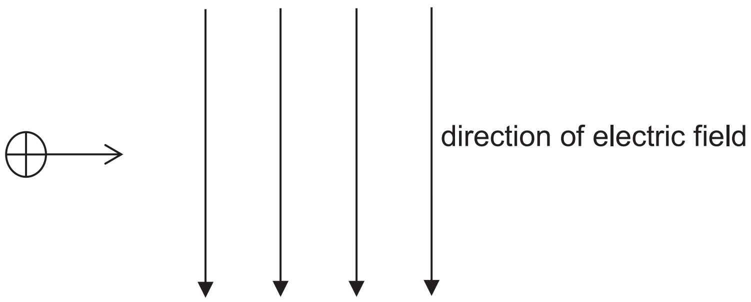
36 The diagram shows a plug that is wired wrongly. The appliance has an external metal casing.



What will happen when the plug is used?

A The appliance will not work because there is a short circuit and causes the fuse to melt.
B The appliance will not work because the external metal casing is at high voltage and causes the fuse to melt.
C The appliance will continue to work without any danger to users.
D The appliance will continue to work but the external metal casing is at high voltage.

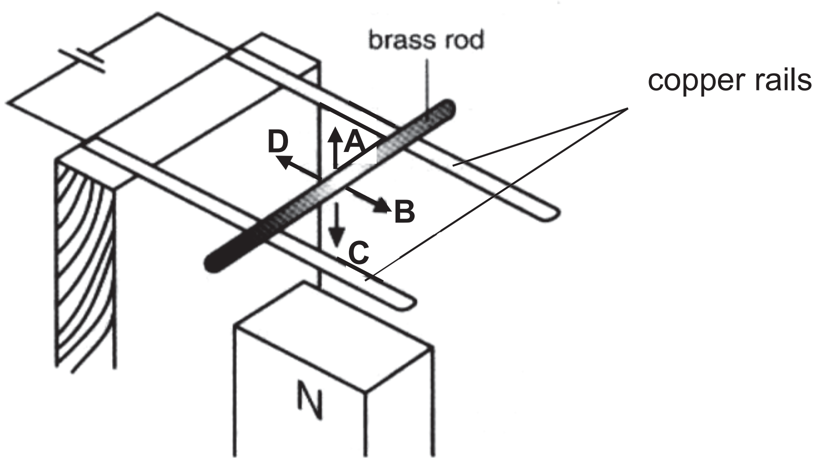
37 The diagram below shows a positive charge travelling towards an electric field.



What is the direction the positive charge will move when it first enters the electric field?

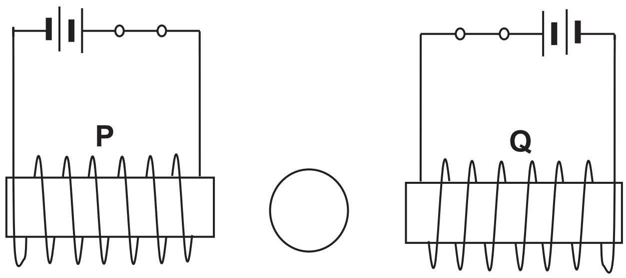
A into the paper
B out of the paper
C upwards
D downwards

38 The diagram shows a brass rod supported on two copper rails that are connected to a battery. The north pole of a magnet is placed beneath the rails.



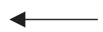
What is the direction of the induced force acting on the brass rod?

39 The diagram shows a compass placed between two solenoids.



The e.m.f. of the battery connected to solenoid P is larger than that of the battery connected to solenoid Q.

Which is the correct direction of the compass needle.

A  **B**  **C**  **D** 

40 The primary coil of an ideal transformer has 200 turns and is connected to a 20V alternating voltage supply. The secondary coil has 3200 turns and is connected to a 120Ω resistor.

Which row gives the correct secondary voltage and primary current?

	secondary voltage / V	primary current / A
A	16	0.11
B	16	0.13
C	320	2.67
D	320	42.7

End of Paper

NORTH VISTA SECONDARY SCHOOL

PRELIMINARY EXAMINATION 2019

80

NAME: ______________________________ (   )   CLASS: _________

SUBJECT: PHYSICS   DATE: 4 SEP 2019

LEVEL / STREAM: SECONDARY 4 EXPRESS   TIME: 1 HR 45 MIN

CODE : 6091/2

INSTRUCTIONS TO CANDIDATES

Write your full name, index number and class on all the work you hand in.
Write your answers in dark blue or black pen.
You may use a HB pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.

The use of an approved scientific calculator is expected, where appropriate.
You may lose marks if you do not show your working or if you do not use appropriate units.

Section A
Answer **all** questions.

Section B
Answer **all** questions. Question 11 has a choice of parts to answer.

Candidates are reminded that all qualitative answers should include appropriate units.
Candidates are advised to show all their working in a clear and orderly manner, as more marks are awarded for sound use of Physics than for correct answers.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

This question paper consists of 21 printed pages.

[Turn over

Section A

Answer **all** the questions in the spaces provided.

1 Fig. 1.1 shows a block of wood moving at a constant speed down a slope.

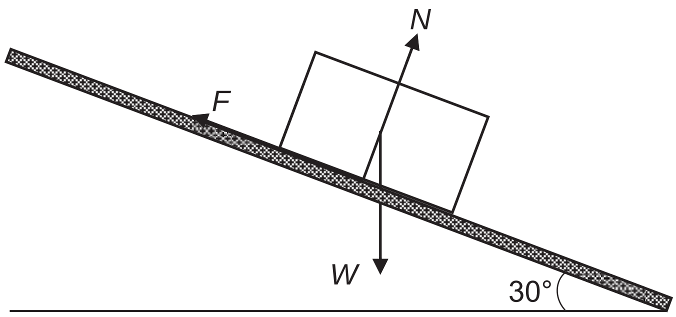


Fig. 1.1

The forces acting on the block are the weight *W* of the block, the normal reaction force *N* exerted by the slope and the friction *F* between the block and the slope.

F is 10.0N and *N* is 17.4N.

(a) In the space below, draw a labelled diagram to show the resultant of *F* and *N*.

Determine the size of the resultant force and the direction between the resultant force and the horizontal ground.

resultant force = ……………………………………………

direction = …………………………………..… [3]

(b) State the weight of the block of wood.

weight = ……………………………………..… [1]

(c) The resultant force in **(a)** and *W* are not a Newton's Third Law action-reaction pair.

Describe the other force that is part of the action-reaction pair with *W* and state which body it acts on.

……………………………………………………………….……………………………..

……………………………………………………………….……………………………..

……………..………………………………………………………….………………………….. [2]

2 Fig. 2.1 shows a student standing with his right foot and right shoulder touching a wall.

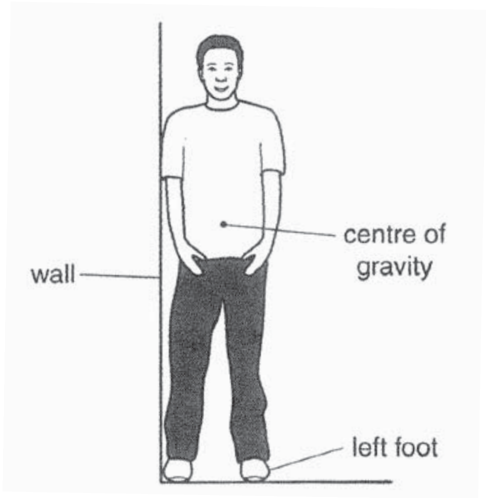


Fig. 2.1

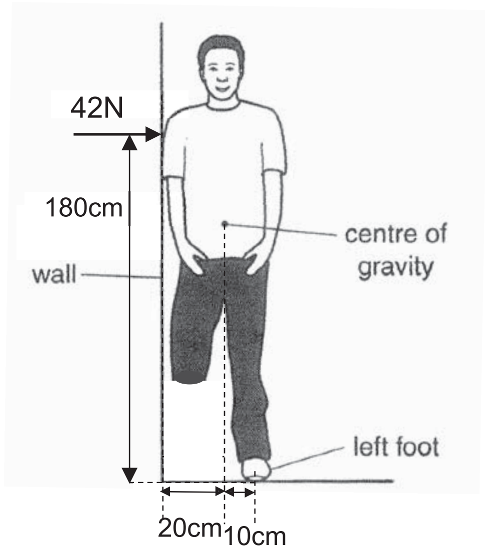


Fig. 2.2

(a) The centre of gravity of the student is shown in Fig. 2.1.

State what is meant by *centre of gravity*.

…….. [1]

(b) The student bends his right knee and raises his right foot off the ground.

Fig. 2.2 shows a 42N force exerted by the wall on his right shoulder to keep him balanced. His left foot acts as the pivot.

By taking moments, determine the weight of the student.

weight = ……………………………………….… [2]

(c) The student now raises his left foot off the ground instead of his right foot.

Using ideas about stability, state and explain what will happen to him.

……..

……..

……..

…….. [3]

3 Fig. 3.1 shows a small crack appearing in a vase of water and a stream of water is pushed out through the crack. The water hits the table where a puddle of water starts to form.

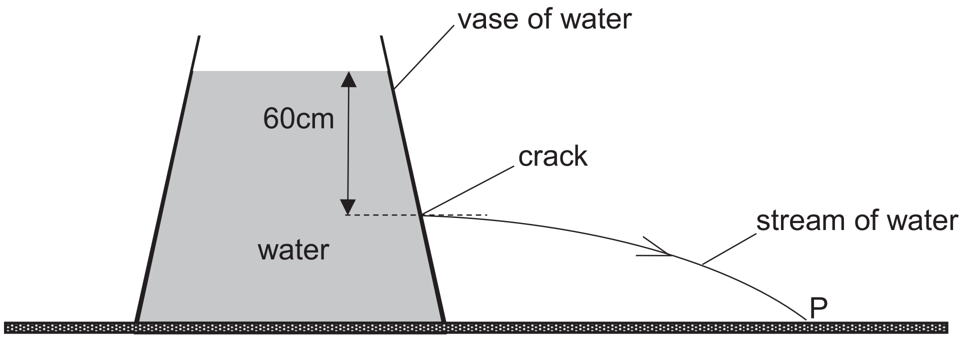


Fig. 3.1

The gravitational field strength *g* is equal to 10N/kg.

(a) The density of water is 1050kg/m^3 and the crack is 60cm below the surface of the water.

(i) Calculate the pressure due to the water at the level of the crack.

pressure = …………………………………..… [2]

(ii) Explain why the atmospheric pressure does not affect the rate at which the water is pushed out through the crack.

…………………………………………………………………..……………….. [1]

(b) As time passes, the point where the water hits the table moves away from P and towards the vase.

Explain why this happens.

…………………………………………………………………………………………………..

…………………………………………………………………………………………………..

……………..………………………………………………………….………………………….. [2]

4 Fig. 4.1 shows a syringe that has a sealed end. Air is trapped in the syringe and the piston is free to move up and down. The piston has negligible weight.

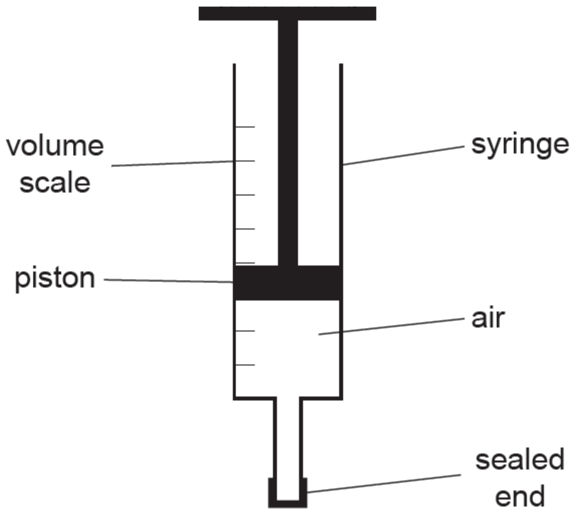


Fig. 4.1

Using the movement of particles,

(a) explain how the trapped air exerts pressure in the syringe;

…………………………………………………………………………………………………

…………………………………………………………………………………………………

…………………………………………………………………………………………………

………………………………………………………………………………………………… [2]

(b) explain why the piston moves down when the temperature of the trapped air decreases.

…………………………………………………………………………………………………

…………………………………………………………………………………………………

…………………………………………………………………………………………………

………………………………………………………………………………………………… [2]

5 Fig. 5.1 shows a ray of light incident at mid-point O of the plane surface AB of a semi-circular diamond block. The angle of incidence at O is 60°

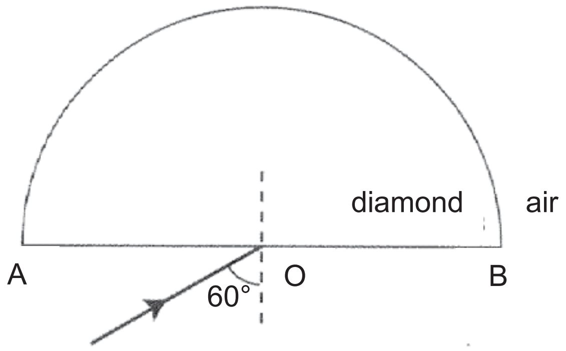


Fig. 5.1

The refractive index of diamond is 2.4.

(a) **(i)** State what is meant by *refractive index of 2.4*.

…………………………………………………………………………………………………

…………………………………………………………………………………………………. [1]

(ii) Calculate the angle of refraction of this ray at O.

angle of refraction = ………………………………………. [2]

(b) Draw the path of this ray from O on Fig. 5.1 and continue its path until it has emerged into the air. [2]

(c) Calculate the critical angle for the diamond-air boundary.

critical angle = ………………………………………. [1]

(d) The semi-circular diamond block can be used to demonstrate total internal reflection at surface AB.

Describe how this can be done.

…………………………………………………………………………………………………

…………………………………………………………………………………………………

…………………………………………………………………………………………………. [2]

6 Fig. 6.1 shows a positively charged metal sphere, P hanging from a string. It is placed near an uncharged metal sphere, Q, supported on an insulating stand. P is attracted to Q but both spheres are not in contact.

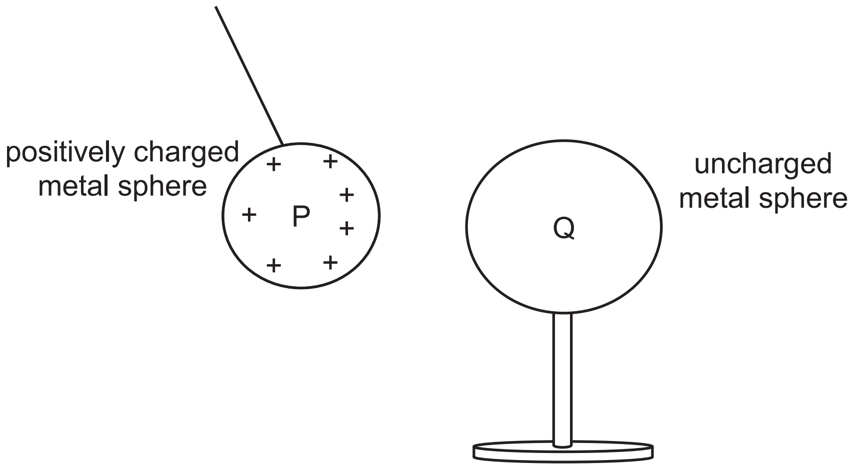


Fig. 6.1

(a) Define the term *direction of electric field*.

……………………………………………………………………………………………...

…………………………………………………………………………………………….. [1]

(b) On Fig. 6.1, draw the charge distribution in sphere Q and the electric field pattern in the space between the two spheres. [2]

(c) Explain why sphere P is less positively charged on the left side.

……………………………………………………………………………………………...

……………………………………………………………………………………………. [1]

(d) Sphere Q is moved towards the left until it makes contact with sphere P.

Describe and explain what happens to sphere P.

……………………………………………………………………………………………...

……………………………………………………………………………………………...

……………………………………………………………………………………………. [2]

(e) When sphere P is earthed, 20C of charges flow to the sphere in 25s.

Calculate the current flowing in the earth wire.

current = ……………………. [2]

7 Fig. 7.1 shows a magnet attached to a paper cone and placed near a coil of wire that is connected to a d.c. source. The magnet can **vibrate horizontally** about its rest position.

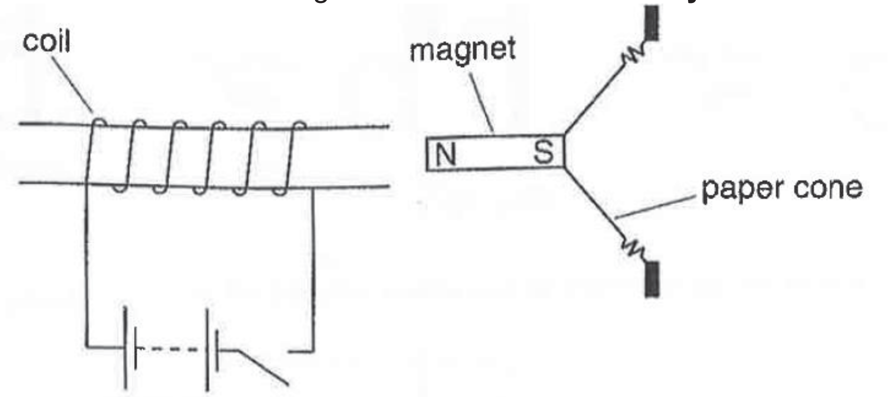


Fig. 7.1

(a) When the switch is closed, the magnet would move momentarily before it comes to a stop.

When the switch is opened, the magnet would move back to its original position.

State the direction the magnet would move when the switched is closed.

.... [1]

(b) When the battery is replaced by an a.c. source, the alternating current in the coil will cause the magnet and the paper cone to vibrate continuously. Sound will be heard if the frequency of the vibration is within the audible frequency.

(i) State the range of audible frequency of a normal healthy human.

.... [1]

(ii) Explain how sound is produced by the cone and transmitted to the surrounding.

....

....

....

....

.... [3]

(iii) The magnet is now replaced by a soft iron bar.

State and explain whether the alternating current in the coil will cause the soft iron bar and the paper cone to vibrate continuously.

....

....

.... [2]

8 Fig. 8.1 shows a torch that does not use batteries.

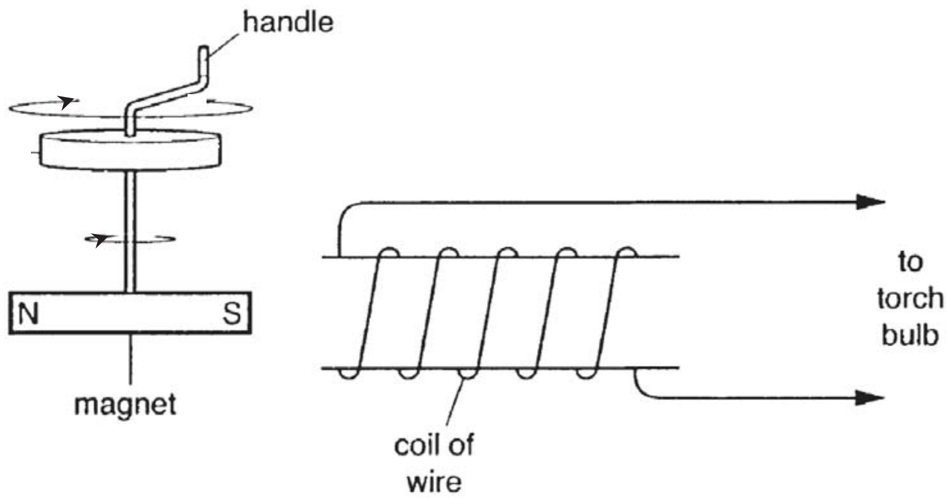


Fig. 8.1

To use the torch, the handle is turned to rotate a magnet near a coil of wire. This will illuminate the torch bulb.

(a) Explain why the torch bulb is illuminated when the magnet rotates.

…………………………………………………………………………………………………...

…………………………………………………………………………………………………...

…………………………………………………………………………………………………...

………………………………………………………………………………………………….. [2]

(b) Describe the changes in light emitted, if any, by the torch bulb when the rate of rotation of the magnet is decreased slowly.

…………………………………………………………………………………………………...

…………………………………………………………………………………………………...

………………………………………………………………………………………………….. [2]

(c) When the handle is turned, a force is induced that acts against the rotation of the magnet.

Explain why there is an induced force and how it acts against the rotation of the magnet.

…………………………………………………………………………………………………...

…………………………………………………………………………………………………...

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…………………………………………………………………………………………………...

………………………………………………………………………………………………….. [2]

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Please Turn To Page 12 for Section B

Section B

Answer **all** the questions in the spaces provided.
Answer only one of the two alternative questions in **Question 11.**

9 Fig. 9.1 shows a circuit consisting of a thermistor and a 2.00kΩ fixed resistor connected in series to an a.c. source with a peak voltage of 230V. A cathode ray oscilloscope (c.r.o.) is connected in parallel to the fixed resistor. The circuit can be used to measure the room temperature by studying the display on the c.r.o.

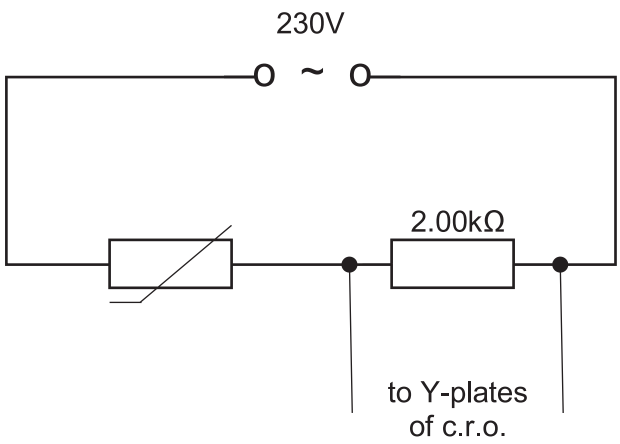

Fig. 9.1

Fig. 9.2 shows the resistance of the thermistor and peak voltage output to the c.r.o. at different temperature. The peak voltage of the a.c. source and the resistance of the fixed resistor remain constant.

temperature of thermistor / °C	resistance of thermistor / kΩ	resistance of fixed resistor / kΩ	peak voltage of a.c. source / V	peak voltage output to c.r.o / V
5.0	2.60	2.00	230	100
10.0	1.75	2.00	230	123
15.0	1.25	2.00	230	
20.0	1.10	2.00	230	148
25.0	1.00	2.00	230	153

Fig. 9.2

(a) The resistance of the thermistor is dependant of its temperature.

(i) Define the term *resistance*.

……………………..……………………………………………………………..

…………………………………….……………………………………… [1]

(ii) Describe how the resistance of the thermistor changes with increasing temperature.

……………………..……………………………………………………………..

…………………………………….……………………………………… [1]

(iii) Using Fig. 9.2, state and explain one limitation of the above circuit in measuring room temperature.

…………….….…………………………………………………………………….

……………………………………………………………………………………… [1]

(b) Calculate the peak voltage output to c.r.o when the temperature of the thermistor is 15.0°C.

peak voltage output = ... [2]

(c) Fig. 9.3 shows the display on the c.r.o. at 5°C. The time base setting is 5.0ms/div.

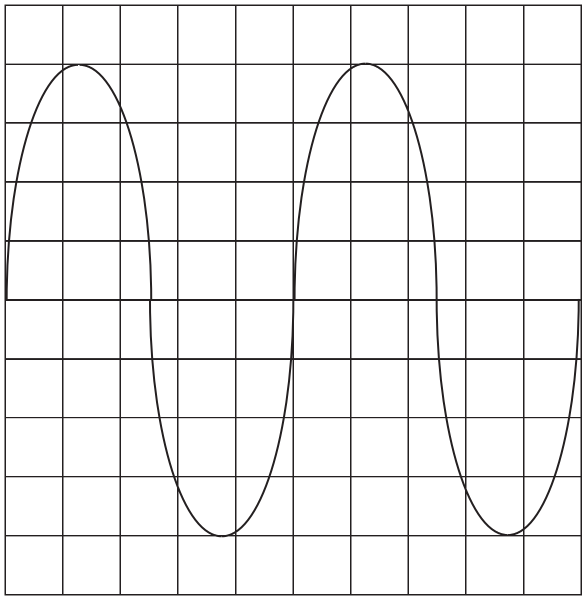

Fig. 9.3

(i) Calculate the Y-gain setting of the c.r.o.

Y-gain setting = ……………………. [1]

(ii) Calculate the period of the a.c. source.

period = ……………………. [1]

(iii) Describe the changes to the display, if any, on the c.r.o. if both the time base setting and the Y-gain setting are doubled.

………………………………………………………………………………………

……………………………………………………………………………………….. [2]

(d) The circuit in Fig. 9.1 is modified by replacing the fixed resistor with the thermistor. The new circuit is shown in Fig. 9.4

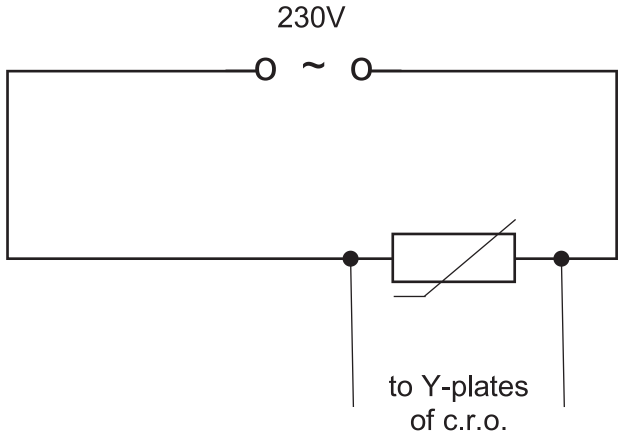

Fig. 9.4

State and explain if the modified circuit in Fig. 9.4 can be used to measure room temperature.

…………………………………………………………………………………………………..

…………………………………………………………………………………………………..

………………………………………………………………………………………………… [1]

10 A student uses a long rope to demonstrate a transverse wave. A ribbon is tied at a point P on the rope.

Fig. 10.1 (full scale)

The student's hand moves up and down 10 times every 4.0 seconds. Fig. 10.1 shows, to full scale, a side-ways view of the rope at one instant.

(a) Determine the

(i) amplitude of the wave,

amplitude = ………………………. [1]

(ii) wavelength of the wave

wavelength = ………………………. [1]

(iii) Calculate the speed of the wave. State clearly the equation used.

speed = ………………………. [2]

(b) On Fig. 10.1, mark a point on the rope that has the same vertical speed as point P, but which moves in the opposite direction to P. Label this point Q. [1]

(c) Using the same rope, the student produces a wave of longer wavelength than that shown in Fig. 10.1.

State how the student does this.

……………………………………………………………………………………………………

…………………………………………………………………………………………………… [1]

(d) Electromagnetic waves are also transverse waves.

(i) State one property of electromagnetic waves that differentiate them from all other waves.

…………………………………………………………………………..………………. [1]

(ii) X-rays are part of the electromagnetic waves.

Hospital uses them to discover whether the bones are broken. However, X-rays can cause ionisation of living cells and tissue.

Explain what is meant by *ionisation* and describe the effects on living cells and tissue.

…………………………………………………………………..…………………..

…………………………………………………………………..…………………..

…………………………………………………………………..…………………..

…………………………………………………………..……………………… [2]

(iii) Fig. 10.2 shows the relationship between the energy of electromagnetic waves and the wavelength of the waves.

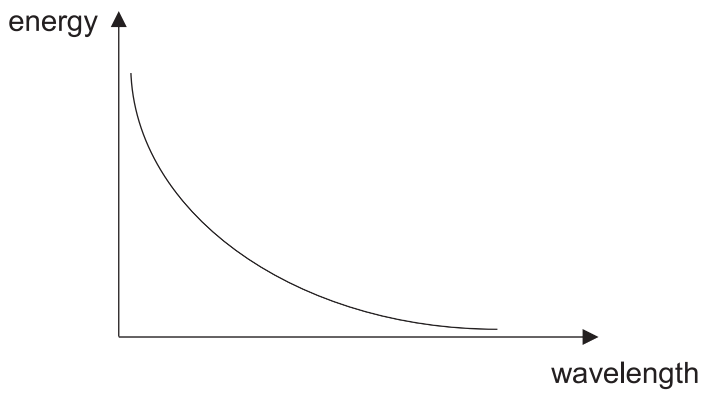

Fig. 10.2

State the component of the electromagnetic waves with the lowest energy.

…………………………………………………………………..………………. [1]

11 EITHER

Fig. 11.1 shows a pot of water placed above a flame.

Fig. 11.1

(a) State the thermometer you would use to measure the temperature of the flame.

……………………………………………………………………………………………….. [1]

(b) The pot, with the lid, is made of metal and has a shiny smooth external surface.

Explain how the above features of the pot minimises the time to boil the water

…………………………………………………………………………………………………...

…………………………………………………………………………………………………...

…………………………………………………………………………………………………...

……………………………………………………………………………………………… [3]

(c) On Fig. 11.2, sketch the temperature-time graph of the water when its temperature is increased from room temperature to boiling point. [1]

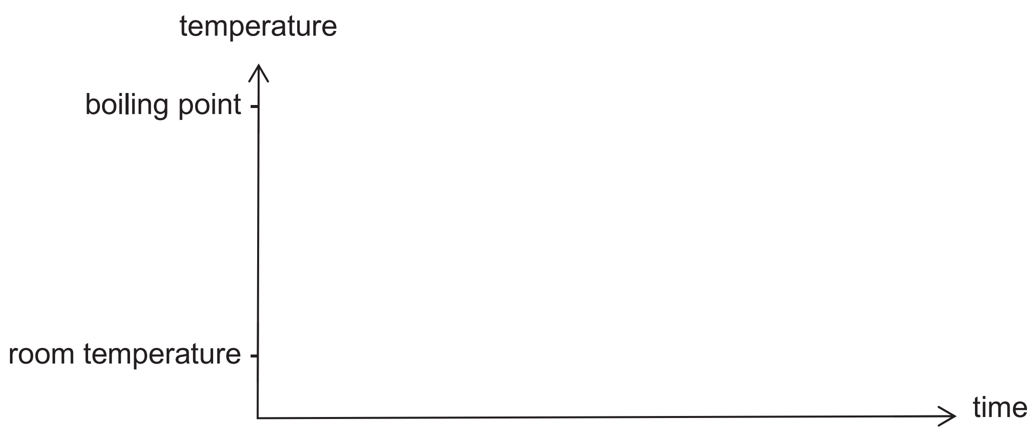

Fig. 11.2

(d) Noodles are placed in water at boiling point. In order to cook the noodles in a shorter time, the size of the fire is increased.

Explain why the above suggestion **does not** shorten the cooking time of the noodles.

…………………………………………………………………………………………………...

…………………………………………………………………………………………….. [1]

(e) The specific latent heat of vaporisation of water is 2200kJ/kg.

(i) State what is meant by the above statement.

…………………………………………………………………………………….………..

……………………...…………………………………………………………...….. [1]

(ii) Using common apparatus found in school laboratory and the value of the specific latent heat vaporisation of water, describe a method to determine the approximate value of the rate of thermal energy supplied by the fire. State clearly how the result is obtained.

…………………………………………………………………………………………………

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…………………………………………………………………………………………………

……………………………………………………………………………………………...

………………………………………………………………………………………… [3]

OR

A children's ride consists of a steel cable that runs between two posts of different heights, as shown in Fig. 11.3.

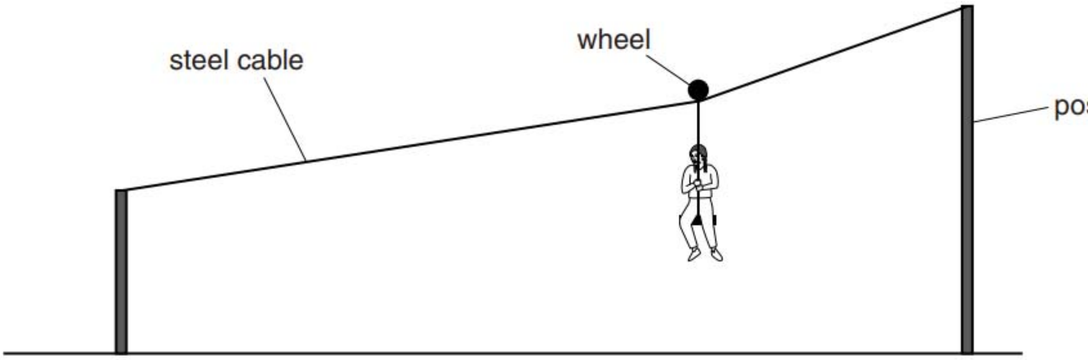


Fig. 11.3

A child starts and finishes the ride at rest. His horizontal motion can be taken as

- an initial decreasing acceleration for 5.0s, followed by
- a constant velocity of 1.6m/s for a further 3.0s and
- a final uniform deceleration that lasts for 1.0s.

(a) On Fig. 11.4, draw a velocity-time graph of the horizontal motion.

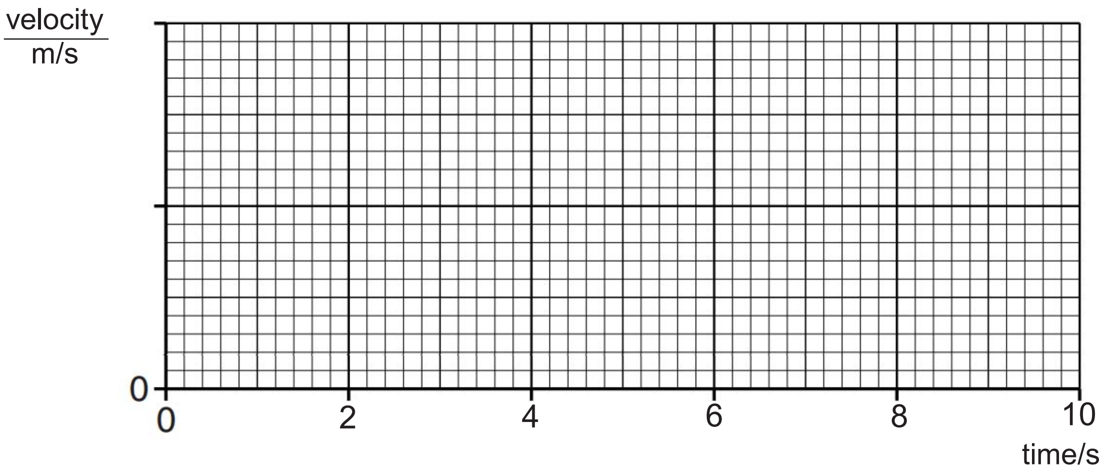


Fig. 11.4 [2]

(b) State how displacement is found from a velocity-time graph.

....

.... [1]

(c) **(i)** The child has a mass of 25kg and falls through a height of 2.0m during the ride.

The gravitational field strength *g* is 10N/kg.

Calculate the decrease in gravitational potential energy of the child.

decrease in potential energy = …………………….. [2]

(ii) Suggest why the loss in gravitational potential energy and the increase in kinetic energy are different and explain how the law of conservation of energy applies in this case.

………………………………………………………………………………………………

………………………………………………………………………………………………

……………………………………………………………………………………………[2]

(d) A group of students make measurements to show that the child's velocity is constant during the middle section of the ride.

Suggest what measurements are made and how they show that the velocity is constant.

………………………………………………………………………………………………

………………………………………………………………………………………………

………………………………………………………………………………………………

………………………………………………………………………………………………

………………………………………………………………………………………………

……………………………………………………………………………………………….. [3]

END OF PAPER

Answer to P1

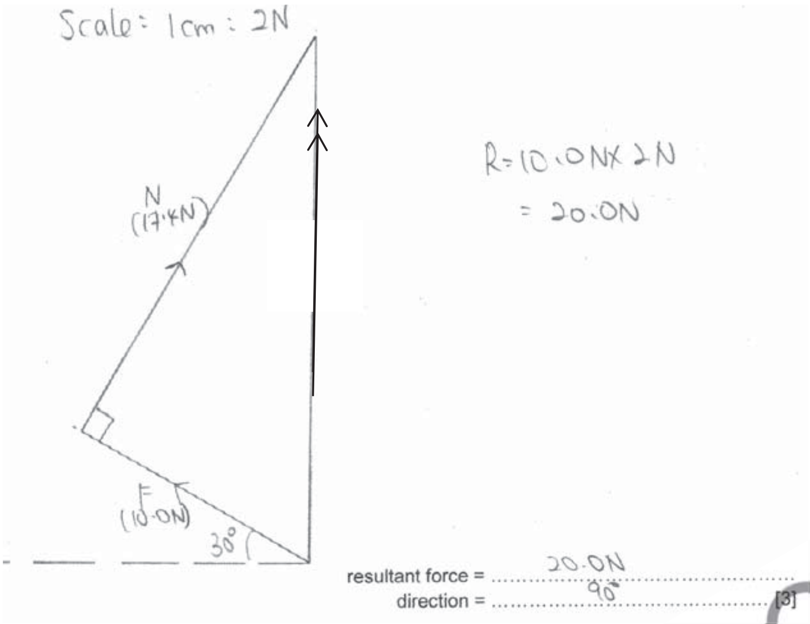
1	**C**	Refer to textbook page 6 and7.
2	**D**	Pascal is unit for Pressure
3	**C**	Diameter = measurement – zero error = 10.13 – (-0.06) = 10.19cm
4	**B**	Period is the time taken for one complete oscillation *(A to B and back to A again)*
5	**C**	Terminal velocity only happens when all forces are balanced (net force is zero), hence zero acceleration and constant velocity.
6	**C**	Higher acceleration means higher gradient (steeper vel-time graph).
7	**D**	Constant speed = zero acceleration = zero resultant force
8	**A**	Friction opposes the relative motion between 2 bodies in contact. The foot is pushing backward in order for the man to move forward. Hence friction pushes the foot forward (opposite direction)
9	**D**	Things to note: Acceleration is the rate of change of velocity. Change in velocity can be either direction or numerical value (speed). When there is an acceleration, a resultant force must be present. (not change in resultant force).
10	**A**	When the container decelerates, the water has bigger mass, bigger inertia as compare with the bubble of air. Hence the water will continue forward and pushes the air bubble backward.
11	**D**	Both cubes are made of the same material.
12	**D**	Least stability = highest C.G (top heavier) and smallest base area.
13	**D**	$P_1 = P_2$ 150/10 = (1500 x 10)/A A= 1000cm^2
14	**B**	When atmospheric pressure drops, mercury column QR decreases, PQ increases. R rises as more mercury flows out of mercury column, hence PR decreases. Height PS is fixed.
15	**A**	Useful work done = gain in mgh = 2000 x0.8 Or useful work done = resultant force x distance in direction of force = (1300-500)(2.0)
16	**A**	$E_k = ½ Mv^2$ New $E_k = ½ (M/2)(2v)^2 = 2 (½Mv^2) = 2E_k$
17	**A**	collisions by air particles Key word is "by" as air particles are moving in continuous and random motion at high speed
18	**C**	The water particles move further apart from each other when heated. This will increase the volume of water and decrease the density. **B** is wrong because particles do not expand when heated.
19	**D**	The gas particles are all moving in a continuous and random motion. The probability of the particles hitting at any point in the container with the same average speed (and force) is the same. **B** and **C** are wrong unless the options contain the word in bold: "**average** number of collisions with the internal walls of the container per unit time" and "move at the same **average** speed".

20	**B**	increases	decreases	
21	**A**	by conduction only C is wrong because the question did not ask for thermal energy transferred within the liquid.		
22	**C**	1.30Ω 40°C = [R - 0.50Ω]/[2.50Ω - 0.50Ω] × 100°C R = 1.30Ω		
23	**B**	1.00 Specific heat capacity is the same for objects from the same material		
24	**A**	21kJ energy removed = 0.20kg × 25°C × 4.20kJ/kg°C = 21kJ		
25	**D**	Speed of water waves decreases in shallow water as wavelength decreases. Frequency is constant.		
26	**C**	Shift the wave to the right by half a waveform		
27	**C**	n = c/v = $3.0\text{x}10^8$/ $1.8\text{x}10^8$ = 1.67 c= $\sin^{-1}$ (1/1.667) = 36.9°		
28	**D**	Angle of reflection is the same as angle of incidence, i.e. the angle between Normal and incident ray.		
29	**A**	Key words from question “Magnified image …. on a screen” [Real, magnified image] Case 4 from table 12.5 in textbook pg 242 where object is placed between f and 2f.		
30	**D**	Sound need medium to travel and is fastest in solid where particles are very closely packed.		
31	**C**	t diff = [2 x distance from Q to man/ speed] - [2 x distance from P to man/ speed] 2.0 = [2x350 - 2x50] / speed Speed = 300m/s		
32	**B**	4.0Ω 1.5R = 3.0V / 0.50A = 6.0Ω R = 4.0Ω		
33	**B**	Decrease because p.d. across P decreases	Increase because p.d. across Q increase	
34	**C**	5A current = 1100W / 230V = 4.78A		
35	**D**	$40.66 cost = (1.10kW × 7 × 24hrs) × $0.22 = $40.66		
36	**D**	The appliance will continue to work but the external metal casing is at high voltage. Both live and earth wire are at high voltage but are not connected to each other. The fuse is in the live wire. The fuse and the live wire are not connected to the earth wire unless the live wire touches the metal casing. So fuse will not melt because current is flowing through the appliance as normal.		
37	**D**	downwards Positive charge at the top and negative charge at the bottom. This does not require Fleming’s Left hand Rule because the field is not a magnetic field.		
38	**B** Using Fleming’s Left hand Rule b			

39	**B**	← Direction of the magnetic field of the two coils is the same. Using Right Hand Grip, the magnetic field is towards the left.		
40	**D**	320V secondary voltage = [3200 / 200] × 20V = 320V	42.7A power input = power input = $(320V)^2$ / 120Ω = 853.3W primary current = 853.3W / 20V = 42.7A	

Solutions for Section A

1 **(a)**



(b) 20.0N (downward)
Allow ecf from (a)

(c) Force by the block of wood on Earth.
Acting in opposite direction (or upwards) and equal in magnitude as W

2 **(a)** Centre of gravity is a point through which the whole weight seems to act.

(b) Taking moments about the left foot,
ACW = CW
W × 10 = 42 × 180
W = 756N

(c) The student will be unstable, causing him to topple/ lose his balance.
The line of action of weight falls outside the base (right foot), resulting in a clockwise moment about his right foot.

3 **(a)** **(i)** P = hρg
= (60/100) (1050)(10)
= 6300Pa

(ii) Atmospheric pressure acts at both sides of the crack, i.e. at internal side and the external of the crack.
Accept there is atmospheric pressure at the top of liquid as well outside the crack.

(b) The height of water above the crack decreases.
Since P = hρg, the pressure due to the liquid at the crack decreases.

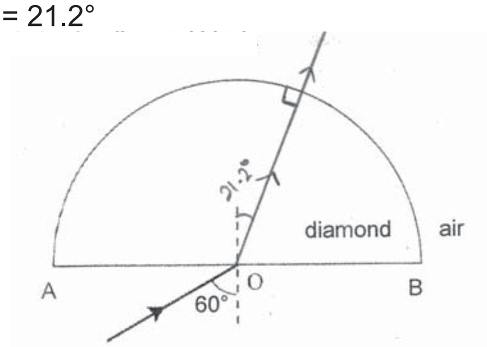
4 **(a)** **(i)** Air particles are travelling at high speed in a continuous and random motion. They collide with the internal walls of the syringe. The average force exerted per unit area is the air pressure.

(ii) KE (and speed) of the air particles decreases. They collide less frequently and with smaller force with the internal wall.
Pressure of trapped air is lower than atmospheric pressure and a resultant force acts downwards on the piston.

5 **(a)** **(i)** The speed of light in vacuum is 2.4 times faster than the speed of light in diamond.

(ii) 2.4 = sin 60/sin r
r = 21.2°

(b)

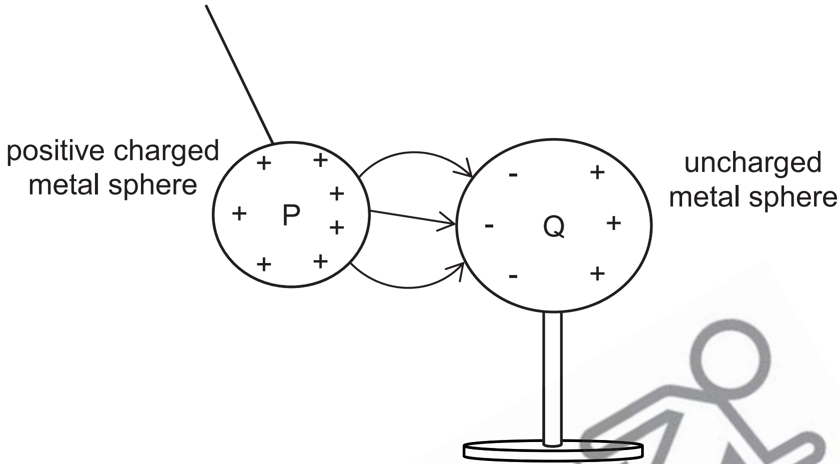


(c) $c = \sin^{-1}(1/n)$
$= \sin^{-1}(1/2.4)$
$= 24.6°$

(d) Ensure the ray of light is incident at the curved surface so that light can enter the diamond block and travel from diamond (more optically denser) towards the boundary with air (optically less dense).

Make sure the angle of incidence in diamond more than critical angle of 24.6°.

6



(a) The direction of the electric force acting on a small positive charge.

(b) See above.
Correct charge distribution
Correct field lines

(c) The induced negative charge on the left side of Q repel the electrons in P to the left side.

(d) The electrons in Q will be attracted by the positive charged P. They will move into P until both spheres are equally positive charged.
P swings away from Q because like charges repel.

(e) current = Q / t
= 20C / 25s [1] = 0.80A

7 **(a)** It will move to the left.

(b) **(i)** 20Hz to 20kHz.

(ii) The cone vibrates and collide with the neighbouring air particles to vibrate. This disturbance (or vibration) is passed on to other air particles.
The vibration of the particles is parallel to the propagation of the sound.
The sound is transmitted in a series of compressions and rarefactions.

(iii) The soft iron bar will always be attracted to the coil regardless of the direction of the magnetic field of the current.
The soft iron bar will not vibrate (and no sound is produced).

8 **(a)** There is a change in the magnetic field lines linkage with the coil.
This induces an emf and thus a current in the coil.

(b) Light is less bright and blink less often (or frequency of blinking decreases or light is emitted a shorter time).

(c) The interaction of the magnetic field of the induced current and the magnet will induce the force (or the induced current in the coil will set up a magnetic field that will exert a force on the magnet).
The direction of the induced force will oppose rotation of the magnet in accordance to Lenz's Law (a like pole will be induced when the magnet is moving towards the coil and an unlike pole will be induced when the magnet is moving away from it).

Solutions for Section B

9 **(a)** **(i)** The ratio of the p.d. across it to the current flowing through it.

(ii) Resistance decreases at a decreasing rate.

(iii) It <u>cannot measure high temperature</u> because the decrease in resistance is insignificant.

(b) peak voltage output = [2.00kΩ / (2.00 + 1.25)kΩ] × 230V
= 142V

(c) **(i)** Y-gain setting = 100V / 4div = 25V/div

(ii) period = 5.0ms/div × 5div = 25.0ms

(iii) time base setting: twice the no. of waveforms or 4 waves are seen

Accept: halved the period/number of divisions needed per waves

Y-gain setting: amplitude is halved or amplitude is 2 div

(d) No. The output voltage to c.r.o. is the same as the e.m.f. regardless of the resistance of thermistor.

10 **(a)** **(i)** amplitude = height from crest to tough / 2 = 2.0cm /2 = 1.0cm

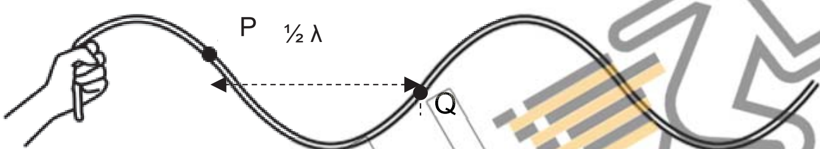
Accept 0.9 to 1.1 cm

(ii) wavelength = distance between crest to crest = 6.0cm

Accept 5.8 to 6.2 cm

(iii) v = f λ
= (10/4) (6.0)
= 15 cm/s
Accept 0.15m/s

(b)



(c) The student moves his hand up and down slower/ decrease the frequency/ lower speed/ less times per second

(d) **(i)** *Accept one:*
Can travel in vacuum or
travel at 3.0×10^8 m/s in vacuum.

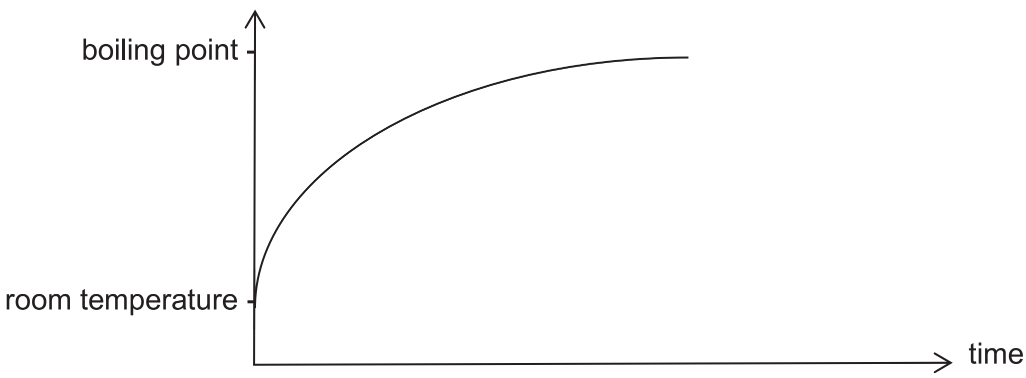
(ii) Ionisation is the removal of electrons from atoms/molecules to form ions.
Causes damage to living cells and abnormal cell divisions, e.g. cancer, deformed foetus.

(iii) Radiowave

11 E **(a)** Thermocouple or data logger with temperature sensor.

(b) Metal (is a good conductor of heat and) transfers thermal energy from the fire to the water quickly.
Shiny and smooth surface is a bad emitter of thermal energy.
Thermal energy is emitted to the surrounding at a slow rate.

(c)



(d) The bigger fire does not increase the temperature of the boiling water. Noodles is still cooked at the same temperature.

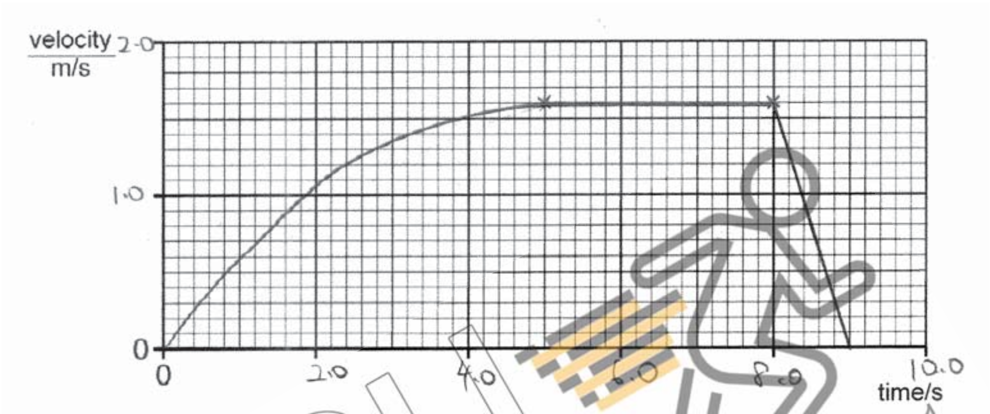
(e) **(i)** 2200kJ of thermal energy is needed to vaporise 1kg of water at boiling point.

(ii) When water is boiling, use a cold flat surface or the lid of the pot to condense the steam.
The mass of steam, m, condensed is measured using a weighing machine.
The time, t, take to condense the steam is measured using a stop watch.

Approx. rate of thermal energy supplied = m × 2200kJ/kg / t

Also accept measuring the different in mass of the pot and boiling water using weighing machine after a specific time.

11 O **(a)**



(b) Area under velocity-time graph

(c) **(i)** Decrease in GPE = mgh
$= (25)(10)(2.0)$
$= 500J$

(ii) <u>Work done against the friction present between the moving parts in the ride/ work done against air resistance/ converted to thermal and sound energy</u>
Energy cannot be created or destroyed but converted from one form to another and total energy is the same, i.e. <u>the difference in loss of GPE and gain in KE is the amount of thermal and sound energy or work done against friction/air resistance.</u>

(d) Measurement of least two distances/displacement and corresponding times mentioned.
Description of how the actual measurement is made
- make marking on the ground every second and measure the distances/displacements
- note video position every second and use a scale to find the distance/displacement
- make mark on ground every metre and measure the time as the girl passes

Description of how constant speed/velocity using measurement is proven
- Same distance/displacement travelled between each position for the same time interval
- Same time internal for same distance/displacement
- Constant gradient for distance-time graph/ displacement-time graph plotted.

SINGAPORE CHINESE GIRLS' SCHOOL
PRELIMINARY EXAMINATION 2019
SECONDARY FOUR

CANDIDATE NAME			
CLASS	4	REGISTER NUMBER	
CENTRE NUMBER		INDEX NUMBER	

PHYSICS **6091/1**

Wednesday **4 September 2019** **1 hour**

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name, class and index number on the Question Paper **and** Answer Sheet in the spaces provided.

There are **forty** questions in this paper. Answer **all** questions. For each question, there are four possible answers, **A**, **B**, **C**, **D**.

Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
The use of an approved scientific calculator is expected, where appropriate.
Take g = 10 ms^{-2} or 10 Nkg^{-1} unless specified otherwise.

This question paper consists of 22 pages

1 A micrometer screw gauge is used to measure the diameter of a copper wire.

The reading with the wire in position is shown in diagram 1. The wire is removed and the jaws of the micrometer are closed. The new reading is shown in diagram 2.

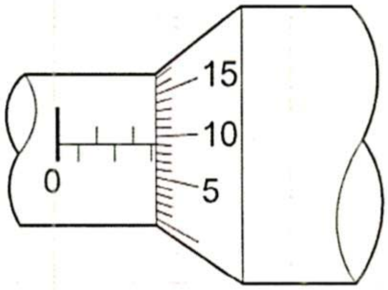


diagram 1

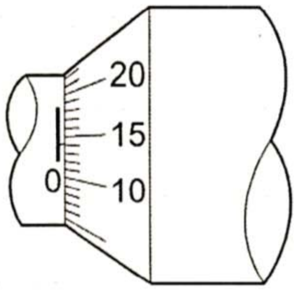


diagram 2

What is the diameter of the wire?

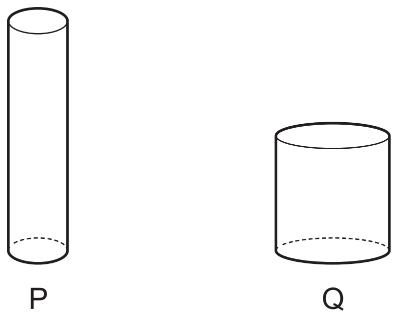
A 1.90 mm

B 2.45 mm

C 2.59 mm

D 2.73 mm

2 Two cylinders P and Q are made of copper.



The height of P is twice the height of Q. The diameter of P is half the diameter of Q.

Which statement is correct?

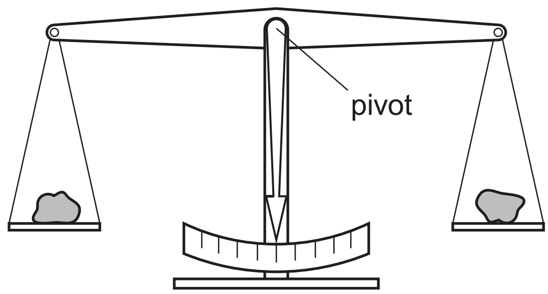
A The density of cylinder P is four times that of cylinder Q.

B The density of cylinder P is twice that of cylinder Q.

C The density of cylinder P is equal to that of cylinder Q.

D The density of cylinder P is half that of cylinder Q.

3 The diagram shows two objects on a beam balance.



The beam balance is in equilibrium.

Which quantities may be different?

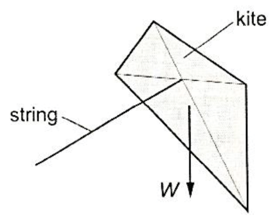
A The masses of the two objects

B The moments about the pivot of the two objects

C The volumes of the two objects

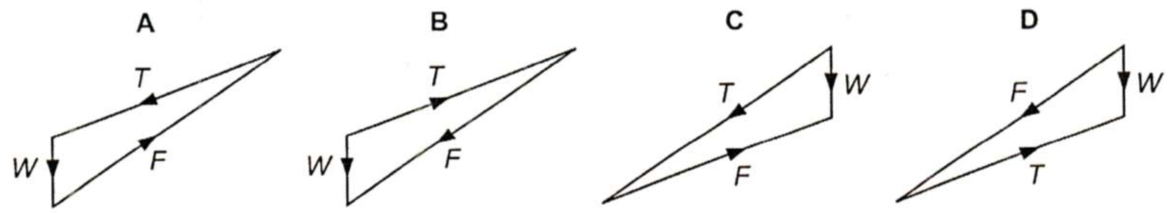
D The weights of the two objects

4 A kite is in equilibrium at the end of a string, as shown.



The kite has three forces acting on it: its weight *W*, the tension *T* in the string, and the force *F* from the wind.

Which vector diagram represents the forces acting on the kite?

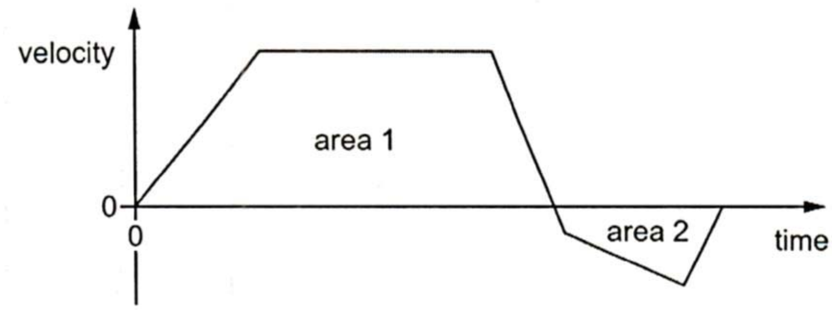


5 A stone of mass *m* is dropped from a tall building. There is significant air resistance. The acceleration of free fall is *g*.

When the stone is falling at a constant (terminal) velocity, which information is correct?

	magnitude of the acceleration of the stone	magnitude of the force of gravity on the stone	magnitude of the force of air resistance on the stone
A	g	zero	mg
B	zero	mg	mg
C	zero	zero	mg
D	zero	mg	zero

6 The velocity-time graph for an object is shown.



How can the total displacement of the object be determined?

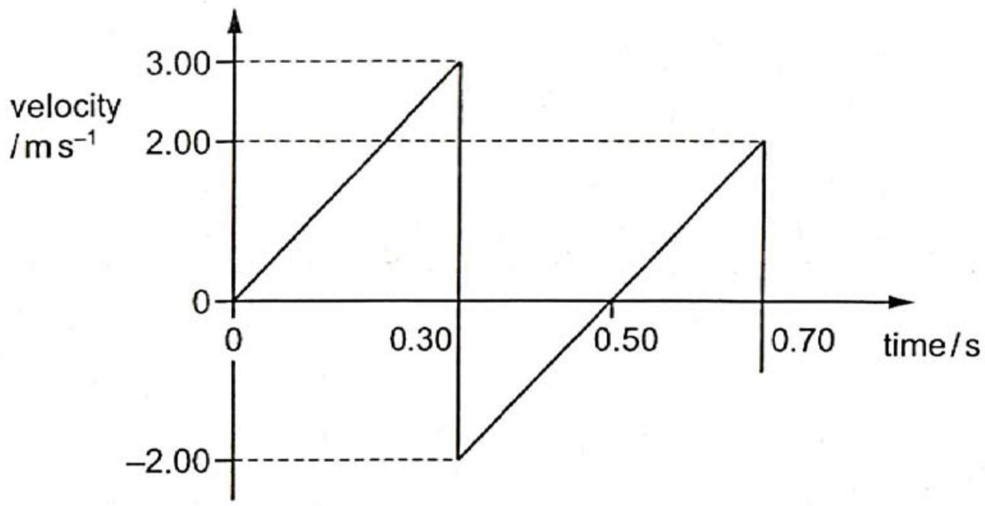
A area 1 – area 2

B (area 1 + area 2) ÷ 2

C area 1 + area 2

D area 2 – area 1

7 A ball is released from rest above a horizontal surface. It strikes the surface and bounces several times.
The velocity-time graph for the first two bounces is shown.



What is the maximum height of the ball after the first bounce?

A 0.20 m **B** 0.25 m **C** 0.45 m **D** 0.65 m

8 What is not the definition of power?

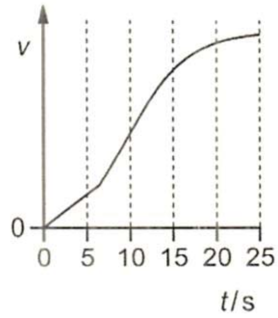
A force x displacement

B force x velocity

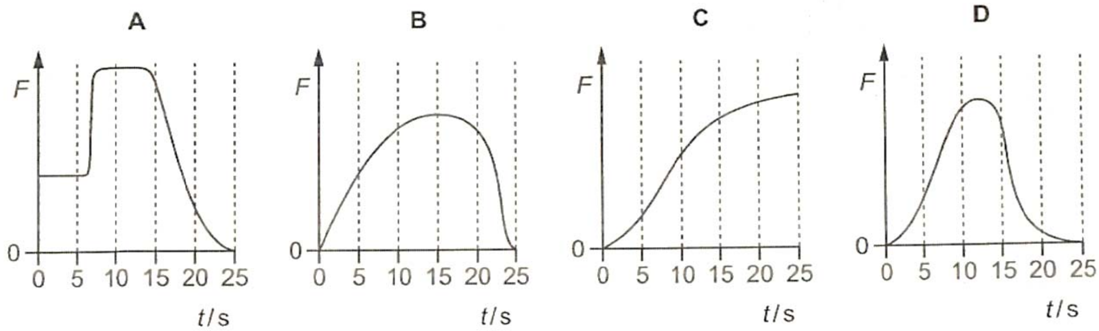
C voltage x current

D work done ÷ time

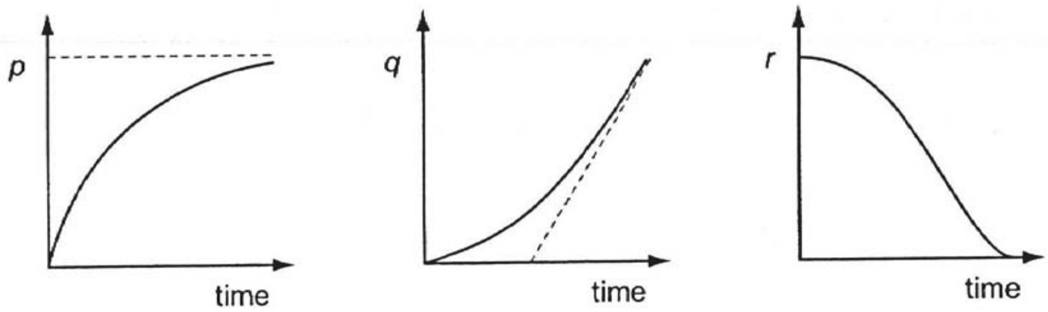
9 A bus takes 25 s to reach a constant speed while travelling in a straight line. A graph of speed v against time t is shown.



Which graph shows the variation of the resultant force *F* on the bus with *t*?



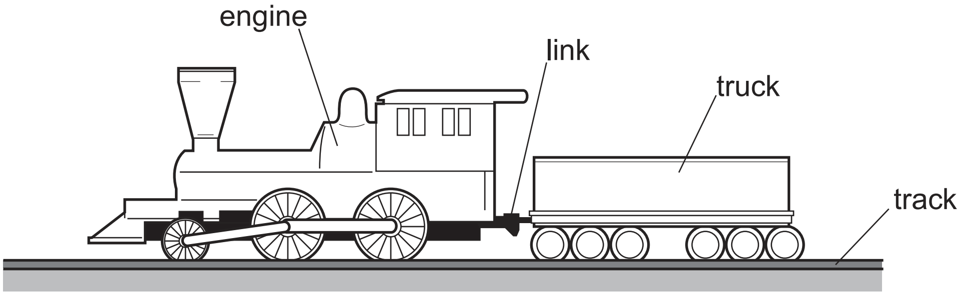
10 A stone is released at a great height in air and falls due to gravity. Each of the three graphs below represents the variation of one of the three variables *p*, *q* and *r* with time.



Which row correctly identifies the three variables *p*, *q* and *r*?

	p	*q*	*r*
A	acceleration	displacement	velocity
B	displacement	velocity	acceleration
C	velocity	acceleration	displacement
D	velocity	displacement	acceleration

11 An engine pulls a truck at constant speed on a level track.

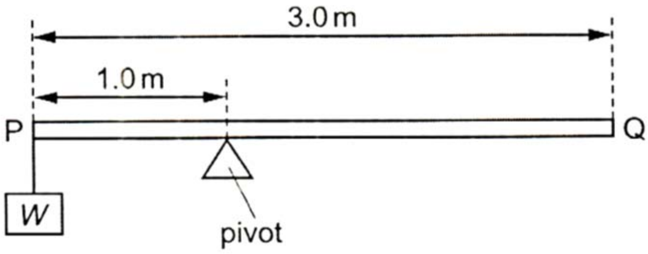


The link between the engine and the truck breaks. The driving force on the engine remains constant.

What effect does this have on the engine and on the truck?

	engine	truck
A	speed stays constant	slows down
B	speeds up	slows down
C	speed stays constant	stops immediately
D	speeds up	stops immediately

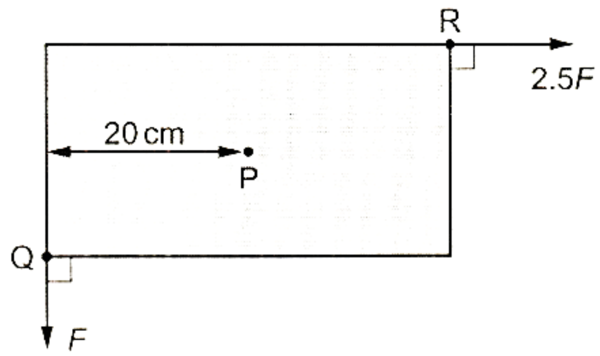
12 The diagram shows a uniform beam PQ. The length of the beam is 3.0 m and its weight is 50 N. The beam is supported on a pivot 1.0 m from end P. A load of weight *W* is hung from end P and the beam is in equilibrium.



What is the value of *W*?

A 25 N **B** 50 N **C** 75 N **D** 100 N

13 A uniform rectangular board is supported by a frictionless pivot at its centre point P.



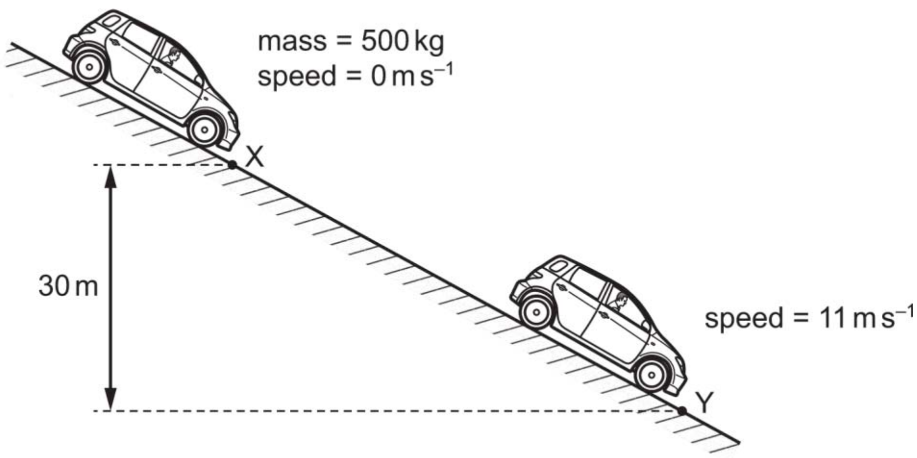
Two forces act in the plane of the board. Force F acts at corner Q and a force 2.5 F acts at corner R. The perpendicular distance between the line of action of the force F and the point P is 20 cm. The board is in equilibrium.

What is the area of the board?

A 160 cm^2 **B** 320 cm^2 **C** 640 cm^2 **D** 1600 cm^2

14 A car of mass 500 kg is at rest at point X on a slope, as shown.

The car's brakes are released and the car rolls down the slope with its engine switched off. At point Y the car has moved through a vertical height of 30 m and has a speed of 11 m s^{-1}.



What is the energy dissipated by frictional forces when the car moves from X to Y?

A 3.0×10^4 J **B** 1.2×10^5 J **C** 1.5×10^5 J **D** 1.8×10^5 J

15 In which situation is there no work done?

A A man carrying two luggage bags and walking up a slope

B A ball is dropped and falls to the ground

C A box moves at constant speed across a smooth horizontal surface

D A crane lifting a steel beam at constant speed

16 A rocket is fired vertically upwards.

As it accelerates upwards after leaving the launch pad, which forms of energy are changing?

A Chemical energy, gravitational potential energy and kinetic energy

B Chemical energy and gravitational potential energy only

C Chemical energy and kinetic energy only

D Gravitational potential energy and kinetic energy only

17 A crane lifts a weight of 600 N through a vertical height of 30 m in 25 s. The efficiency of the crane is 40%.

What is the total power input of the crane?

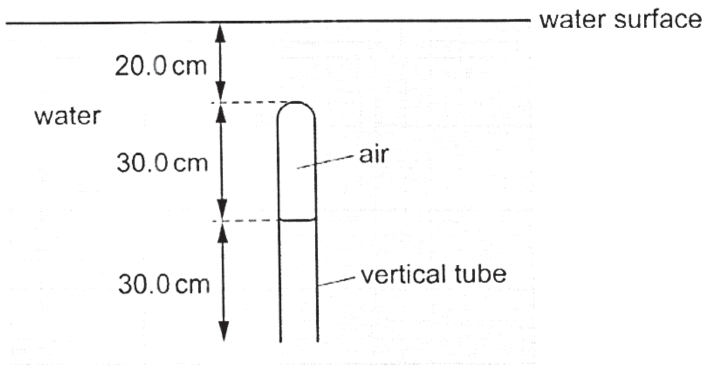
A 0.29 kW

B 0.72 kW

C 1.8 kW

D 1800 kW

18 A vertical tube, closed at one end, is immersed in water. A column of air is trapped inside the tube.



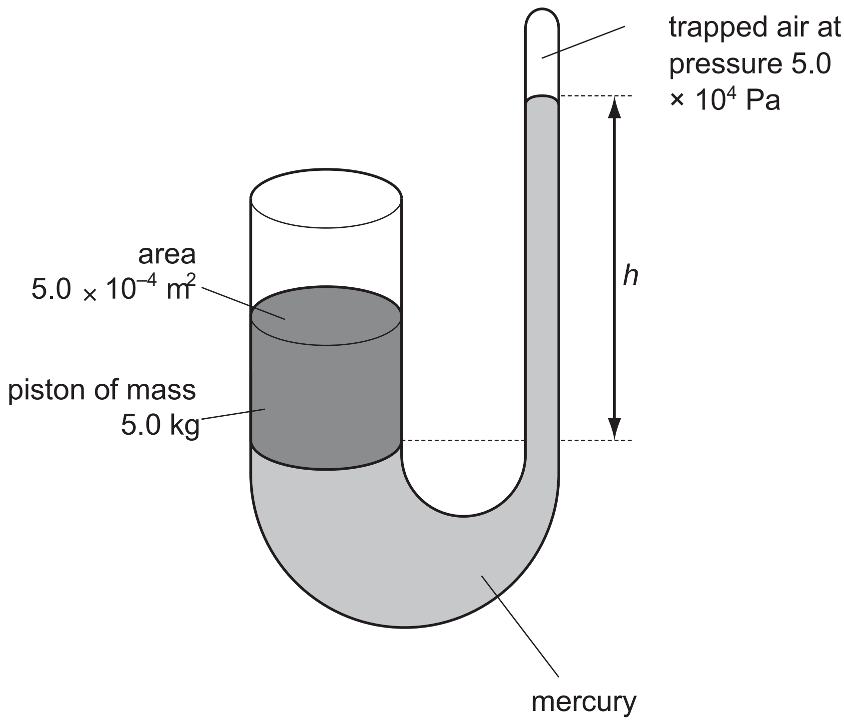
The density of water is 1000 kgm^{-3}.

What is the difference between the pressure of the air in the tube and the atmospheric pressure?

A 2000 Pa **B** 3000 Pa **C** 5000 Pa **D** 8000 Pa

19 A U-tube closed at one end contains mercury. Air at a pressure of 5.0×10^4 Pa is trapped at the closed end. The other end is open to the atmosphere and is fitted with a piston of mass 5.0 kg and cross-sectional area 5.0×10^{-4} m^2.

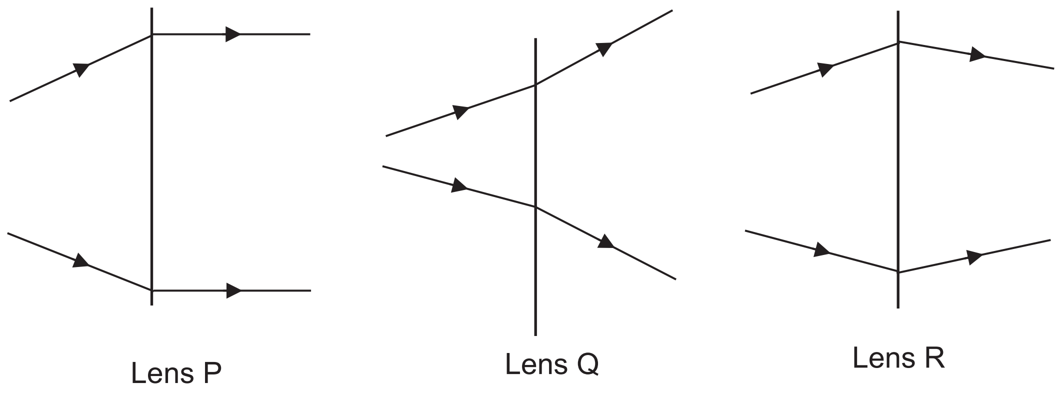
The density of mercury is 13 600 kg m^{-3} and atmospheric pressure is 1.01×10^5 Pa.



What is the height *h* of the mercury column?

A 39 cm **B** 46 cm **C** 76 cm D 111 cm

20 Which lens does not show rays of light passing through a converging lens?



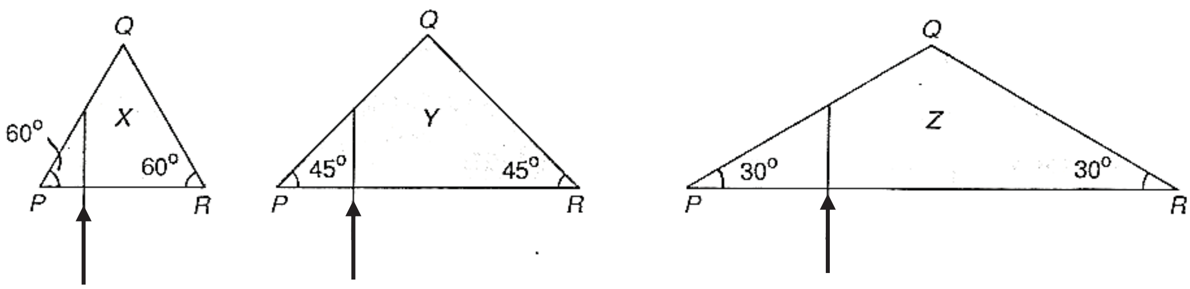
A Lens Q only

B Lens P and Q only

C Lens Q and Lens R only

D Lens P and Lens R only

21 Vertical beams of light are incident on the horizontal faces of three plastic prisms, *X*, *Y* and *Z*. The refractive index of plastic is 1.8.



In which prism(s) will total internal reflection occur at the surface PQ?

A *X* but not Y and Z
B *X* and *Y* but not *Z*
C *Y* and *Z* but not *X*
D *X, Y* and *Z*

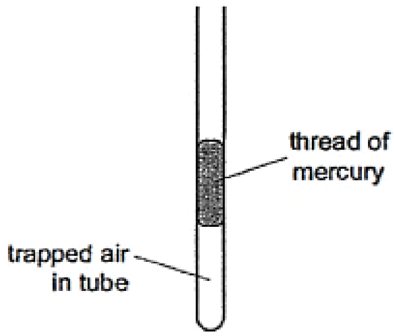
22 Containers A and B are filled with equal amounts of hot water at the same temperature. The temperature of the water in the containers are measured with a thermometer some time later. It is observed that container A has a much lower temperature than container B.

What are the possible reasons?

(i) Container A is painted black and container B is painted white
(ii) Container A has a lid and container B is not covered
(iii) Container A is made of aluminium and container B is made of plastic

A (i) and (ii) only
B (i) and (iii) only
C (ii) and (iii) only
D (i), (ii) and (iii)

23 A thin tube contains a thread of mercury which traps air at the end of the tube. The other end of the tube is open to the atmosphere.



When the tube is turned upside down,

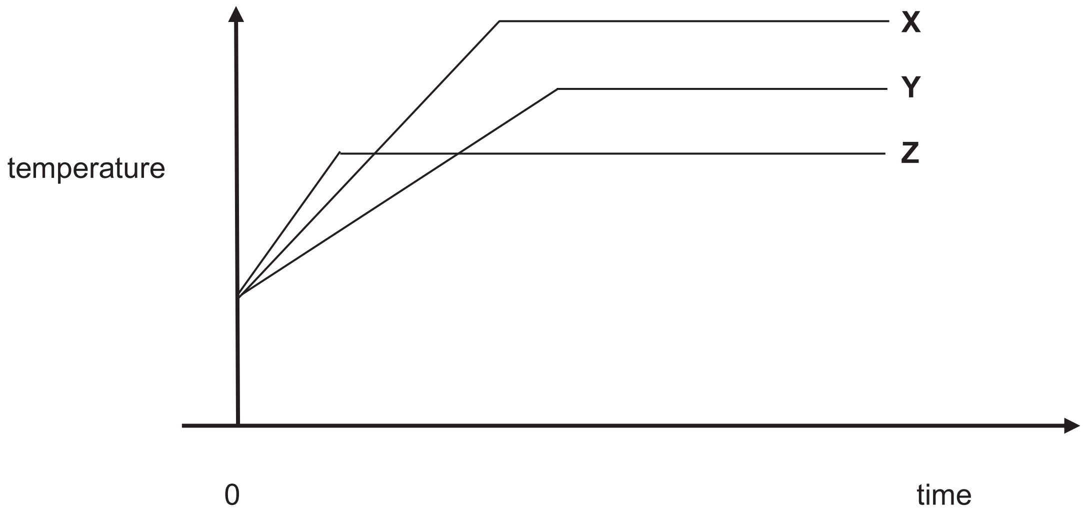
A the volume of the trapped air increases because the pressure in the trapped air is reduced.

B the volume of the trapped air increases because the atmosphere pushes less when it acts upwards on the mercury.

C the volume of the trapped air decreases because the pressure in the trapped air is reduced.

D the volume of the trapped air decreases because gravitational force acting on the mercury increases when the tube is turned upside down.

24 Equal masses of three liquids X, Y and Z are heated from room temperature. Energy is supplied by heating at the same rate to each liquid.
The graph shows how the temperature of each liquid varies with time after heating starts.



What can be deduced from the graph?

A X has the highest melting point.

B X gains the most internal energy.

C Y has the largest specific heat capacity.

D Z has the smallest specific latent heat of vaporisation.

25 Using an electric kettle, 200 g of water at 100 °C is converted into steam at 100 °C in 300 seconds. The specific latent heat of steam is 2250 J/g.

What is the average electrical power used?

A 1.5 W
B 1500 W
C 3380 W
D 135 MW

26 A new liquid is tested to decide whether it is suitable for use in a liquid-in-glass thermometer. It is found that the liquid does not expand uniformly with temperature.

What will be effect of this on the scale of the thermometer?

A It will have a short range.

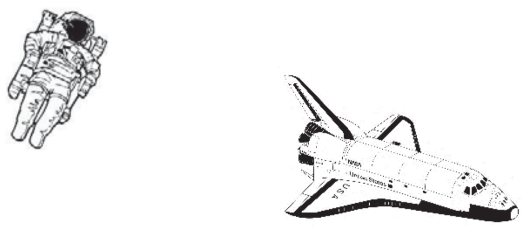
B The markings will be too far apart.

C The markings will be too close together.

D The markings will be spaced unevenly.

27 An astronaut wishes to communicate with his fellow astronauts inside the space shuttle some distance away.

Which two waves, in the correct nature and sequence, are being used during the communication?



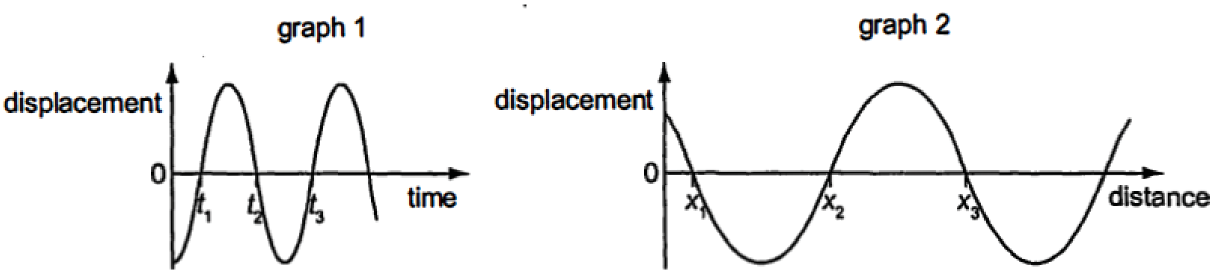
A transverse → longitudinal

B longitudinal→ transverse

C transverse → longitudinal →transverse

D longitudinal → transverse → longitudinal

28 Graph 1 shows how the displacement of one particular point of a wave varies with time.
Graph 2 shows how the displacement of the same wave varies with distance along the wave at one particular time.



Which expression gives the speed of the wave?

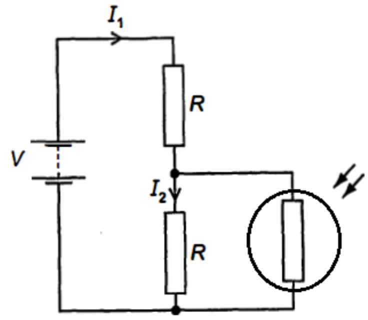
A $\frac{X_1}{t_1}$ **B** $\frac{X_2}{t_2 - t_1}$ **C** $\frac{X_2 - X_1}{t_2}$ **D** $\frac{X_3 - X_2}{t_2 - t_1}$

29 A guitar player struck a note on a guitar string. The same string is then struck harder.

Which of the following correctly compares the speed and wavelength of the second note with the first note?

	Speed	Wavelength
A	same	same
B	same	different
C	different	same
D	different	different

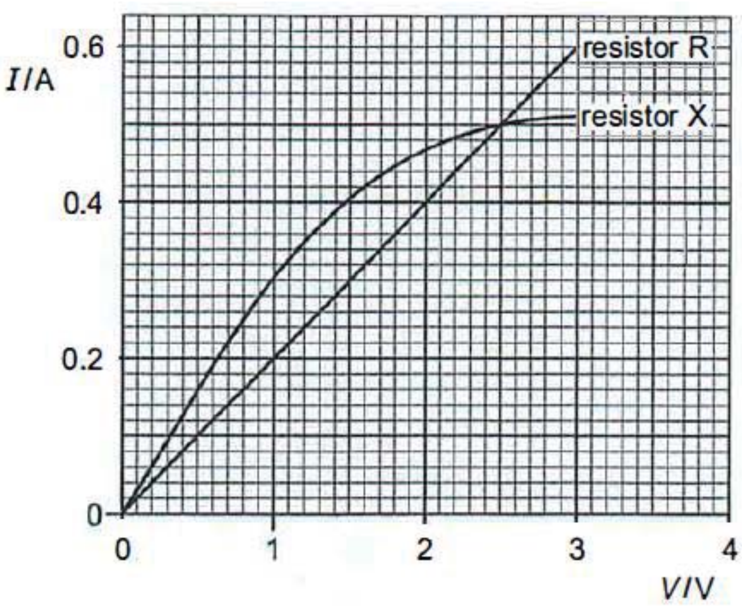
30 In normal light, the resistance of a light-dependent resistor (LDR) is ***R***. It is connected in the circuit with two resistors, each of resistance ***R***. The currents in the two resistors are I_1 and I_2 as shown.



How do the currents change when the circuit is moved to a brighter place?

	I_1	I_2
A	increase	increase
B	increase	decrease
C	decrease	decrease
D	decrease	increase

31 The graph shows the current-voltage (I-V) characteristics of two resistors R and X.



The resistors R and X are connected in series with a cell. The current in the circuit is 0.3A.

The resistors R and X are then connected in parallel with the same cell.

What is the e.m.f. of the cell and the current in the cell when the resistors are connected in parallel?

	e.m.f. / V	current / A
A	1.0	0.3
B	1.5	0.7
C	2.5	0.5
D	2.5	1.0

32 Which is a consequence of connecting several electrical appliances to the same power socket?

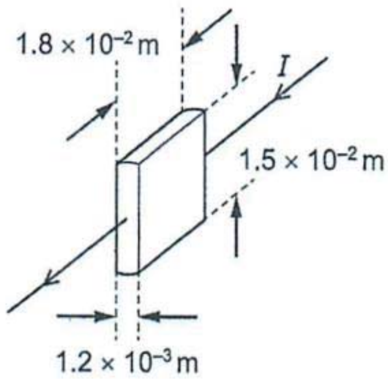
A Current drawn by each appliance is increased.

B Total resistance of all appliances is increased.

C Voltage drawn by each appliance is decreased.

D Total energy consumption is increased.

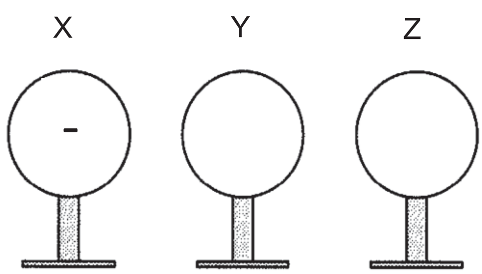
33 A current of 40 mA passes through a slice of semi-conducting material of dimensions as shown.



The slice dissipates 400 mW of heat energy.
What is the resistivity of the semiconductor under these conditions?

A 0.25 Ωm
B 0.36 Ωm
C 56 Ωm
D 380 Ωm

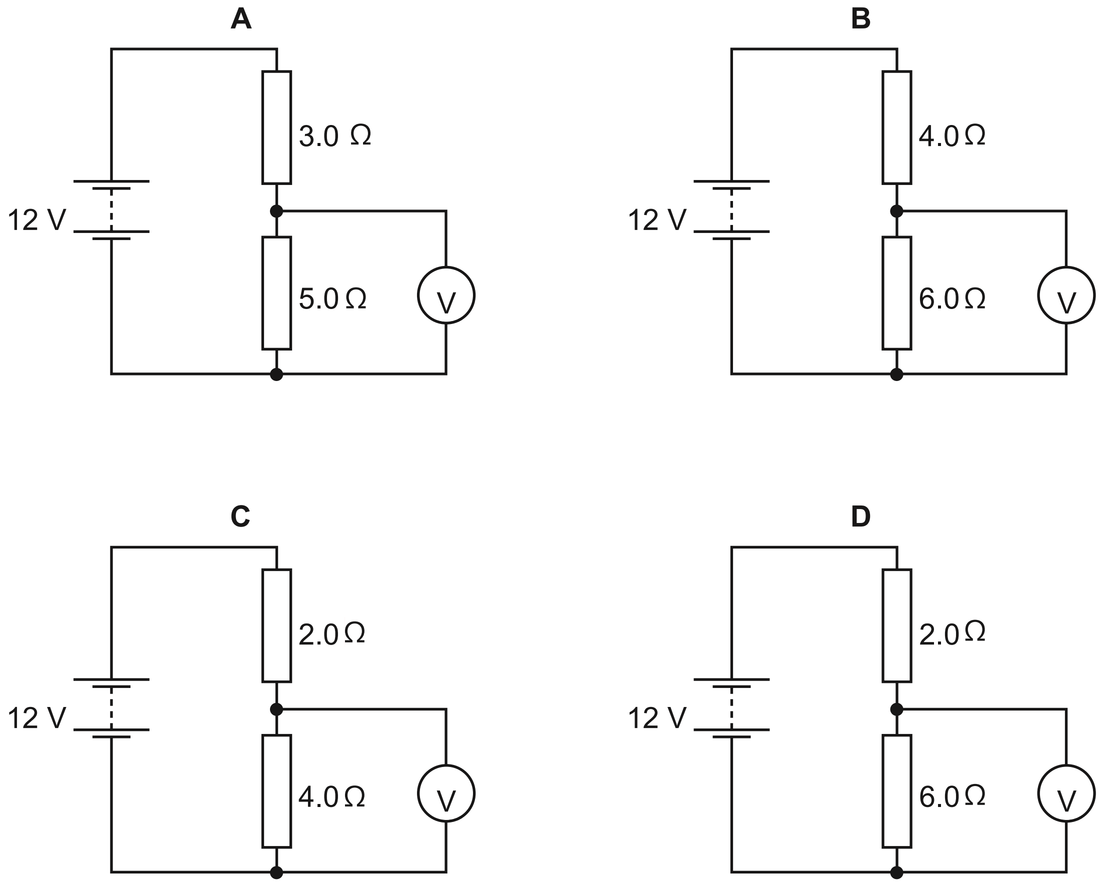
34 Three conductors are placed close to each other. Conductor X is negatively-charged. Both conductors Y and Z are neutral.



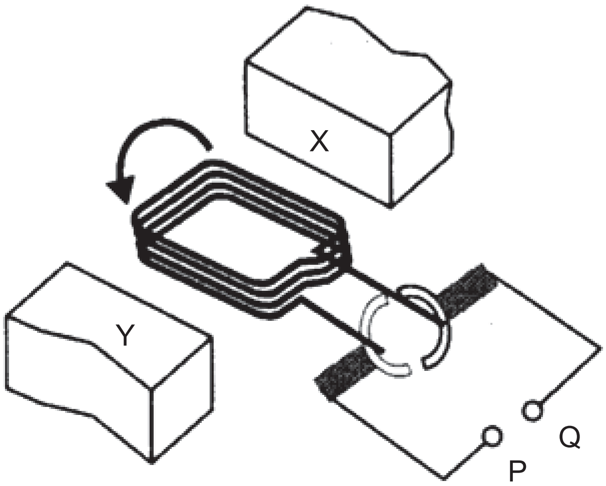
What will be the charge in conductor Z after it is being earthed momentarily?

A neutral **B** positive **C** negative **D** no charge

35 In which circuit is the voltmeter reading 7.2 V?



36 The diagram shows a simple d.c. motor.



Which combination(s) will achieve the direction of rotation shown in the diagram?

	Polarity	Direction of current
1	X is S-pole, Y is N-pole	P is +, Q is –
2	X is N-pole, Y is S-pole	P is -, Q is +
3	X is N-pole, Y is S-pole	P is +, Q is –

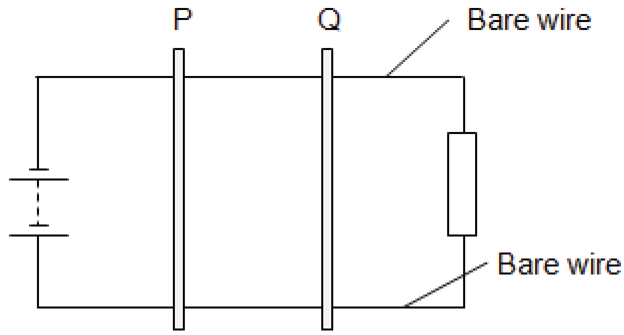
A 2 only

B 1 and 2 only

C 2 and 3 only

D 1 and 3 only

37 Copper rods P and Q are placed on top of rigid bare wires as shown.



Which observation is correct when the power supply is changed to a low frequency alternating current ?

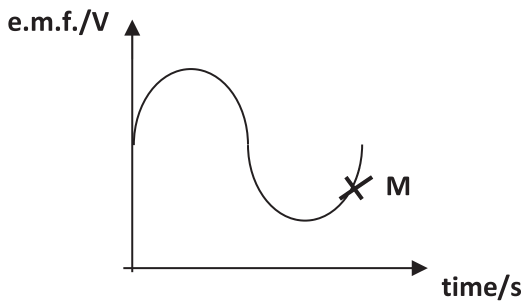
A P and Q attract each other.

B P and Q repel each other.

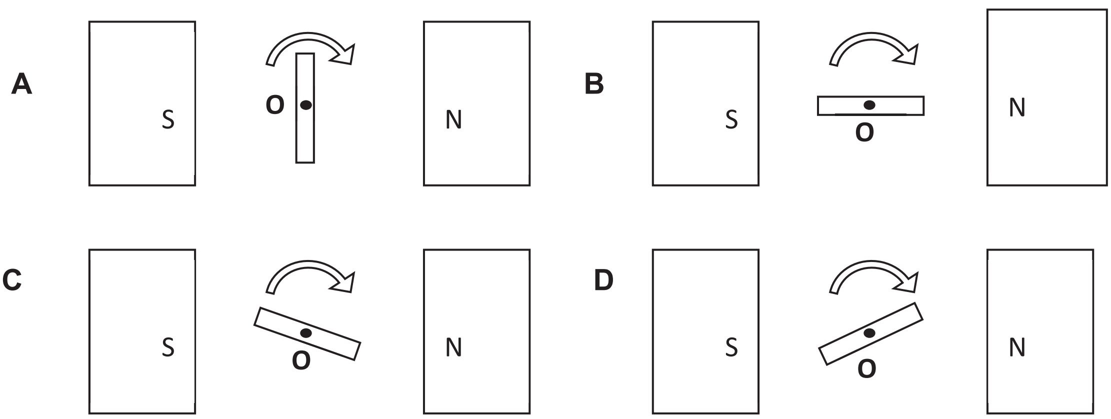
C P and Q repel then attract each other.

D P and Q both roll to the right and then to the left, keeping the same distance apart.

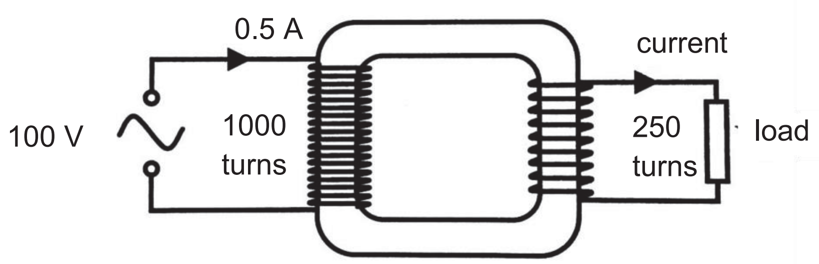
38 The graph below shows how the e.m.f. of an A.C. generator varies with time.



The diagrams below show the front view of the coil of an A.C. generator. The coil is being rotated about an axis through **O** in a uniform magnetic field. Which of them shows the position of the coil when the value of the induced emf is at **M**?



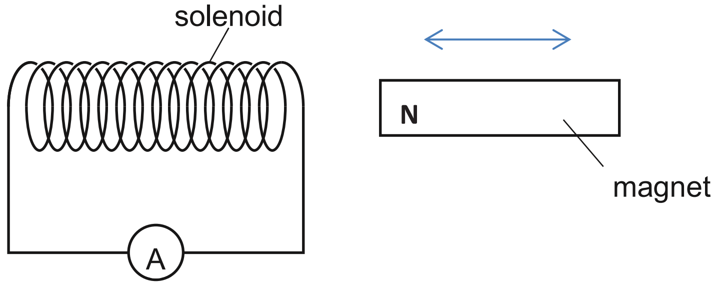
39 The diagram shows an ideal transformer. An a.c. supply of 100 V is supplied to the primary coil. A current of 0.5 A flows through it.



What is the potential difference and current flowing through the load?

	potential difference / V	current / A
A	25	2
B	25	4
C	50	2
D	50	4

40 A teacher moves a magnet into and out of a coil of wire, as shown, in order to demonstrate electromagnetic induction.



Which statement is correct?

A As the magnet is moved into the coil, the right-hand end of the coil becomes a S-pole.

B As the magnet is taken out of the coil, the right-hand end of the coil becomes a N-pole.

C Increasing the speed at which the magnet enters the coil increases the induced voltage.

D Increasing the speed at which the magnet leaves the coil decreases the induced voltage.

END OF PAPER

SINGAPORE CHINESE GIRLS' SCHOOL
PRELIMNARY EXAMINATION 2019
SECONDARY FOUR

CANDIDATE NAME										
CLASS	4				REGISTER NUMBER					
CENTRE NUMBER					INDEX NUMBER					

PHYSICS **6091/2**

Monday **2 September 2019** **1 hour 45 mins**

Candidates answer on the Question Paper.
No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Section A

Answer **all** questions.

Section B

Answer **all** questions. Question 11 has a choice of parts to answer.

Candidates are reminded that **all** quantitative answers should include appropriate units.
The use of an approved scientific calculator is expected, where appropriate.
Candidates are advised to show all their working in a clear and orderly manner, as more marks are awarded for sound use of Physics than for correct answers.

The number of marks is given in brackets [ ] at the end of each question or part question.

Take g = 10 ms^{-2} or 10 Nkg^{-1} unless stated otherwise.

For Examiner's Use	
Section A	50
Section B	30
Total	80

This question paper consists of 27 printed pages and 1 blank page.

SECTION A

Answer all the questions in this section.

1 A steel ball of mass 250 kg is suspended from the boom of a crane, a shown in **Fig. 1.1.**

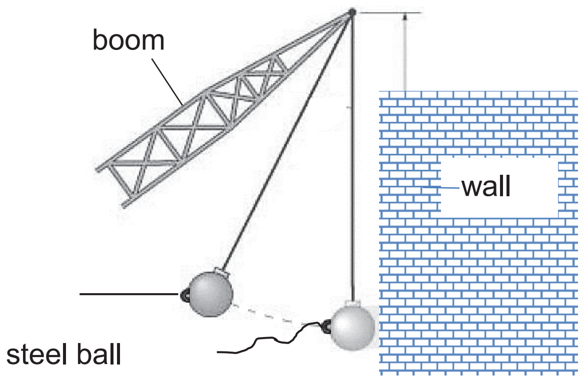


Fig. 1.1

(a) In order to demolish a wall, the ball is pulled from the wall at an angle and then released and hits the wall. The variation of the speed *v* of the ball with time *t* is shown in **Fig. 1.2**.

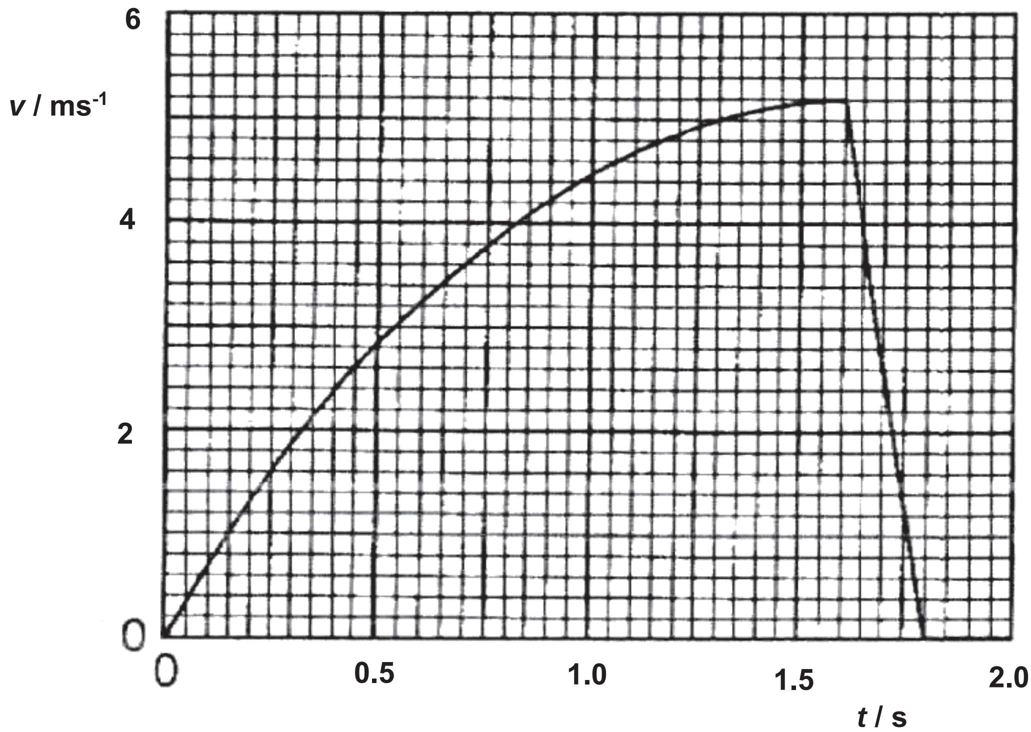


Fig. 1.2

Using **Fig. 1.2**, determine

(i) the magnitude of the acceleration of the ball at time t = 0.8 s.

Acceleration = …………….[2]

(ii) the total distance moved by the ball from the moment of release to when it comes to rest.

Distance moved = ……………………….[2]

(b) Explain why the steel ball undergoes decreasing acceleration after it is released, and then uniformly decelerates till it comes to rest.

…………………………………………………………………………………………………..…

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……………………………………………………………………………………………………..[2]

[Total: 6 m]

2 A model rocket of initial mass 1.3 kg is fired vertically into the air. Its mass decreases at a constant rate of 0.23 kgs^{-1} as the fuel burns. The final mass of the rocket is 0.38 kg.

(a) Calculate the weight of the fuel being burnt off.

Weight of fuel being burnt off = ……………………..[1]

(b) The variation with time *t* of the upward force on the rocket during the first 3 seconds after firing is shown in Fig. 2.1. The dotted line from 3.0 – 3.5 s is the predicted variation of the upward force on the rocket with time t.

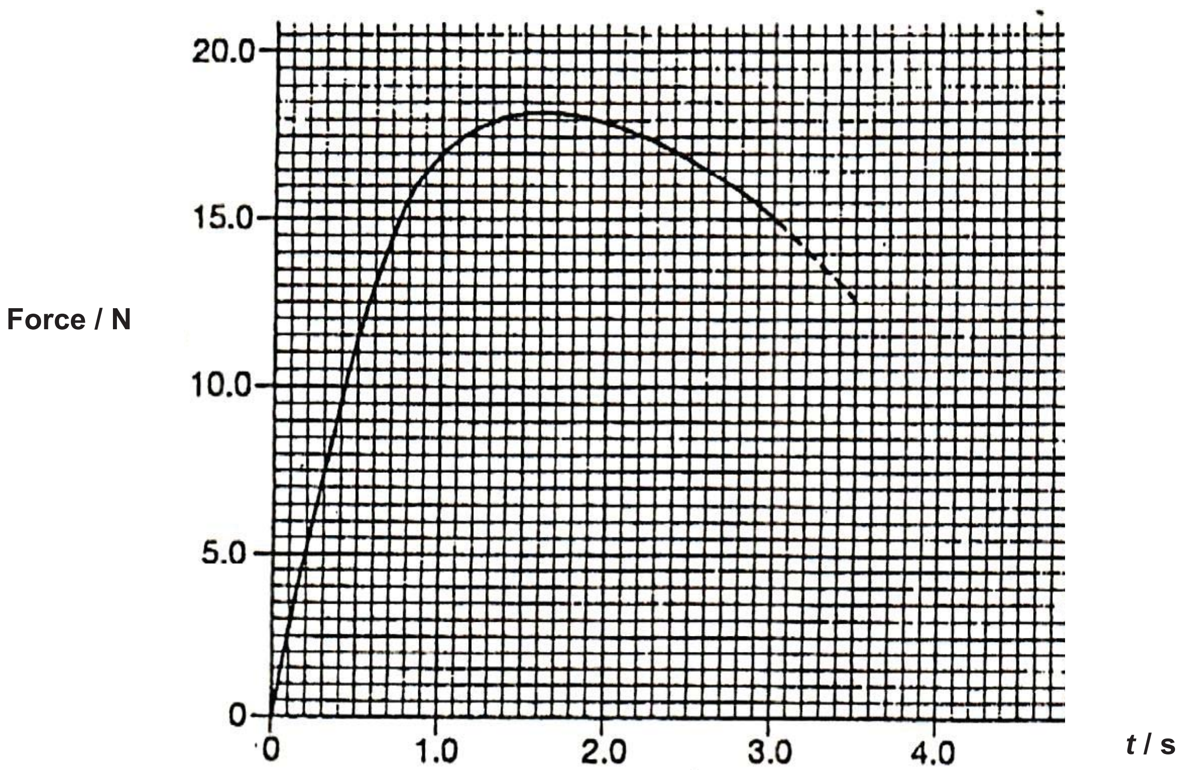

Fig. 2.1

On Fig. 2.1, draw a line drawn to represent the variation with time *t* of the total weight of the rocket during the first 5 seconds after firing. [2]

(c) **(i)** From the graph drawn in Fig. 2.1, read off the time delay between firing the rocket and lift-off.

Time delay = ……………………….. [1]

(ii) Determine the resultant force acting on the rocket at *t* = 2.5 s. Show clearly how you arrived at your answer in the space below.

Resultant force = …………………….[2]

[Total : 6 m]

3 Fig. 3.1 shows a student sitting on a chair. Fig. 3.2 shows the same student with his chair tilted backwards slightly. The four legs of the chair are identical.

Fig. 3.1

Fig. 3.2

(a) (i) State and explain how the pressure of the chair on the floor differs in the two positions.

……………………………………………………………………………………………………

……………………………………………………………………………………………………

……………………………………………………………………………………………………

…………………………………………………………………………………………………[2]

(ii) The chair and student fall over if the chair is tilted backwards more than in Fig. 3.2. Explain why.

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……………………………………………………………………………………………………

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…………………………………………………………………………………………………[3]

(b) Fig. 3.3 shows a painter standing on a wooden plank, directly above the right-hand support.

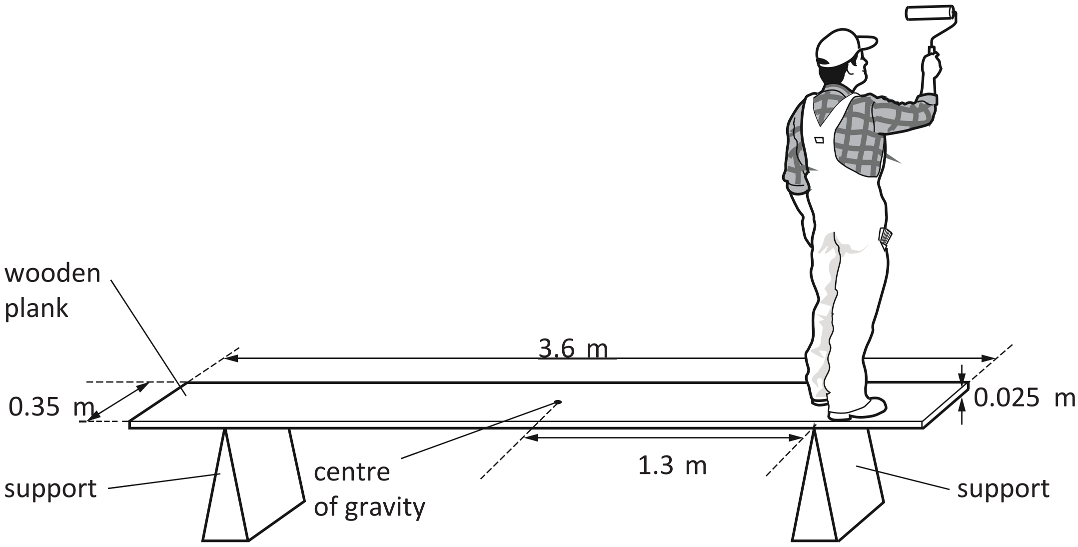


Fig. 3.3

The plank has a length of 3.6 m and a mass of 23 kg. The centre of gravity of the plank is in the middle of the plank at a distance of 1.3 m from each of the supports. The gravitational field strength g is 10 N / kg.

(i) Calculate the moment of the plank about the right-hand support.

moment = ... [1]

(ii) The painter moves further to the right along the plank and the plank rotates about the right hand support.

Explain why the plank rotates.

………………………………………………………………………………………………………...

………………………………………………………………………………………………………..

…………………………………………………………………………………………………....[1]

[Total : 7 m]

4 A lamp is positioned at the bottom of a small pool of water. The *critical angle* for light passing from water into air is 49°.

(a) Explain what is meant by the term *critical angle*.

....

....

....[1]

(b) The lamp sends light towards the surface of the pool.

Fig. 4.1 shows three rays of light that are at 30°, 60° and 90° to the horizontal.

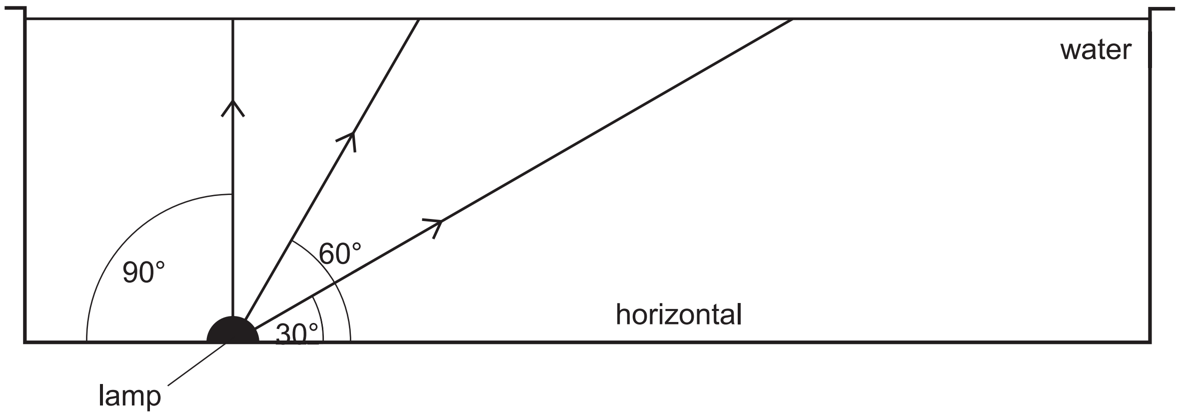


Fig. 4.1

On Fig. 4.1, draw the path taken by each of the three rays after they strike the surface of the water. [2]

(c) Determine n_{water}, the refractive index of water.

n_{water} = …………………..[2]

(d) The lamp is moved towards the right. It is observed that, at a certain position, a circular patch of light is seen on the surface of the water.

Explain how this circular patch is formed.

....

....

....[2]

[Total : 7 m]

5 Fig. 5.1 shows two glass containers, one painted black and one painted white, containing gases A and B respectively. They are connected together by a tube containing mercury.

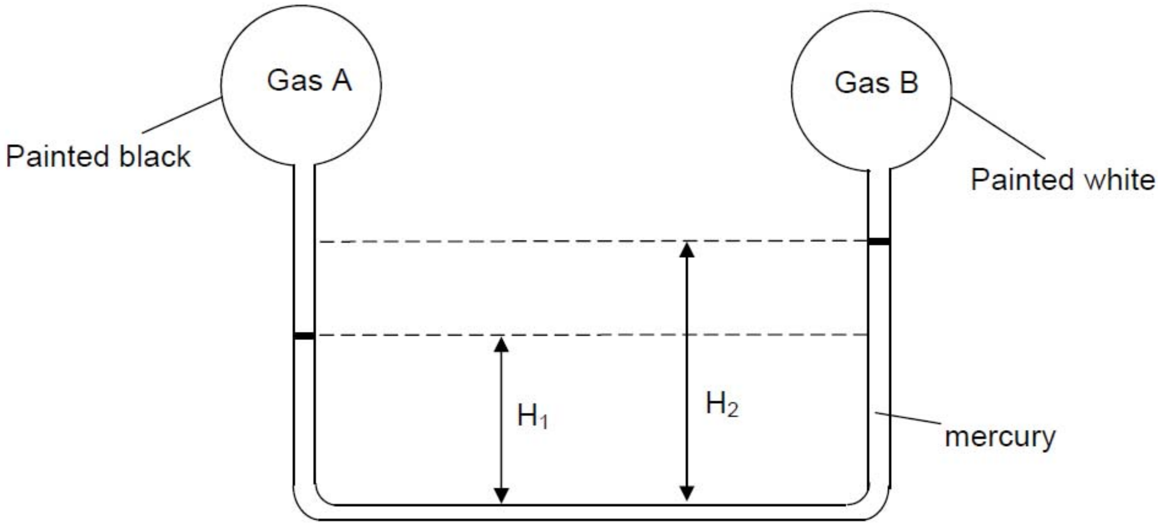


Fig.5.1

The density of mercury density is 13 600 kgm^{-3}.

(a) State which of the two types of gases is at higher pressure.

……………………………………………………………………………………………………[1]

(b) Given that H_1 = 40.0 cm and H_2 = 48.0 cm and Gas A is at 120 000 Pa, calculate the pressure of Gas B.

Pressure= …………………………[2]

(c) The whole set up is then placed under strong sunlight. Describe and explain how H_1 and H_2 would change.

……………………………………………………………………………………………………

……………………………………………………………………………………………………

……………………………………………………………………………………………………

……………………………………………………………………………………………………

……………………………………………………………………………………………………[3]

[Total : 6 m]

6 Fig. 6.1 shows a cylindrical copper kettle that contains cold water.

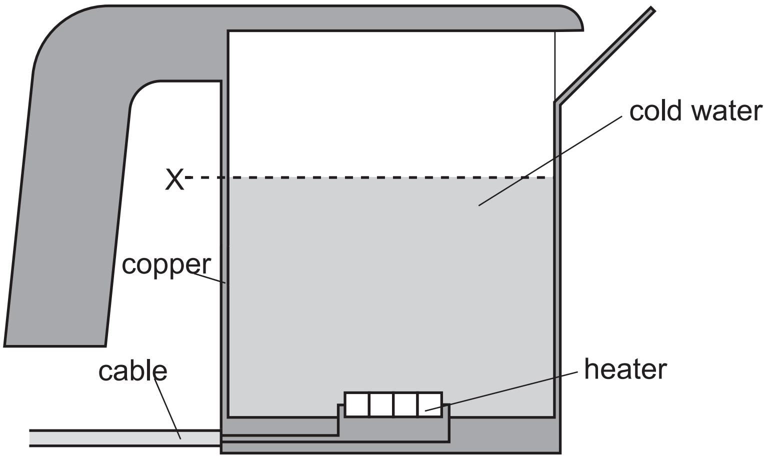


Fig. 6.1

(a) State and explain the advantage of heating the water from below.

....

....

....

.... [2]

(b) As the water is heated, it expands.

(i) Explain, in terms of molecules, why water expands when it is heated.

....

....

....

.... [2]

(ii) Copper also expands when heated.

State what happens to level X of the water in the kettle. Explain your answer in terms of the expansion of the copper and the water.

....

....

....

.... [2]

[Total : 6 m]

7 Fig. 7.1 shows a design for a simple circuit breaker in a household circuit.

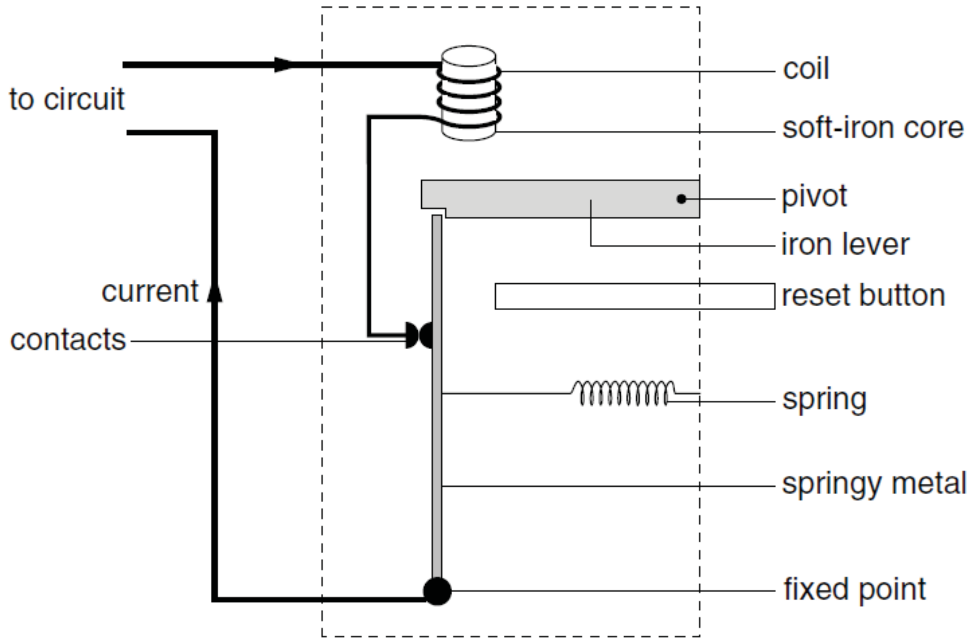


Fig. 7.1

(a) The circuit breaker opens the circuit when the current gets too high. Explain how the circuit breaker works as a safety device in the household circuit.

....

....

....

....

....

....[4]

(b) Explain what will happen if the current direction is reversed.

....

....

....[1]

[Total : 5 m]

8 Fig. 8 shows the cut-out section of the handle and cradle of an electric toothbrush. The figure on the right of the cut-out section shows the actual handle and cradle.

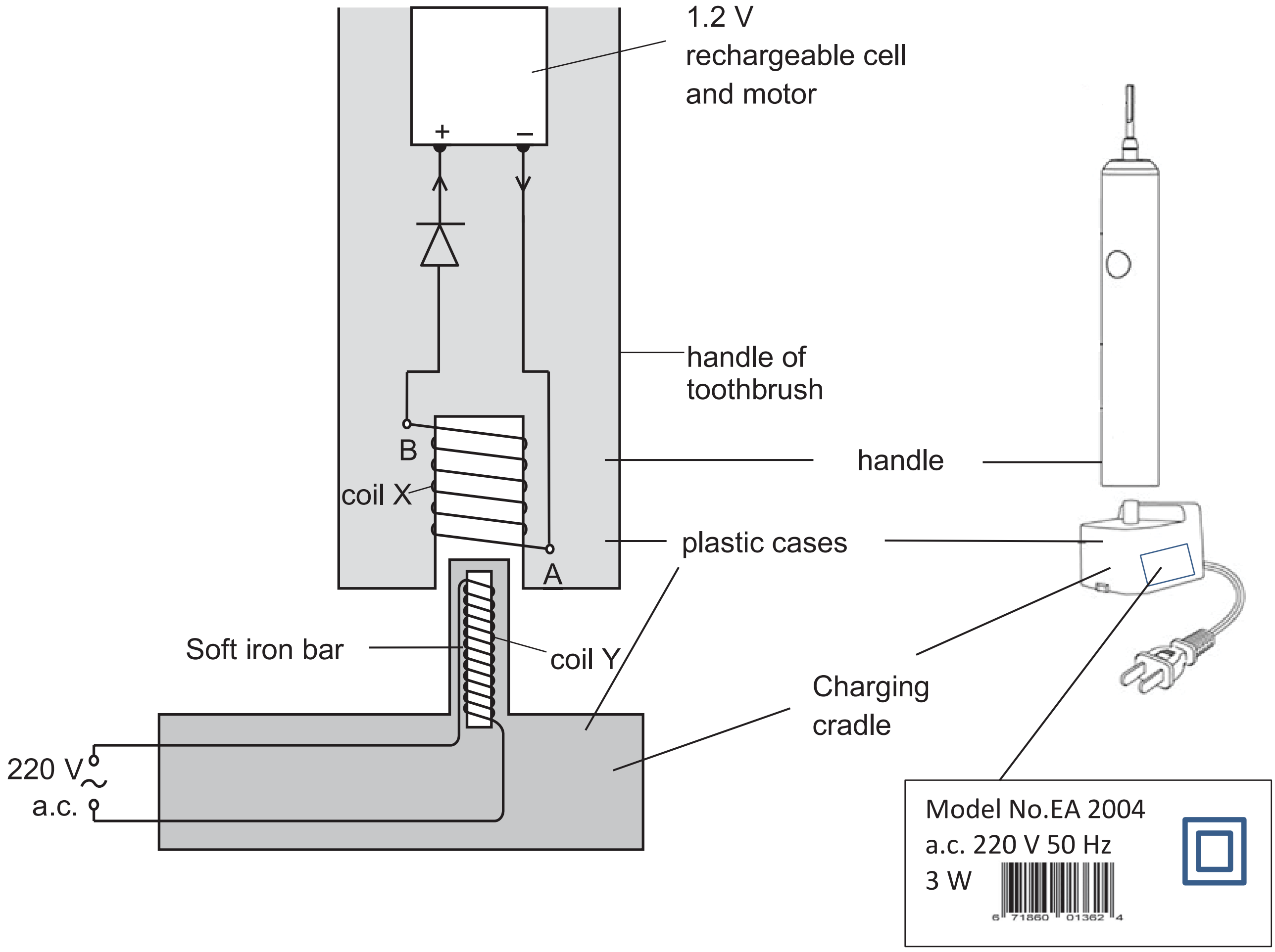


Fig. 8

The handle consists of a 1.2 V rechargeable cell and a motor. The cell is connected to coil **X** located at the bottom of the unit. The cradle consists of a short projection which houses a coil **Y** wound round a soft-iron bar. The cradle is connected to a 230 V a.c. mains supply. When the handle is inserted into this short projection, the battery is recharged.

The handle and the charging cradle are completely covered by plastic cases and there is no metal contact between them.

A label is also pasted at the side of the charging cradle.

(a) When the toothbrush is in operation, the current flowing through the motor is 1.8 A. Calculate the power consumed by the motor.

Power = …………………[1]

(b) It takes 16 hours to recharge the cell fully. Calculate the amount of energy needed.

Amount of energy = …………………….[2]

(c) Explain how an electromotive force (e.m.f.) is produced in the brush unit to recharge the cell.

……………………………………………………………………………………………………….

……………………………………………………………………………………………………….

……………………………………………………………………………………………………….

……………………………………………………………………………………………………….

……………………………………………………………………………………………………….

…………………………………………………………………………………………………[3]

(d) The charging unit is fitted with a two-pin plug.

Suggest one reason why it is safe for the charging unit to be fitted with a two-pin plug.

……………………………………………………………………………………………………….

……………………………………………………………………………………………………….

…………………………………………………………………………………………………[1]

[Total : 7 m]

END OF SECTION A

SECTION B

Answer **all** the questions in this section.
Answer any one of the two alternative questions in Question 11.

9 When a large earthquake occurs at a particular location near the surface of the Earth (known as the Epicentre) three types of seismic waves are produced. These waves are called Primary Waves (P-waves), and Secondary Waves (S-waves) and Surface Waves.

Fig. 9.1 shows the characteristics of these three types of waves.

Primary Waves (P-wave)	Secondary Waves (S-wave)	Surface Waves
• Longitudinal waves • Travels through the ground • Fastest waves • Can travel through solid and liquid	• Transverse waves • Travels through the ground • Medium speed waves • Only travel through solids	• Transverse waves • Travels on the surface. • Slowest waves

Fig. 9.1

(a) Explain the difference between a longitudinal wave and a transverse wave in terms of particle motion.

……………………………………………………………………………………………………

……………………………………………………………………………………………………

……………………………………………………………………………………………………[1]

(b) Seismic stations around the Earth detect these seismic waves using an instrument called a seismograph. Two types of seismographs are shown in Fig. 9.2(a) and Fig. 9.2(b).

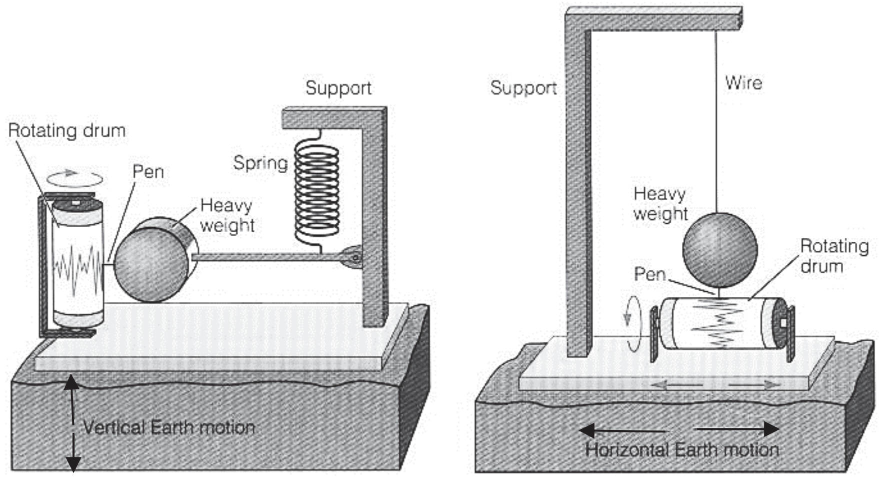
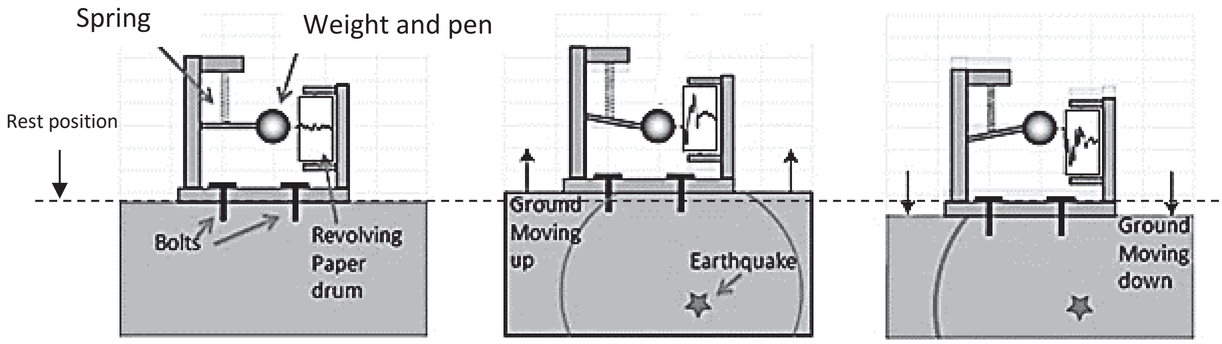


Fig. 9.2(a) Seismograph X **Fig. 9.2(b) Seismograph Y**

(i) Which type of wave does Seismograph X detect?

....[1]

Fig. 9.3 shows how seismograph X works when an earthquake occurs. The bolts secure the base of the seismometer to the ground. **Fig. 9.3(a)** shows the seismograph before an earthquake occurs.



(a) **(b)** **(c)**

Fig. 9.3

When an earthquake occurs, a seismic wave passes through the ground below the seismograph. The weight moves down when the ground moves up and moves up when the ground moves down. A trace of this motion, known as a seismogram, is recorded on rotating graph paper.

(ii) Explain how the up-and-down movement of the ground results in the weight moving up and down.

……………………………………………………………………………………………………

……………………………………………………………………………………………………

……………………………………………………………………………………………………

……………………………………………………………………………………………………

……………………………………………………………………………………………………

……………………………………………………………………………………………….[2]

(c) Fig. 9.4 shows the travel times for a P-wave and a S-wave with distance from the epicentre of an earthquake.

Graph of P-Wave and S-Wave travel time versus distance from epicentre of earthquake

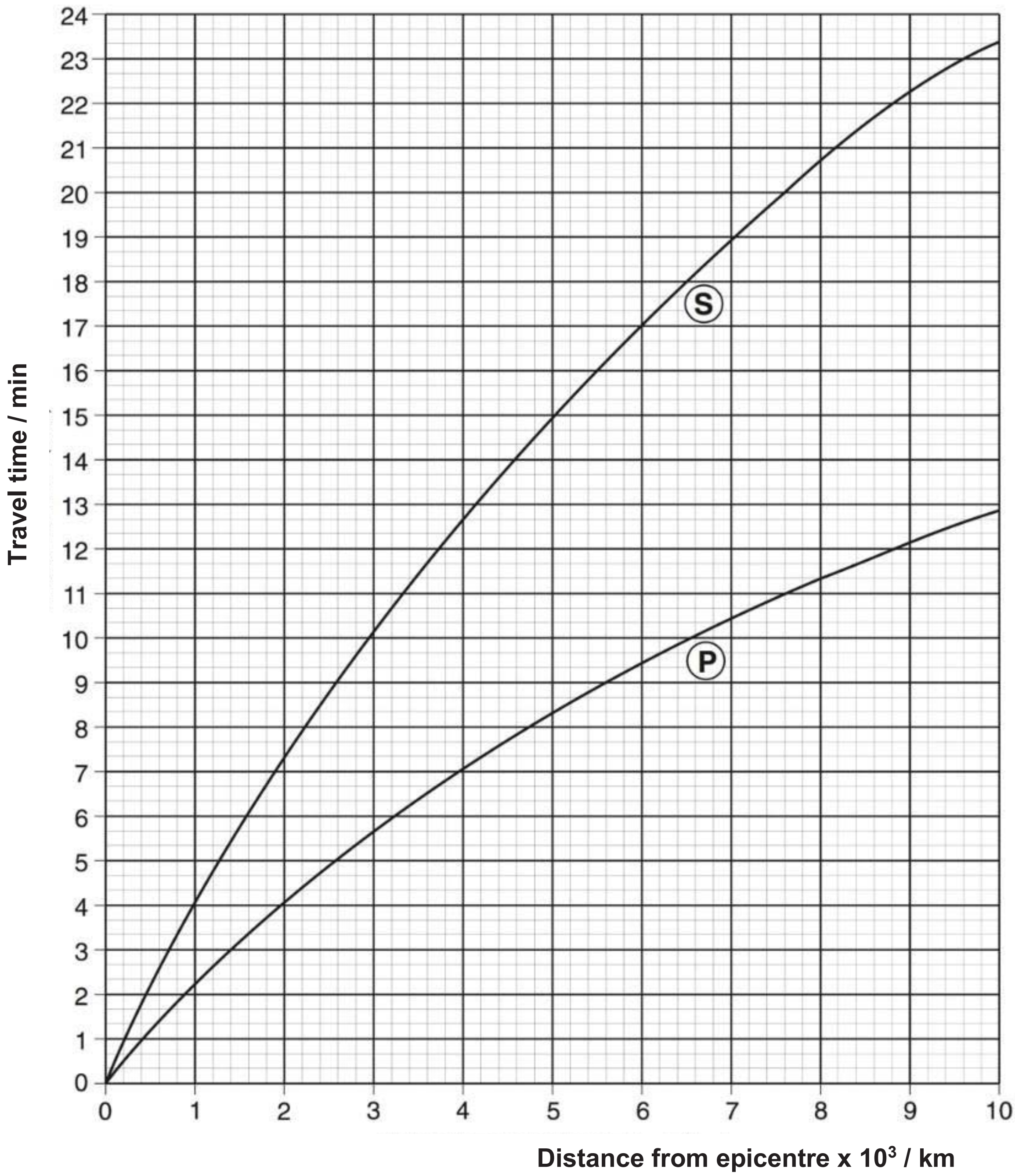


Fig. 9.4

(i) A seismographic station, A, detects the arrival of an S-wave 5 minutes 40 seconds after the arrival of a P-wave. Using Fig. 9.4, state the distance of the seismographic station from the epicentre of the earthquake. Mark clearly on the graph to show how you arrive at your answer.

Distance = ……………………….[2]

.

(ii) Determine the average speed of the P-waves arriving at Station A in kms^{-1}.

Average speed = ... [2]

(iii) Two other seismographic stations, B and C, are located 3.2×10^3 km and 7.8×10^3 km from the epicentre. Determine the average speed of the S-waves in kms^{-1}.

Average speed = ... [2]

10 Fig. 10.1 shows a rotating magnet in an alternating current generator that is used to power a lamp.

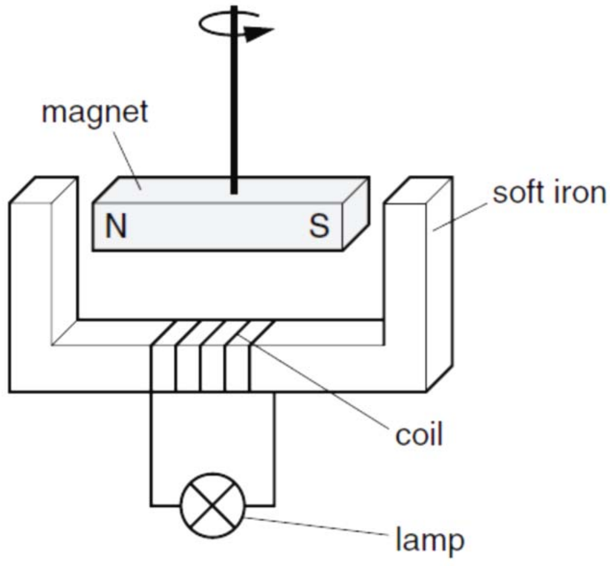


Fig. 10.1

(a) **(i)** Explain, in detail, how **alternating** current is produced by the apparatus shown in Fig. 10.1.

....

....

....

....

....

....[3]

(ii) State two ways in which the current in the lamp may be increased.

1..

2..[2]

(b) The generators at a power station produce a voltage of 25 000 V. This voltage is stepped up to 400 000 V by a transformer for long-distance transmission on overhead power lines. The voltage is later stepped down to 240 V.

(i) State and explain why the voltage is stepped up for long-distance transmission.

....

....

....[2]

(ii) Calculate the ratio of the number of turns in the primary coil of the step-up transformer to the number of turns in its secondary coil.

ratio = ...[1]

(iii) An electric drill of power 800 W is used in a country where the mains voltage is 240 V. State and explain the most appropriate fuse to use with this drill. You should select a fuse from the following values: 1 A, 3 A, 4 A, 13 A.

....

....

....[2]

11 EITHER

11(a) What do you understand by *electrostatic induction* ?

……

……

……[1]

(b) Fig. 11.1 shows two identical light conducting spheres P and Q hanging vertically from two points on insulating threads.

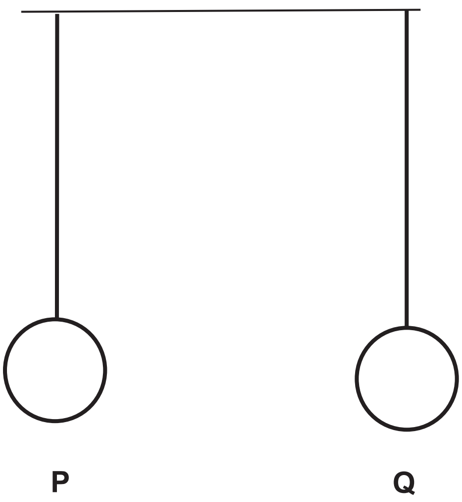


Fig. 11.1

Describe and explain what happens if

(i) P is negatively-charged and Q is neutral,

…………………………………………………………………………………………………

…………………………………………………………………………………………………

…………………………………………………………………………………………………

…………………………………………………………………………………………………

…………………………………………………………………………………………………

…………………………………………………………………………………………………[2]

(ii) both P and Q have the same amount of negative charges.

……………………………………………………………………………………………………

……………………………………………………………………………………………………

……………………………………………………………………………………………………

……………………………………………………………………………………………………

……………………………………………………………………………………………………

…………………………………………………………………………………………… ….[3]

(c) When a balloon is rubbed on hair, the balloon becomes negatively charged. The balloon is shown in Fig. 11.2.

Fig. 11.2

(i) Explain how rubbing causes the balloon to become negatively charged.

……………………………………………………………………………………………………

……………………………………………………………………………………………………

……………………………………………………………………………………………………

…………………………………………………………………………………………………… [2]

(ii) Explain why the hair is attracted towards the balloon.

....

....

....[1]

(iii) Explain why it is important that the balloon is made from an electrical insulator.

....

....[1]

11 **OR**

Newton's third law of motion can be expressed in the following form.

"When body A exerts a force on body B, then body B exerts a force on body A. These forces are

- equal in magnitude,
- opposite in direction,
- of the same nature.

(a) An object is undergoing free fall with no air resistance. Explain, using a labelled force diagram, the application of Newton's third law to this falling object.

....

....

....

....[2]

(b) An object is dropped out of a plane from 10,000 m. Air resistance increases as the object speeds towards Earth.

(i) On Fig. 11.1, sketch a graph to show how the speed of the object falling from rest in air varies with time.

[1]

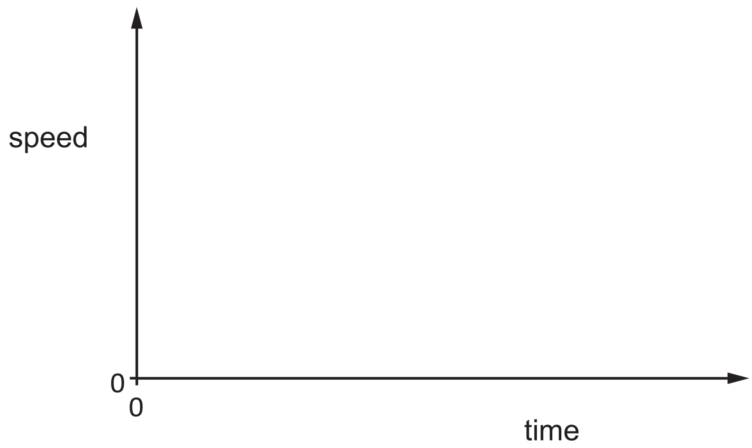


Fig. 11.1

(ii) Explain, using a labelled force diagram, the application of Newton's third law to this falling object at terminal velocity. You should exclude the answer you gave in **(b)(i)** above if they are the same.

....

....

....

....

....

....[2]

(c) A diver of height 1.80 m has his centre of gravity (C of G) 1.00 m above his feet when standing on the springboard. Fig. 11.2 illustrates the diver leaving the springboard, moving upwards and then entering the water.

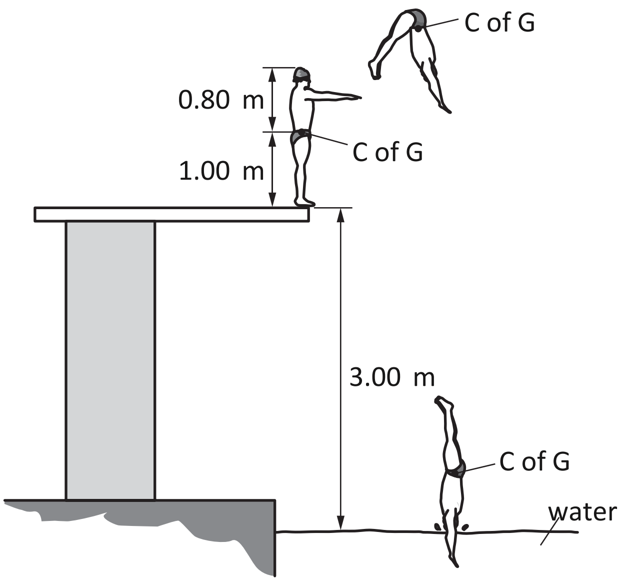


Fig. 11.2 (not to scale)

The diver leaves the springboard with an upward velocity of 5.6 m s^{-1}. The take-off point on the board is 3.00 m above the water.

Assume that the centre of gravity (C of G) of the diver remains at the same position within the diver throughout the dive and ignore air resistance.

(i) Explain what you understand by the centre of gravity (C of G) of an object.

………………………………………………………………………………………………

…………………………………………………………………………………………….[1]

(ii) Determine the maximum height of his centre of gravity above the water.

height = ... [2]

(iii) Determine the speed at which the diver's head reaches the water.

speed = ... [2]

END OF PAPER

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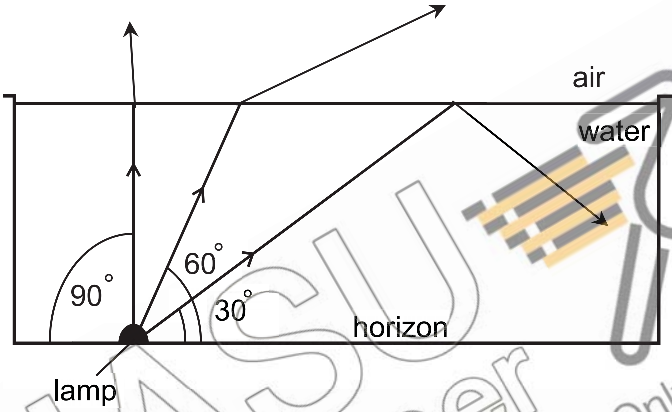
2019 PRELIMINARY EXAMINATION
PHYSICS 6091

PAPER 1

1	B	2	C	3	C	4	A	5	B
6	A	7	A	8	A	9	A	10	D
11	B	12	A	13	C	14	B	15	C
16	A	17	C	18	C	19	D	20	A
21	B	22	B	23	A	24	C	25	B
26	D	27	D	28	D	29	A	30	B
31	D	32	D	33	A	34	B	35	B
36	B	37	A	38	C	39	A	40	C

PAPER 2

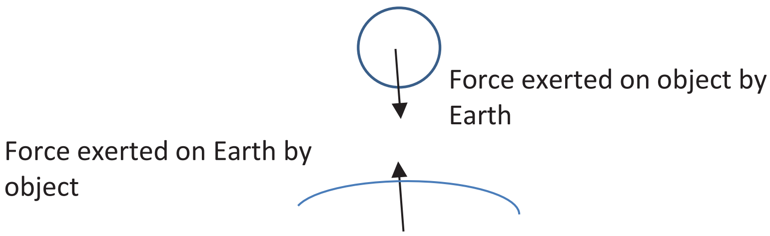
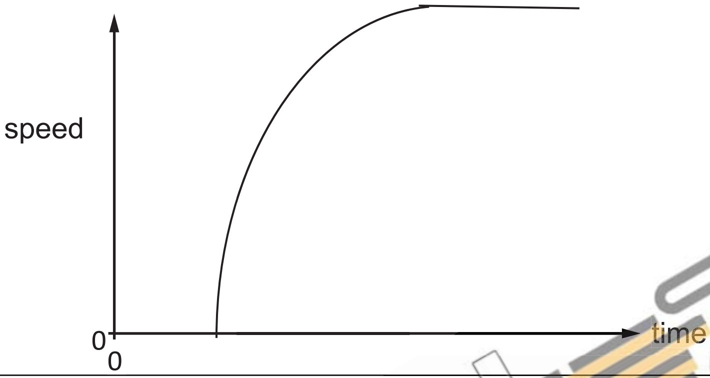
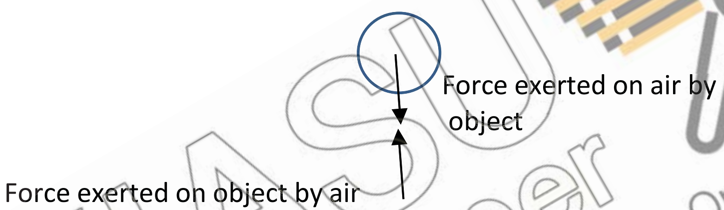
Qn	Suggested solution	Mark	Remark
1(a)(i)	Acceleration = (5.6 – 2.2)/1.35 – 0.20 = 2.3 ms^{-2}	[2]	Evidence (two coordinates and tangent shown on graph
(ii)	Total distance = area under v-t graph ≅6.0 m	[2]	Calculation showing how area is derived
(b)(i)	▪ Air resistance increases with increasing speed as GPE is converted to KE.From F_{net} =ma, the net force acting on the ball decreases and it will undergo deceleration [1] ▪ The wall's resistance is constant. From $F_{resistance}$ = ma, the deceleration is a constant. [1]	[2]	
	Total	6	
2(a)	Weight = (1.3– 0.38)x10 Nkg^{-1} = 9.2 N	[1]	No marks for no working/wrong unit
	Line sloping from 13.0 N to 3.8 N Line parallel from t-axis from 4.0 s *Time taken for the fuel to blast off = 0.92 kg/0.23 kgs^{-1} = 4.0 s *working optional	[1] [1]	
(c)(i)	0.5 s	[1]	
(ii)	Resultant force acting at 2.5 s = 16.7 – 7.3* N [1] = 9.4 N [1]	[1] [1]	*value as per graph drawn
	Total	6	
3(a)(i)	Pressure exerted on the floor in Fig. 3.2 is greater than that in Fig. 3.1. Weight of the boy and chair, W_T is distributed over two legs compared to over four legs plus the shoes, so from P =W/A, the smaller area of contact in Fig.3.2 will result in a larger pressure.	[2]	

(a)(ii)	The line of action of the combined weight of the student and the chair is in line with the pivot [1]in Fig. 3.2. If he tilted further backwards, the line of action of this combined weight is not in line with the pivot [1] and this creates a resultant anticlockwise moment about the two hind legs[1].	**[3]**	Unstable equilibrium not accepted unless accompanied by explanation
(b)(i)	Anticlockwise moment of plank = 230 N x 1.3 m = 299 Nm = 300 Nm (2s.f.) [1]	**[1]**	
3(c)	The painter's weight created a net clockwise moment about the right hand support / the clockwise moment > 299 Nm	**[1]**	
	Total	**7**	
4(a)	It is the incident angle in the optically less dense medium which resulted in a refracted angle of 90° in the optically less dense medium	**[2]**	
(b)		**[2]**	Three rays correctly drawn [2] Two rays correctly drawn [1]
(c)	$n_{water} = 1/ \sin c_{water}$ $= 1/ \sin 49^o$ $= 1.33$	**[2]**	
(b)	▪ Within the circular patch – the light is incident at the surface at an angle of incidence δ49° and emerge out of the water [1]. ▪ Beyond the circular patch, the light is incident on at the water surface at an angle of incidence > 49°, resulting in total internal reflection. Light does not emerge out [1]. The edge of the circular patch thus represents the boundary between total internal reflection and no total internal reflection.	**[2]**	
	Total	**7**	
5(a)	Gas A	**[1]**	
(b)	$P_B + (0.08)(13600)(10) = 120000$ [1] PB = 1.09×10^5 Pa or 1.1×10^5 Pa. [1]	**[2]**	
(c)	H_1 will drop and H_2 will rise [1] resulting in a bigger difference between the two levels . Black surfaces are good absorbers of radiation/thermal energy. Gas A receives the thermal energy, resulting in a pressure build-up [1]. This increase in pressure pushes the level of mercury down in the left arm and up in the right arm, thus increasing the height difference between the two levels. [1]	**[3]**	

	Total	6	
6(a)	Even heating throughout / Take less time / speed up heating / even temperature[1] Heating the water from below creates a convection current due to the displacement of cooler denser water at the top by warmer but less dense water below[1] This continuous movement of water will ensure that thermal energy is evenly spread throughout and time taken for heating the water is less.	**[2]**	
(b)(i)	Molecules vibrate vigorously on receiving thermal energy. The increase in the amplitude of molecular vibration increases the spacing between the molecules[1]. Layers of liquid molecules are moving faster and move further apart[1]. Both factors produce an increase in the volume of water. Thus water expands.	**[2]**	
(ii)	Level X drops and then rises [1] Copper expand faster than water. The increase in volume of copper will lower the water level first. After the copper ceases expanding, the continual expansion of water will raise its level.	**[2]**	
	Total	6	
7(a)	▪ When a high current passes through, the iron core is magnetized because a magnetic field is set up in the coil [1] ▪ The magnetized core then attracts the iron lever, rotating it about the pivot and lifting it up [1] ▪ This causes the springy metal to be released as it is pulled by the spring and this causes the contacts to be opened. ▪ The spring also pulls the springy metal towards the reset button thereby pushing it outwards[1]	**[4]**	
(b)	The workings will not be affected as the core is still magnetized and attraction still take place.	**[1]**	
	Total	5	
8(a)	P = 1.8 x 1.2 = 2.16 W	**[1]**	
(b)	E = Pt = 3 x 16 x 60 x 60 = 172800J	**[2]**	
(c)	▪ The a.c. flowing in the coil in the charging unit produces a changing magnetic field in coil Y, which is concentrated by the soft-iron bar [1]. ▪ When the brush unit is placed on the charging unit, the changing magnetic flux linking coil Y and X produces the induced e.m.f. [1] ▪ The induced a.c. current in coil X will charge the cell connected to it	**[3]**	
(d)	Because both the brush and charging unit are completely covered by plastic, the casing will not be 'live' even if there is a fault and	**[1]**	

	hence the earth wire is not necessary and a two-pin plug will suffice.		
	Total	**7**	
9(a)	Difference is in the direction of oscillation of the particles. Longitudinal wave, the particles oscillate parallel to the direction of wave propagation Transverse wave, the particles oscillate perpendicular to the direction of wave propagation.	**[1]**	
(b)(i)	S-wave / Secondary Wave and surface waves	**[1]**	
(ii)	When the ground move up, the weight, due to its inertia, will tend to remain in its state of rest and move downwards. The spring is stretched[1] When the ground move down, the stretched spring will release its stored elastic potential energy and pull the weight up [1]	**[2]**	
(c)(i)	4 x 10^3 km [1 m] 1m – clear marking on the graph	**[2]**	
(ii)	Average speed = 4000 km / (7x 60)s = 9.52 kms^{-1}	**[2]**	
(iii)	Average speed = (7.8 – 3.2)x 10^3 km÷(20 mins 20 s – 10 min 40 s) = 4.6 x 10^3 ÷ 9 min 40 s = 7.93 kms^{-1}	**[2]**	
	Total	**10**	
10(a)(i)	▪ The rotation of the magnet induces each end of the ▪ soft iron to alternate in polarity at every half rotation. [1] ▪ The strength of the magnetic flux in the soft iron increases and decreases as the magnet move towards and away from the soft iron. [1] ▪ The coil experiences a constant rate of change of magnetic flux linkage with this alternating polarity and changing magnetic field strength. This induces an alternating e.m.f hence an alternating current in the coil. [1]	**[3]**	
(ii)	more turns in coil/ thicker wires/ stronger magnet/ faster rotation	**[2]**	
(b)(i)	To reduce power loss because with high voltage and low current is lowered [1] This reduces power loss through joule heating/heating effect by the current [1]	**[2]**	
(ii)	N = 25/400 = 0.0625 (1:16)	**[1]**	
(iii)	P = VI 800W = 240 x I I = 800/240 = 3.33 A	**[2]**	Calculation shown that warrant correct

	Fuse : 4 A		selection of fuse rating.
	Total	**10**	
Either **11(a)**	Charging without contact between a conductor and a charged body/ separation of charges in a conductor when the conductor is placed in an electric field	**[1]**	
(b)(i)	▪ P induces positive charges on Q on the side closer to P/repels electrons on Q to the right side leaving positive charges induced on the side closer to P[1] ▪ P and Q are attracted to each other as opposite charges attract[1].	**[2]**	
(ii)	▪ P and Q will be repelled away from each other as like charges repel [1]. ▪ Both P and Q will be displaced at the same angle from the vertical and remain in that equilibrium position [1]. ▪ Both spheres have the same amount of charge and the force of repulsion are action-reaction pair forces [1]	**[3]**	
(c)(i)	EITHER Electrons from the hair are stripped off/transferred from the hair atoms and deposited on the balloon [1].The excess electrons on the balloon cause it to become negatively-charged [1] OR Friction between the hair and the balloon generates thermal energy[1]. The weakly-attracted electrons of the atoms of the hair gain this thermal energy to escape and deposited on the balloon thereby making it negatively-charged [1]	**[2]**	
(c)(ii)	EITHER The negatively-charges on the balloon and the polarized atoms on the hair. Opposite charges attracts, causing the hair to be attracted to the balloon. **OR** The negatively-charged balloon attracts the positively-charged hair / induces the positively-charge on the hair closer to the balloon. As opposite charges attract, the hair is attracted to the balloon.	**[1]**	
(iii)	Charges accumulated on the balloon will be retained on the balloon in and around the region where the balloon is being rubbed.	**[1]**	
	Total	**10**	

11OR (a)(i)	 Earth and object exerts an equal and opposite pull on earth other. The force exerted on the object is the weight. The object exerts an amount of force equal to this weight on the Earth.	**[1]** **[1]**	
(b)(i)		**[1]**	
(ii)	 At terminal velocity, object exerts a force on the body of air as it passes through it. The body of air exerts an amount of force equal in magnitude and opposite in direction to this force.	**[1]** **[1]**	
(c)(i)	It is a point on or outside a body where the whole weight of the body appears to act.	**[1]**	
(ii)	From $mgh = ½ mv^2$ $h = ½ (5.6)^2 ÷ 10$ $= 1.57$ m [1] Height of CG above water = 1.57 + 4.00 = 5.57 m [1]	**[2]**	
(iii)	From $v = \sqrt{(2gh)}$ $= \sqrt{(2 \times 10 \times (5.57 - 0.8))}$ [1] $= 9.8$ ms^{-1} [1]	**[2]**	
	Total	**10**	

TANJONG KATONG GIRLS' SCHOOL
PRELIMINARY EXAMINATION 2019
SECONDARY FOUR

6091/01 **PHYSICS**
Paper 1 Multiple Choice

WEDNESDAY **4 SEP 2019** **1 hour**

Additional materials: OMR answer sheet

INSTRUCTIONS TO CANDIDATES

Do not open this booklet until you are told to do so.

Write your name, class and index number on the OMR Answer Sheet.

There are **forty** questions in this paper. Answer **all** questions. For each question, there are four possible answers, **A**, **B**, **C** and **D**.

Choose the one you consider correct and record your choice in **soft pencil** on the OMR Answer Sheet.

Take gravitational field strength to be 10 N/kg unless stated otherwise in the question.

Read the instructions on the OMR Answer Sheet very carefully.

At the end of the examination, hand in the OMR Answer Sheet.

INFORMATION FOR CANDIDATES

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any rough working should be done in this booklet.

This question paper consists of 17 printed pages including this cover page.

Answer **ALL** the questions in this paper on the OMR sheet provided.

1 Which of the following is a good estimate for the thickness of a fingernail?

A 1 dm **B** 1 cm **C** 1 mm **D** 1 μm

2 A student intends to determine the volume of a copper pipe which spans several metres long. The pipe has a uniform cross-sectional area. The external diameter of the copper pipe is estimated to be 5 cm.

Which pair of instruments will allow him to measure the necessary dimensions accurately?

A vernier calipers and tape

B micrometre screw gauge and tape

C vernier calipers and rule

D micrometre screw gauge and vernier calipers

3 Three forces 3 N, 4 N and 8 N act on an object. Which of the following cannot be the resultant force acting on the object?

A 0 N **B** 1 N **C** 8 N **D** 14 N

4 A racing car is fitted with an on-board computer which can record the distance travelled by the car for every one second. The computer starts recording when the car passes the starting line and moves along a straight line.

Which set of data shows that the car is accelerating during the next 2 seconds?

A

Time / s	Distance / m
0	0
1	100
2	200

B

Time / s	Distance / m
0	0
1	90
2	180

C

Time / s	Distance / m
0	0
1	100
2	180

D

Time / s	Distance / m
0	0
1	80
2	190

5 The diagram shows a person using a rope to pull a block on a rough surface to the right. The block moves at a constant speed.

Which pair of forces is a pair of action and reaction force?

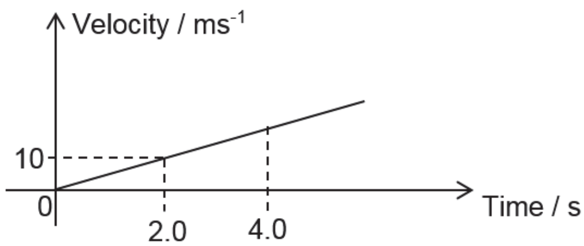
A Frictional force acting on the block by the ground and the pulling force on the block

B The pulling force on the block and the tension force experienced by the rope

C The weight of the block and the normal reaction force acting on the block by the ground

D The frictional force acting on the person by the ground and the frictional force acting on the block by the ground

6 The diagram shows the velocity-time graph of a car. The total resistive force acting on the car is 1000 N. The mass of the car is 1000 kg.



What is the resultant force acting on the car at t = 4.0 s?

A 0 N **B** 4000 N **C** 5000 N **D** 6000 N

7 An astronaut lands on a planet where the acceleration of free-fall at its surface is greater than that on Earth. Which of the following will be the same as that on Earth?

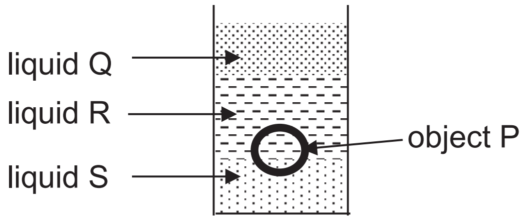
A The weight of the astronaut

B The period of oscillation of a simple pendulum

C The height reached by the astronaut when he jumps with the same initial velocity

D The acceleration of a block when being pushed horizontally by the same force on a smooth surface

8 A circular object P is lowered into a cylinder which contains 3 different layers of immiscible liquids. The diagram shows the position of object P in the cylinder.



Which of the following correctly shows the densities of the substances arranged in increasing order?

A liquid Q, object P, liquid R, liquid S

B liquid Q, liquid R, object P, liquid S

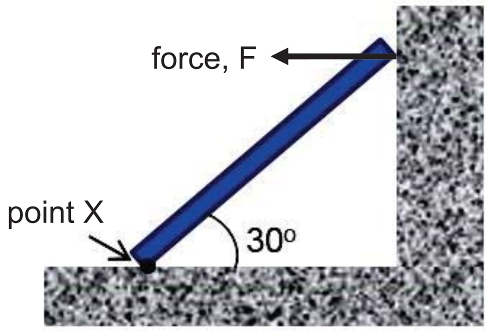
C liquid S , liquid R, object P, liquid Q

D liquid S, object P, liquid R, liquid Q

9 The diagram shows a stationary uniform ladder leaning against a smooth wall and making an angle of 30° with the ground at point X.

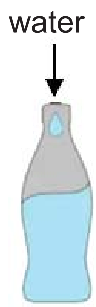
The wall exerts a horizontal force F on the ladder. The weight of the ladder is 500 N.

What is the magnitude of the force F?



A 144 N **B** 250 N **C** 433 N **D** 500 N

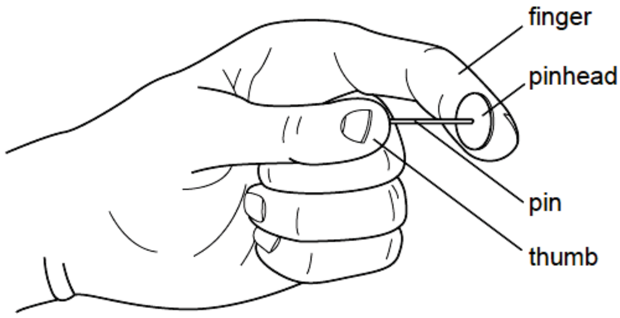
10 The diagram shows a bottle being filled up with water.



What happens to the stability and the centre of the gravity of the bottle (with water) as the bottle is filled with water?

	Stability	Centre of Gravity
A	become less stable	centre of gravity is raised
B	become less stable	centre of gravity is lowered
C	become more stable	centre of gravity is raised
D	become more stable	centre of gravity is lowered

11 The diagram shows a pin being squeezed between a finger and the thumb.



Which statement is correct?

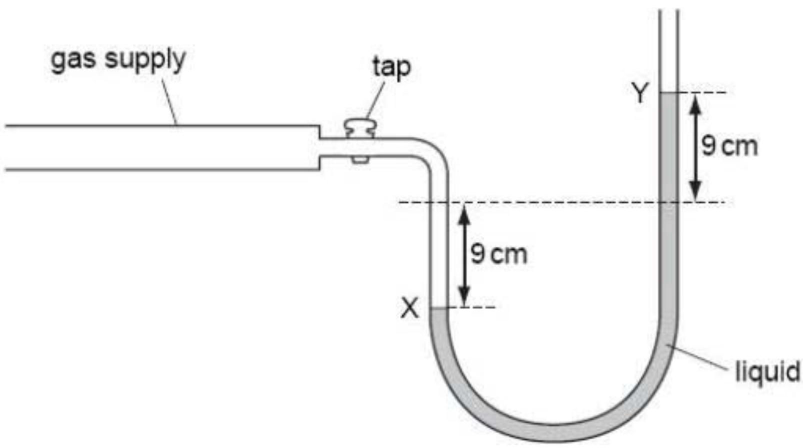
A The force of the pin is larger on the finger than on the thumb.

B The force of the pin is larger on the thumb than on the finger.

C The pressure of the pin is larger on the finger than on the thumb.

D The pressure of the pin is larger on the thumb than on the finger.

12 The diagram shows the levels X and Y in a liquid manometer with the gas tap open.

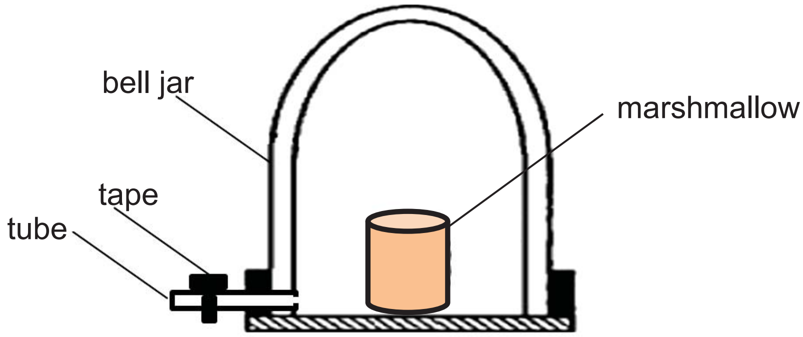


The gas supply is now replaced by a new gas supply which has a pressure that is 2 cm of the liquid above the previous gas supply.

What will be the new difference in height between level X and Y?

A 16 cm **B** 18 cm **C** 20 cm **D** 22 cm

13 The diagram shows a marshmallow placed inside a bell jar with the tap closed.



The pressure of the gas in the bell jar is half of the atmospheric pressure.

The tap is then opened and the air from the surrounding rushes in through the tube.

What happens to the size of the marshmallow and the gas pressure in the marshmallow?

	Size of marshmallow	Gas pressure in marshmallow
A	decreases	increases
B	decreases	decreases
C	increases	increases
D	increases	decreases

14 To calibrate a liquid-in-glass thermometer without using another thermometer, fixed point(s) will be required.

Which statement is correct?

A Only one fixed point is required.

B Both a lower fixed point and an upper fixed point are required.

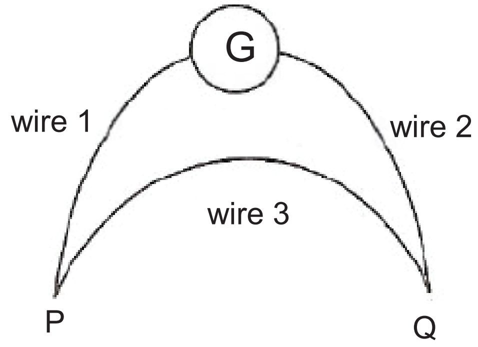
C Any temperature above the melting point of liquid can be used as fixed points.

D The melting point and boiling point of the liquid in the thermometer are always the fixed points.

15 A resistance thermometer has a resistance value of 20 Ω and 80 Ω when the temperature is 10 °C and 90 °C respectively. What will be the expected temperature if the resistance of the thermometer is 100 Ω?

A 90 °C **B** 107 °C **C** 117 °C **D** 133 °C

16 The diagram shows a thermocouple connected to a galvanometer. Two ends of the wires are placed in junction P and Q respectively.



However, the galvanometer does not show any deflection.

Which of the following **<u>is not</u>** a possible reason for the observation?

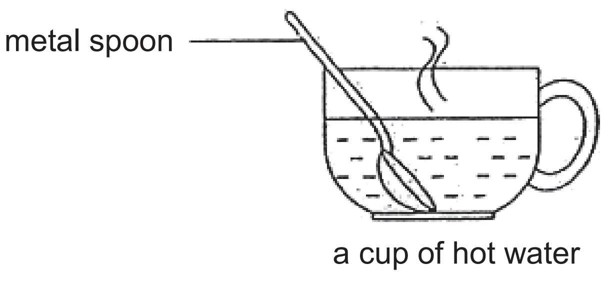
A Wire 1 and wire 2 are made of the same material.

B Wire 1 and wire 3 are made of the same material.

C Both junctions P and Q have same temperature.

D The galvanometer is not sensitive enough to detect the current.

17 The diagram shows a metal spoon in a cup of hot water.



Why does the top end of the metal spoon becomes hot after a while?

A Heat transfers from the hot water to the top of metal spoon by radiation.

B Heat transfers from the hot water to the top of metal spoon by convection.

C Heat transfers from the surrounding air to the top of metal spoon by conduction.

D Heat transfers from the hot water to the top of metal spoon by conduction.

18 A solid object with a mass of 5.0 kg is heated from 30 °C to 40 °C. The heat capacity of the object is 500 J K^{-1}. Which expression gives the amount of thermal energy required to raise the temperature of this object?

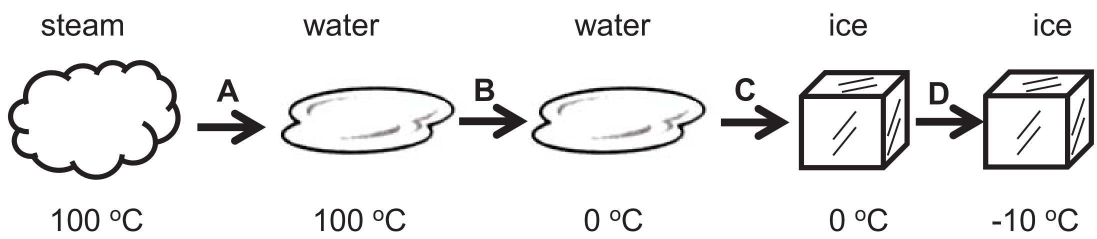
A 500 x 10

B 5.0 x 500 x 10

C 500 x (273 + 10)

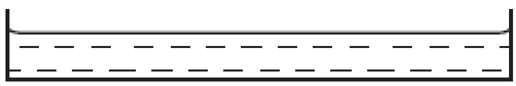
D 5.0 x 500 x (273 + 10)

19 The diagram shows the change of state of matter for 1 kg of steam into ice.



Which stage **A**, **B**, **C** or **D** involves the specific latent heat of vaporisation?

20 A student is investigating the rate of evaporation of water.



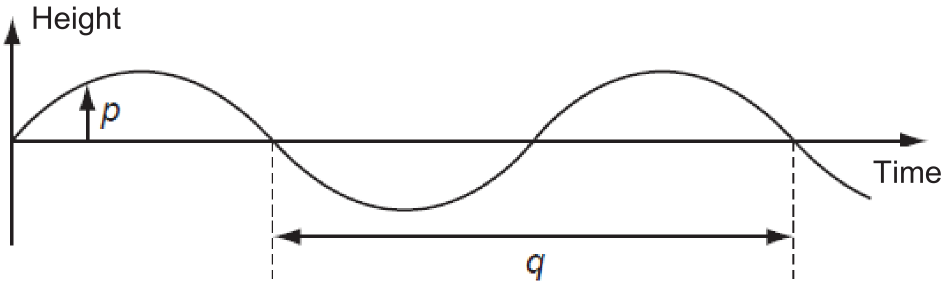
The student can change the following:

1. the depth of the water;
2. the atmospheric pressure;
3. the temperature of the water.

How many of these changes, if any, would alter the rate at which evaporation occurs?

A 0 **B** 1 **C** 2 **D** 3

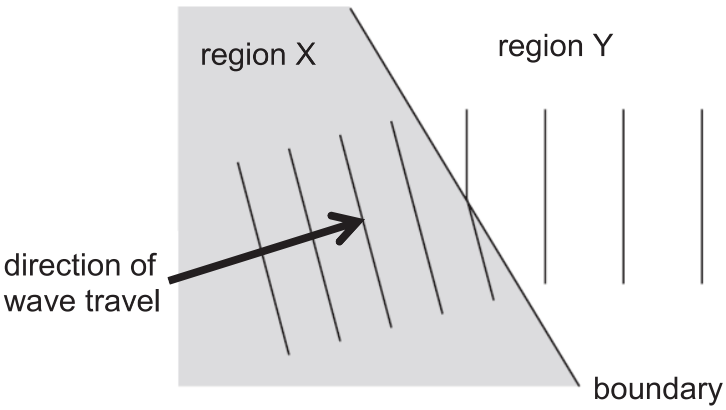
21 The graph shows how the height of a water surface at a point in a harbour varies with time as waves pass the point.



What are *p* and *q*?

	p	*q*
A	displacement	period
B	displacement	wavelength
C	amplitude	period
D	amplitude	wavelength

22 A ripple tank is used to demonstrate refraction of plane water waves.



Which statement is true?

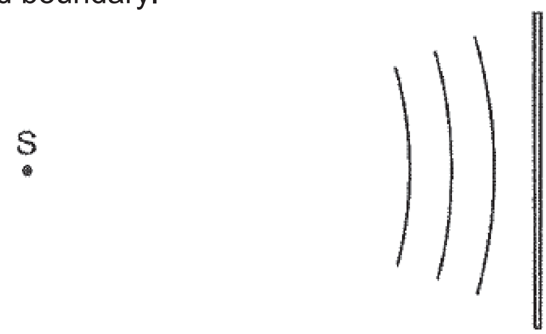
A Region X is deeper than region Y and the direction of wave travel bends towards the normal at the boundary.

B Region X is deeper than region Y and the direction of wave travel bends away from the normal at the boundary.

C Region X is shallower than region Y and the direction of wave travel bends towards the normal at the boundary.

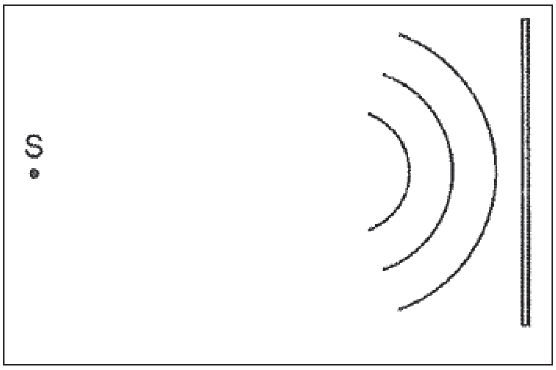
D Region X is shallower than region Y and the direction of wave travel bends away from the normal at the boundary.

23 The diagram represents circular wavefronts coming from point S. The wavefronts are about to strike a solid boundary.

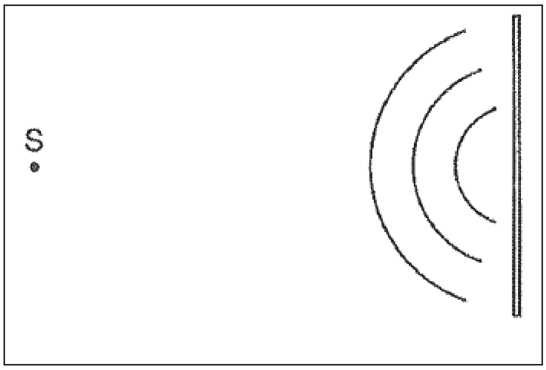


Which diagram correctly shows the reflected wavefronts?

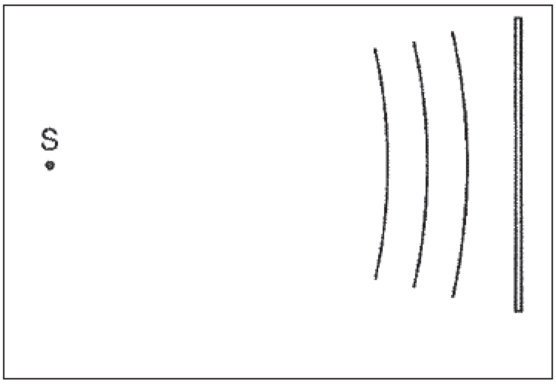
A



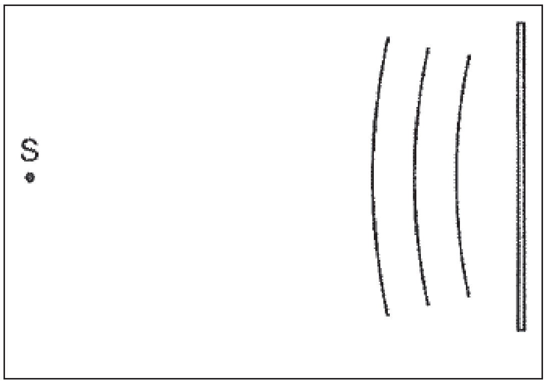
B



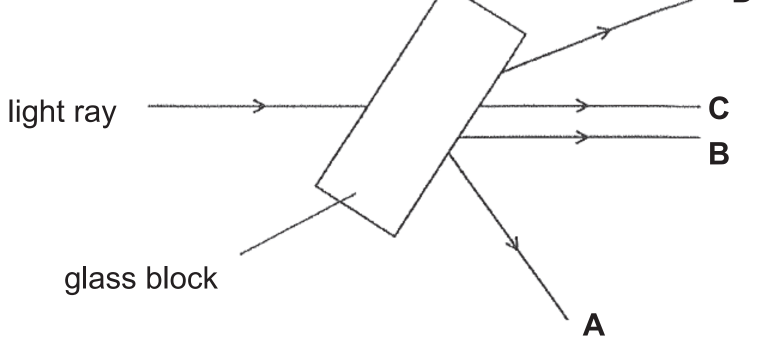
C



D



24 Which line shows the path of light ray after it passes through the glass block?



25 Which coloured light, red or violet, has a higher frequency and which one has a longer wavelength?

	Higher frequency	Longer wavelength
A	violet	violet
B	violet	red
C	red	violet
D	red	red

26 The diagram shows a contactless payment system which involves the consumers tapping their credit cards or debit cards on the card reader to make their payment. In the process, a particular electromagnetic wave will be sent between the card and the card reader.

What is likely to be this electromagnetic wave?

A Radio wave

B Ultrasound

C Ultra-violet radiation

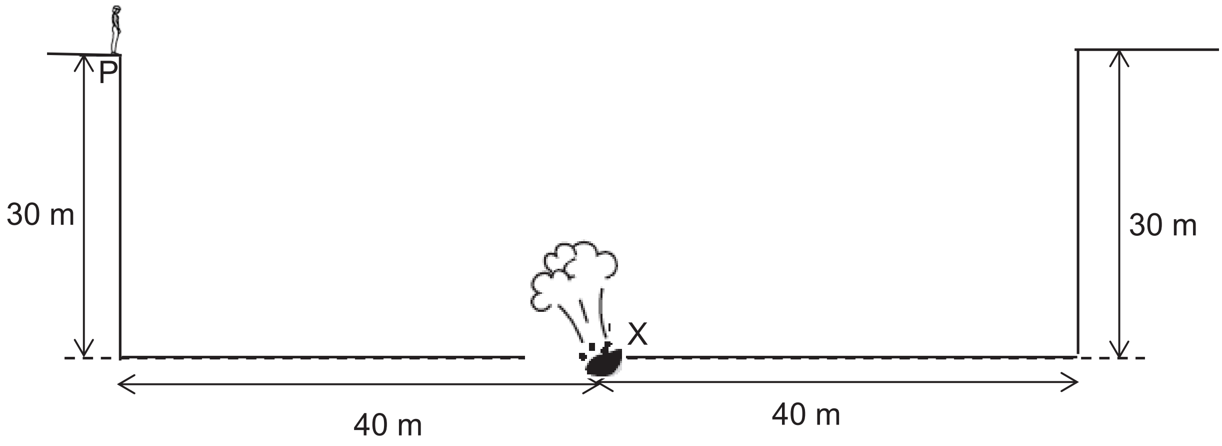
D X-ray

27 A person strikes a tuning fork near a wall.

What will happen to the frequency and speed of the sound as it travels from air and through the wall?

	Frequency	Speed of Sound
A	increases	increases
B	decreases	decreases
C	unchanged	decreases
D	unchanged	increases

28 The diagram shows an engineer standing at P overlooking an explosion at X.

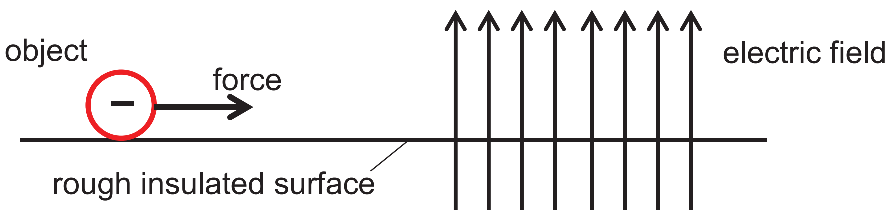


After the explosion, she hears two bangs. The speed of sound in the air is 300 m s^{-1}.

What is the time lapse between the two bangs?

A 0.12 s **B** 0.17 s **C** 0.25 s **D** 0.34 s

29 The diagram shows a negatively charged object subjected to a constant pulling force and is moving to the right on a rough insulated surface at a uniform speed before entering a uniform electric field. The electric force exerted on the charged object due to the electric field is greater than the weight of the charged object.



Which statement describes the motion of the charge in the electric field?

A The object will decelerate along the rough surface.

B The object will accelerate along the rough surface.

C The object will move along a curved path towards the top of paper.

D The object will move in the direction that is perpendicular to the plane of this paper.

30 The diagram shows a positively charged acetate strip and a negatively charged polythene strip that are freely suspended.

When an object is brought either to the acetate strip or polythene strip, the strip moves towards the object.

What is the state of charge of the object?

A Neutrally charged

B Positively charged

C Negatively charged

D Cannot be determined

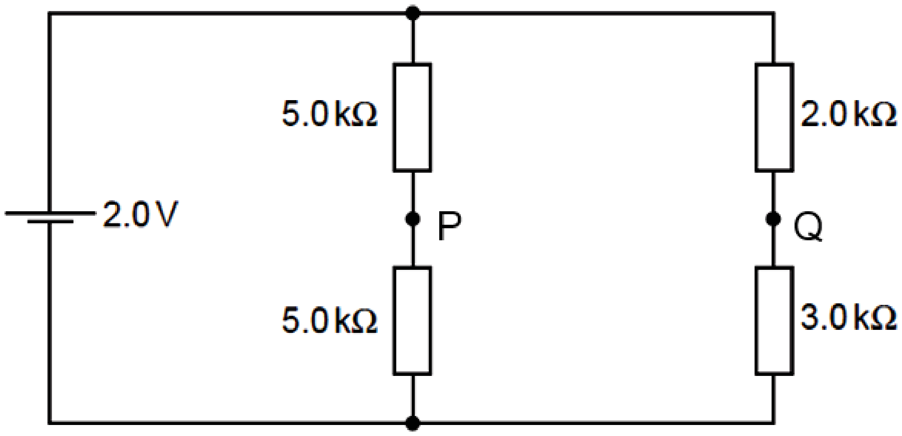
31 The diagram shows an electroshock gun that law enforcement officers use to immobilise a person. The gun delivers electric current to a person and disrupts voluntary control of muscles in the person.

During a single activation that last for 5.0 s, the electroshock gun can deliver a charge of 100 mC with an average voltage of 350 V to the person.

What is the electrical energy transferred to the person?

A 7 J **B** 35 J **C** 7000 J **D** 35 000 J

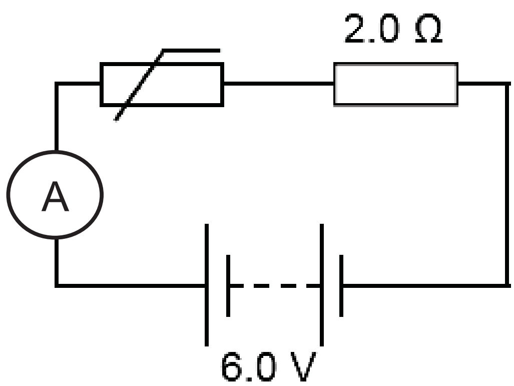
32 A cell of e.m.f. 2.0 V is connected to a network of resistors shown.



What is the potential difference across P and Q?

A 0.2 V **B** 0.5 V **C** 0.8 V **D** 1.0 V

33 The diagram shows a 6.0 V battery connected to a transducer and a fixed resistor.



The following information is provided:

Transducer	**Range of Resistance / Ω**
Light dependent resistor	4.0 to 10.0
Thermistor	3.0 to 7.0

What is the reading of the ammeter when the transducer is exposed to high temperature?

A 0.50 A **B** 0.67 A **C** 1.0 A **D** 1.2 A

34 What will happen to a bar magnet if it is dropped too often?

A The poles of the magnet will switch position.

B Both ends of the magnet will have the same pole.

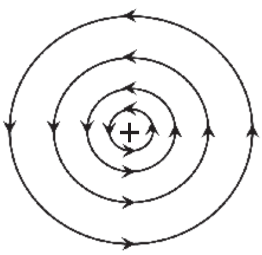
C The strength of the magnet will increase.

D The strength of the magnet will decrease.

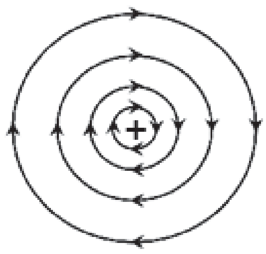
35 A positive charge is moving into the plane of this paper.

Which diagram shows the magnetic field produced by the positive charge when viewed from the top of this paper?

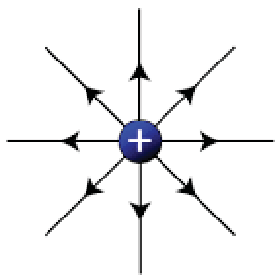
A



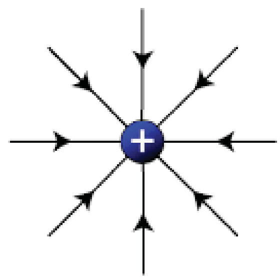
B



C



D



36 What is the purpose of the split-ring commutator in a motor?

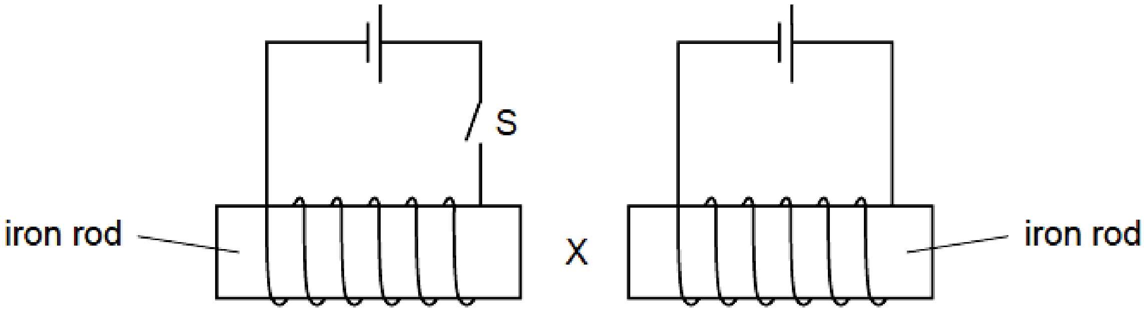
A To ensure that the current produced is a direct current.

B To ensure that the current produced is an alternating current.

C To ensure that the forces acting on the coil will always rotate the coil in the same direction.

D To ensure that there is continuous electrical contact between the coil and the external circuit at all times.

37 Two circuits are set up as shown. The iron rods are placed close together, and are free to move.



What happens to the size of the gap at X when switch S is closed?

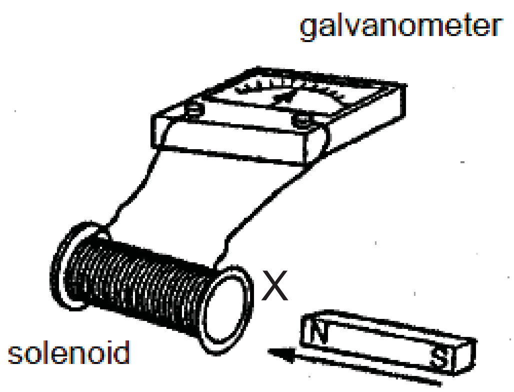
A It decreases.

B It decreases and then increases.

C It increases.

D It does not change.

38 The North pole of a bar magnet is pushed into a solenoid via end X, as shown in the diagram. An electromotive force is induced which moves the galvanometer needle to the left.



Which action, using the same end of the solenoid, would produce the same deflection in the galvanometer?

A Pulling a North pole out of the solenoid via end X

B Pushing a South pole out of the solenoid via end X

C Pulling the solenoid away from a North pole

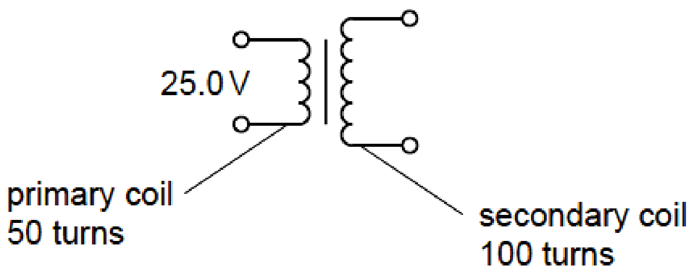
D Pulling the solenoid away from a South pole

39 An a.c generator is able to produce a peak voltage of V when the coil is rotated with a frequency of F.

What will be the new peak voltage if the number of turns of the coil is now three times as before and the coil is rotated with a frequency of $2F$?

A $3V$ **B** $5V$ **C** $6V$ **D** $8V$

40 A transformer has 50 turns on its primary coil and 100 turns on its secondary coil. An alternating voltage of 25.0 V is connected across the primary coil.



What is the voltage across the secondary coil?

A 12.5 V **B** 50 V **C** 175 V **D** 200 V

—— END OF PAPER ——

Candidate Name ……………………………………………..

Class	Register No.

TANJONG KATONG GIRLS' SCHOOL
PRELIMINARY EXAMINATION 2019
SECONDARY FOUR

6091/02 **PHYSICS**
Paper 2

MONDAY **2 SEP 2019** **1 hour 45 minutes**

INSTRUCTIONS TO CANDIDATES

Do not open this booklet until you are told to do so.

Write your name, class and register number in the spaces at the top of this page and on any separate answer paper used.

Write in dark blue or black pen.
You may use a soft pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Take gravitational field strength to be 10 N/kg, unless specified in the question.

Section A
Answer **all** questions. Write your answers in the spaces provided on the Question Paper.

Section B
Answer **all** questions. Question 11 has a choice of parts to answer.

INFORMATION FOR CANDIDATES
The number of marks is given in brackets [ ] at the end of each question or part question.

Candidates are reminded that **all** quantitative answers should include appropriate units.

Candidates are advised to show all their working in a clear and orderly manner, as more marks are awarded for sound use of physics than for correct answers.

The use of an approved scientific calculator is expected, where appropriate.

For Examiner's Use	
Section A	
Section B	
Total	**/ 80**

Setter : Mr Koh Meng Hong

This question paper consists of 22 printed pages including this cover page.

SECTION A [50 marks]

Answer **ALL** questions from this section.

1 Fig 1.1 shows a hot-air balloon rising with a constant velocity of 15 m s^{-1}. A sandbag was dropped by the pilot at time t = 0 s. Air resistance acting on the sandbag is considered to be negligible.

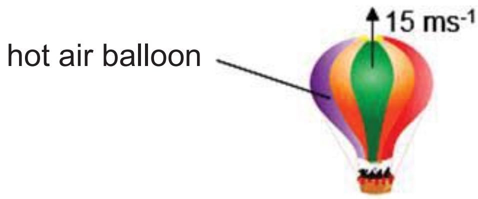


Fig 1.1

(a) A person at ground level observed that the sandbag was moving up with an initial velocity of 15 m s^{-1} at the time of drop. Explain this observation.

……………………………………………………………………………………………......

……………………………………………………………………………………………...[1]

(b) Sketch the velocity-time graph of the sandbag for the first 3.0 s. [2]

(c) Calculate the distance travelled by the sandbag between time t = 0 s and when it reaches its highest point.

Distance travelled = ……………[1]

(d) Determine the distance between the sandbag and the hot air balloon at time t = 3.0 s. Show your workings clearly.

Distance = ……………[2]

2 Fig 2.1 shows a side view of a windmill.

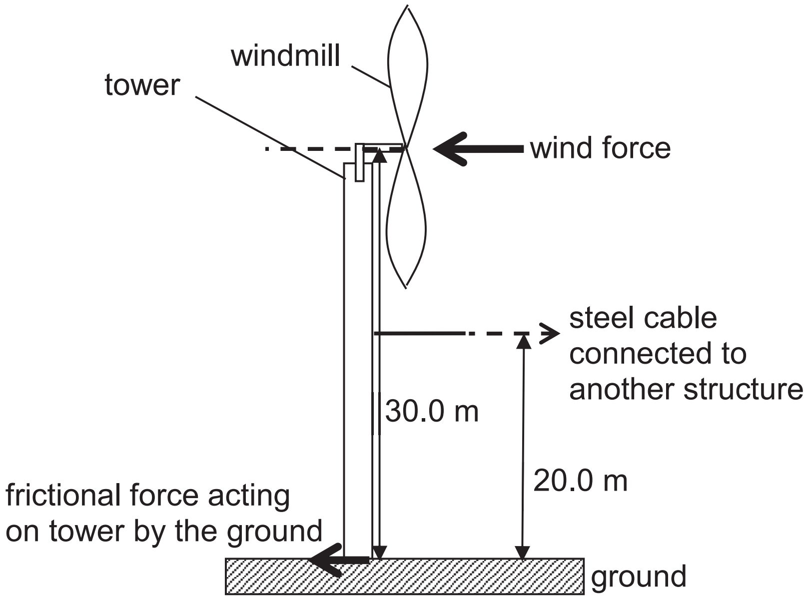


Fig 2.1

The windmill stands on a tower whose base is anchored into the ground. The centre of the windmill is 30.0 m from the ground. The tower is held in place and connected to another structure (not shown in the diagram) via a horizontal steel cable. The steel cable is 20.0 m from the ground. The position of the combined centre of mass of the tower and the windmill is within the tower.

(a) State *the principle* of *moments*.

....

....

....[1]

(b) It can be modelled that the wind force acts through the centre of the windmill. When a wind force of 2000 N is acting horizontally on the windmill, the windmill and the tower remains in equilibrium.

Calculate the magnitude of the frictional force acting on the tower by the ground.

Magnitude of frictional force = ……………[2]

For Examiner's Use

(c) The combined weight of the tower and the windmill is 5000 N. The frictional force acting on the tower by the ground is 3000 N. Using a scaled diagram, determine the magnitude and the direction of resultant force acting on the tower by the ground.

For Examiner's Use

Magnitude = ……………

Direction = …………………………

[3]

3 In the movie *Spiderman*, Spiderman attempted to use two flexible flag poles to shoot himself into the sky as if like a catapult. Fig 3.1 shows the set-up which Spiderman attaches his web to the top of the flag poles. He then moves backwards to his final position (as shown in Fig 3.2) just before shooting up into the sky.

For Examiner's Use

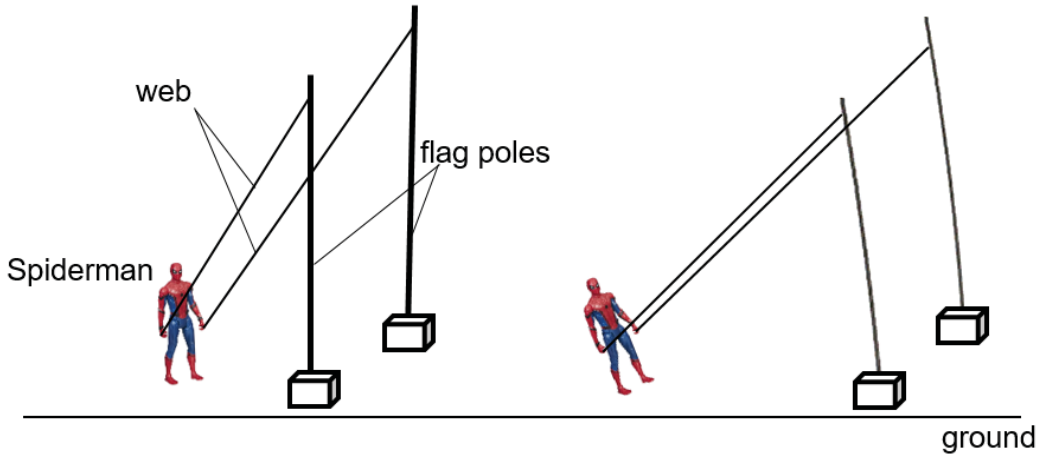


Fig 3.1 Fig 3.2

(a) Describe the energy changes that have occurred when Spiderman moves backward from his original to his final position as shown in Fig 3.1 and Fig 3.2 respectively. Assume the web is not stretchable.

....

....

....

....

....

....[3]

(b) The mass of Spiderman is 65.0 kg. When he released his foot grip from the ground, he shot up to the sky with an initial speed of 40.0 m s^{-1}. When he is at his highest point, he had a speed of 15.0 m s^{-1}. The work done against air resistance during this journey is 5000 J.

(i) Determine the loss in kinetic energy from the time he leaves the ground to the time he reaches the highest point.

Loss in kinetic energy = ……………[2]

For Examiner's Use

(ii) Determine the distance of Spiderman from the ground when Spiderman is at his highest point.

Height = ……………[2]

4 **(a)** Fig 4.1 shows a plastic container with a lid cover. A lid tightener is used to control the movement of the base of the lid. As a person flips down the lid tightener, the base of the lid moves up and increases the volume of air in the container. The container is air tight and it becomes difficult to remove the lid cover.

Fig 4.1

(i) Using the kinetic model of matter, explain why the air pressure in the container decreases as the base of the lid moves up.

....

....

....

....

....

....

....[2]

For Examiner's Use

(ii) Explain in terms of pressure, why it is difficult to remove the lid cover when the base of the lid moves up.

....

....

....[1]

(b) Fig 4.2 shows a hydraulic press that is used to lift up the body of the car during the replacement of a car tyre. A force of 30 N is exerted on piston A.

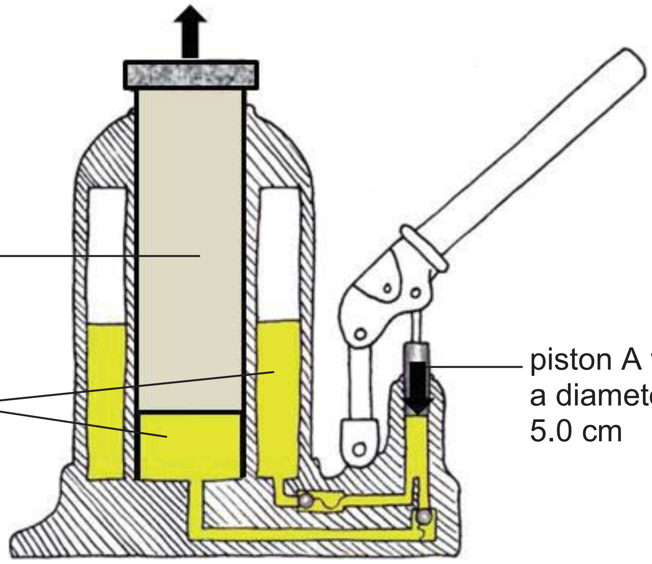


Fig 4.2

(i) Using the idea of molecules, explain why a liquid, such as oil, is used in the hydraulic press.

....

....[1]

(ii) Calculate the force exerted on piston B.

Force = ……………[2]

5 Fig 5.1 shows a light dependent resistor (LDR) connected to a circuit. Fig 5.2 shows the relationship between the potential difference V across and the current I flowing through the LDR.

For Examiner's Use

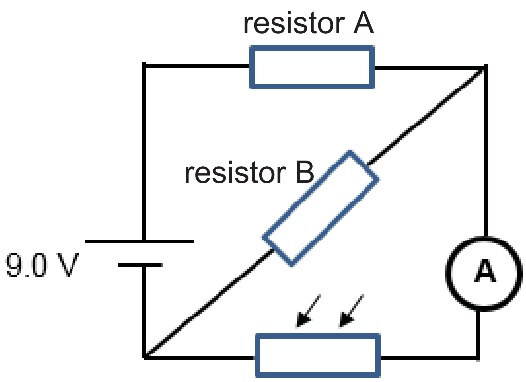


Fig 5.1

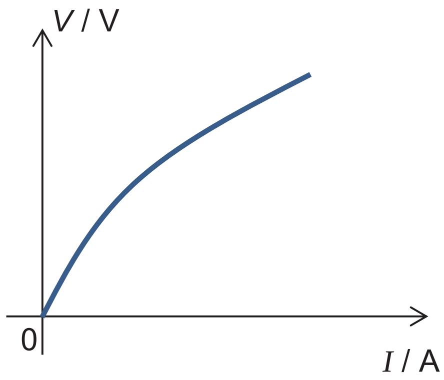


Fig 5.2

(a) Describe how the resistance of the LDR changes with light intensity.

....

....[1]

(b) Explain how the graph in Fig 5.2 shows that the LDR is a non-ohmic conductor.

....

....

....[1]

(c) The resistances of resistor A and B are 1000 Ω and 3000 Ω respectively. When the resistance of the LDR is 2000 Ω,

determine, by showing detailed workings,

(i) the effective resistance of resistor B and LDR.

Effective resistance = ...[2]

(ii) the potential difference across resistor A.

For Examiner's Use

Potential difference = ……………[2]

(iii) the current through the LDR.

Current = ……………[2]

6 A 2.4 kW water heater is connected to a 240 V main supply.

For Examiner's Use

(a) Calculate the current in the heating element of the water heater when it is working normally.

Current = ……………[2]

(b) The water heater is protected by a 13 A fuse.

Explain how the fuse works.

…………………………………………………………………………………………...

…………………………………………………………………………………………..

…………………………………………………………………………………………...

…………………………………………………………………………………………..

…………………………………………………………………………………………..[2]

(c) The water heater has double insulation. Explain whether it is necessary for the water heater to have an earth wire connected to the casing.

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…………………………………………………………………………………………..

…………………………………………………………………………………………..

…………………………………………………………………………………………..[2]

7 Fig 7.1 shows the use of an electromagnetic relay switch to switch on another secondary circuit that is connected to a high voltage power supply.

For Examiner's Use

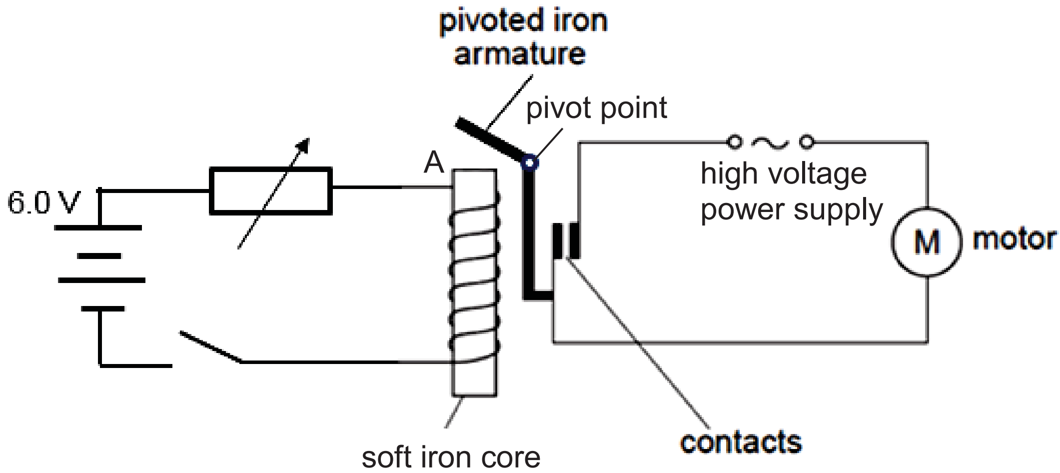


Fig 7.1

(a) Explain how, by adjusting the resistance of a variable resistor, the motor in the secondary circuit can be switched on.

……………………………………………………………………………………………

……………………………………………………………………………………………

……………………………………………………………………………………………

……………………………………………………………………………………………

……………………………………………………………………………………………

……………………………………………………………………………………….[2]

(b) State the pole at end A of the soft iron core when current is flowing through the coil.

……………………………………………………………………………………….[1]

(c) Fig 7.2 shows a simplified diagram of the motor which is connected to the high voltage supply. Points P and Q are two corners of a copper coil.

For Examiner's Use

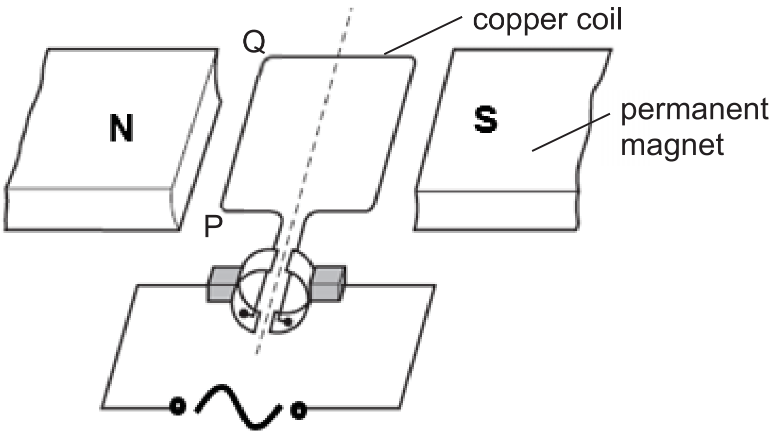


Fig 7.2

(i) Name one electrical device that can be included into the circuit to ensure that the coil in the motor will only turn in one direction.

……………………………………………………………………………...[1]

(ii) At a particular instant, the magnetic force acting on the wire between points P and Q is in the upward direction. Using the idea of magnetic fields, explain why this is so.

………………………………………………………………………………

………………………………………………………………………………

………………………………………………………………………………

………………………………………………………………………………

………………………………………………………………………………

……………………………………………………………………………..[2]

8 Fig 8.1 shows a set-up with two coils of wire wound around a soft iron core.

For Examiner's User

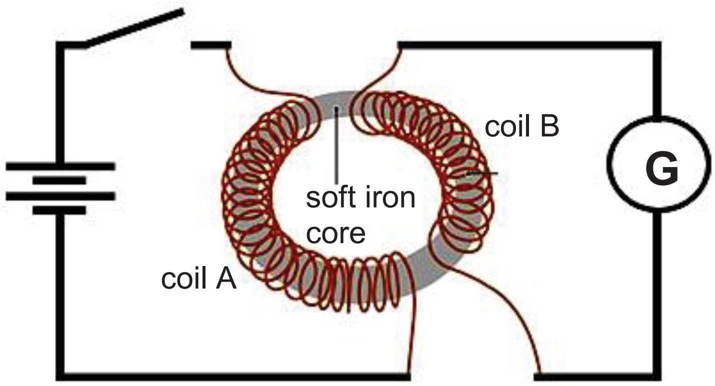


Fig 8.1

(a) State *Faraday's law of electromagnetic induction*.

…………………………………………………………………………………………...

…………………………………………………………………………………………..

…………………………………………………………………………………………..[1]

(b) Explain why the galvanometer shows a deflection when the switch is just closed.

…………………………………………………………………………………………...

…………………………………………………………………………………………..

…………………………………………………………………………………………..

…………………………………………………………………………………………..

…………………………………………………………………………………………..[2]

(c) Suggest one change to be made to the set-up if

(i) the galvanometer is to have a continuous deflection at all times.

……………………………………………………………………………………...[1]

(ii) the galvanometer is to show a larger deflection with the same power input.

……………………………………………………………………………………...[1]

Section B [30 marks]

Answer **all** the questions in this section.
Answer only one of the two alternative questions in **Question 11**.

For Examiner's Use

9 I-Fly is an indoor skydiving facility which uses high air speeds to keep a person floating in the air. Fig 9.1 shows a simplified setup of how high air speeds are projected onto the person (flyer). Air is drawn into the chamber using the wind blade. The shape of the chamber allows air to move upward at high speed. The speed of the air is regulated by the speed of the wind blade.

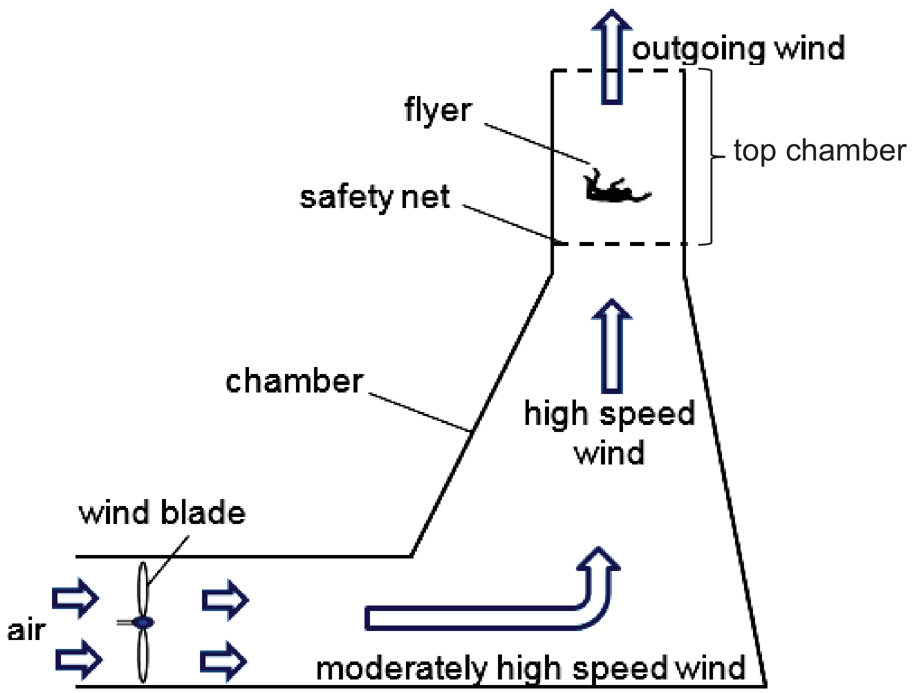


Fig 9.1

Fig 9.2 shows the power of the wind blade and the average wind force acting on a person.

Average Wind Force / N	200	400	640	800	900
Power of Wind Blade / MW	2.0	3.0	4.0	5.0	8.0

Fig 9.2

(a) State *Newton's 1st Law of Motion*.

....

....[1]

(b) Draw the free body diagram acting on the flyer when he is floating in the air. Label and name all the forces. [2]

(c) Using the data shown in the Fig 9.2, plot a graph of the average wind force acting on the flyer against the power of the wind blade in Fig 9.3 . [2]

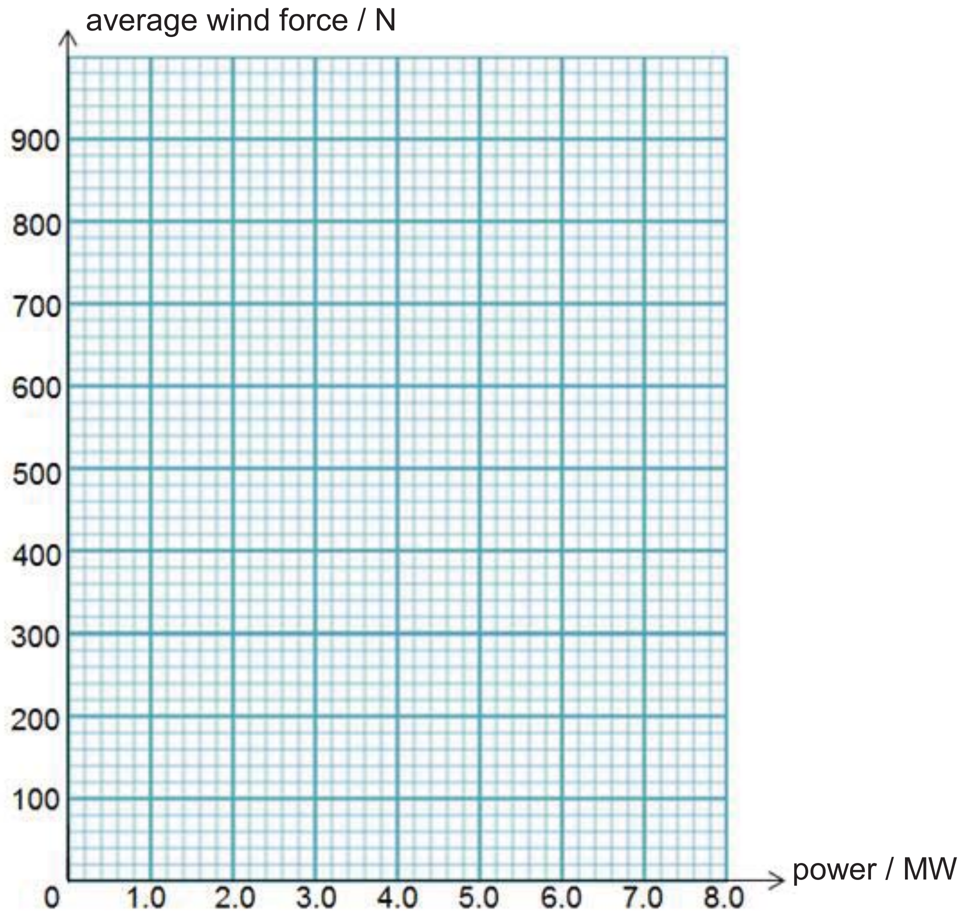


Fig 9.3

For Examiner's User

For Examiner's User

(d) A person with a mass of 75 kg has signed up to be a flyer.

(i) State the weight of the person.

Weight = ……………[1]

(ii) Using the plotted graph in Fig 9.3, determine the minimum power of the wind blade required to keep the person floating in the air.

Minimum power = ……………[1]

(iii) The power of the wind blade is adjusted to 5.0 MW. Using the data in Fig 9.2, calculate the initial acceleration of the person.

Acceleration = ……………[2]

(e) Explain why it is important to have a safety net installed at the base of the top chamber.

....

....[1]

For Examiner's Use

10 (a) Fig 10.1 shows a light ray travelling from diamond to medium X. The diamond has a refractive index of 2.4.

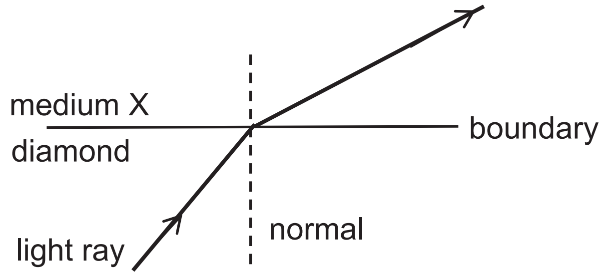


Fig 10.1

(i) Compare the refractive index of medium X to that of the diamond. Use Fig 10.1 to explain how you reach the answer.

……………………………………………………………………………………..

……………………………………………………………………………………..

……………………………………………………………………………………..

……………………………………………………………………………………..[2]

(ii) If medium X is glass, the critical angle is found to be 39°.

1. State what is meant by critical angle.

………………………………………………………………………………………

……………………………………………………………………………………..[1]

2. A light ray strikes the boundary with an angle of incidence 42°. State and explain what will happen to this light ray.

………………………………………………………………………………………

………………………………………………………………………………………

………………………………………………………………………………………

……………………………………………………………………………………..[2]

3. If medium X is water which is optically less dense than glass, state, if any, the changes to the critical angle.

……………………………………………………………………………………..[1]

(b) Fig 10.2 shows a slanted lens with a focal length of 2.0 cm. The height of the object is 1.5 cm. The intersection point between the horizontal line and the lens is the optical centre of the lens. The diagram is drawn to scale.

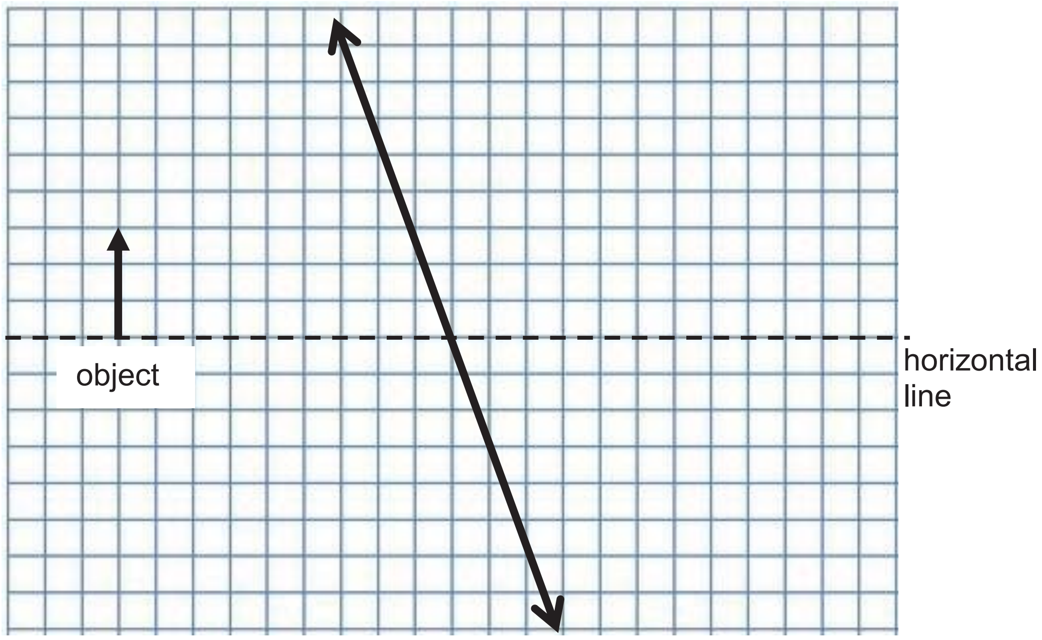


Fig 10.2

(i) Define *principal axis*.

…………………………………………………………………………………………

…………………………………………………………………………………………

……………………………………………………………………………………[1]

(ii) In Fig 10.2,

1. sketch the principal axis and label the principal focal points of the lens as f_1 and f_2. [1]

2. sketch two rays from the tip of the object to locate the image of the tip of the object. Mark this point with "X". [2]

Either

11 Fig 11.1 shows a car equipped with a reverse parking sensor at the car's back bumper.

For Examiner's Use

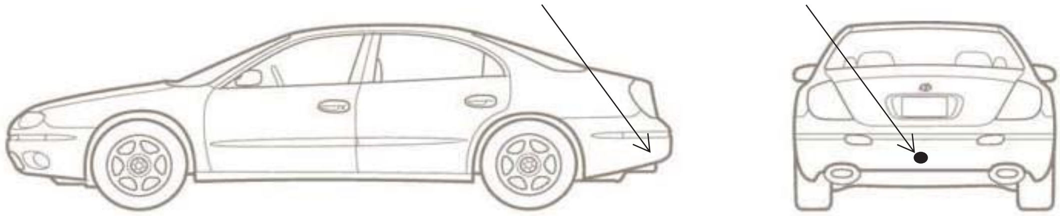


Fig 11.1

The reverse parking sensor uses ultrasound to measure the distance between the car's bumper and nearby objects. The sensor is connected to a sound buzzing system which will provide beep sounds in the car to alert the driver of the obstacles while parking the car.

(a) Define *ultrasound*.

……………………………………………………………………………………………..

……………………………………………………………………….……………..[1]

(b) Fig 11.2 shows a screen displaying the signal of one set of pulses picked up by the reverse parking sensor.

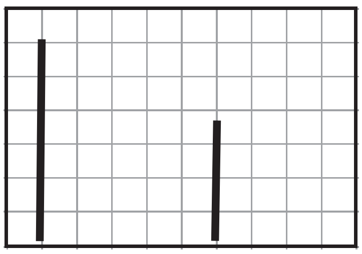


Fig 11.2

The time interval between the two pulses is 800 μs. The ultrasound has a frequency of 25 kHz and the speed of ultrasound is 330 m s^{-1}.

(i) Using the idea about the molecular motion in air, describe what is meant by "a frequency of 25 kHz".

………………………………………………………………………………...

………………………………………………………………………………...[1]

(ii) Calculate the distance (in cm) between the back bumper and the obstacle.

For Examiner's Use

Distance = ……………cm [2]

(iii) On Fig 11.2, sketch the returning pulse for the same emitting pulse if the distance between the back bumper and the obstacle is smaller than the value calculated in part **(b)(ii).** [1]

(c) Sound wave comprises regions of compression and rarefaction.

(i) Explain, in terms of pressure, the meaning of region of rarefaction.

…………………………………………………………………………………...

…………………………………………………………………………………...[1]

(ii) In Fig 11.3, line X represents the position of the air molecules in a sound wave at a particular instant. The sound wave is travelling to the right.

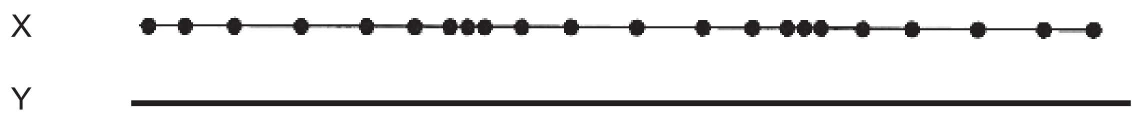


Fig 11.3

1. In Fig 11.3, mark a distance equal to the wavelength of the sound wave on line X. [1]

2. In Fig 11.3, mark the position of the centre of all compressions after another 1½ period on line Y. [1]

3. Describe how you obtained your answer in part **2.**

…………………………………………………………………………………….

…………………………………………………………………………………….

…………………………………………………………………………………….

…………………………………………………………………………………….

………………………………………………………………………………..…….[2]

Or

11 (a) Fig 11.1 shows a simplified diagram of a power station that involves the combustion of natural gas to generate electricity. Water is directed into combustion chamber via a pipe.

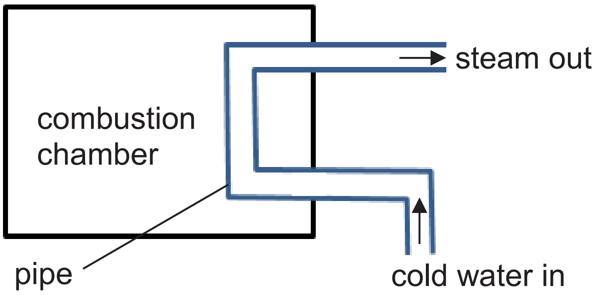


Fig 11.1

(i) Suggest an appropriate material for the pipe. Explain your answer.

………………………………………………………………………………...

………………………………………………………………………………..[1]

(ii) "Using natural gas to generate electricity is an environmentally friendly method".

Do you agree with this statement? Justify your answer.

………………………………………………………………………………...

………………………………………………………………………….……..[1]

(iii) In 1.0 minute, 2.0 kg of water at 30°C is converted to steam at 100°C. The specific heat capacity of the water and the specific heat latent heat of vaporisation are 4200 J kg^{-1} $°C^{-1}$ and 2.1 MJ kg^{-1} respectively.

1. Calculate the amount of thermal energy required to change 2.0 kg of water at 30°C to steam in 1.0 minute.

Leave your answer to the appropriate number of significant figures.

For Examiner's Use

Amount of thermal energy = ……………[3]

For Examiner's Use

2. The efficiency of the system is 80%.

Calculate the power input.

Power input = ……………[2]

(b) Nuclear energy is considered as a good source of energy to generate electricity, however, the gamma radiation produced is extremely dangerous.

(i) Explain why some countries continue to use nuclear energy to generate electricity despite the danger.

…………………………………………………………………………………...

…………………………………………………………………………..……..[1]

(ii) Gamma radiation belongs to a family of waves. Name this family.

…………………………………………………………………………..……..[1]

(iii) Suggest why gamma radiation is extremely dangerous.

…………………………………………………………………………………...

…………………………………………………………………………………...

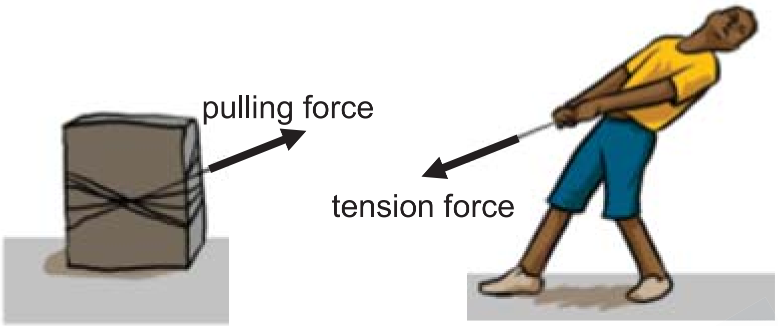
…………………………………………………………………………..……..[1]

—— END OF PAPER ——

Solution to Sec 4 Physics Prelim Exam 2019 Paper 1

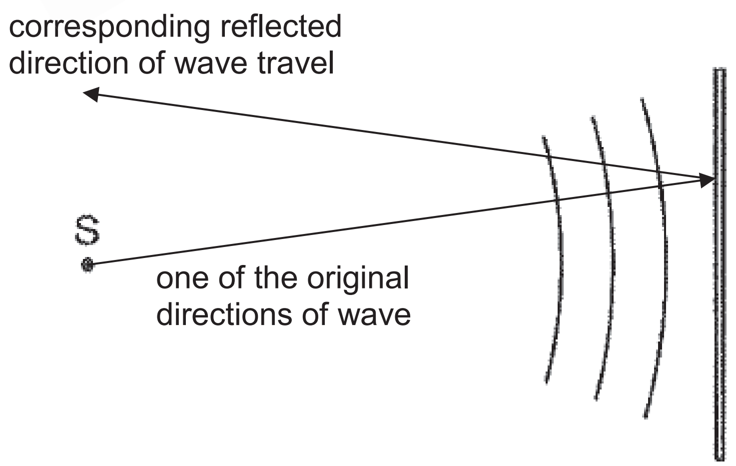
1	**C**	6	**C**	11	**D**	16	**A**	21	**A**	26	**A**	31	**B**	36	**C**
2	**A**	7	**D**	12	**C**	17	**D**	22	**D**	27	**D**	32	**A**	37	**A**
3	**A**	8	**B**	13	**A**	18	**A**	23	**D**	28	**C**	33	**D**	38	**D**
4	**D**	9	**C**	14	**B**	19	**A**	24	**B**	29	**A**	34	**D**	39	**C**
5	**B**	10	**A**	15	**C**	20	**C**	25	**B**	30	**A**	35	**B**	40	**B**

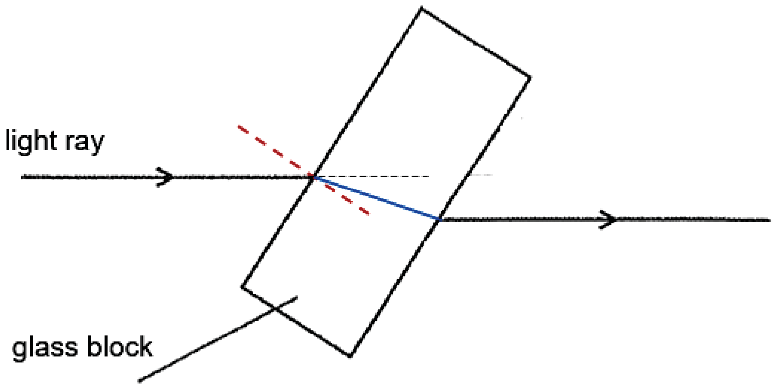
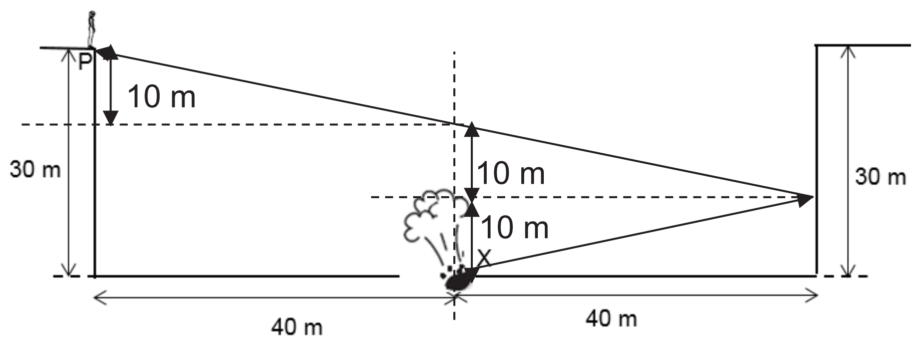
Qn	Solution	Ans
1	Thickness of a fingernail is approximately 1 mm. Note: A student can use his existing ruler to estimate that the fingernail must be around 1 mm.	**C**
2	To measure a length of several metres, the measuring instrument will have to be measuring tape. Other measuring instruments can only measure up to 1 m. To determine the volume of the pipe, both external and internal diameter of the pipe is needed. Thus, the best measuring instrument will be vernier caliper. Laboratory micrometer screw gauge can only up to 25.0 mm and only for external diameter.	**A**
3	Maximum resultant force occurs when all the three forces are in the same direction and the value is 3+4+8+15 N. Thus, option D is possible resultant force. By elimination, option A will be the not be a possible value of the resultant force. Note: We can always pair up two forces and determine the maximum and minimum value. Thus, if we pair up 3 N and 4 N forces, their resultant force will be in the range of 1 N to 7 N. When this resultant force is combined with 8 N force, then the total resultant force will be in the range of 1 N and 15 N.	**A**
4	When the car is accelerating, this means that the speed of the car is increasing. This implies that the distance travelled by the car per unit time (in this case, for every one second interval) should be increasing. Note: For option D, the distance travelled in the 1^{st} second (from t=0 s to t =1 s) = 80 m the distance travelled in the 2^{nd} second (from t=1s to t=2 s) = 110 m	**D**

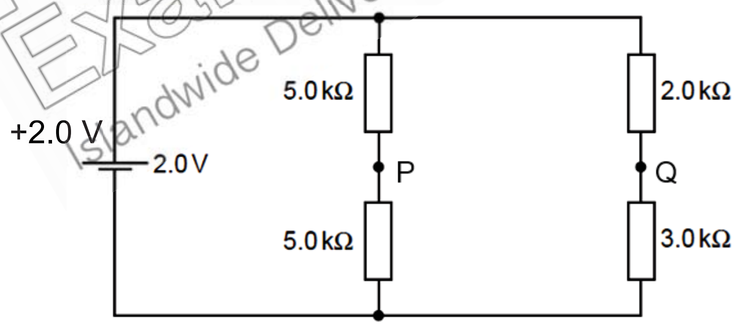
5	Action-reaction forces must be acting on mutually opposite bodies and cannot be on the same body. For option A, the pulling force on the block is due to the rope. The tension (always acting away from the body of interest) experienced by the rope is due to the block. See free body diagram below illustrating the two forces 	**B**
6	Acceleration of the car (through the journey) = rate of change in velocity = 10/2.0 = 5.0 m s^{-2} Using Newton's 2nd Law, Resultant force, F_{net} = m x a = 1000 x 5.0 = 5000 N	**C**
7	The question is focus on the effect of gravitational field strength on mass and weight. Mass of a body will be constant and hence with the same amount of applied force and hence resultant force acting on the block, the acceleration of the block will be constant. Note: Although the period of pendulum *T* is not dependent on the mass, it is dependent on gravitational field strength *g*. $T^2 = 4\pi^2 l / g$.	**D**
8	Concept of flotation: Object or liquid of a smaller density will float above the liquid of larger density. Thus, liquid Q must have the smallest density and liquid S must have the largest density. Since liquid R floats on top of object P, density of object P must be larger than liquid R.	**B**

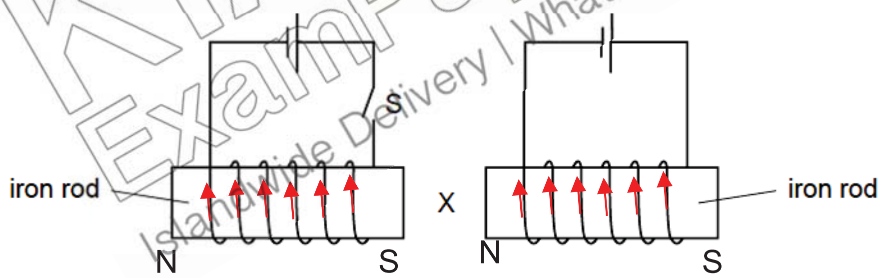
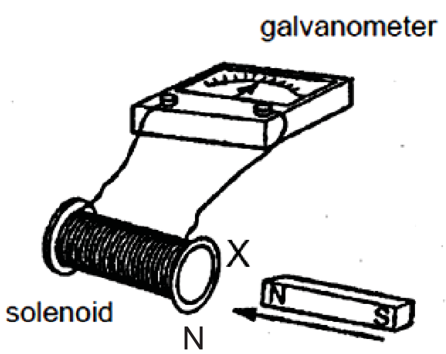
9	Let the length of ladder by l m. By principle of moment, taking moment about point X, anti-clockwise moment due to force F = clockwise moment due to weight of the ladder $F \times l \sin 30^{o} = 500 \times \frac{1}{2} l \cos 30^{o}$ F $F \sin 30^{o} = 250 \cos 30^{o}$ $F = 433$ N Note: (1) Perpendicular distance between line of action of the force F and the pivot point X is $l \sin 30^{o}$ (2) Since the c.g of the ladder is at the mid-point of the ladder, perpendicular distance between line of action of the force F and the pivot point X is $\frac{1}{2} l \cos 30^{o}$	**C**
10	As more water is added to the bottom, the combined centre of gravity will be raised as the centre of gravity of the water will be raised. There is no change in the base area. Thus, with a higher centre of gravity, the bottle with water will be less stable as the line of action of the weight of the bottle with water is likely to be outside the base area of the bottle when displaced slightly.	**A**
11	The pin is not moving. Thus, the pin is at equilibrium. The force of the pin is equal on the finger and on the thumb. Since pressure = force / area of contact, and the area of contact between the pin and the thumb is smaller as compared to that at the finger, the pressure of the pin is larger on the thumb.	**D**
12	The pressure of the gas supply = pressure due to a liquid column of 18 cm + atmospheric pressure. The new pressure of the gas supply = pressure due to a liquid column of 20 cm + atmospheric pressure. Thus, the difference in level X and Y = 20 cm Note: Level X will have dropped by 1 cm and level Y have risen by 1 cm.	**C**
13	As air rushes in, the external pressure acting on the marshmallow increases. The resultant pressure hence produces a resultant force acting inward towards the centre of marshmallow. The size of the marshmallow decreases. With a reduction in the size of the marshmallow, the area of contact between the gas particles in the marshmallow and the internal surface of the marshmallow decreases. Pressure in the marshmallow increases.	**A**

14	Fixed points must be easily reproducible and obtainable through any physical processes. Two fixed points are required so that the length of the liquid can be divided into equal intervals. Note: Option C is not entirely correct as the fixed point must be below the boiling point so that the substance remains in liquid state.	**B**
15	The two given temperatures are not 0°C and 100°C. Thus, the temperature formula cannot be used. Using the underlying concept that the change in the thermometric property is directly proportional to the change in the temperature. change in resistance ≡ change in temperature (80 – 20) Ω ≡ 90°C - 10°C 60 Ω ≡ 80°C Using 10°C as the reference temperature, When resistance changes from 20 Ω to 100 Ω, change in resistance = 80 Ω. Corresponding change in temperature = 80 / 60 x 80 = 107 °C Thus, the expected temperature = 107 + 10 = 117 °C	**C**
16	For thermocouple, to have deflection for galvanometer, two conditions must be met: (1) There is a temperature difference between the hot and the cold junctions. (2) The wires connecting at the two junctions must be of different metal.	**A**
17	The focus of the question is the metal spoon which is gaining heat from the hot water which has a higher temperature. Since the spoon is a metal which a good conductor of heat and the spoon is in physical contact with the water, the main process of heat transfer is conduction. Note: The initial temperature of the metal spoon is assumed to be the same as the surrounding air.	**D**
18	In this case, the heat capacity of the object is given, rather than the specific heat capacity. Using $Q = C\,\Delta\theta$, Amount of heat, Q = 500 x (40 – 30) = 500 x 10	**A**

19	Specific latent heat of vaporisation = amount heat absorbed by 1.0 kg of liquid as it changes from liquid to gas at boiling point = amount of heat absorbed by 1.0 kg of gas as it changes from gas to liquid at condensation point. Boiling point = condensation point.	**A**
20	Rate of evaporation depends on how readiness the liquid molecules at the surface of the liquid is able to leave the liquid, and this depends on whether the liquid molecules have sufficient energy to escape from the surface of the liquid. In this case, atmospheric pressure and temperature of the liquid are the only two factors that affect the rate of evaporation.	**C**
21	In this case, it is noted that *p* is not the maximum height of the water surface at a particular point. Thus, *p* is the displacement of the water. This is the displacement-time graph, and hence the graph only provide the information on period (the time taken for the particle to complete one oscillation).	**A**
22	The wavelength has increased as it travels from regions X to Y. Frequency of wave remains constant (as there is no change in the source). Using $v = f \times \lambda$, this implies that the speed of the wave increases. Thus, region X is shallower and region Y. Using the concept of refraction, the direction of wave travel will bend away from the normal as speed of the wave increases.	**D**
23	Strategy: (1) Sketch a direction of wave travel and use the concept of reflection (2) Wavefronts always perpendicular to the direction of wave travel.  	**D**

24	Light ray bends towards the normal as it travels from optically less dense medium to more dense medium, and vice versa. 	**B**
25	Using infra-red radiation and ultra-violet as reference, red light will have a larger wavelength and smaller frequency than the violet light.	**B**
26	The electromagnetic waves must be safe for usage and hence must not have high ionisation energy (or high frequency). Note: Ultrasound is not an electromagnetic wave.	**A**
27	Due to atoms or molecules are closer to each other in solid as compared to that in the air, the speed of sound is larger in solid than in the air. However, as there is no change in the source, the frequency of the sound remains unchanged.	**D**
28	The first sound heard by the engineer is the sound that travels directly from the source to him. Distance travelled by this sound to reach the engineer $= \sqrt{30^2 + 40^2}$ $= 50$ m The second sound heard by the engineer is the sound that reflected on the vertical wall on the right. Distance travelled by this sound to reach the engineer (See below) $= 3 \times \sqrt{10^2 + 40^2}$ ≈ 124 m 	**C**

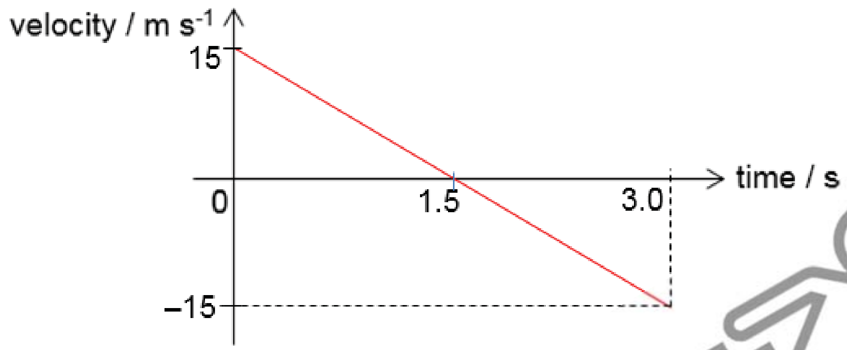
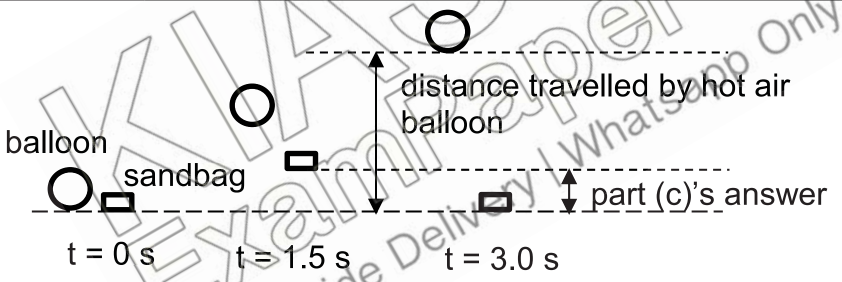
	Time lapse between the two sounds = (124 – 50) / 300 = 0.25 s	
29	Initially, the force applied on the object is equal to the frictional force (since the object is moving with constant speed). When the negative charged object enters the electric field, there will be a downward electric force acting on the object and pressing the object against the rough surface. The frictional force acting on the object will increase. By Newton's 2nd Law, as there is a now resultant force acting on the object opposing the motion. The object will decelerate. Note: The direction of electric field shows the direction of the electric force acting on the positively charged object.	**A**
30	When an object is neutrally charged, induced separation of charges can cause an object to be attracted to a charged object. On the other hand, an object that is oppositely charged can also be attracted to a charged object. Thus, only repulsion can determine the state of charge of an object.	**A**
31	Using definition of electromotive force, Ɛ = W / Q Amount of electrical energy transferred, W = Ɛ x Q = $350 \times 100 \times 10^{-3}$ = 35 J	**B**
32	 Potential at P = 2.0 – potential difference across 5.0 kΩ = 2.0 – 1.0 = 1.0 V Potential at Q = 2.0 – potential difference across 2.0 kΩ $= 2.0 - \frac{2.0}{2.0 + 3.0} \times 2.0$ = 1.2 V Potential difference across P and Q = 1.2 – 1.0 = 0.2 V	**A**

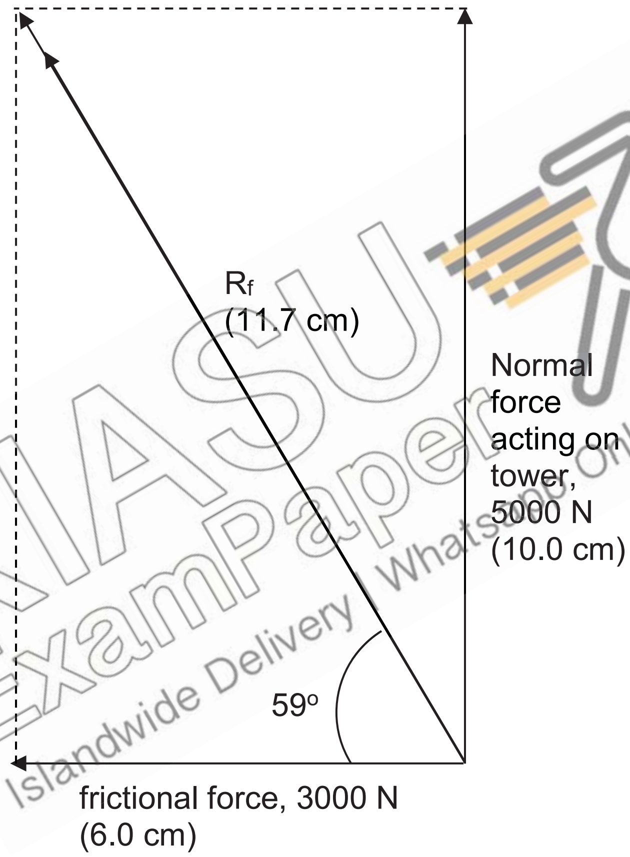
33	The symbol shown is the symbol for thermistor. At high temperature, thermistor will have low resistance. Total effective resistance in the circuit = 3.0 + 2.0 = 5.0 Ω Using R = V / I, ammeter reading = R / V = 6.0 / 5.0 = 1.2 A	**D**
34	This is one of the method to demagnetise a magnet. When the magnet is dropped onto the floor, the energy absorbed by the magnet will disorientate the atomic magnets and hence the atomic magnets will no longer align themselves in the same direction. Thus, the magnet will lose magnetism.	**D**
35	This is a recall question. Flow of positive charge is equivalent to the flow of conventional current and hence the motion of positive charge will create a magnetic field. Using right hand grip rule with the thumb pointing into the paper, the direction of magnetic field will be in clock-wise direction (as given by the fingers).	**B**
36	This is a recall question. The ultimate function of split ring commutator is to ensure the direction of current in the coil is always in the same direction so that the coil will always turn in the same direction at all times. Note: A motor is to convert electrical energy to mechanical energy, rather than producing electrical energy.	**C**
37	Direction of current when switch S is closed:  Both iron rods will be magnetised with opposite polarities as shown above. Since unlike poles attracts, the spacing at X will decrease.	**A**
38	 The induced current in the solenoid will flow such that it can induce a	**D**

	N-pole at X when the magnet moves into the solenoid at X. Thus, to create the same deflection, the cause should be able to create a N-pole at X, that is, pulling a S-pole of the magnet out from X and pulling a solenoid away from a S-pole.	
39	By Faradays' Law of electromagnetic induction, the magnitude of the induced emf is directly proportional to the rate of cutting of magnetic field lines by the conductor. Thus, when the number of coils increases to three times as before, the induced emf will be 3V. When the frequency of rotation is now 2F (twice of the original rate of rotation), the induced emf will be 2 times of 3V, that is 6V.	**C**
40	Using $\frac{N_s}{N_p} = \frac{V_s}{V_p}$, Voltage across secondary coil, V_s = 100 / 50 x 25 = 50 V	**B**

Solution to 2019 Sec 4 Physics Prelim Paper 2

Section A

Qn	Solution	Marking Scheme
1(a)	Due to inertia, the sandbag will have a reluctancy to change its state of motion and will appear to move with an initial velocity of 15 m s^{-1}.	B1
(b)		B1 – straight line with gradient of 10 m s^{-2} B1 – coordinates of all the critical points.
(c)	Distance travelled = area under the v-t graph from t = 0 s to t = 1.5 s = ½ x 15 x 1.5 ≈ 11 m (also accept 11.3 m)	B1
(d)	 At t = 3.0 s, the sandbag is back at the original drop off point. Distance between the sandbag and the hot air balloon = distance travelled by the hot air balloon from the original drop off point = 3.0 x 15 = 45	M1 – student shows attempts to find this value A1
2(a)	Principle of moment states that when an object is in equilibrium, the total clockwise moments about a point is equal to the total anti-clockwise moments about the same point.	B1

(b)	By principle of moment, taking moment about the point at which the steel cable is connected to the windmill, $f_r \times 20.0 = 2000 \times (30.0 - 20.0)$ $f_r = 1000$ N	M1 A1
(c)	Normal reaction force on the tower = 5000 N Frictional force on the tower = 3000 N (to the left) Scale: 1.0 cm to 500 N  Resultant force = 11.7 x 500 = 5850 N (also accept 5550 N to 6150 N) Direction = 59° clockwise from the frictional force (also accept 56° to 62°)	M1 – correct drawing A1 – correct magnitude A1 – correct direction

3(a)	The chemical potential energy possessed by Spiderman is converted to work done on the ground by his foot as Spiderman is walking backwards. This energy is then converted to elastic potential energy of the flag pole. The total energy in the system remains a constant. The loss in chemical potential energy of Spiderman is equal to the gain in the elastic potential energy of the pole.	B1 B1 B1
(b)	Loss in kinetic energy = initial kinetic energy – final kinetic energy = ½ x 65.0 x 40.0^2 - ½ x 65.0 x 15.0^2 = 44687.5 ≈ 44 700J	M1 A1 – accept only 3 sf
(c)	By conversation of energy, loss in kinetic energy = gain in GPE + work done against air resistance 44687.5 = 65.0 x 10 x h + 5000 h ≈ 61.1 m	M1 A1
4(a) (i)	As the base of the lid moves up, this increases the surface area at which the air molecules hitting the internal surface of the container. The number of air molecules hitting per unit area of the internal surface of container (that is, the frequency of collisions of the air molecules with the internal surface of the container) decreases. Since the amount of force exerted by each air molecules on the internal surface of container remains unchanged during collision, the pressure of the air in the container decreases.	B2 – student's answer contains all the three points B1 – student's answer contains all one to two points B0 – student's answer does not contains any of these three points
	Note: $\text{Pressure} = \dfrac{\text{Total force exerted by molecules}}{\text{Total surface area}}$ $\text{Pressure} = \dfrac{\text{Force exerted by one molecule} \times \text{Total no. of molecules}}{\text{Total surface area}}$	

	Pressure $=$ Force exerted by one molecules $\times$ frequency of collision	
(ii)	The atmospheric pressure acting on the lid is much larger than the pressure of the air in the container. A large upward force is needed to overcome this pressure difference.	B1

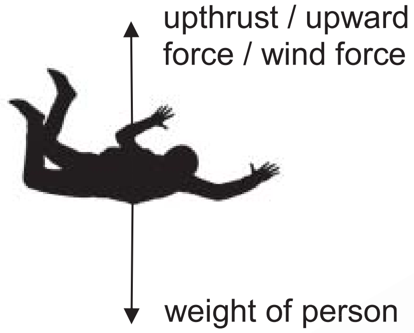
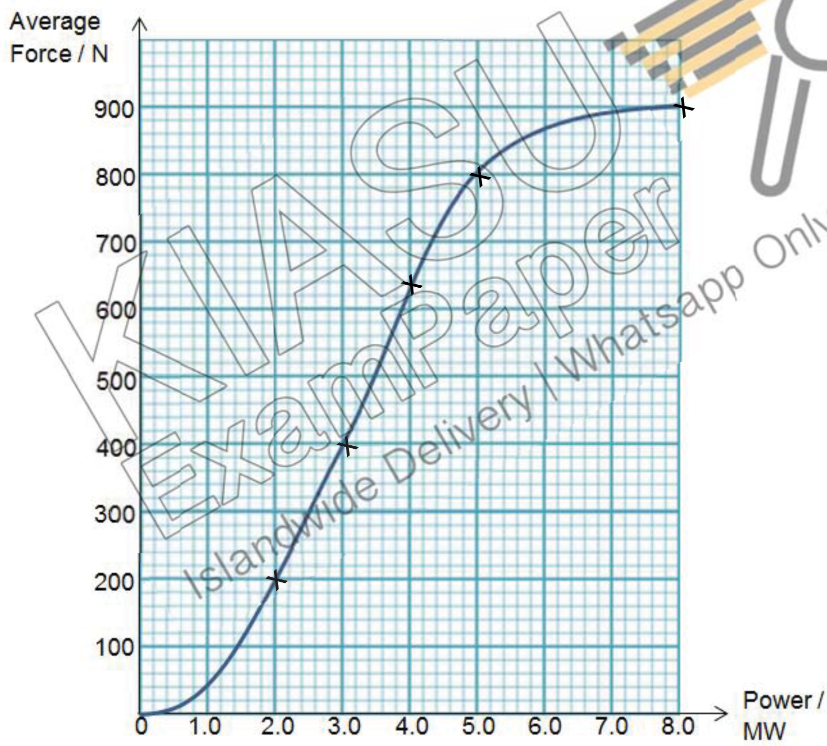
(b) (i)	Molecules are closely packed due to strong intermolecular forces of attraction, however, the molecules are still free to move.	B1
(ii)	Pressure on piston A = Pressure on piston B $F_A / A_A = F_B / A_B$ $\dfrac{30}{\pi (2.5)^2} = \dfrac{F_B}{\pi (7.5)^2}$ $F_B = 9 \times 30$ $F_B = 270$ N	M1 A1
5(a)	As the light intensity increases, the resistance of LDR decreases or vice versa.	B1
(b)	The graph does not shows a straight line passing through the origin, that is, potential difference across LDR is not directly proportional to the current flowing through it.	B1
(c) (i)	Resistor B and LDR are connected parallel to each other. $\dfrac{1}{R_{eff}} = \dfrac{1}{3000} + \dfrac{1}{2000}$ $\dfrac{1}{R_{eff}} = \dfrac{1}{1200}$ $R_{eff} = 1200\ \Omega$	M1 A1
(ii)	Using potential divider concept, p.d across resistor A $= \dfrac{1000}{1000+1200} \times 9.0$ ≈ 4.1 V	M1 A1 - accept 2 sf only
(iii)	p.d across LDR = 9.0 – 4.1 = 4.9 V Using R = V / I, Current through LDR = V / R = 4.9 / 2000 = 0.00245 A ≈ 0.0025 A	M1 A1 – sf must be consistent with part (ii)

6(a)	Using P = I V, Current through the heating element = P / V = (2.4 x 10^3) / 240 = 10 A	 M1 A1
(b)	When there is a current exceeding 13 A, the fuse will be heated up and melt when the melting point is reached. This cause the circuit to be an open circuit and current will no longer flow through the appliance. Hence, this protect the appliance which can be damaged due to over-heating.	B1 B1
(c)	When the water heater has double insulation, this means that the outer-casing is made of non-electrical conducting material. Hence, even if there is an electrical fault such that live wire touching the casing, the casing remains at low potential. A person touching the casing will not get electricl shock. Thus, earth wire is not required to be connected to the casing.	B1 B1
7(a)	By adjusting the resistance of variable resistor to a smaller value, this will increase the current flowing through the coil wounding around the soft iron core. The increase in the current will increase the magentic field strength in the coil and the soft iron core will be magnetised and become a stronger magnet. Due to induced magnetism, one end of the iron armature will be attracted towards the soft iron core and the turning effect on the iron armature will close the contacts and close the circuit connecting to the motor and motor is switched on.	B2 – student's answer contains all the three points B1 – student's answer contains all one to two points B0 – student's answer does not contains any of these three points
(b)	South pole. Note: Student needs to first establish the direction of current flowing in the coil and then apply right hand grip rule.	B1
(c) (i)	Diode Note: Diode only allows current to flow in a single direction.	B1

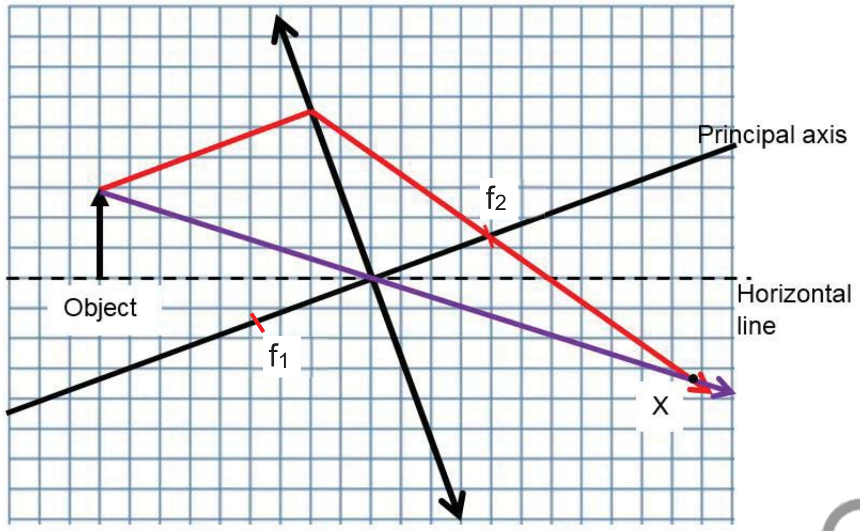
(ii)	The magnetic force on the wire PQ is in the upward direction as the magnetic field strength below the wire PQ is larger than that above the wire PQ. The difference in the magnetic field strength is due to the interaction of the magnetic field due to the current that is flowing from Q to P and the magnetic field due to the permanent magnet.	B1 B1 – student is required to state the direction of the current in wire PQ
8(a)	Faraday's law of electromagnetic induction states that the magnitude of the induced emf is directly proportional to the rate of cutting of magnetic field lines by the conductor. or Faraday's law of electromagnetic induction states that the magnitude of the induced emf is directly proportional to the rate of change magnetic flux linkage with the conductor.	B1
(b)	When the switch is first closed, the increase in the current flowing through coil A result in an increase in the magnetic field strength experienced by coil B. By Faraday's Law, there is an induced emf in coil B. Since it is a closed circuit between coil B and the galvanometer, there is an induced current flowing through galvanometer which shows a deflection.	B1 B1
(c) (i)	The batteries is replaced by an alternating current supply. Also accept any changes that can produce a continuous changing magnetic field in coil A.	B1

(ii)	One of the following: - decreasing the number of turns in coil B (explanation: use $N_s/N_p = V_s/V_p$ and $P = I_sV_s$, since V_s decreases) - increasing the number of turns in coil A (expalanation: use $N_s/N_p = V_s/V_p$ and $P = I_sV_s$, since V_s decreases) - Use a more sensitive galvanometer (explanation: greater deflection for the same amount of current flow through the galvanometer) - Use connecting wire of a lower resistance (explanation: will give a larger amount of current flow for the same power output, use $P = I^2R$) (Do not accept open and close the switch faster as this will not affect the rate of cutting of magnetic field lines by the conductor. The mangetic field is produced at the instant when the switch is just close)	B1

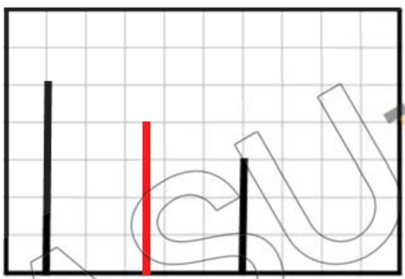
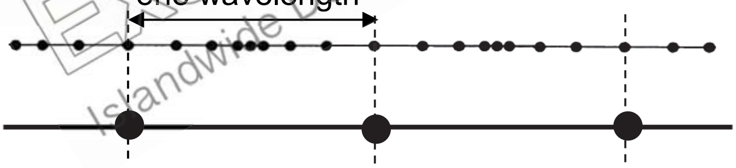
Section B

Qn	Solution	Marking Scheme
9(a)	Newton's 1st law of motion states that an object will remain at rest or continue to move with a constant speed along a straight line unless a resultant force acts on the object.	B1
(b)		B1 – students name the two forces correctly B1 – both arrows must have the same length
(c)		B1 – correct plotting of points B1 – correct shape of graph (no marks if student draws a straight line)
(d)(i)	750 N	B1
(ii)	From the graph, the power required = 4.6 MW	B1 – allow ecf from part (c)

(iii)	Corresponding wind force = 800 N Using Newton's 2nd Law, $F_{net} = m \times a$ $800 - 750 = 75 \times a$ $a \approx 0.067 \text{ m s}^{-2}$ (2 sf)	 M1 A1 – accept only 2 sf
(e)	As <u>the wind force can be smaller than the weight of the person</u>, the person will descend vertically and a safety net will be able to prevent the person from any impact with the base of the chamber.	 B1
10(a) (i)	The light ray is moving away from the normal as it across the boundary. This implies that the speed of light ray in the medium X is higher than the speed of the light ray in the diamond. Thus, the refractive index of medium X is smaller than of the diamond.	M1 A1
(ii) 1.	Critical angle is the angle of incidence when the light ray is travelling from an optically denser medium to a less dense medium and the angle of refraction is 90°.	B1
(ii) 2.	As the angle of incidence is larger than the critical angle, the light ray will go through total internal reflection. Using law of reflection, the angle of reflection will be equal to the angle of incidence.	B1 B1
(ii) 3.	Critical angle is smaller than 39°. Note: For the same angle of incidence, the light ray will bend more away from the normal if medium X is water. Thus, this implies that the critical angle will not need to reach 39° for angle of refraction to be 90°.	B1
(b) (i)	Principal axis is defined as a straight line passing through the optical centre and perpendicular to the vertical plane of the lens.	B1

(ii)	 Marking points: 1. Correct construction of principal axis and labelling of focal points 2. - **Ray** from object passing through optical centre - **Ray** parallel to principal axis and passing through focal point. - **Direction** of rays from object - **Labelling** of image X	B1 mark B2 marks –all 4 correct marking point B1 marks – only 2 or 3 correct (allows ecf from part **(ii)1.)**

Either

11(a)	Ultrasound is defined as sound with a frequency that is greater than 20 000 Hz.	B1
(b) (i)	It means that for every one second, the particle will make 25000 complete oscillations about its undisturbed position. Note: Do not accept the source generates 25000 completes waves in one second.	B1
(ii)	Distance between the obstacle and the back bumper = ½ x total distance travelled by the ultrasound = ½ x (speed of sound x time taken) = ½ x 330 x 800 x 10^{-6} = 0.132 m = 13.2 cm	 M1 A1
(iii)		B1 – the returning pulse should have a larger amplitude and nearer to the emitter pulse.
(c) (i)	Rarefaction is the region in the sound wave which has the lowest air pressure (the adjacent particles are the furthest apart).	B1
(ii) 1. 2.		 B1 B1
3.	After 1 period, all the particles will have returned back to the original position. When another ½ period has progressed, all the rarefaction zone will be changed to compression zone. The particle at the centre of rarefaction would have moved to its furthest point and returned back to its undisturbed position and will now be at the centre of compression zone.	B1 B1

Or

11(a) (i)	Copper metal. Copper is a good conductor of heat and resistant to corrosion.	B1
(ii)	Agree. Comparing to generate electricity using burning of fossil fuel, the by-products generated are less harmful. Disagree. Natural gas is a non-renewable source of energy and will be depleted. There are by-products released to the environment during the combustion and this can pollute the environment.	Either one. B1
(iii) 1.	Amount of thermal energy to change 2.0 kg of water to steam in 1.0 minute = amount of energy to increase the temperature of water + amount of energy to convert water at 100°C to steam $= m\,c\,\Delta\theta + m\,l_v$ $= 2.0 \times 4200 \times (100 - 30) + 2.0 \times 2.1 \times 10^6$ ≈ 590 000 (2 sf) + 4 200 000 = 4 790 000 J	M1 – correct $m\,c\,\Delta\theta$ M1 – correct $m\,l_v$ A1 - accept 3 sf only.
2.	Efficiency = useful power output / power input x 100% 80% = useful power output / power input x 100% Therefore, power input = (100 / 80) x useful power output = (100 / 80) x (4 790 000 / 60) ≈ 100 000 W (2 sf)	M1 – finding useful power output A1 – 2 sf
(b)(i)	A small amount of the raw material (radioactive substance) can help to generate a large amount of electrical energy.	B1
(ii)	Electromagnetic wave	B1
(iii)	Gamma radiation has extremely high frequency and hence ionising power. Exposure of gamma radiation can lead to mutation of cells, cause cancer and lead to death.	B1

Name	Class	Index Number

UNITY SECONDARY SCHOOL

PRELIMINARY EXAMINATION 2019

SECONDARY FOUR EXPRESS

PHYSICS 6091/01 **18 SEPTEMBER 2019**

PAPER 1 **1 HOUR**

Additional Materials : Optical Answer Sheet

READ THESE INSTRUCTIONS FIRST

1. This paper consists of **40** Multiple Choice Questions.
2. Answer all questions on the Optical Answer Sheet (**OAS**).
3. Write your name, class and shade your register number in the spaces on the **OAS**
4. Do not fold nor use any correction fluid on the **OAS**. Read the instructions on the **OAS** carefully.
5. The total mark for this paper is 40 marks.

This paper consists of **19** printed pages, including this cover page.

1 Which of the following statements is **CORRECT**?

A The length of a bus is about 1×10^2 m.

B The diameter of an atom is about 1×10^{-5} m.

C The diameter of the Earth is about 1×10^7 m.

D The thickness of a human's hair is about 1×10^{-2} m.

2 Figure I shows the reading of the zero error of the micrometer screw gauge. Figure II shows the reading of the same instrument when it is used to measure the width of an object.

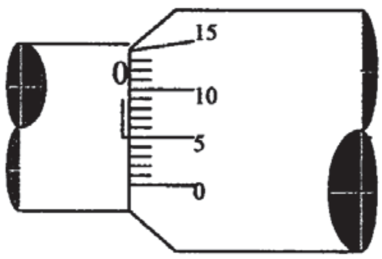


Figure I

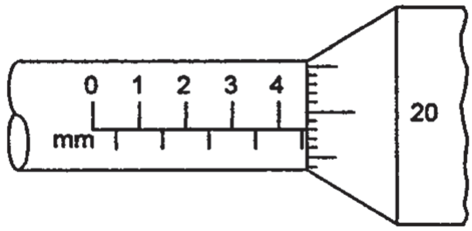


Figure II

What is the actual width of the object?

A 4.63 mm

B 4.73 mm

C 4.83 mm

D 4.85 mm

3 A car travels for 10 m in 2 seconds.

What can be deduced from the information given?

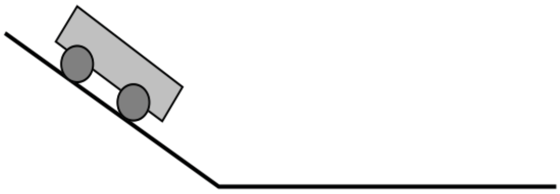
A The average speed of the car is 5 m/s.

B The car travels at a constant speed.

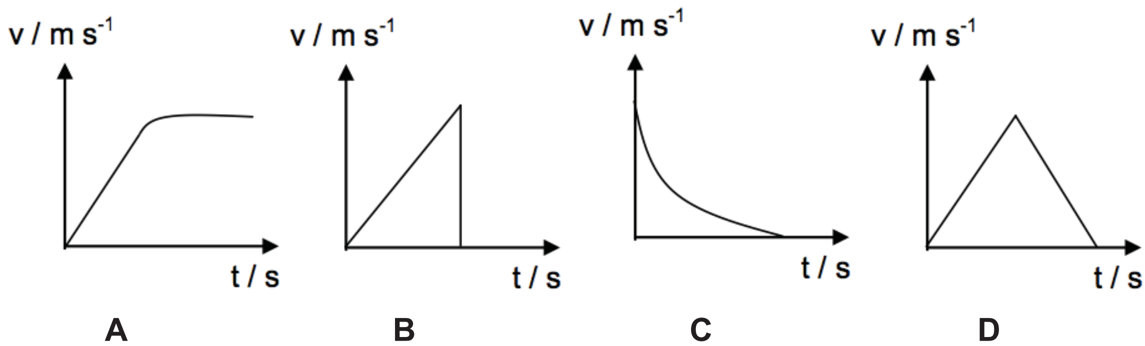
C The maximum speed of the car is 5 m/s.

D The minimum speed of the car is 5 m/s.

4 The diagram shows a trolley that starts rolling down a sloping runway connected to a flat floor. Assume all the surfaces are frictionless.



Which of the following velocity-time graphs best illustrates the motion of the trolley?



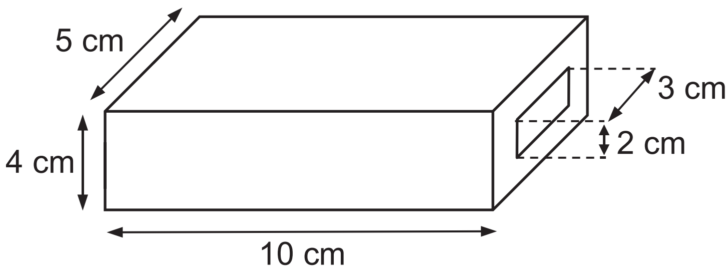
5 The total mass of a skydiver and her equipment is 80.0 kg when she jumps from an aircraft. When the parachute just opens, she decelerates at 2.5 m/s^2.

What is the tension in the cord at this instance?

A 200 N **B** 600 N

C 800 N **D** 1000 N

6 A hollow rectangle metal block has the dimensions shown. The hole in the middle goes all the way through the block. The density of the metal is 10 g/cm^3.



What is the mass of the block?

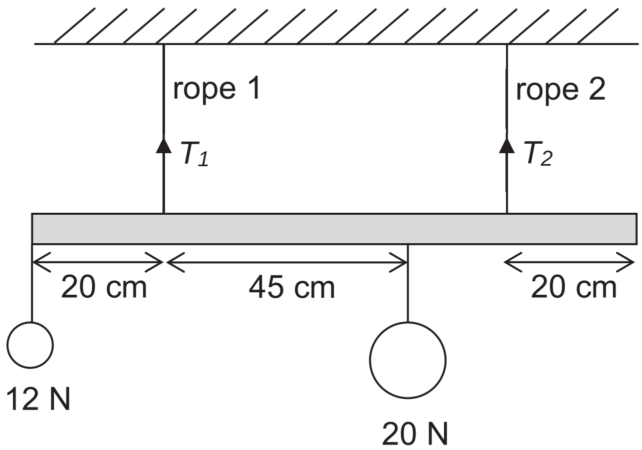
A 14 g

B 400 g

C 1400 g

D 2000 g

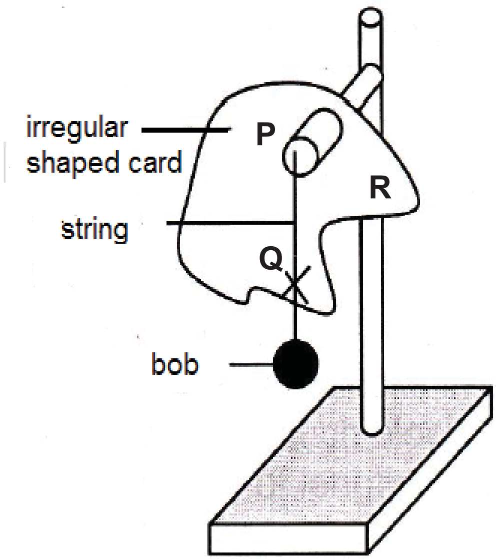
7 The figure below shows a metre rule hanging from the ceiling using two ropes. Two weights, 12 N and 20 N, are attached to the metre rule.



Assuming the weight of the metre rule is negligible, what is the tension T_2?

A	11 N	**B**	12 N
C	21 N	**D**	32 N

8 The diagram shows the first step in an experiment to determine the position of the centre of gravity of mass of an irregular shaped card.



What is the next step in this experiment?

A find the mid-point of **PQ**

B hang the card from **R**

C measure the mass of the card

D measure the thickness of the card

9 Which of the following objects is in neutral equilibrium?

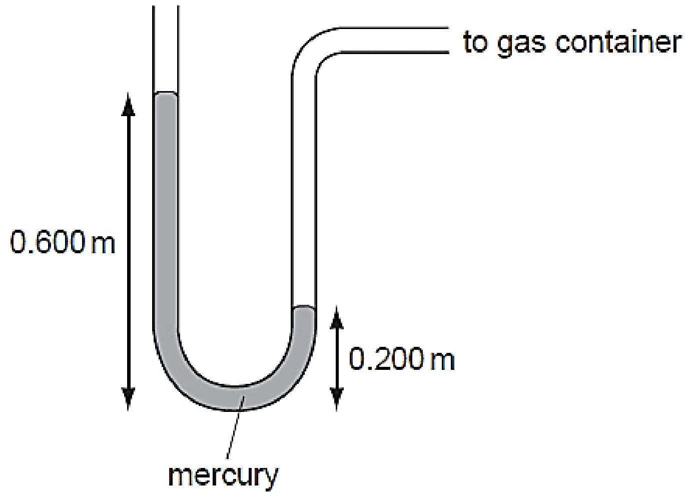
A a pencil balanced on its sharp tip

B a playground swing that is at rest

C a traffic cone that is upright

D an ice cream cone resting on its slant edge

10 The diagram shows a mercury manometer connected to a gas container. The density of mercury is 13 600 kg/m^3. The gravitational field strength g is 10 N/kg.



What is the pressure difference between the gas in the container and the atmosphere?

A	27 200 Pa	**B**	40 800 Pa
C	54 400 Pa	**D**	81 600 Pa

11 A lift of mass 1000 kg rises 50 m in 2.0 minutes.

If the efficiency of the lift is 80 %, what is the power supplied to the motor? (The gravitational field strength on Earth, g, is 10 N/kg.)

A 3.33 kW

B 5.00 kW

C 5.21 kW

D 250 kW

12 A tungsten wire has a resistance of 30 Ω at -10 °C and 50 Ω at 90 °C.

What is the working temperature of the wire if its resistance is 70 Ω?

A	100 °C	**B**	170 °C
C	190 °C	**D**	210 °C

13 Diagram I shows a thermocouple with junction **P** and **Q**. The millivoltmeter shows a deflection that depends on the temperature difference between the junctions **P** and **Q**. Diagram II shows how the temperature difference between junctions **P** and **Q** corresponds to the deflection in the millivoltmeter.

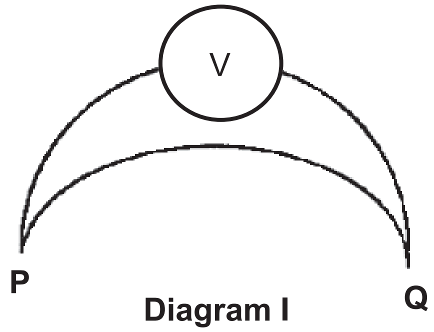


Diagram I

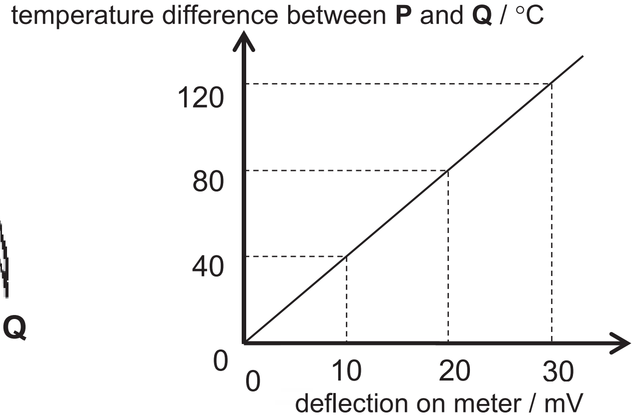


Diagram II

If **P** is placed in a substance of 20 °C and **Q** is placed in another substance of higher temperature, a deflection of 30 mV is seen.

What is the temperature of **Q**?

A	20 °C	**B**	100 °C
C	120 °C	**D**	140 °C

14 A gas in a sealed cylinder with fixed volume is heated.

Which of the following does **NOT** increase as the gas is heated?

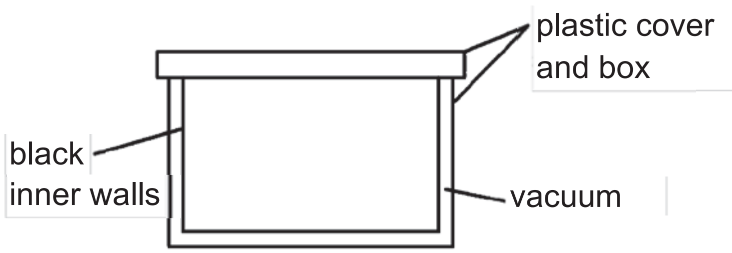
A The average distance between the gas molecules.

B The average kinetic energy of the gas molecules.

C The average number of gas molecules hitting the cylinder walls per second.

D The average speed of the gas molecules.

15 The diagram below shows the cross-section of a plastic container that a manufacturing company has created.



The company claims that the container can keep food warm for a duration that surpasses other brands of container. It offers the following explanations to justify their claims:

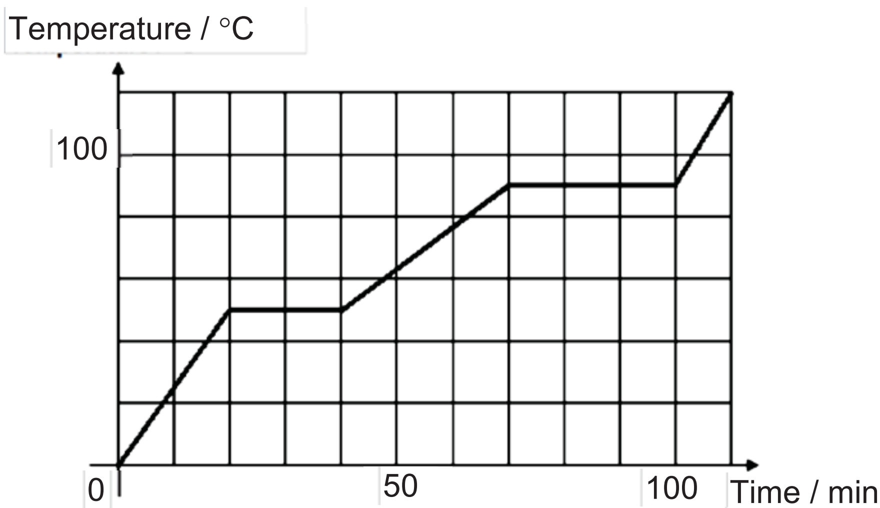
1. The plastic cover will reduce heat loss through conduction as plastic is a poor conductor of heat.
2. The black inner walls will absorb heat from the environment to keep food warm since black surfaces are good absorbers of heat.
3. The vacuum between the interior and exterior walls of the container will prevent heat losses to the surroundings through conduction, convection and radiation.

Which of the statements is/are **CORRECT**?

A 1 only **B** 1 and 2 only

C 2 and 3 only **D** All of the above

16 The graph shows the change in temperature when heat is supplied at 200 W to 1 kg of the substance.



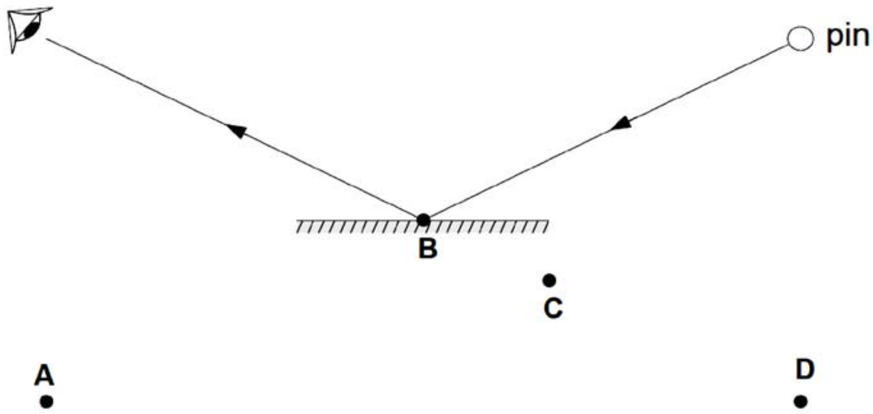
The specific latent heat of vaporisation of the substance is _________ J/kg.

A 4 000 **B** 6 000

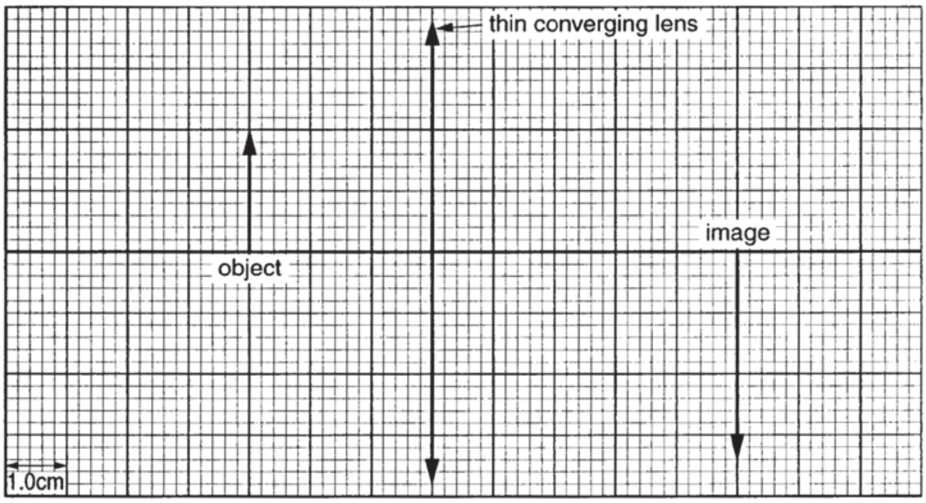
C 240 000 **D** 360 000

17 A pin is placed in front of a plane mirror as shown.

Where is the image of the pin?



18 The diagram below shows an image of an object formed by a thin converging lens.



The lens is replaced with another lens of twice the focal length.

What are the properties of the new image?

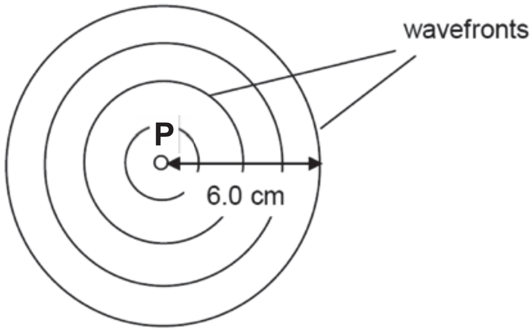
A real, inverted, diminished

B real, inverted, same size

C real, inverted, enlarged

D virtual, upright, enlarged

19 The diagram below shows circular wavefronts radiating from a point source **P**.



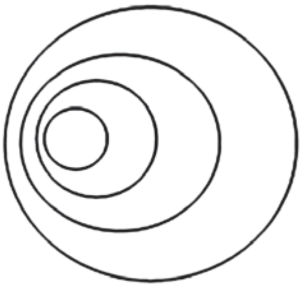
The point source is then set to vibrate with a gradually decreasing frequency.

Which of the following shows the possible resulting wavefronts?

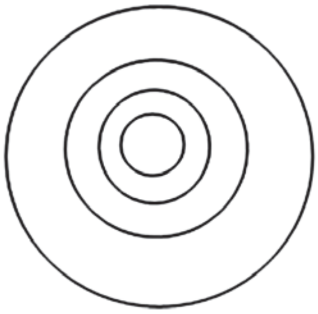
A

B

C



D



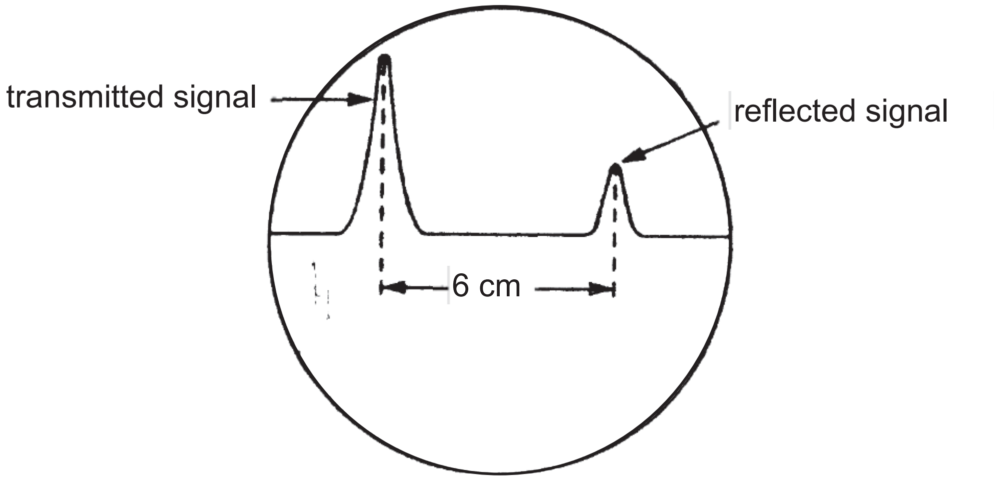
20 The wavelength of X-rays is roughly the size of an atom.

What is the frequency of the X-rays?

A 1×10^{-10} Hz **B** 3×10^{8} Hz

C 1×10^{10} Hz **D** 3×10^{18} Hz

21 Sonar waves are emitted from a surface vessel to determine the depth of the sea. The emitted signal and its reflection from the sea bed are displayed on the screen of a cathode-ray oscilloscope as shown below.



Given that the speed of sound in water is 1200 m/s and that the time-base of the oscilloscope is 8 cm/s. What is the depth of the sea at this point?

A 450 m

B 800 m

C 900 m

D 7200 m

22 The frequencies of two musical notes **X** and **Y** are 256 Hz and 512 Hz respectively.

If **X** and **Y** have the same amplitude, which of the following statements is/are **<u>TRUE</u>**?

1. **Y** has a higher pitch than **X**.
2. The loudness of **X** is larger than that of **Y**.
3. The wavelength of **Y** is longer than that of **X**.

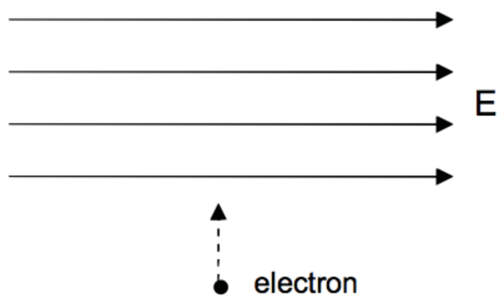
A 1 only

B 3 only

C 1 and 3 only

D 2 and 3 only

23 An electron is projected at right angles to a uniform electric field **E** as shown in the diagram.



In the absence of other fields, in which direction is the electron deflected?

A to the left

B to the right

C into the plane of the paper

D out of the plane of the paper

24 A bird is seen standing safely on a high voltage transmission line.

Which statement best explains this?

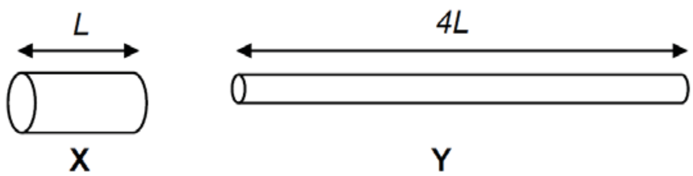
A The body of the bird has a high resistance.

B The scaly feet of the bird are good insulators.

C The trapped air in the feathers of the bird acts as an electrical insulator.

D There is negligible potential difference between the two feet.

25 The diagram below shows two copper wires **X** and **Y**. Both wires have the same volume and wire **Y** is four times as long as wire **X**.



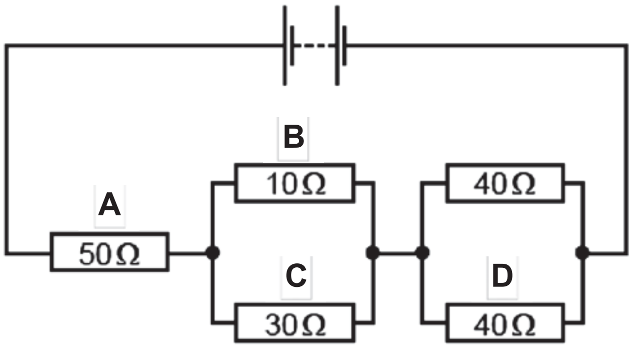
What is the ratio of the resistance of wire **Y** to resistance of wire **X**?

A 4:1 **B** 8:1

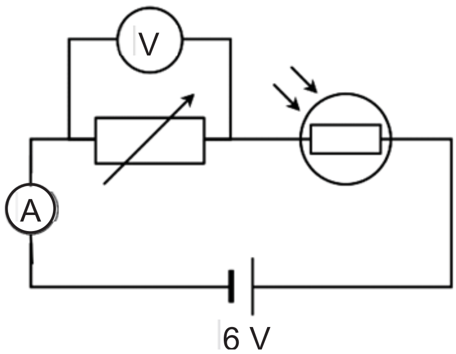
C 16:1 **D** 64:1

26 The diagram shows a circuit containing five resistors connected to a battery.

Through which resistor is the current the smallest?



27 The diagram below shows a circuit with a variable resistor and light dependent resistor (LDR) connected in series.



When light shines brighter on the LDR, what will happen to the reading on the ammeter and voltmeter?

	ammeter reading	**voltmeter reading**
A	increases	increases
B	increases	decreases
C	decreases	increases
D	decreases	decreases

28 An electrical circuit uses insulated copper wire and the wire overheats.

Which of the following correctly explains how the wire should be replaced to prevent it from overheating again?

A Use thicker copper wire which has less resistance.

B Use thicker insulation to reduce conduction.

C Use thinner copper wire which has more resistance.

D Use thinner insulation to reduce conduction.

29 Ben connects a fuse along the neutral wire of a fan.

Which of the following statement(s) is/are **CORRECT**?

1. The fan will be safe to touch after the fuse blows.
2. When there is a large current, the fuse will blow and prevents the fan from overheat.
3. There is no current passing through the neutral wire after the fuse blows.

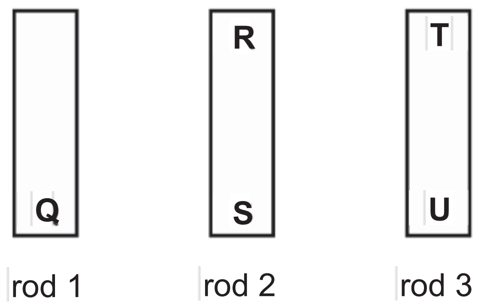
A 3 only

B 1 and 2 only

C 1 and 3 only

D 2 and 3 only

30 The ends of three metal rods are tested by holding end **Q** of rod 1 close to the others in turn.



The results are as follows:

End **Q** attracts end **R**.
End **Q** attracts end **S**.
End **Q** attracts end **T**.
End **Q** repels end **U**.

Which metal rod is a magnet?

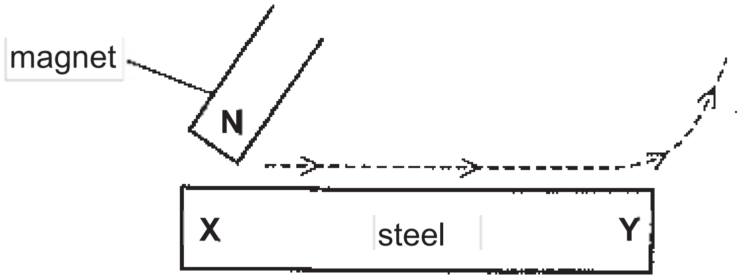
A rod 1 only

B rod 1 and rod 2

C rod 1 and rod 3

D rod 3 only

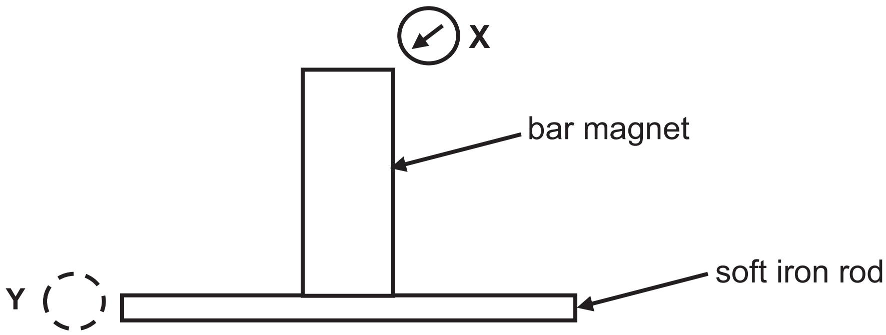
31 A piece of steel can be magnetised by stroking it with a magnet.



When the magnet is moved in the direction shown, which poles are produced at **X** and at **Y**?

	X	**Y**
A	North	North
B	South	North
C	North	South
D	South	South

32 A soft iron rod is attracted by a bar magnet as shown the diagram below. When a plotting compass is placed at **X**, the needle points in a direction as shown.



Which of the following shows the correct direction of the compass needle when it is moved from position **X** to **Y**. (Ignore earth's magnetic field)

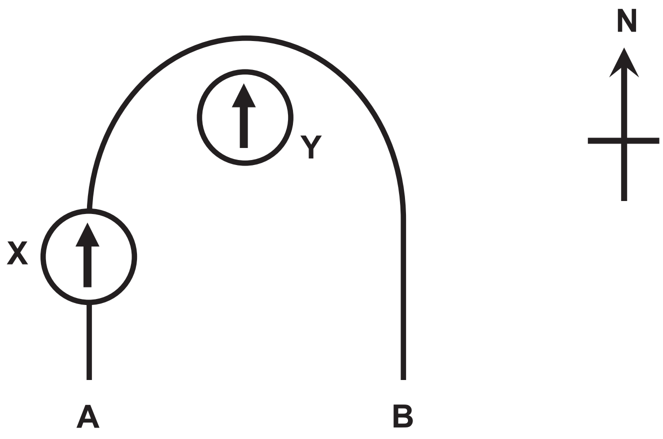
A 

B 

C 

D 

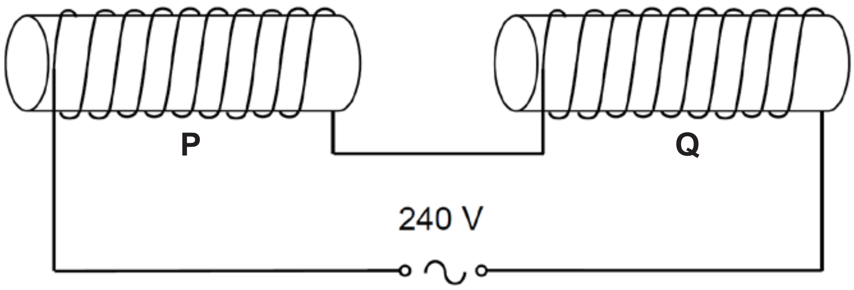
33 The diagram shows a wire **AB** that is bent into a U-shape and placed along the earth's north-south direction. Two plotting compasses are placed at the positions **X** and **Y**. The compass at **X** is above the wire.



What will happen when a current flows from **A** to **B** in the wire?

	compass at X	**compass at Y**
A	deflects to the right	remains in the position shown
B	deflects to the right	deflects to the left
C	deflects to the left	deflects to the right
D	remains in the position shown	remains in the position shown

34 Two iron bars **P** and **Q** are placed inside two solenoids as shown below.



What will happen to **P** and **Q**, when the solenoids are connected to an a.c. power supply?

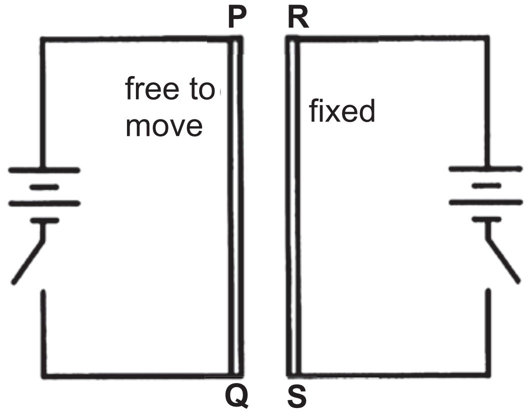
A repel each other

B attract each other

C oscillate towards and away from each other.

D oscillate upwards and downwards

35 Two long parallel wires **PQ** and **RS** are connected to batteries as shown in the diagram. **PQ** can move freely in any direction but **RS** is fixed.



When both switches are closed, what happens to wire **PQ**?

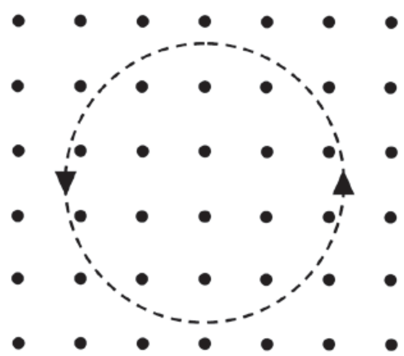
A **PQ** moves away from **RS**.

B **PQ** moves towards **RS**.

C **PQ** moves in a direction into the plane of the paper.

D **PQ** moves in a direction out of the plane of the paper.

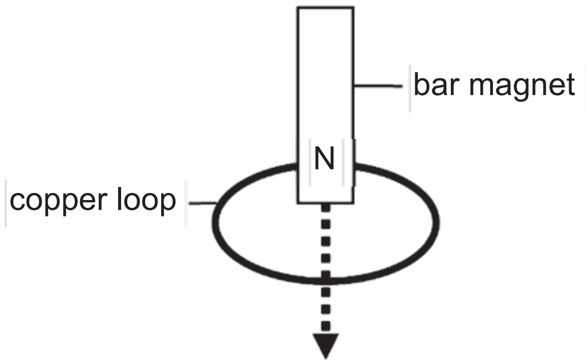
36 The diagram below shows the circular anti-clockwise path of a charged particle in a field. The direction of the field is out of the paper.



Ignoring the effect of gravity, which of the following correctly describes a possible state of charge of the particle and the nature of the field?

	charge	field
A	negative	magnetic
B	positive	electric
C	negative	electric
D	positive	magnetic

37 A bar magnet is dropped through a loop of copper wire as shown.



Which of the following statement(s) is/are **CORRECT**?

1. When the magnet approaches the copper loop, a current is induced in the loop that flows in clockwise as seen by the observer from the top of the loop.

2. When the magnet moves through the copper loop, the current induced in the copper loop sets up a magnetic field that always repel the magnet.

3. Heat is produced in the copper loop.

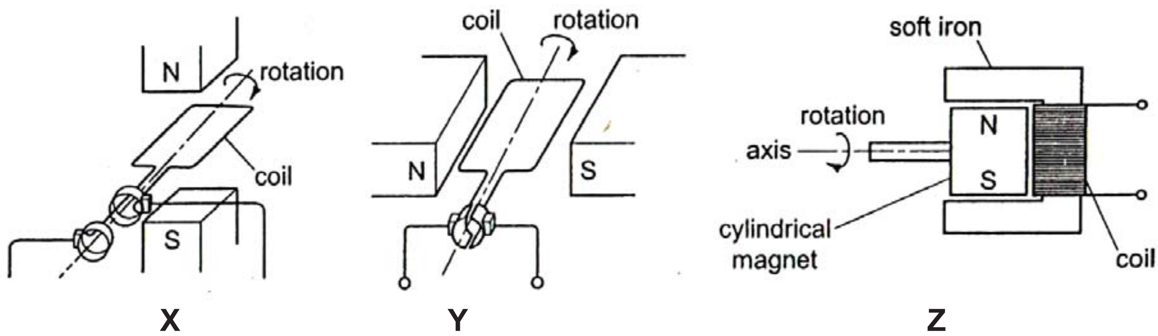
A 2 only

B 1 and 2 only

C 2 and 3 only

D 3 only

38 The diagrams show three generators, **X**, **Y** and **Z**.



Which is/are alternating current generator(s)?

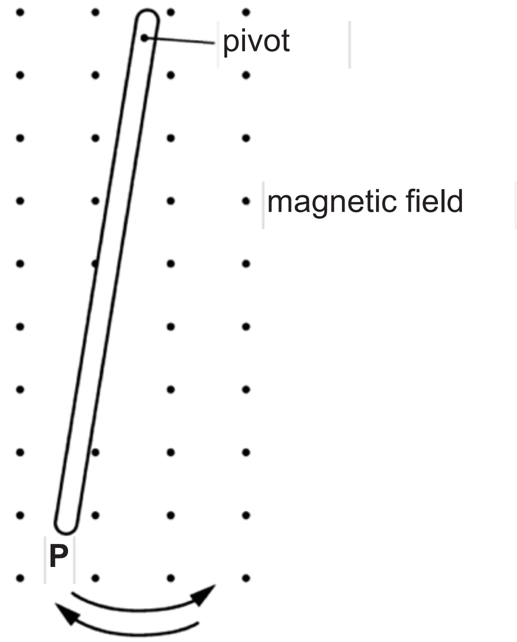
A **X** only

B **Y** only

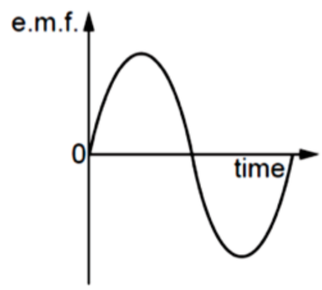
C **X** and **Y** only

D **X** and **Z** only

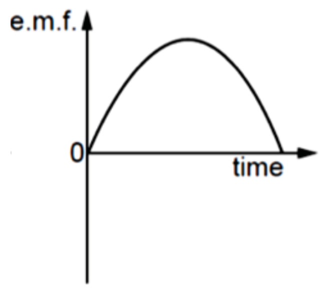
39 The diagram shows a metal bar swinging like a pendulum across a uniform magnetic field. The motion induces an e.m.f. between the ends of the bar.



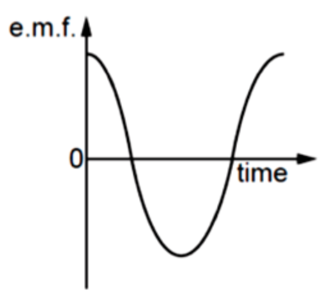
Which graph represents this e.m.f. during one complete oscillation of the bar, starting and finishing at **P**?



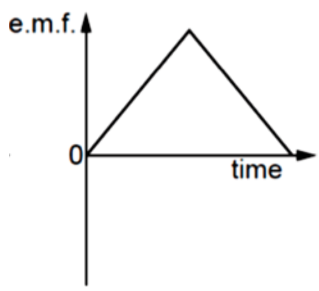
A



B



C



D

40 The number of turns in a primary coil and secondary coil of a transformer is N_p and N_s respectively.

Which pairs of values for N_p and N_s will result in an output voltage of 240 V when the input voltage is 20 000 V?

	N_p	N_s
A	2 000	240
B	10 000	240
C	10 000	480
D	30 000	360

*****END OF PAPER*****

Name	Class	Index Number

UNITY SECONDARY SCHOOL

PRELIMINARY EXAMINATION 2019

SECONDARY FOUR EXPRESS

PHYSICS 6091/02 **18 SEPTEMBER 2019**

PAPER 2 **1 HOUR 45 MINUTES**

Additional Materials : NIL

READ THESE INSTRUCTIONS FIRST

1. Answer **ALL** questions in Section **A** on the question paper.
2. In **Section B**, answer Questions **10** and **11**, and ***either part*** of Question **12**. Write your answers in the spaces provided on the question paper.
3. All workings and constructions must be shown clearly. **Omission of essential working will result in loss of marks**
4. The number of marks is given in brackets [ ] at the end of each question or part question.
5. You are expected to use an electronic calculator to evaluate explicit numerical expression.
6. The total mark for this paper is 80 marks.

This paper consists of **19** printed pages, including this cover page.

Section A [50 Marks]

Answer **all** the questions in this section.

1 A fisherman's buoy is held submerged in sea water by a rope anchored to the sea bed. Currents in the sea cause the buoy to be displaced so that the rope makes an angle of 30° with the vertical as shown in Fig. 1.1.

The buoy may be considered to be acted upon by three forces: the tension *T* in the rope which is 600 N, a horizontal force of sea current *D* and a vertical force known as upthrust *V*.

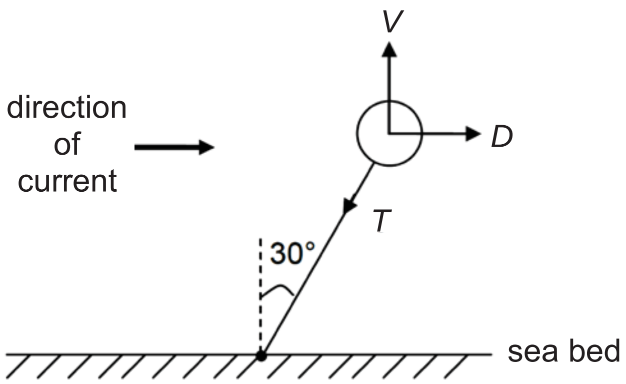


Fig. 1.1

By means of a scale drawing, determine the value of the upthrust, *V* and horizontal force, *D*.

scale ………………………….. [1]

upthrust, *V* = ………………………….. [2]

force, *D* = ………………………….. [1]

2 Fig. 2.1 shows a diver working below the surface of a lake. The density of the water in the lake is 1000 kg/m^3, the atmospheric pressure at the surface is 1.0 x 10^5 Pa.

Fig. 2.1

The diver inflates a balloon with air at a depth of 15 m and attaches the balloon to a tray of objects.

(a) Calculate the total pressure acting on the balloon at 15 m below the surface of the lake.

pressure = ………………………….. [2]

(b) The diver releases the tray and the balloon, and they begin to rise. The temperature of the air in the balloon does not change. The volume of the balloon is 0.3 m^3 at 15 m depth.

Calculate the volume of the balloon when it reaches the surface.

volume = ………………………….. [2]

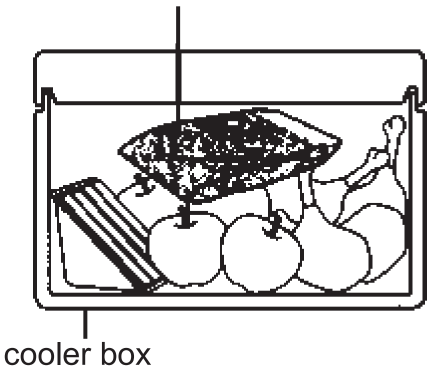
(c) Explain, in terms of the air molecules inside the balloon, why the air pressure in the balloon is less at the surface.

……………………………………………………………………………………......

……………………………………………………………………………………......

……………………………………………………………………………….. [2]

3 Fig. 3.1 shows a cooler box packed with food and a coolant pack is placed on top. Fig. 3.2 shows the temperature-time graph of the contents over a period of six hours.



Manufacturer's information on coolant pack:

mass = 0.20 kg

specific heat capacity
of liquid coolant= 3820 J/(kg °C)

specific latent heat of fusion
of coolant =2.1 x 10^5 J/kg

Fig. 3.1

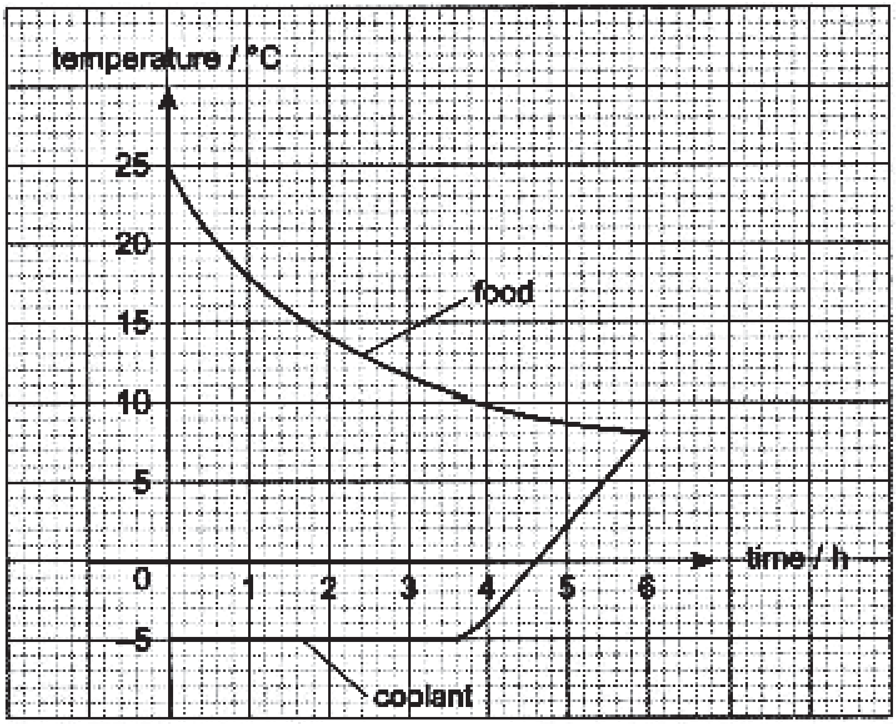


Fig. 3.2

(a) Explain why the coolant pack must be placed on top of the food in order to bring down the temperature.

……………………………………………………………………………………......

……………………………………………………………………………………......

…………………………………………………………………………………….. [2]

(b) Explain why coolant at solid state is better in keeping the content cold for a longer period of time as compare to coolant at liquid state.

……………………………………………………………………………………......

……………………………………………………………………………………......

……………………………………………………………………………………......

…………………………………………………………………………………….. [2]

(c) Using the information given in Fig 3.1 and 3.2, calculate the total energy lost by the food to the coolant pack during the period of six hours. Assume that there is no energy lost to the surrounding outside the cooler box.

total energy lost = ………………………….. [3]

4 Fig. 4.1 shows a narrow laser beam directed towards a point **A** on a vertical wall. A semicircular glass block **G** is placed symmetrically across the path of the beam.

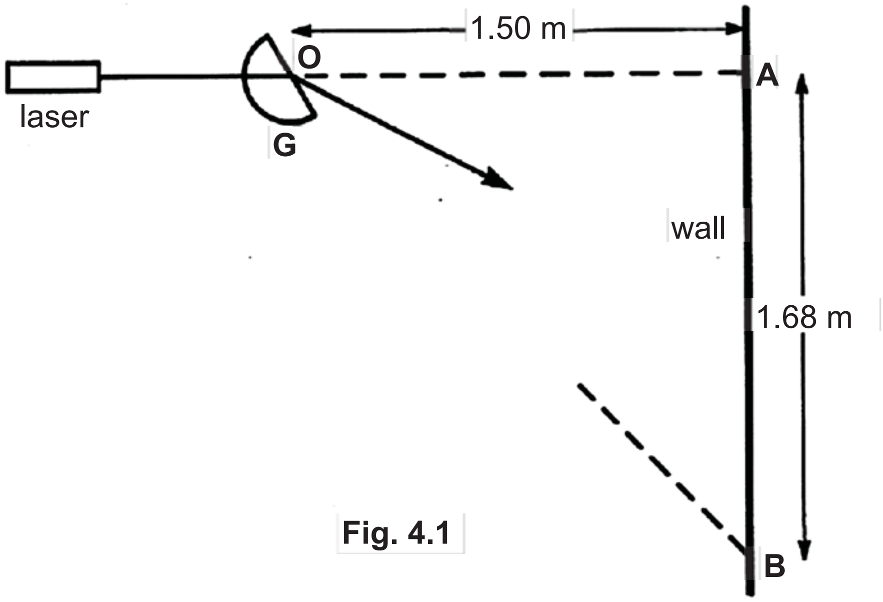


Fig. 4.1

When the beam strikes the wall at **A**, a bright spot is formed at **A**. The glass block is then rotated about the centre, **O**, and the bright spot moves down from **A** to **B** and then disappears.

(a) State the direction of rotation (clockwise or anticlockwise) of the glass block **G** in order to obtain the bright spot to move down from **A** to **B**.

……………………………………………………………………………………….. [1]

(b) Explain why the bright spot disappears as it moves beyond **B**.

……………………………………………………………………………………….

……………………………………………………………………………………….

……………………………………………………………………………………….. [2]

(c) Given that **OA** = 1.50 m and **AB** = 1.68 m,

(i) calculate the critical angle of the glass block,

critical angle = ………………………….. [2]

(ii) and hence determine the refractive index of the glass block.

refractive index = ………………………….. [1]

5 Fig. 5.1, not drawn to scale, shows water waves generated by a dipper vibrating in a ripple tank with the wave travelling from the deep region to the shallow region.

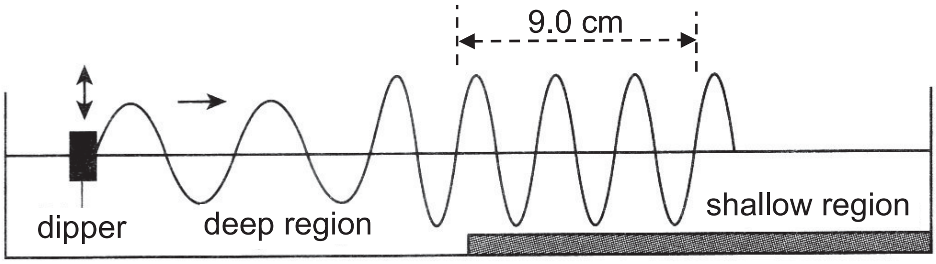


Fig. 5.1

(a) State what happens to the frequency and speed of the water waves as it moves from the deep region to the shallow region.

……………………………………………………………………………………………......

…………………………………………………………………………………………….. [2]

(b) The vibrating dipper makes 10 vibrations in 2 s.
Calculate the speed of the water waves in the shallow region.

speed = ………………………….. [2]

(c) The rate of vibration of the vibrating dipper is doubled.

State what will happen to the speed and the wavelength of the wave in the shallow region.

……………………………………………………………………………………………......

…………………………………………………………………………………………….. [1]

6 Fig. 6.1 shows a positively charged sphere held with an insulating handle. When the sphere is brought near the metal plate, the galvanometer needle deflects momentarily.

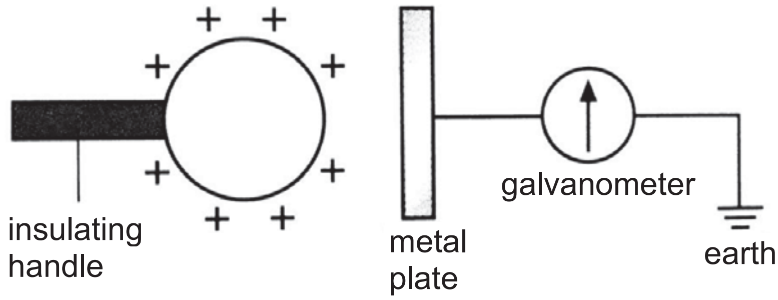


Fig. 6.1

(a) Explain clearly why there is a momentary deflection in the galvanometer needle.

....

....

....

....

....

.... [3]

(b) Suggest a method that would increase the magnitude of the deflection.

....

.... [1]

(c) State clearly what can be observed when the positively charged sphere is removed quickly.

....

.... [1]

7 Fig. 7.1 below shows a circuit connected to a battery of unknown e.m.f.

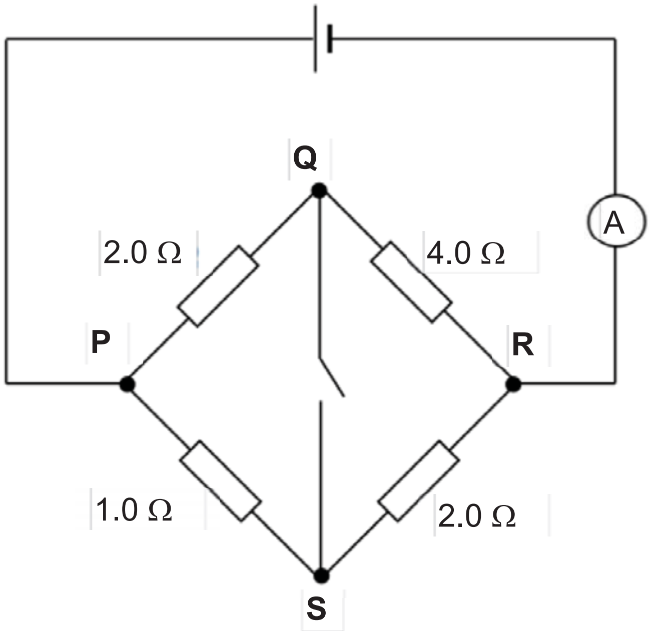


Fig. 7.1

(a) When the switch is opened, the ammeter reads 3.0 A.

(i) Calculate the e.m.f. of the battery.

e.m.f. = ………………………….. [2]

(ii) Calculate the current passing through **PSR**.

current = ………………………….. [1]

(b) The switch is now closed. Explain whether a current will flow through **QS**.

……………………………………………………………………………………….....

……………………………………………………………………………………….....

……………………………………………………………………………………….....

…………………………………………………………………………………….. [2]

8 A student has made a battery tester shown in Fig. 8.1. It uses a magnet, wire that is flexible and springy, and a pointer. With it, she can check whether a small battery is "live" or "dead". When she connects a battery to the tester, the pointer moves.

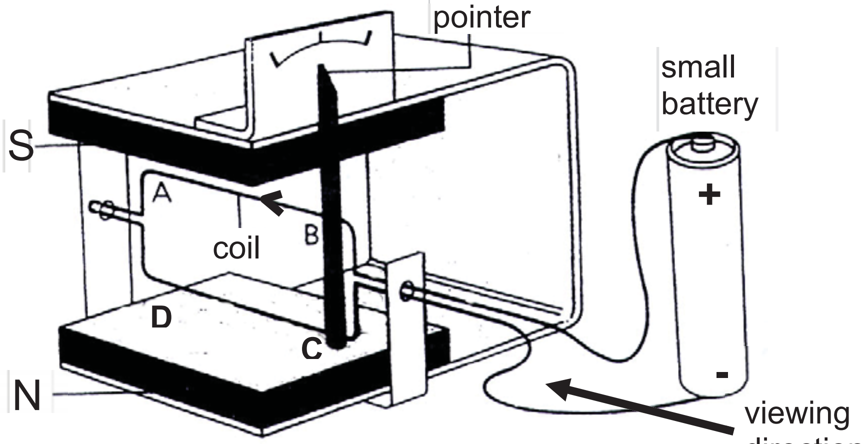


Fig. 8.1

(a) Fig. 8.2 shows the magnet and coil as viewed in the direction shown in Fig. 8.1. In Fig. 8.2, draw

(i) magnetic field lines around the cross-section of wires **AB** and **CD**. [1]

(ii) arrows to indicate the direction of motion of wires **AB** and **CD**. [1]

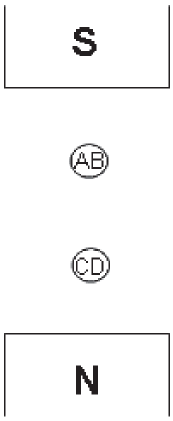


Fig. 8.2

(b) State the observation on the pointer if

(i) the battery delivers less current;

………………………………………………………………………………….. [1]

(ii) the battery terminals are reversed;

………………………………………………………………………………….. [1]

(iii) the battery is replaced by an alternating current source.

………………………………………………………………………………….. [1]

9 A bar magnet is suspended by a spring so that it can oscillate vertically and freely in and out of a coil as shown in Fig. 9.1. The coil is connected to an an oscilloscope.

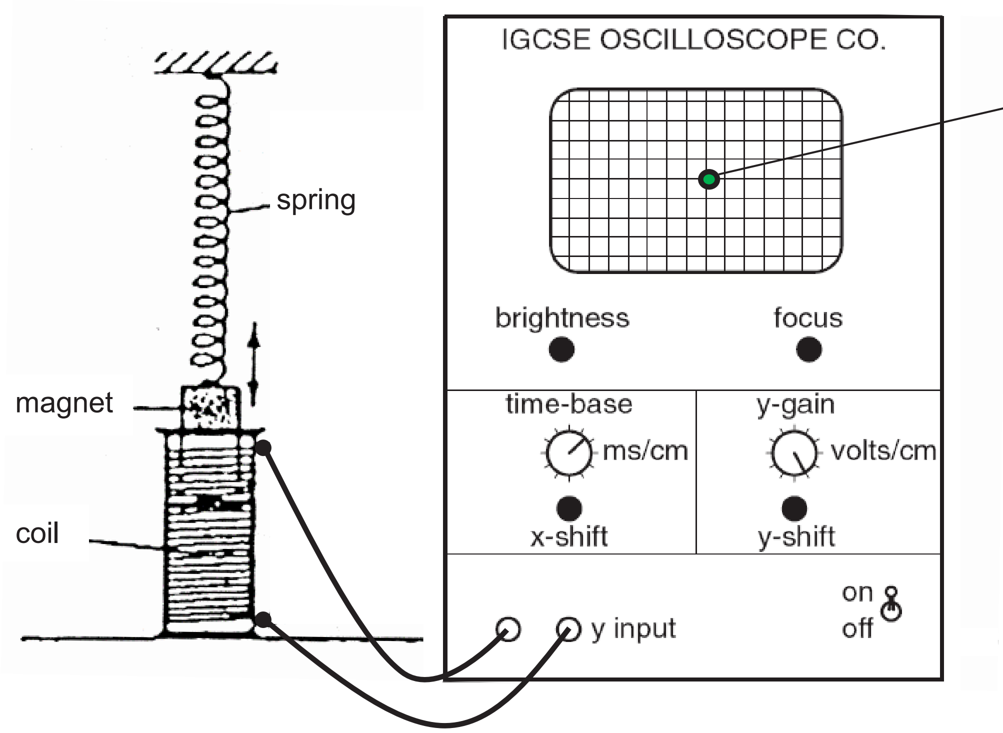


Fig. 9.1

(a) The time-base is switched off, and the oscilloscope is adjusted so that the bright spot is in the middle of the screen when the magnet is not oscillating.

(i) Describe and explain what is seen on the screen as the magnet oscillates.

…………………………………………………………………………………......

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…………………………………………………………………………………......

…………………………………………………………………………….... [3]

(ii) Describe the changes that will be observed on the screen when the magnet oscillates at a faster rate.

…………………………………………………………………………………

……………………………………………………………………………….. [1]

(b) With the magnet still in motion, the time-base of the oscilloscope is switched on. The controls are suitably adjusted until the trace in Fig. 9.2 is seen on the screen.

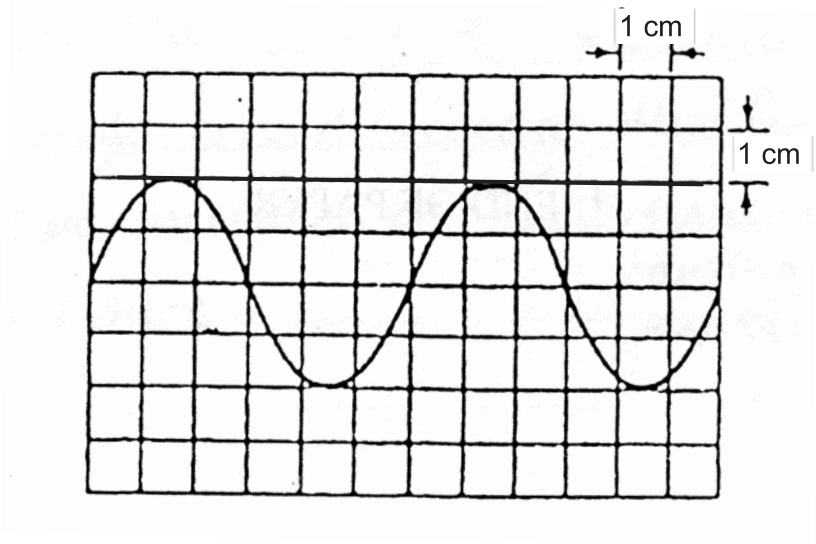

Fig. 9.2

On Fig. 9.2, mark with "**X**" one position of the bright spot that corresponds to the position of the magnet when the magnet is at the lowest point. [1]

(c) The trace in Fig. 9.2 is obtained when the time-base control is set to 0.50 s/cm. Determine the frequency of the oscillation of the magnet.

frequency = ……………………….. [2]

Section B [30 Marks]

Answer **all** the questions in this section.
Answer only <u>one</u> of the two alternative questions in **Question 12**.

10 Fig. 10.1 shows two of the towers that support a single cable of total length 5.0 km, which links a factory to the electrical grid.

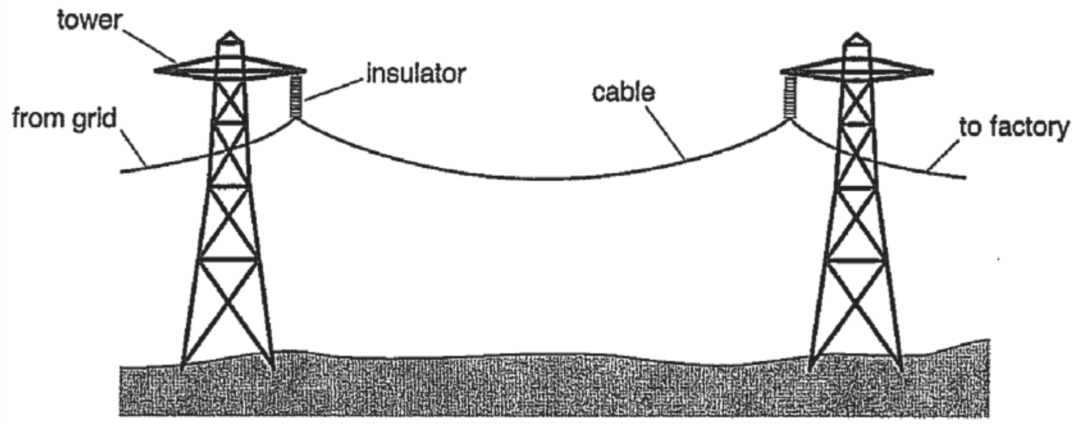

Fig. 10.1

If the weight of the cable between two towers is larger than a given force *F*, then the cable breaks. The value of *F* depends on the material from which the cable is made. The table gives the value of *F* and other data for three cables made from different materials.

cable	material	*F* / N	resistance of 1 km / Ω	density / kg/m³	cross-sectional area / m²
1	aluminum	6 000	0.075	2 700	3.0×10^{-4}
2	copper	9 000	0.050	8 900	3.0×10^{-4}
3	steel	27 000	210	7 800	3.0×10^{-4}

(a) Assuming that *g* is 10 N/kg, calculate

(i) the mass of a copper cable of length 5.0 km,

mass = …………………………….. [2]

(ii) the minimum number of towers needed between the grid and the factory to support this copper cable.

number = …………….…………….. [2]

(b) The cable used is actually made from aluminium and the current in it is 500 A.

For this cable, calculate

(i) the potential difference (p.d.) between the grid and the factory,

p.d. = ………………………….. [1]

(ii) the power loss in the cable,

power = …………………………. [2]

(iii) the cost of this power loss in 1 day. 1 kWh costs 22 cents.

cost = …………………………. [2]

(c) Using data from the table, explain why

(i) the aluminium is more suitable material than copper for the cable,

…………………………………………………………………………………

…………………………………………………………………………………

…………………………………………………………………………………

…………………………………………………………………………………

……………………………………………………………………………..… [2]

(ii) steel is an unsuitable material for the cable.

…………………………………………………………………………………

……………………………………………………………………………..… [1]

11 At a sharp corner on a car racing circuit there is an escape lane, as shown in Fig. 11.1.

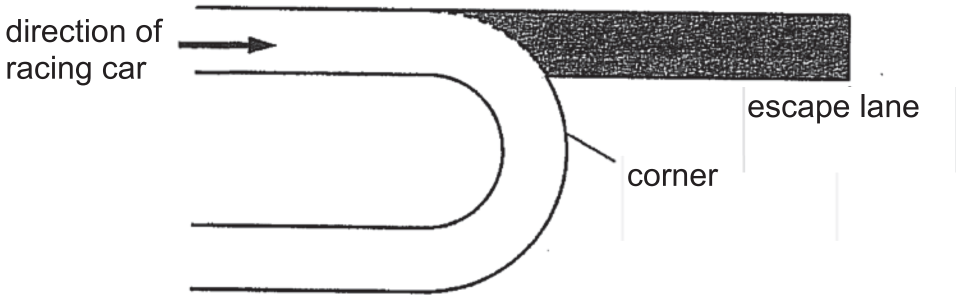

Fig. 11.1

The escape lane is a bed of small stones. The escape lane slopes upwards. A car of mass 700 kg approaches at a speed of 40 m/s. The brakes fail and the car stops in the escape lane.

(a) Describe what happens to the kinetic energy of the car as it stops.

…………………………………………………………………………………………

…………………………………………………………………………………………

……………………………………………………………………………………….. [2]

(b) The car comes to rest 40 m along the escape lane, having risen through a vertical distance of 3.0 m. The acceleration of free fall is 10 m/s^2.
Calculate

(i) the change in gravitational potential energy of the car,

change = ……………………………[2]

(ii) the average frictional force on the car in the escape lane.

force = ……………………………[3]

(c) The frictional force on the car in the escape lane is not constant. Suggest one factor, apart from the car's speed, that affects the value of the frictional force.

…………………………………………………………………………………………

……………………………………………………………………………………….. [1]

12 EITHER

An appliance is connected to the live, neutral and earth conductors of the mains supply. The current in the circuit is 4.0 A and the rating of the fuse is 5 A.

(a) Explain what is meant by

(i) *live*,

……………………………………………………………………………………

…………………………………………………………………………………. [1]

(ii) *neutral*.

……………………………………………………………………………………

…………………………………………………………………………………. [1]

(b) When a fault occurs in the appliance, no damage or injury is caused provided that the correct fuse is used and the metal case is connected to earth.

(i) The 5 A fuse is replaced by a 30 A fuse.

Explain why this presents a risk of damage or injury.

……………………………………………………………………………………

……………………………………………………………………………………

……………………………………………………………………………………

……………………………………………………………………………………

…………………………………………………………………………………. [2]

(ii) The earth is **not** connected to the metal case.

Explain why this present a risk of damage or injury.

……………………………………………………………………………………

……………………………………………………………………………………

……………………………………………………………………………………

……………………………………………………………………………………

…………………………………………………………………………………. [2]

(c) State one advantage of using a circuit breaker rather than a fuse to protect the appliance.

…………………………………………………………………………………………

………………………………………………………………………………………….. [1]

(d) Describe an experiment to check that a fuse blows at 5 A.

In your account

- draw a diagram of the apparatus,
- describe the procedure to be taken. [3]

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12 OR

Fig. 12.1 shows a thermistor connected to a battery of e.m.f. 6.0 V in a circuit.

Fig. 12.2 shows the variation of the voltmeter reading with the temperature of the thermistor.

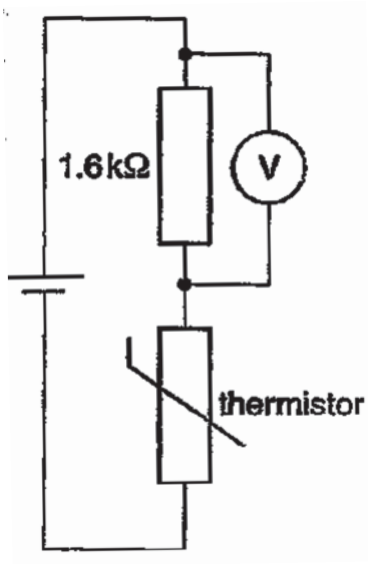

Fig. 12.1

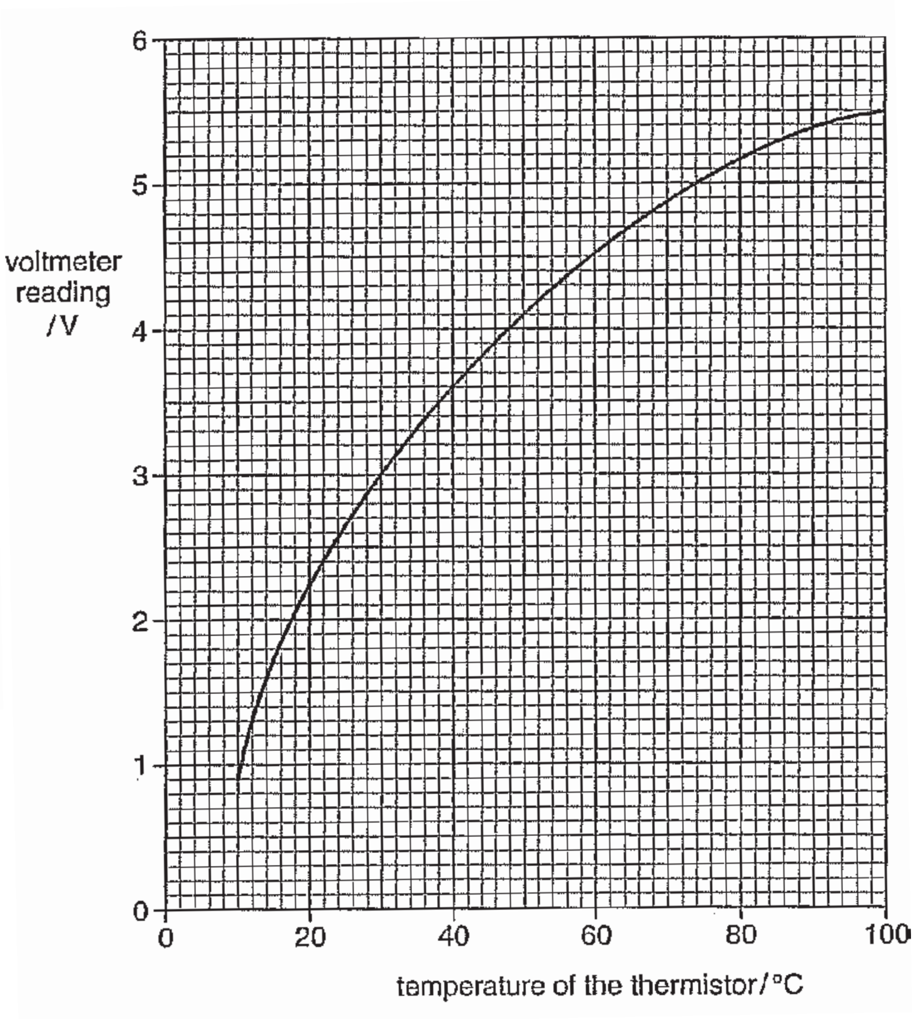

Fig. 12.2

(a) Explain why the voltmeter reading increases as the temperature rises.

....

....

....

....

....

.... [2]

(b) Determine the resistance of the thermistor when its temperature is 40°C.

resistance = …………………………… [3]

(c) On Fig. 12.2, draw a graph to show how the voltage across the thermistor varies with the temperature. [2]

(d) Describe an experiment, using the circuit of Fig. 12.1, to produce the graph of the voltmeter reading in Fig. 12.2.

In your account

- List all the apparatus you use, apart from the apparatus shown in Fig. 12.1,
- Describe the procedure you use to obtain the readings. [3]

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***** End of Paper *****

Sec 4E Express (Physics) Prelim Exam Marking Scheme 2019

P1 MCQ:

Qn	Ans	Qn	Ans	Qn	Ans	Qn	Ans	Qn	Ans	Qn	Ans	Qn	Ans	Qn	Ans
1	**C**	6	**C**	11	**C**	16	**D**	21	**A**	26	**C**	31	**C**	36	**A**
2	**A**	7	**A**	12	**C**	17	**D**	22	**A**	27	**A**	32	**B**	37	**C**
3	**A**	8	**B**	13	**D**	18	**D**	23	**A**	28	**A**	33	**A**	38	**D**
4	**A**	9	**D**	14	**A**	19	**B**	24	**D**	29	**D**	34	**B**	39	**A**
5	**D**	10	**C**	15	**A**	20	**D**	25	**C**	30	**C**	35	**B**	40	**D**

P2 Section A:

1

scale 1 cm : 50 N **[A1]**
Correct diagram **[M1]**
upthrust, V = 520 N ± 10 N **[A1]**
force, D = 300 N ±10 N **[A1]**

2(a) Pressure $= (1.0 \times 10^5) + (15 \times 1000 \times 10)$ **[M1]**
$= 250\ 000$ Pa **[A1]**

2(b) $P_1V_1 = P_2V_2$
$V_2 = P_1V_1 / P_2$
$= (250\ 000)(0.3) / (100\ 000)$ **[M1]**
$= 0.75\ m^3$ **[A1]**

2(c) As the balloon increases in volume, this causes the number of air molecules per unit volume decreases. **[A1]**
The frequency of the air molecules colliding with the inner wall decreases. **[A1]**

3(a) The air at the top is cooled and the cold air contracts, becomes more dense and sink. **[A1]**
The warmer air at the bottom rises up to replace the sunken cool air. This cycle continues to setup a convection current to bring the temperature down quickly and uniformly. **[A1]**

3(b) The coolant at solid state absorb a lot more heat from the content to change to liquid state. It will then absorb more heat to increase its temperature. **[A1]**
Coolant at liquid state only absorb a limited amount of heat from the content to increase its temperature. Therefore, coolant at solid state absorb more heat from the content. **[A1]**

3(c) total energy lost by food = total energy absorb by coolant
= $ml_f + mc\Delta\theta$
= $(0.2 \times 2.1 \times 10^5)$ **[M1]** + $(0.2 \times 3820 \times 13)$ **[M1]**
= 51 932 J
= 51 900 J **[A1]**

4(a) anticlockwise **[A1]**

4(b) When the glass block is rotated further, the angle of incidence becomes more than the critical angle **[A1]** and the laser undergoes total internal reflection. **[A1]**

4(c)(i) Angle AOB = $\tan^{-1}(1.68 / 1.50)$
= $48.2°$ **[M1]**
$c = 180° - 90° - 48.2° = 41.8°$ **[A1]**

4(c)(ii) n = 1/sin c
= 1 / sin 41.8°
= 1.50 **[A1]**

5(a) Frequency remains the same. **[A1]**
Speed decreases. **[A1]**

5(b) f = 10 / 2 = 5 Hz
λ = 9 / 3 = 3 cm
Speed = $f\lambda$ = 5 x 3 **[M1]**
= 15 cm/s **[A1]**

5(c) Speed remains the same.
Wavelength reduce by half. **[A1]**

6(a) Electrons are attracted from earth by the positively charged sphere as unlike charges attract. **[A1]**
The flow of electrons which carry negative charges is detected by the galvanometer and hence there is a deflection. **[A1]**
The electrons remain attracted by the positively-charged sphere and they stay in the metal plate. There is no flow of electrons and the galvanometer needle return to zero. **[A1]**

6(b) Use a positively-charged sphere with higher magnitude of charge. **[A1]**
OR
Bring the sphere closer to the plate.

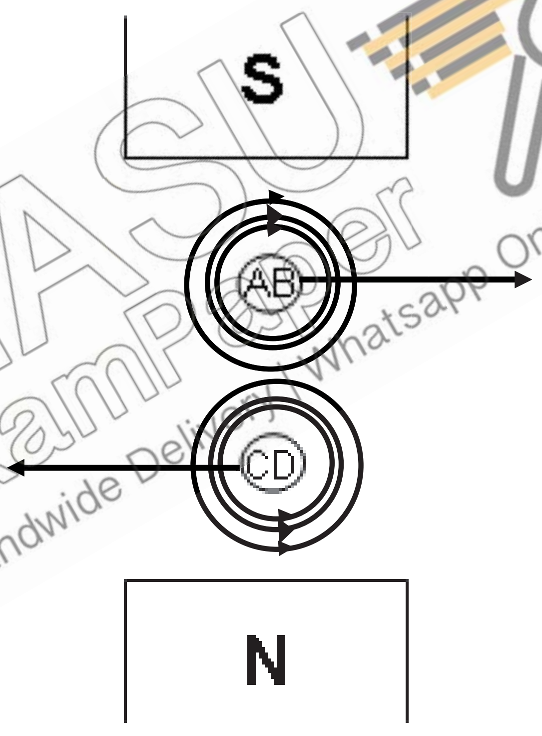
6(c) The galvanometer deflect momentarily to the other side. **[A1]**

7(a)(i) $R_{eff} = (1/6 + 1/3)^{-1}$
$= 2\ \Omega$
Emf $= 3A \times 2\Omega$ **[M1]**
$= 6V$ **[A1]**

7(a)(ii) $I = 6V / 3\Omega = 2A$ **[A1]**

7(b) The potential difference across PQ is $1A \times 2\Omega = 2V$. So potential at Q is $6V - 2V = 4V$
The potential difference across PS is $2A \times 1\Omega = 2V$. So potential at S is $6V - 2V = 4V$. **[M1]**
Since Q and S has same potential, potential difference is zero, so no current flow. **[A1]**

8(a)(i) concentric circles – closer (near to wire), further apart (far from wire)
8(a)(ii)



8(b)(i) deflect less to right **[A1]**

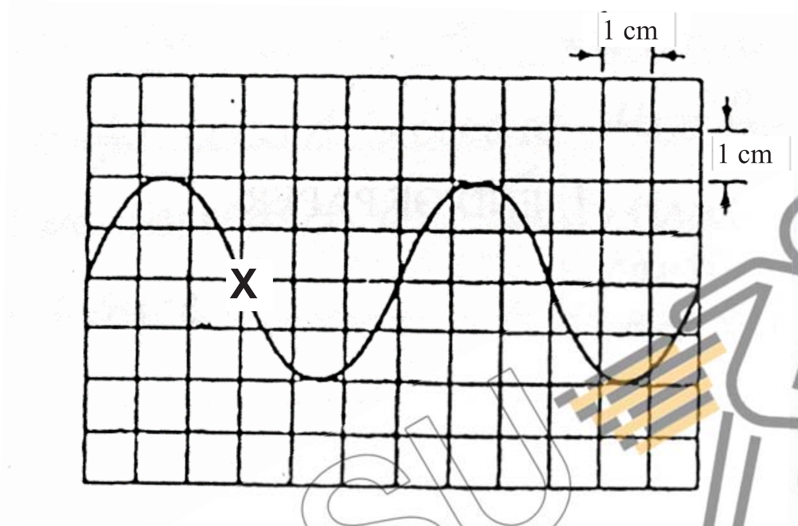
8(b)(ii) deflect to left **[A1]**

8(b)(iii) vibrate to and fro between left and right. **[A1]**

9(a)(i) A vertical line is seen on the screen. **[A1]**
When magnet moves down into the coil, there is cutting of magnetic field lines and an emf is induced in the coil. This causes the y-plates to be charged which moves the electron beam either up or down. **[A1]**
When the magnet moves up out of the coil, there is cutting of magnetic field lines in the opposite direction and an emf is induced in the opposite direction. This causes the y-plates to move the electron beam the other direction. **[A1]**

9(a)(ii) The vertical line becomes longer. **[A1]**

9(b)



9(c) T = 6 x 0.5 = 3 s **[M1]**
f = 1/3 = 0.333 Hz **[A1]**

Section B

10(a)(i) m = 8900 x 5000 x 3.0 x 10^{-4} **[M1]**
= 13 350 kg
= 13 400 kg **[A1]**

10(a)(ii) number = 133500 N / 9000N **[M1]**
= 14.83 = 15 **[A1] (accept 16) ecf 10a(i)**

10(b)(i) R = 0.075 x 5 = 0.375Ω
pd = 500A x 0.375 Ω
= 187.5 = 188 V **[A1]**

10(b)(ii) power loss = I^2R
= 500A x 500A x 0.375Ω **[M1{**
= 93 750 W
= 93 800 W **[A1]**

10(b)(iii) cost = 24h x 93.75kW x $0.22 **[M1]**
= $495 **[A1]**

10(c)(i) Aluminium wire has a much lower density than copper, about 3 times lower. **[A1]** The number of towers used to support 5km of the wire can be reduced by 3 times. **[A1]**

10(c)(ii) The resistance of steel is too high compare to aluminium and copper. This will incur lots of power loss. **[A1]**

11(a) The kinetic energy is converted into thermal, sound **[A1]** and gravitational potential energy **[A1]** as it stops.

11(b)(i) GPE = 700 x 10 x 3 **[M1]**
= 21 000 J **[A1]**

11(b)(ii) KE = ½ x 700 x 40^2
= 560 000 J **[M1]**

KE = GPE + loss
Loss = KE – GPE
Friction x distance = KE – GPE
Friction = (KE – GPE) / distance
= (560 000 – 21 000) / 40 **[M1]**
= 13 475 N
= 13 500 N **[A1]**

11(c) Texture (size of the small stones) of the escape lane, weight of car, **[A1]**

12 EITHER

12(a)(i) having a high potential **[A1]**

12(a)(ii) maintain at zero potential **[A1]**

12(b)(i) When a current of larger than 4.0 A passes through the appliance, the large current is not large enough to blow the 30 A fuse. **[A1]**
The large current can then cause over heating in the appliance and may lead to fire. **[A1]**

12(b)(ii) When there is a fault in the appliance, the metal case may become live. With the absence of earth wire, the current is not able to flow between the metal case to the earth terminal to blow the fuse or trip the ELCB. **[A1]**
If a user touches the metal case, large current will flow through the user between the metal case and the earth and may lead to electric shock. **[A1]**

12(c) When large current trip a circuit breaker, we do not need to replace the circuit breaker. But we will need to replace a fuse if it is blown by a large current. **[A1]**

12(d)

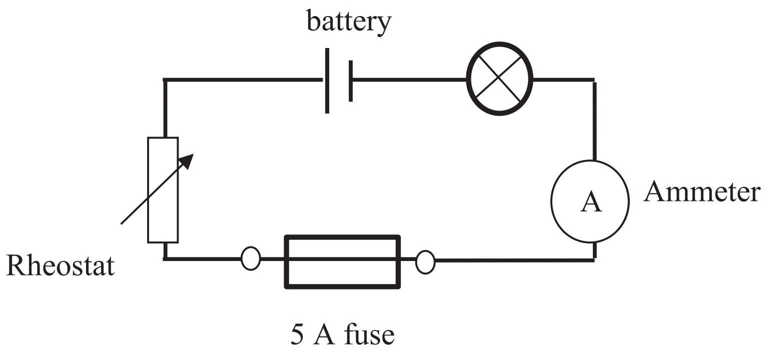


Diagram [A1]

1. Adjust rheostat to give the largest resistance and minimum reading in ammeter.
2. Adjust rheostat slowly to decrease the resistance and increase the ammeter reading to 4 A.
3. Adjust rheostat slowly to **increase the ammeter reading by 0.1A each time. [A1]**

4. Repeat step 3 until **bulb goes off.** When the bulb goes off, this indicates that the fuse has blown.
5. The reading on the ammeter just before the bulb goes off is the current which blows the fuse. **[A1]**

12 OR

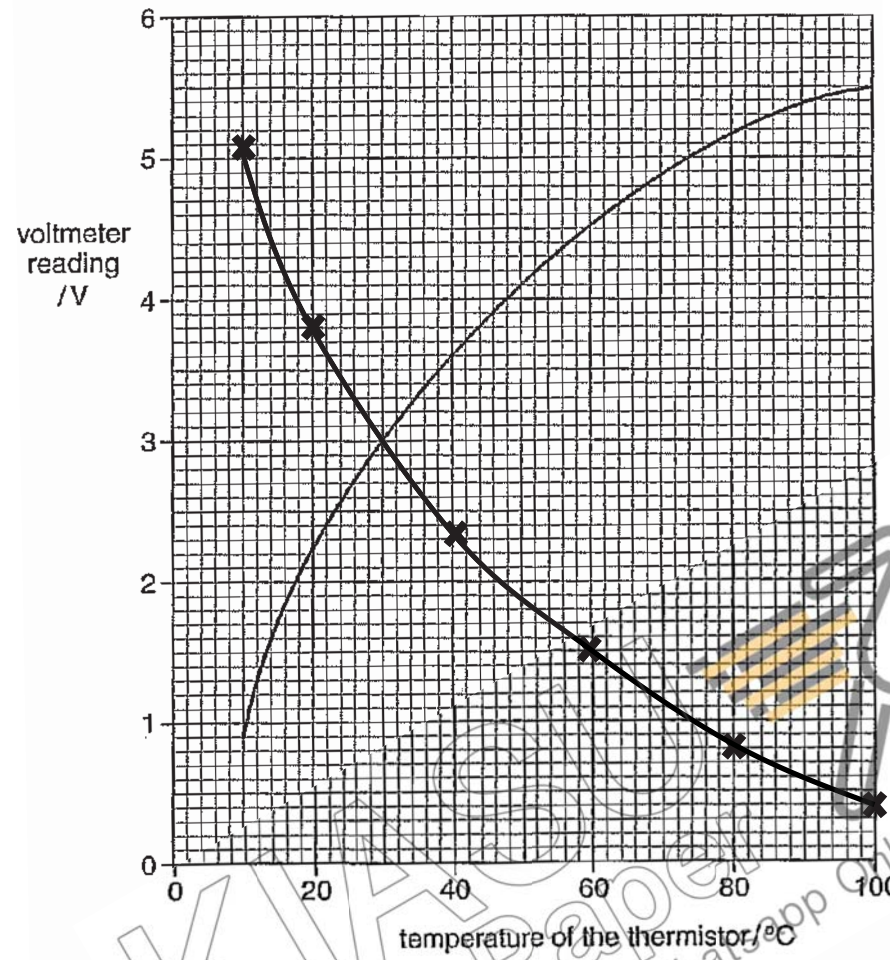
12(a) When temperature increases, the resistance of thermistor decreases. **[A1]**
The potential difference across the thermistor decreases.
Since the emf remains constant, the potential difference across the resistor increases. **[A1]**
Therefore the voltmeter reading increases.

12(b) At 40°C, pd across resistor = 3.6V

Current = 3.6V / 1600Ω = 0.00225 A **[M1]**

R of thermistor = (6V-3.6V) / 0.00225 A **[M1]**
= 1070 Ω **[A1]**

12(c)



6
5
voltmeter reading /V
4
3
2
1
0
0
20
40
60
80
100
temperature of the thermistor/°C

12(d)

Apparatus:

a. Retort stand
b. Beaker
c. Plastic sheet
d. Laboratory thermometer
e. Wire gauze
f. Tripod
g. Bunsen burner

[A1]

Procedures:

1. Setup as shown in diagram. Use water use temperature of about 5 °C
2. Wrap the thermistor in a plastic sheet to prevent water from entering the thermistor and immerse it into the beaker of water. **[A1]**
3. Heat the water.
4. When thermometer shows 10°C, record the voltmeter reading.
5. Repeat step 4 for every increase in 10 °C until thermometer reaches 100 °C.**[A1]**
6. Tabulate Temperature of Thermistor (T) and voltmeter reading of resistor (V).
7. Plot a graph of V against T.

Name: ________________________________ (   ) Class: _________

WHITLEY SECONDARY SCHOOL

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PRELIMINARY EXAMINATION 2019

SUBJECT :	**PHYSICS Paper 1 (6091/01)**
LEVEL :	**Sec 4 Express**
DATE :	**2 Sep 2019 (Mon)**
DURATION :	**1 hr**
TOTAL MARKS:	**40**

INSTRUCTIONS TO CANDIDATES

Do not open this booklet until you are told to do so.
Write your name, index number and class in the spaces on the Multiple Choice Answer Sheet and at the top of this cover page.
Do not use staples, paper clips, highlighters, glue or correction fluid/tape.

There are **forty** questions in this section. Answer all questions. For each question, there are four possible answers, **A**, **B, C** and **D**.
Choose the **one** you consider correct and record your choice in soft pencil on the separate answer sheet provided.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
The use of an approved scientific calculator is expected, where appropriate.

Take the value of the acceleration due to free fall on earth to be 10 m/s^2.

This document consists of **17** printed pages including the cover page.

Answer **all** questions.

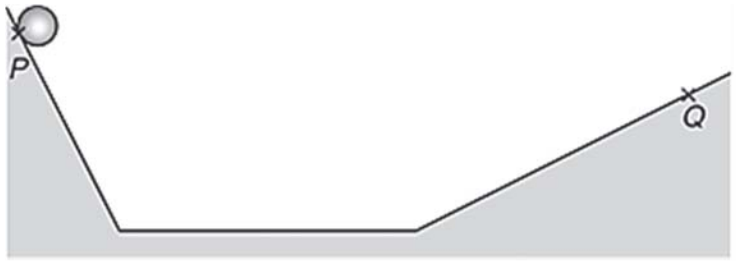
1 Three groups of quantities are shown below.

I mass, force, weight
II weight, work done, acceleration
III weight, force, displacement

Which group of quantities consists of only vectors?

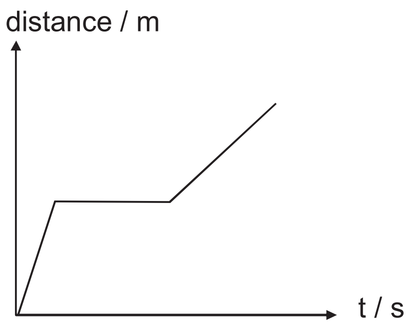
A I only **B** I and II only **C** III only **D** All of them

2 A sphere runs along a smooth rail from P to Q as shown.

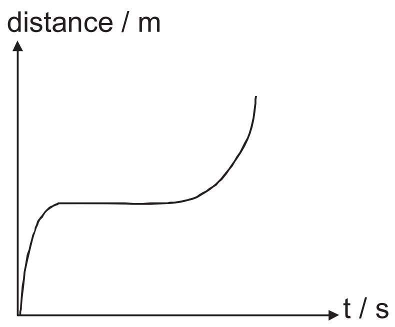


Which of the following graphs best represents the variation of the distance *d* travelled by the sphere with time *t*?

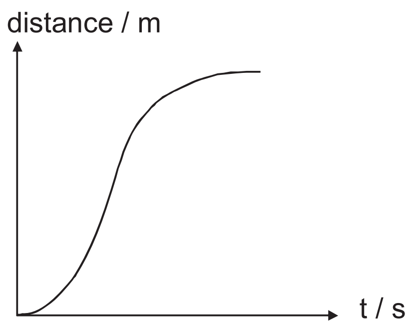
A



B



C



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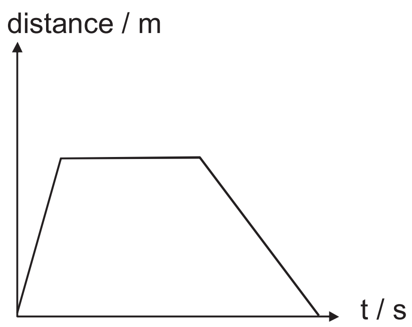


3 A car, which was travelling due east at a speed of 3.6 m/s initially, changes direction and travels due west at a speed of 6.2 m/s.

Taking the direction to the east as positive, determine the change in speed and velocity.

	change in speed (m/s)	change in velocity (m/s)
A	2.6	– 2.6
B	9.8	2.6
C	2.6	9.8
D	2.6	– 9.8

4 A wooden block that is pushed along a horizontal flat surface moves at constant speed.

Which statement is correct?

A The frictional force is greater than the pushing force.

B The frictional force is equal and opposite to the pushing force.

C The frictional force is less than the pushing force.

D The frictional force increases as the block moves at constant speed.

5 A magician pulled a tablecloth swiftly off a table top. An empty glass which was set on the tablecloth remained on the table top when the table cloth was removed.

Which of the following modifications would make this performance easier?

A use a rough table cloth

B use a glass of a lighter mass

C wet the table cloth

D fill the empty glass with water

6 Suppose some aliens landed on several planets.

alien	mass / kg	weight / N
P	40	80
Q	20	200
R	10	200
S	20	400

From the information given, which two aliens are likely to have landed on the same planet?

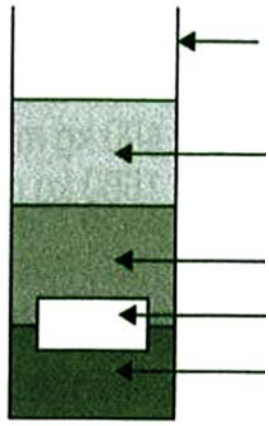
A P and S

B Q and S

C Q and R

D R and S

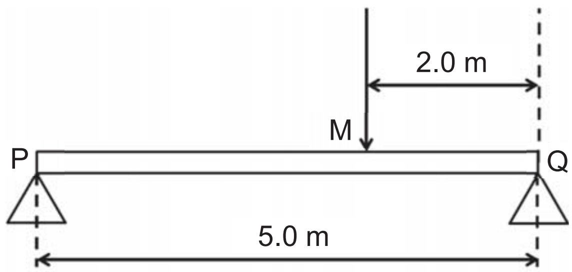
7 The following density experiment was set up.



Which of the following is a possible density for iron?

A 600 kg/m^3 **B** 1000 kg/m^3 **C** 8000 kg/m^3 **D** 14 000 kg/m^3

8 The diagram below shows a uniform 5.0 m beam. The beam is supported at P and Q. A man of weight 800 N stands at M such that QM = 2.0 m. Assume that the mass of beam is negligible.

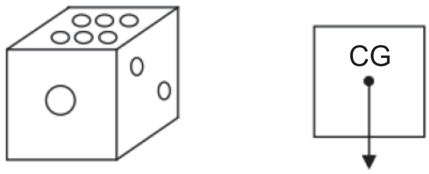


What are the reaction forces at P and Q due to the weight of the man?

	reaction force at P	reaction force at Q
A	300 N	500 N
B	320 N	480 N
C	400 N	400 N
D	480 N	320 N

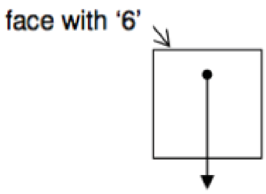
9 A die is unbiased when its centre of gravity (CG) is at its geometrical centre whereas a biased die has its centre of gravity nearer to one of its six faces.

The diagram below shows an unbiased dice.

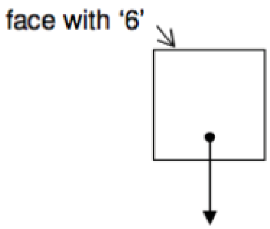


Which one of the following **biased** dice has a higher chance of getting a ‘6’ on top after it is rolled?

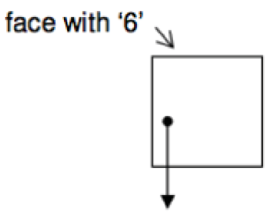
A



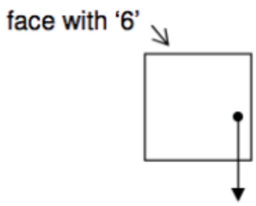
B



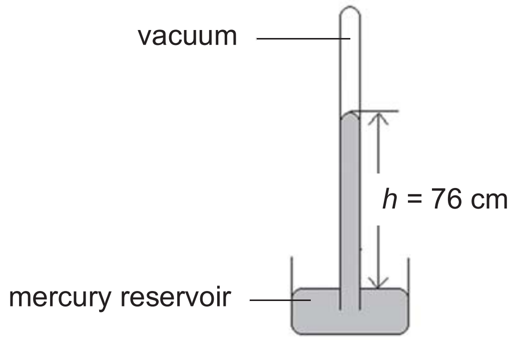
C



D



10 The diagram shows a simple mercury barometer. The height of mercury, h, was recorded as 76 cm.



Which of the changes will result in a smaller h being observed?

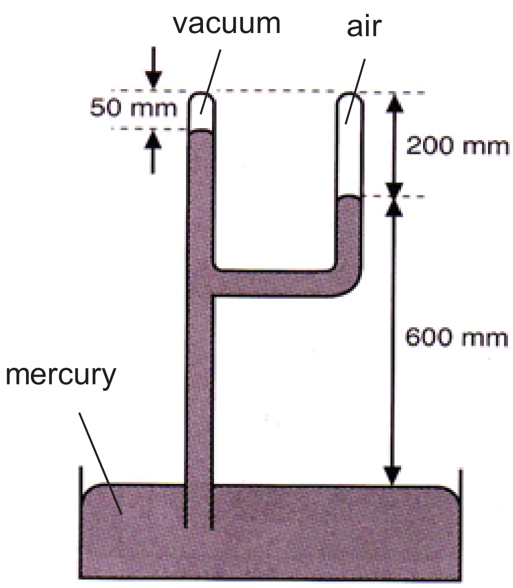
A conduct the experiment under a shelter

B conduct the experiment below sea level

C tilt the mercury barometer

D replace the mercury with a liquid of a greater density

11 The diagram shows a forked tube containing mercury, air in one branch and a vacuum in the other.



What is the pressure exerted by the air?

A 50 mm Hg **B** 150 mm Hg **C** 600 mm Hg **D** 750 mm Hg

12 A ball of mass 0.50 kg is released from rest at a height of 3.0 m above the ground.

Assuming that air resistance is negligible, what is the kinetic energy of the ball when it is 2.0 m above the ground? Take the acceleration due to gravity to be 10 m/s^2.

A 5.0 J **B** 10.0 J **C** 15.0 J **D** 25.0 J

13 When a liquid evaporates, its temperature is lowered.

Which of the following is the most appropriate explanation for this observation?

A The liquid lost transferred heat to the surroundings.

B The average internal kinetic energy of the molecules in the liquid decreased.

C The total internal energy of the liquid decreased.

D The total internal kinetic energy of the molecules in the liquid decreased.

14 A match would ignite if held 10 cm above a Bunsen flame but not if held 10 cm away to one side of the flame.

This is because the match above the Bunsen flame gains more thermal energy through

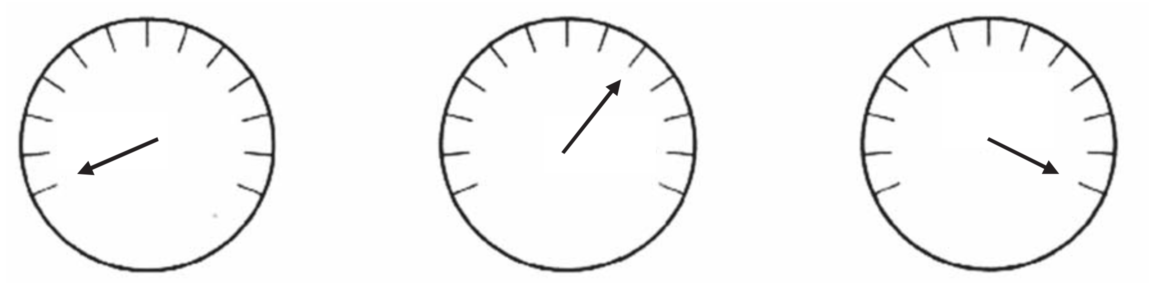
A convection.

B conduction.

C radiation.

D diffusion.

15 The diagrams show the scale of a voltmeter connected to a thermocouple thermometer.



ice point   steam point   unknown temperature

What is the temperature of the liquid?

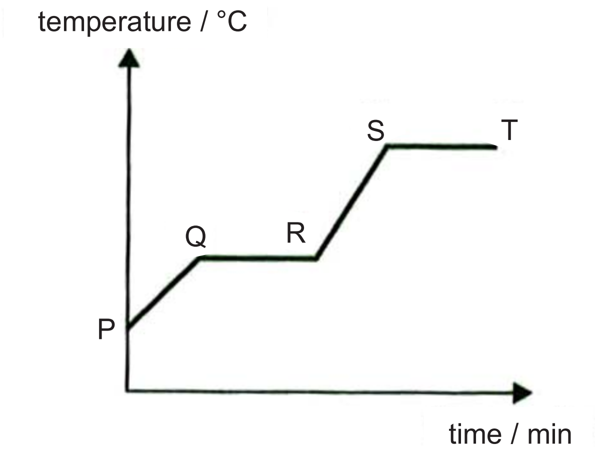
A 12.5 °C   **B** 100 °C   **C** 125 °C   **D** 150 °C

16 18 000 J of energy is required to increase the temperature of 2 kg of liquid by 4 °C.

What is the heat capacity of the liquid?

A 2250 J/K   **B** 4500 J/K   **C** 9000 J/K   **D** 12 000 J/K

17 A solid substance is placed in a boiling tube and heated steadily. The temperature-time graph of the substance is shown below.



At which portion(s) do the substance gain internal potential energy?

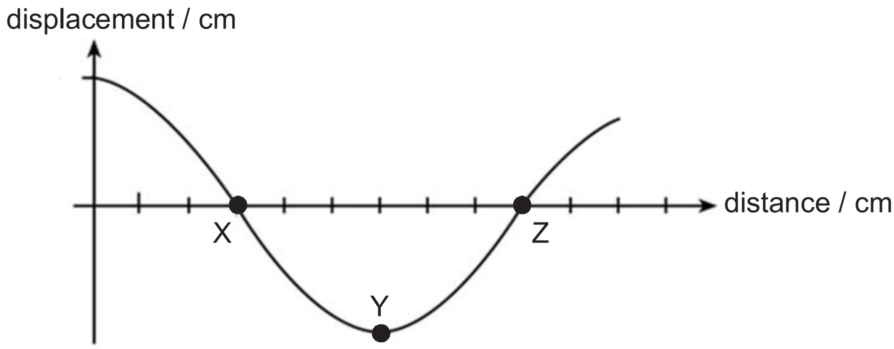
A PQ and QR only

B PQ and RS only

C RS and ST only

D QR and ST only

18 The graph shows the displacement-distance graph of a sound wave. The sound wave is travelling to the right. Three of the particles X, Y and Z in the sound wave are marked below.



Which particle(s) in the graph above is/ are centre(s) of compression?

(Assume that a displacement to the right is positive displacement and a displacement to the left is negative displacement.)

A particle X

B particle Y

C particle Z

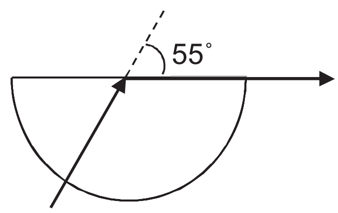
D particles X and Z

19 In a ripple tank experiment, a dipper is connected to a motor to generate water waves.

If the motor rotates with higher speed, what is the effect on frequency, wavelength and speed of the water waves generated?

	frequency	wavelength	speed
A	decreases	increases	decreases
B	decreases	increases	no change
C	increases	decreases	increases
D	increases	decreases	no change

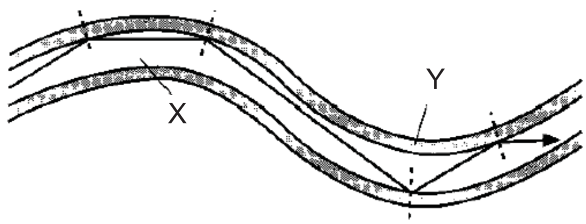
20 A ray of light is incident normally at the curved surface of a semicircular transparent block. It is found that the light deviates by 55˚ from its original path and emerges as shown below.



What is the refractive index of the material of the block?

A 1.00 **B** 1.22 **C** 1.74 **D** 2.00

21 The diagram shows how light travels through the optical fiber of an endoscope used to look into stomach of ulcer patients. X represents the inner material of the optical fiber while Y represents the outer material.



Which of the following statements is false?

A No light is lost through the optical fiber.

B The refractive index of X is greater than the refractive index of Y.

C The refractive index of Y is greater than the refractive index of X.

D The light in the optical fiber obeys the Laws of reflection.

22 The table shows the properties of some waves.

Which of the following correctly describes the properties of the waves?

	waves	types of waves	speed of wave in vacuum
A	gamma rays	longitudinal	3.0×10^8 m/s
B	X-rays	transverse	3.0×10^8 m/s
C	radio waves	transverse	340 m/s
D	sound waves	longitudinal	340 m/s

23 The statements below describes the property of a kind of electromagnetic wave.

I It causes chemical reactions and causes many substances to glow or fluoresce.
II It causes human skin to have sunburn due to prolonged exposure to the Sun.
III It has a wavelength shorter than that of visible light.

Which electromagnetic wave is best described by the statements?

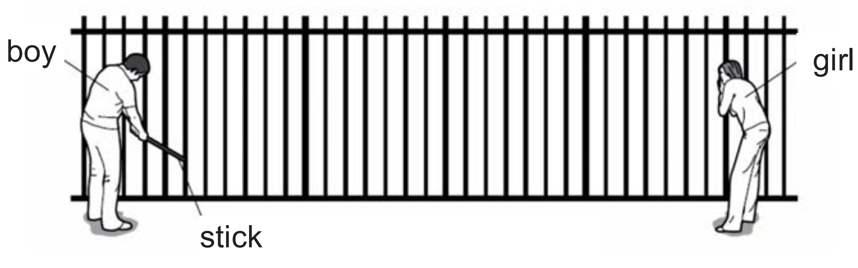
A ultraviolet ray

B infra-red radiation

C microwave

D gamma rays

24 A boy strikes a rigid metal fence with a stick to create a sound along the fence. A girl listens with her ear against the fence. One second after the fence is struck, the girl hears a sound through the air.



How long will it take for the sound to reach the girl through the fence?

A 0.0 s

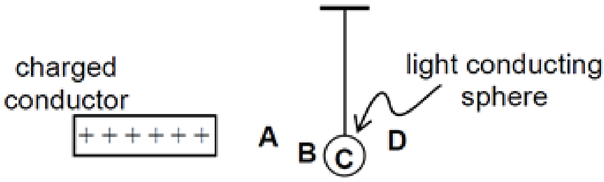
B less than 1.0 sec

C 1.0 s

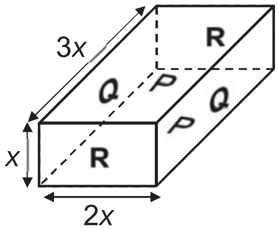
D more than 1.0 sec

25 The figure below shows a light and neutral conducting sphere suspended vertically by an insulated thread near a charged conductor. The sphere moves towards and touches the charged conductor.

In which position will the light conducting sphere come to rest?



26 The diagram shows a rectangular block with dimensions *x*, 2*x* and 3*x*.



P, Q and R mark the opposite faces on the block across which a potential difference is applied.

Across which two faces would there be **maximum** electrical resistance?

A the faces labelled **P**

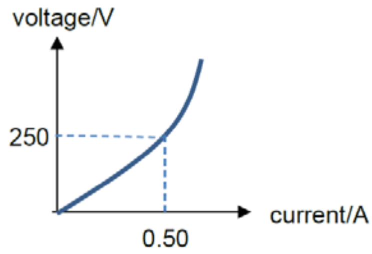
B the faces labelled **Q**

C the faces labelled **R**

D the resistance is the same, whichever pair of faces is used

27 A handphone battery requires 900 C of charge before it is 100% charged.

The following diagram shows the characteristic voltage-current graph of the charging circuit. It initially displays ohmic behaviour at low voltages but its gradient increases as the circuit heats up.



The phone is plugged into a 255 V supply.

Which of the following shows the time required to charge the phone to 100%?

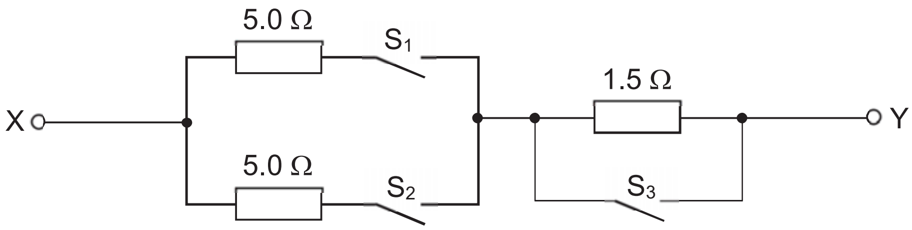
A 1800 s

B 1.8 hours

C slightly more than 1800 s

D slightly less than 1800 s

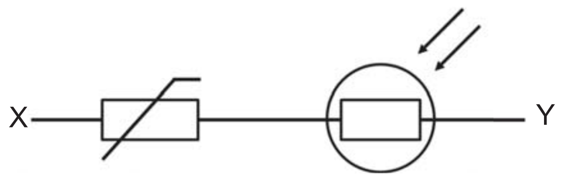
28 The diagram shows a circuit in which all the switches are open.



Which switch positions give a resistance of 4.0 Ω between X and Y?

	S_1	S_2	S_3
A	closed	closed	closed
B	closed	closed	open
C	closed	open	closed
D	closed	open	open

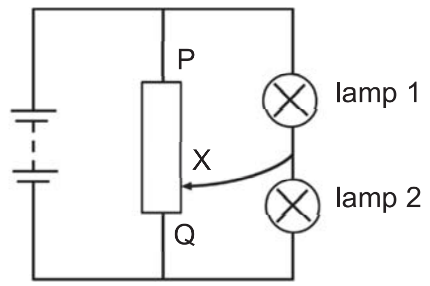
29 The diagram shows a thermistor and a light-dependent resistor connected in series.



Which of these conditions will result in the maximum resistance between X and Y?

	temperature	lighting
A	warm	bright
B	warm	dim
C	cool	bright
D	cool	dim

30 The diagram below shows a potential divider circuit.



What happen to the brightness of the lamps as the contact X moves from Q to P?

	lamp 1	lamp 2
A	dimmer	brighter
B	brighter	brighter
C	brighter	remains the same
D	brighter	dimmer

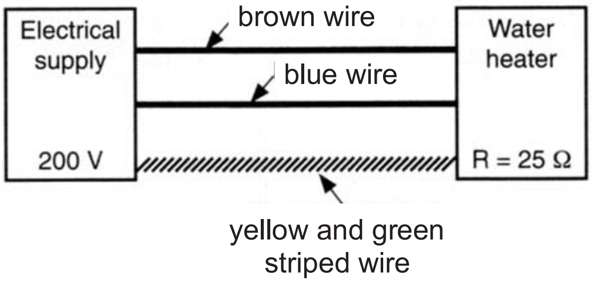
31 The cost of a unit of electricity is $0.10.

appliance	power rating	time used (hours)
lamp	100 W	5
heater	1.5 kW	3
cooker	3 kW	0.5

What is the total cost when all these appliances are used for the durations shown above?

A $0.065 **B** $0.65 **C** $2.65 **D** $50.60

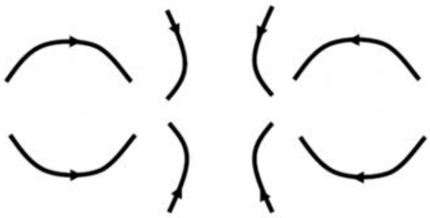
32 The diagram shows the three wires of an electrical supply connected to a water heater.



What is the amount of current that flows through each of the wires when the water heater is switched on?

	brown wire	blue wire	yellow and green striped wire
A	8 A	8 A	8 A
B	8 A	0 A	0 A
C	8 A	0 A	8 A
D	8 A	8 A	0 A

33 The diagram shows a magnetic field lines pattern.



Which pair of bar magnets will produce the magnetic field as shown above?

A

B

C

D

34 Which one of these statements best describes magnetic induction?

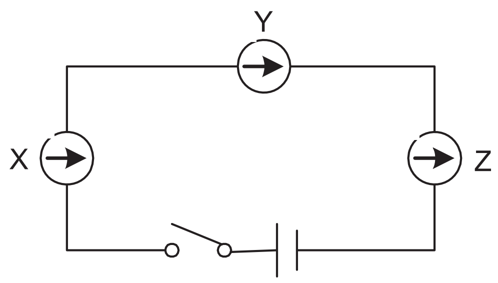
A Magnetic induction is the reason why unmagnetised material may be attracted by a magnet.

B Induced magnetism is always permanent.

C Magnetic induction is the same as electromagnetic induction.

D The material to be induced must be in physical contact with the magnet.

35 Three identical compasses are placed over a wire loop as shown in the diagram below.

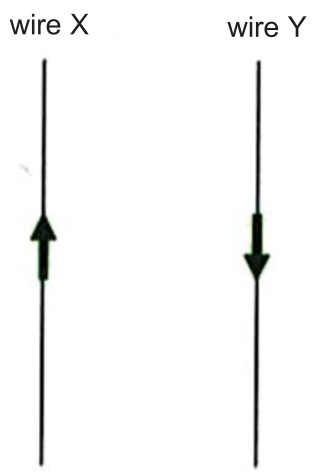


The switch is now closed.

Which row shows the correct orientation of each compass after some time?

	compass X	compass Y	compass Z
A	no change	down	left
B	no change	up	right
C	left	down	left
D	left	up	right

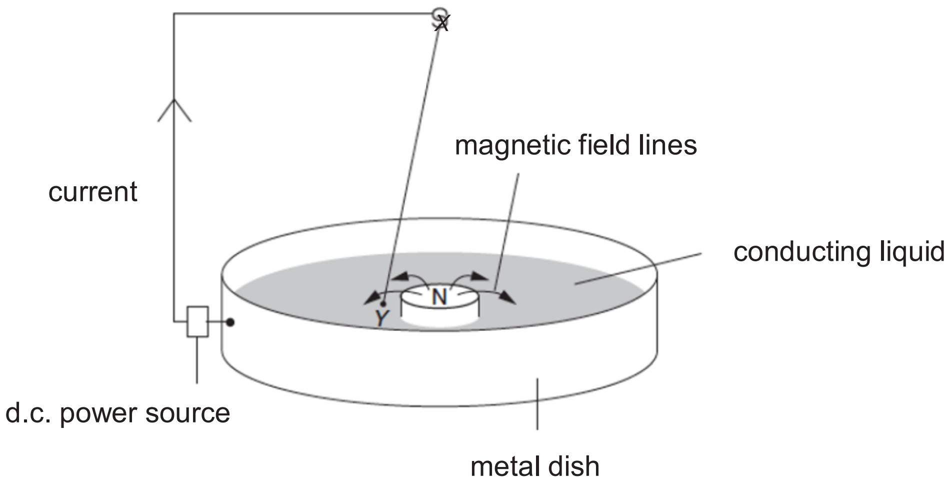
36 Two current-carrying wires X and Y are arranged in parallel as shown below.



What is the direction of the electromagnetic force on each wire?

	wire X	wire Y
A	to the left	to the left
B	to the left	to the right
C	to the right	to the left
D	to the right	to the right

37 One end of a wire **Y** is immersed in a conducting liquid while the other end **X** is connected to a battery and is free to rotate. The direction of the current in the circuit is indicated. A cylindrical magnet is placed in the centre of the conducting liquid with the North Pole facing upwards.



When viewed from the top, which direction will the wire **XY** move?

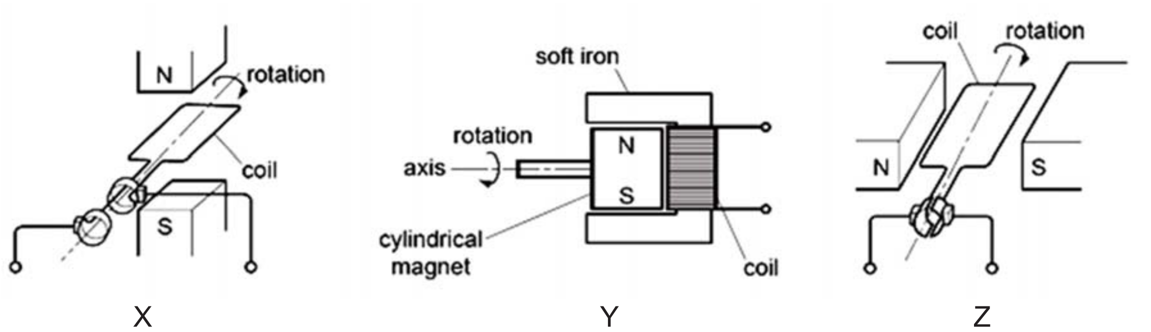
A clockwise

B anti-clockwise

C towards the magnet

D away from the magnet

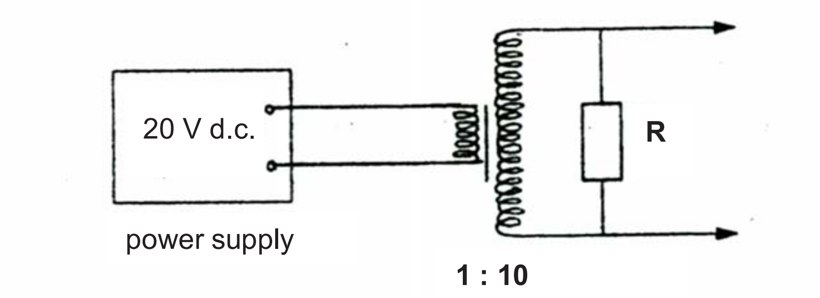
38 The following diagram shows three electrical generators.



Which generator(s) provide an alternating voltage?

A X only **B** Y only **C** X and Y only **D** X and Z only

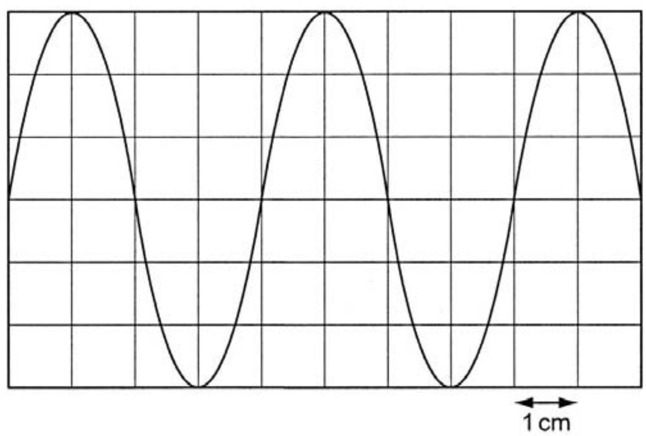
39 The circuit below shows a resistor R connected to a 20 V d.c. power supply through a transformer of turns ratio 1 : 10.



What is the voltage across **R** after some time?

A zero **B** 20 V a.c **C** 200 V d.c **D** 200 V a.c

40 An alternating supply with a period of 0.040 s is connected to a cathode-ray oscilloscope (c.r.o).



What is the time-base setting of the c.r.o?

A 0.4 ms / cm **B** 1 ms / cm **C** 4 ms / cm **D** 10 ms / cm

— End of paper —

Name: ______________________________ (   ) Class: ________

WHITLEY SECONDARY SCHOOL

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PRELIMINARY EXAMINATION 2019

SUBJECT :	**PHYSICS Paper 2 (6091/02)**
LEVEL :	**Sec 4 Express**
DATE :	**29 Aug 2019 (Thur)**
DURATION :	**1 hr 45 mins**
TOTAL MARKS:	**80**

INSTRUCTION TO CANDIDATES

Do not open this booklet until you are told to do so.
Write your name, class and index number in the spaces at the top of this page.
Write in dark blue or black pen in the spaces provided on the Question Paper.
You may use a soft pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid/tape.

Section A [50 marks]
Answer **all** questions. Write your answers in the spaces provided on the question paper.

Section B [30 marks]
Answer **all** questions. Question 10 has a choice of parts to answer.
Write your answers in the spaces on the question paper.

Candidates are reminded that **all** quantitative answers should include appropriate units.
Candidates are advised to show **all** their working in a clear and orderly manner, as more marks are awarded for sound use of physics than for correct answers.

At the end of the examination, fasten separate writing papers (if any) securely to the Question Paper.
The number of marks is given in brackets [ ] at the end of each question or part question.

Take acceleration due to gravity, g as 10 m/s^2.

For Examiner's Use	
Section A	**/ 50**
Section B	**/ 30**
Total	**/ 80**

The document consists of **19** printed pages including this cover page.

Section A [50 marks]

Answer **all** questions in this section in the spaces provided.

1 A ball is given a push to start it rolling freely up a slope. The velocity-time graph in Fig. 1.1 shows the change in the velocity of the ball with time.

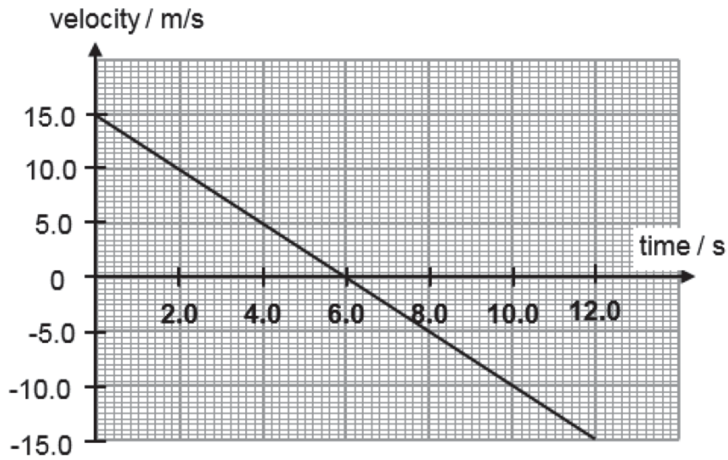


Fig. 1.1

(a) State the time when the ball reaches the highest point on the slope.

time = ………………………….. [1]

(b) Determine the acceleration of the ball at the highest point on the slope.

acceleration = ………………………….. [2]

(c) Determine the average speed of the ball between 2.0 and 12.0 s.

average speed = ………………………….. [2]

(d) On Fig. 1.2, sketch the displacement-time graph of the ball between 0.0 s to 12.0 s. [2]

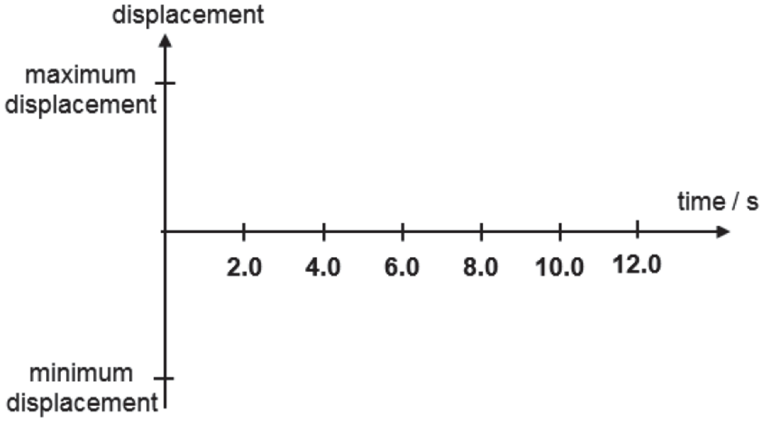


Fig. 1.2

2 A manhole cover is a plate to cover the opening of a manhole or a hole on the ground leading to a sewer. A manhole cover is typically round in shape as shown in Fig. 2.1.

Fig. 2.1

Fig. 2.2 shows the side view of a manhole cover hinged at **X** and with a handle at **Y**.

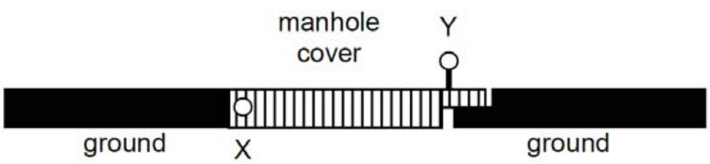


Fig. 2.2

(a) On Fig. 2.2, draw and identify all the forces acting on the manhole cover. [2]

(b) The manhole cover has a weight of 45.0 N and the centre of gravity is 30.0 cm from the hinge at **X**. The handle is 55.0 cm from **X**.

(i) Explain the term the *moment* of a force about a point.

……………………………………………………………………………………………………

…………………………………………………………………………………………………… [1]

(ii) A pulling force is applied at **Y** to lift the manhole cover.

Explain why it is easier to lift the manhole cover if the pulling force at **Y** is normal to the manhole cover.

……………………………………………………………………………………………………

……………………………………………………………………………………………………

…………………………………………………………………………………………………… [2]

(iii) Calculate the minimum pulling force applied at **Y** to lift manhole cover.

minimum pulling force = ……………………………… [2]

3 Fig. 3.1 shows a set of traffic lights supported by two cables, **A** and **B**, which hang from a pole. The set of traffic lights is in equilibrium.

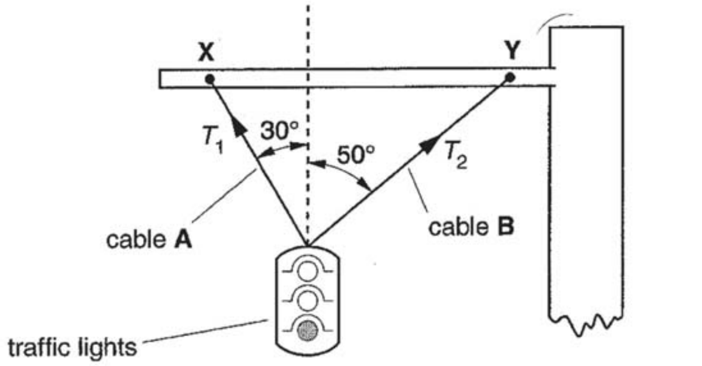


Fig. 3.1

The weight of the set of traffic lights is 350 N. The weight of the cables and pole is negligible. The tensions in the cables **A** and **B** are T_1 and T_2 respectively.

In the space below, draw a labelled vector diagram to show the resultant of the two tensions. State the scale used and determine the magnitudes of T_1 and T_2. [2]

scale = ……..………………….. [1]

T_1 = …………………………... [1]

T_2 = …………………………... [1]

4 Fig. 4.1 shows the plan of a bedroom and part of the main room of a house and their respective temperatures. Other rooms are not shown.

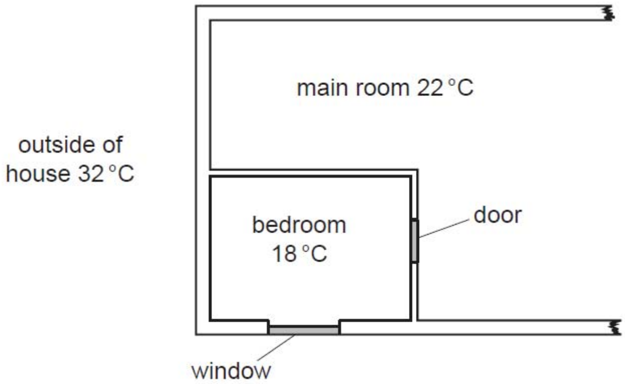


Fig. 4.1

Fig. 4.2 shows all the thermal energy inputs to the bedroom in one hour.

thermal energy input to bedroom	**energy / J**
through the door and walls from main room	4.5×10^4
through the walls from outside of house	2.3×10^6
through the window	1.1×10^6
from the person sleeping in bedroom	2.0×10^5

Fig. 4.2

(a) Explain why more thermal energy enters the bedroom from the outside of the house than from the main room.

……………………………………………………………………………………………

…………………………………………………………………………………………… [1]

(b) An air conditioner keeps the temperature constant in the bedroom by removing thermal energy.

(i) Identify a suitable location of the air conditioner in the bedroom for maximum efficiency.

…………………………………………………………………………………………… [1]

(ii) Explain how the location in **(b)(i)** cools the bedroom efficiently.

……………………………………………………………………………………………

……………………………………………………………………………………………

……………………………………………………………………………………………

……………………………………………………………………………………………

…………………………………………………………………………………………… [3]

(iii) A person sleeping in the bedroom.

Calculate the power of the air conditioner required to keep the temperature in the bedroom constant.

power = …….…………………….. [2]

(iv) State an assumption made in the calculation for **(b)(iii)**.

…..…..……………………..………..…..…………………………………….…………..

…..…..……………………..………..…..…………………………………….………….. [1]

5 An experiment is conducted to determine the specific latent heat of fusion of ice.

Fig. 5.1 shows two set-ups in the same room. The immersion heater in setup 1 is connected to a 12 V power supply and the current is 10.0 A. The heater in setup 2, which serves as a control in the experiment, is not connected to any power supply.

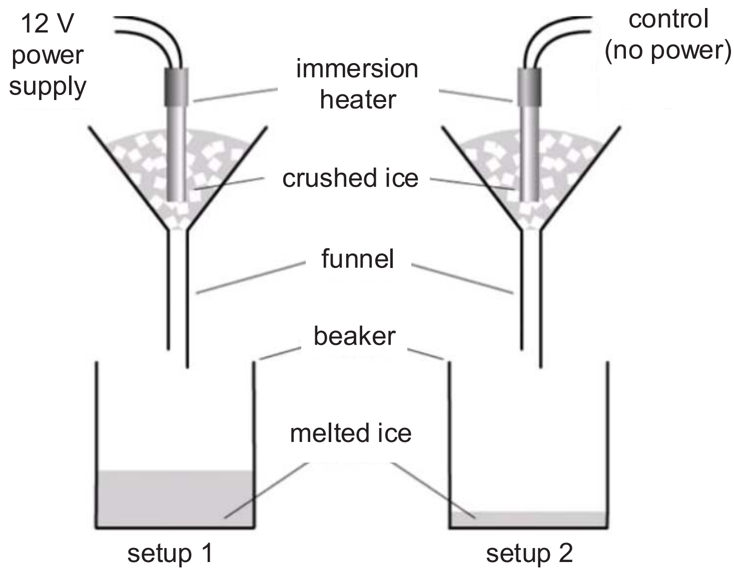


Fig. 5.1

The immersion heater in setup 1 is switched on until water flows at a steady rate from the funnel, for a duration of 5.0 minutes.

Fig. 5.2 shows the data collected from the experiment after 5.0 minutes.

	setup 1	setup 2
mass of empty beaker / g	60	60
mass of beaker with melted ice / g	192	85
mass of melted ice / g		

Fig. 5.2

(a) Define *specific latent heat of fusion*.

……………………………………………………………………………………………………..

…………………………………………………………………………………………………….. [1]

(b) Fill in the blanks for Fig. 5.2. [1]

(c) Setup 2 is known as a control set.

Explain the purpose of having a control set in this experiment.

……………………………………………………………………………………………………..

…………………………………………………………………………………………………….. [1]

(d) Calculate the heat energy provided by the immersion heater for 5.0 minutes.

heat energy = …….………………….. [2]

(e) Calculate the value of the specific latent heat of fusion of ice.

specific latent heat of fusion = …….………………….. [3]

(f) The actual value of specific latent head of fusion of ice is smaller than that calculated in **(e)**.

Suggest and explain why.

……..

…….. [1]

6 A plastic rod is initially electrically neutral. It is rubbed with a cloth and becomes positively charged. After charging, the rod is held close to a suspended table-tennis ball shown in Fig. 6.1. The table-tennis ball is covered with metal paint and is initially uncharged.

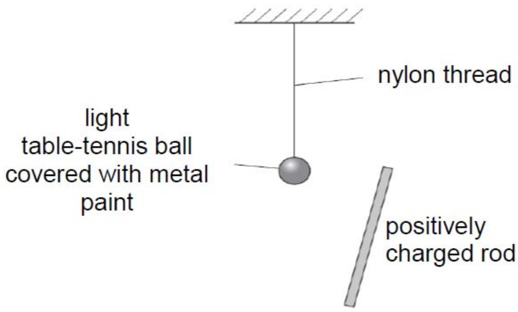


Fig. 6.1

(a) Describe what happens to the charges on the electrically neutral plastic rod when it is rubbed with a cloth.

....

.... [1]

(b) Describe what happens to the charges on the metal-painted table-tennis ball as the positively-charged rod is brought close to the ball.

....

.... [1]

(c) The ball swings towards the positively charged rod.

Explain why this happens.

....

....

.... [2]

(d) When it is a few centimetres away from the rod, the ball is briefly touched by a wire connected to earth.

In terms of the movement of charges, describe what happens to the charge on the ball.

....

....

.... [2]

7 A 600 Ω resistor and a thermistor are connected in series with an ammeter and a power supply of 20 V d.c. (direct current). A voltmeter is in parallel with the resistor.

Fig. 7.1 shows the circuit diagram.

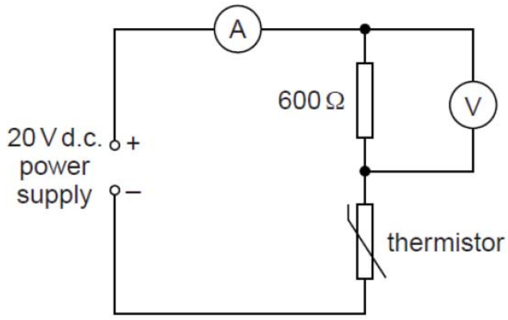


Fig. 7.1

The ammeter reads 0.025 A.

(a) Calculate the reading on the voltmeter.

voltmeter reading = …………………………… [2]

(b) Calculate the resistance of the thermistor.

resistance = …………………………… [2]

(c) Temperature of the thermistor increases.

(i) State and explain what happens to the ammeter reading.

……………………………………………………………………………………………

……………………………………………………………………………………………

…………………………………………………………………………………………… [2]

(ii) State and explain any change to the voltmeter reading.

……………………………………………………………………………………………

……………………………………………………………………………………………

…………………………………………………………………………………………… [2]

Section B [30 marks]

Answer **all** questions in this section in the spaces provided.

Question 10 has a choice of parts to answer.

8 Fig. 8.1 shows a cylindrical tank with two taps at **P** and **Q**. The tank, which contains oil, is resting on a horizontal surface. An empty horizontal tube is attached to tap **P** and an empty U-tube is attached to the tap **Q**. The other ends of the tubes are open. Both taps are initially turned off. Taps **P** and **Q** may be replaced with steel, copper or aluminium taps.

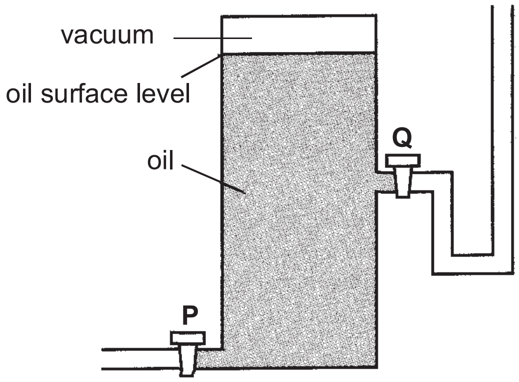


Fig. 8.1

Fig. 8.2 consists of information related to the operation of the taps.

atmospheric pressure	1 x 10^5 Pa
density of oil	800 kg/m^3
gravitational field strength	10 N/kg
height difference between tap **P** and tap **Q**	20 m
height difference between oil surface level and tap **Q**	15 m
base area of tank	18 m^2
cross-sectional area of horizontal tube	0.05 m^2
cross-sectional area of U-tube	0.03 m^2
cross-sectional area of steel tap replacement	0.02 m^2
cross-sectional area of copper tap replacement	0.03 m^2
cross-sectional area of aluminium tap replacement	0.04 m^2

Fig. 8.2

(a) Calculate the oil pressure acting on tap **Q**.

oil pressure = ……..………………….. [2]

(b) Tap **Q** is a copper tap.

Calculate the **net** force acting on tap **Q** when it is **turned on**.

net force = ………………………….. [3]

(c) When only tap **P** is turned on, the oil starts to flow into the horizontal tube.

Suggest why the rate of flow of oil into the horizontal tube is **not** constant as the level of oil falls in the tank.

……..

……..

……..

……..

…….. [3]

(d) State whether steel tap, copper tap or aluminium tap should be installed at **P** for greater rate of flow of oil. Explain your answer.

……..

……..

…….. [2]

9 Fig. 9.1 shows a ray of light incident on an interface of air and corn oil at an angle, i equals to 35°. The ray is transmitted through parallel layers of corn oil and glycerol and is then reflected at the surface of a plane mirror, located below and parallel to the glycerol layer. The ray then emerges from the corn oil back into the air. The refractive index of corn oil is 1.48.

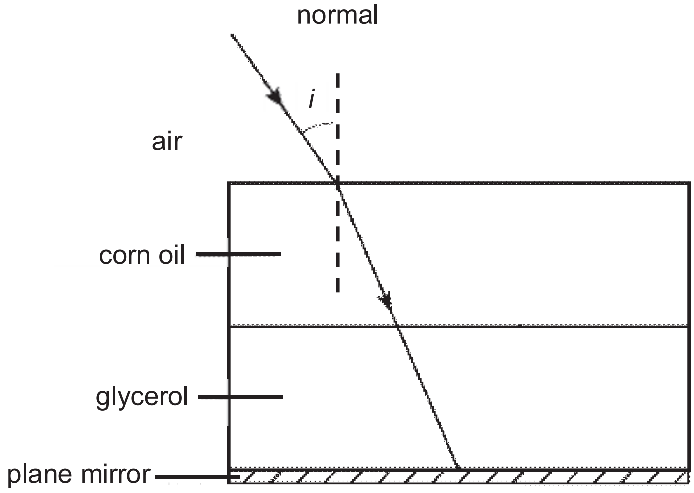


Fig. 9.1

(a) Calculate the angle of refraction of the light ray when it travels from air to corn oil.

angle of refraction = …….…………….…….. [2]

(b) Explain why the light ray did **not** bend at the corn oil and glycerol interface.

…………………………………………………………………………………………………..

…………………………………………………………………………………………………..

………………………………………………………………………………………………….. [2]

(c) Calculate the critical angle of light in the corn oil.

critical angle = …….…………….…….. [2]

(d) Explain why the reflected ray from the mirror will **not** undergo total internal reflection at the corn oil and air interface, regardless of the values of *i*.

………..

………..

……….. [2]

(e) Complete the ray diagram in Fig. 9.1 to show the path of the refracted light ray until it returns to air. [2]

EITHER

10 Fig. 10.1 shows a d.c. motor that is designed to rotate anti-clockwise. A rheostat is used in the circuit to adjust the motor speed.

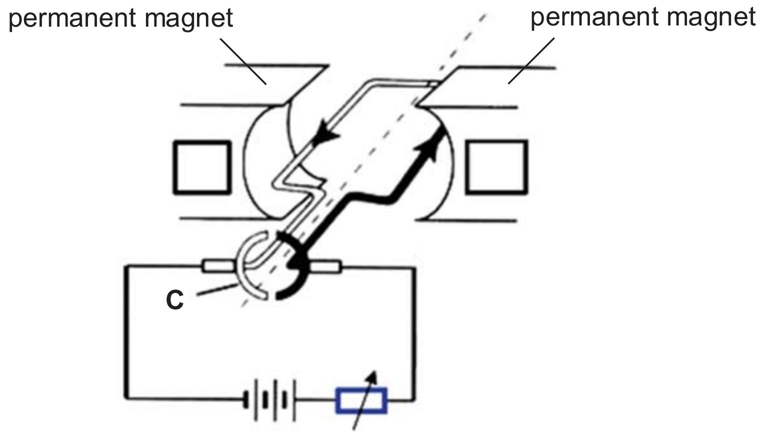


Fig. 10.1

(a) Label the polarities of the permanent magnet in the 2 boxes provided in Fig. 10.1. [1]

(b) Name the component **C** and states its function.

……………………………………………………………………………………………………

……………………………………………………………………………………………………

…………………………………………………………………………………………………… [2]

(c) Explain how the current causes the coil to rotate.

……………………………………………………………………………………………………

……………………………………………………………………………………………………

……………………………………………………………………………………………………

……………………………………………………………………………………………………

…………………………………………………………………………………………………… [3]

(d) Fig. 10.2 shows the rheostat that is connected to the d.c. motor.
The sliding contact is shifted to the right towards terminal **B**.

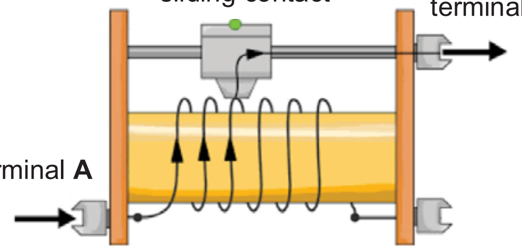


Fig. 10.2

State the effect of shifting the sliding contact to the right on the speed of the d.c. motor.
Explain your answer.

……………………………………………………………………………………………………

……………………………………………………………………………………………………

……………………………………………………………………………………………………

……………………………………………………………………………………………………

……………………………………………………………………………………………………

……………………………………………………………………………………………………

…………………………………………………………………………………………………… [4]

OR

10 Fig. 10.3 shows the compact cassette which is widely used to record and playback audio from the 1960s to the 1990s.

Fig. 10.3

When the cassette is inserted into the audio recorder, the recording head is positioned at the cassette opening.

During recording, as shown in Fig. 10.4, an audio signal is sent to the recording head in the form of an electric current which changes direction.

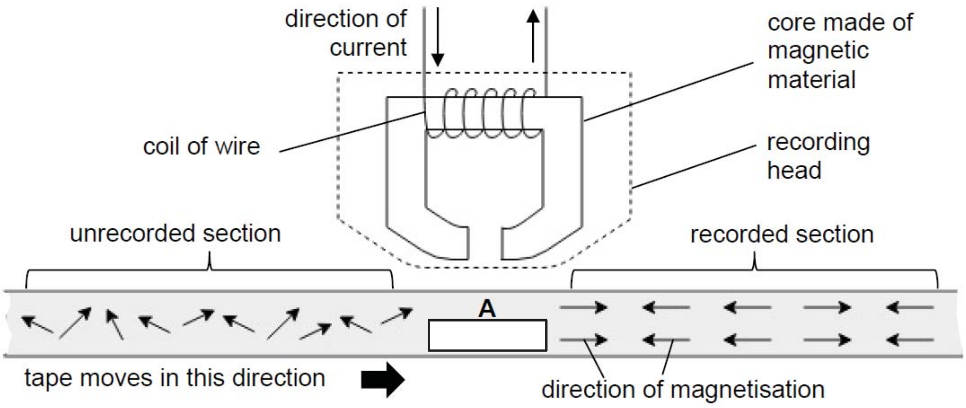


Fig. 10.4

The arrows on the tape represents the direction of magnetisation where the arrow head represents North Pole and the arrow tail represent South Pole.

(a) From the direction of current shown in Fig. 10.4, deduce the direction in which the tape at **A** will be magnetised.

Draw an arrow in the box given in Fig. 10.4 to represent this direction at **A**. [1]

(b) **(i)** State a difference between magnetic materials that form temporary magnets and permanent magnets.

………………………………………………………………………………………………

………………………………………………………………………………………………

……………………………………………………………………………………………… [2]

(ii) Deduce the type of magnetic material used in the tape.

……………………………………………………………………………………………… [1]

(c) When playing back the tape, the same recording head is used to read the tape. As shown in Fig. 10.5, when the tape moves over the recording head, an *electrical signal* is produced in the coil of wire.

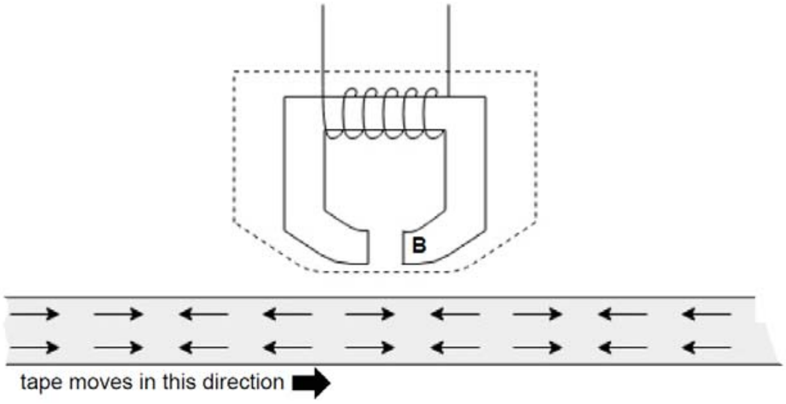


Fig. 10.5

An audio signal is then transmitted from the coil of wires to the speakers in the form of a current. This audio signal matches the audio signal initially used for recording.

Explain why there is an *electrical signal* being produced.

……………………………………………………………………………………………………

……………………………………………………………………………………………………

……………………………………………………………………………………………………

…………………………………………………………………………………………………… [2]

(d) The cassette player also comes with an erase function which activates the recording head to erase the recorded audio on the tape.

Suggest and explain how the recording head achieves this function.

……………………………………………………………………………………………………

……………………………………………………………………………………………………

……………………………………………………………………………………………………

…………………………………………………………………………………………………… [2]

(e) If a cassette is not properly stored, the recorded audio on the tape will gradually be lost over time.

State two reasons why this happens.

1 ……………………………………………………………………………………………………

……………………………………………………………………………………………………

2 ……………………………………………………………………………………………………

…………………………………………………………………………………………………… [2]

– End of Paper –

Whitley Secondary School
Marking Scheme

Assessment: 2019 Prelim
Level and Paper: 4E Pure Phy

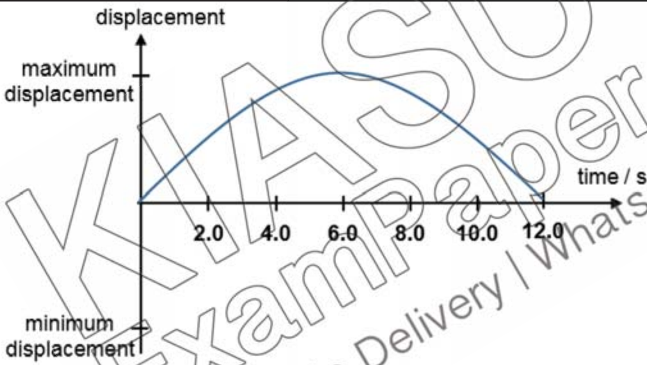
Paper 1

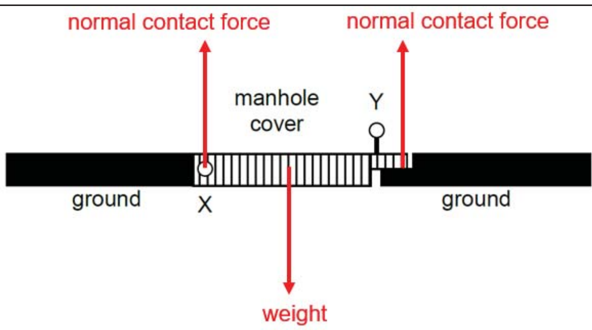
1	C	**11**	B	**21**	C	**31**	B
2	C	**12**	A	**22**	B	**32**	D
3	D	**13**	B	**23**	A	**33**	C
4	B	**14**	A	**24**	B	**34**	A
5	D	**15**	D	**25**	D	**35**	A
6	D	**16**	B	**26**	C	**36**	B
7	C	**17**	D	**27**	D	**37**	A
8	B	**18**	A	**28**	B	**38**	C
9	B	**19**	D	**29**	D	**39**	A
10	D	**20**	C	**30**	A	**40**	D

Paper 2

Deduct 1 mark for the following errors: • Wrong / missing units • Numerical ans not expressed in 3 s.f • Answers expressed in fractions Maximum of 2 marks deduction in a paper (due to any error above).

Section A

Q No.		Answers	Marks
1	(a)	6.0 s	1
	(b)	$acc = \frac{0-15.0}{6.0-0}$ $= -2.5\ m/s^2$	1 1
	(c)	Total distance travelled $= \frac{1}{2}(10)(4.0) + \frac{1}{2}(15)(6.0)$ $= 65\ m$ Average speed $= \frac{65}{10.0}$ $= 6.5\ m/s$	1 1
	(d)	 • Correct shape with max displacement at t = 6.0 s • Decreasing gradient from t = 0.0 s to t = 6.0 s and increasing gradient from t = 6.0 s to t = 12.0 s	1 1

Q No.			Answers	Marks
2	(a)			

			3 correct forces – **B2** 1 or 2 correct forces – **B1** 0 correct force – **B0**	1+1
	(b)	**(i)**	The product of the force and its perpendicular distance from the pivot to the line of action of the force	1
		(ii)	The perpendicular distance from the pivot to the line of action of the force is the <u>longest</u> when the pulling force at **Y** is normal to the manhole cover Force required to apply to the manhole cover will hence be the <u>smallest</u>, in order to produce the same anti-clockwise moment as the clockwise moment due to the weight of the manhole cover	1 1
		(iii)	CW moment = ACW moment $30.0 \times 45.0 = 55.0 \times F$ $F = 24.54545$ $\approx 24.5\ N$ upward	 1 1

Q No.		**Answers**	**Marks**
3		Correctly drawn parallelogram method - Solid lines with arrows and labels for forces - Dotted lines for construction - Double-headed arrow for resultant force - Length of arrows drawn for according to stated scale - Correct measurement of angle between the forces Suitable scale - 1 cm : 50 N or 1 cm : 25 N – **B1** T_1 = 275 N (260 N ~ 290 N) T_2 = 175 N (160 N ~ 190 N)	1+1 1 1 1

Q No.			**Answers**	**Marks**
4	**(a)**		There is <u>greater temperature difference</u> of 14 °C between outside the house and the bedroom than that between the main room and the bedroom which is a temperature difference of 4 °C / The greater the temperature difference, the faster the rate of transfer of thermal energy	1
	(b)	**(i)**	It needs to be placed at the <u>top</u> of the bedroom	1
		(ii)	As the air around the air conditioner <u>cools</u>, it <u>contracts</u> and becomes <u>denser</u> and <u>sinks</u> to the bottom of the room The warmer air, being <u>less dense</u>, <u>rises</u> to the top of the room to be cooled by the air conditioner A <u>convection current is created</u> from top to bottom of room which helps to cool the room efficiently	1 1 1
		(iii)	total thermal energy $= 4.5 \times 10^4 + 2.3 \times 10^6 + 1.1 \times 10^6 + 2.0 \times 10^5$ $= 3\ 645\ 000\ J$ $P = \dfrac{E}{t}$ $= \dfrac{3\ 645\ 000}{60 \times 60}$ $= 1012.5$ $\approx 1010\ W$	1 1

		(iv)	Any reasonable assumption: • There is no thermal energy entering or leaving the room other than what is stated. • The window and door is kept closed throughout. • The temperature outside the bedroom remains as stated.	1

Q No.		**Answers**	**Marks**
5	**(a)**	The amount of thermal energy required to change unit mass (1 kg) of the substance from solid state to liquid state, without a change in temperature	1
	(b)	(see table below)	1
	(c)	Heat energy supplied by the surroundings to melt the ice can be determined / temperature changes in the environment affect both setups in the same way	1
	(d)	$E = IVt$ $= (10)(12)(5 \times 60s)$ $= 36\,000\ J$	1 1
	(e)	Mass of melted ice due to power supply $= 132 - 25$ $= 107\ g$ $E = ml$ $36\,000 = (107)(l)$ $l = 336.44859$ $\approx 336\ J/g$ $336\ J/g = 336\,000\ J/kg$	1 1 1
	(f)	The mass of melted ice due to the power supply should be higher than 107 g. There was additional transfer of thermal energy from setup 1 to setup 2, causing more ice to melt in setup 2 / Mass of melted ice in setup 1 should be more	1

Table for 5(b):

	Setup 1	Setup 2
mass of empty beaker / g	60	60
mass of beaker with melted ice / g	192	85
mass of melted ice / g	192 – 60 = 132	85 – 60 = 25

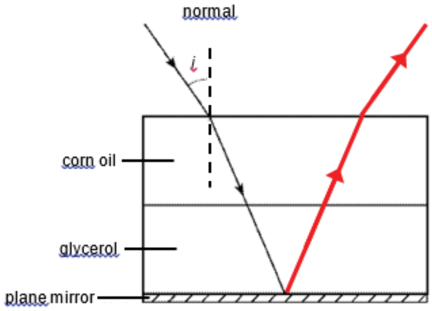
Q No.		**Answers**	**Marks**
6	**(a)**	The electrons from the plastic rod are transferred to the cloth. Hence there are now more electrons than protons, the rod therefore becomes positively charged	1
	(b)	The negative charges (electrons) move towards the rod, leaving positive charges on the left	1
	(c)	The negative charges in the ball are attracted to the positively charged rod The forces of attraction between the unlike charges are stronger than the forces of repulsion between like charges, hence the ball swings towards the charged rod due to the net force to the right	1 1
	(d)	Negative charges (electrons) flow up from earth to the ball through the wire to neutralise the induced positive charges The ball becomes negatively charged	1 1

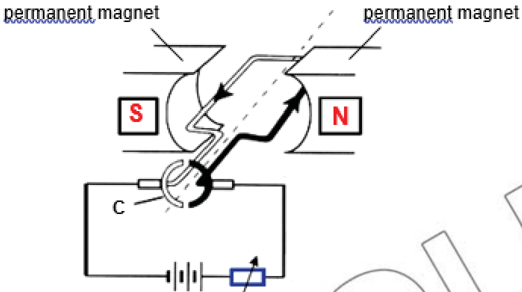
Q No.			Answers	Marks
7	(a)		$V = IR$ $= (0.025)(600)$ $= 15\,V$	 1 1
	(b)		$V = IR$ $20 - 15 = (0.025)(R)$ $R = 200\ \Omega$	 1 1
	(c)	(i)	Ammeter reading <u>increases</u> Resistance of thermistor <u>decreases</u> when its temperature increases which <u>decreases the overall effective resistance</u> of the circuit, hence current increases	1 1
		(ii)	voltmeter reading <u>increases</u> Resistance of thermistor <u>decreases</u> when its temperature increases hence its potential difference <u>decreases</u> and the potential difference of fixed resistor increases	1 1

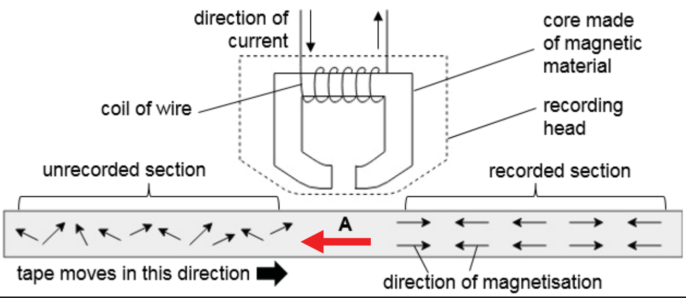
Section B

Q No.		Answers	Marks
8	(a)	$P = h\rho g$ $= (15)(800)(10)$ $= 120\,000\ Pa$	 1 1
	(b)	Atmospheric pressure = 100 000 Pa Net pressure acted at tap Q $= 120\,000 - 100\,000$ $= 20\,000\ Pa$ $P = \frac{F}{A}$ $20\,000 = \frac{F}{0.03}$ $F = 600\ N$	 1 1 1
	(c)	Pressure due to the oil depends <u>on the height of the oil column above the tap **P**</u> As level of oil falls in the tank decreases, the pressure due to the oil <u>decreases</u> The difference in pressure between oil and the atmosphere at P <u>decreases</u> Hence rate of flow of oil decreases	1 1 1
	(d)	Aluminium tap The <u>larger</u> the cross-sectional area of the tap, the <u>larger</u> is the force applied (due to $P = \frac{F}{A}$)	1 1

Q No.		Answers	Marks
9	(a)	$n = \frac{\sin i}{\sin r}$ $1.48 = \frac{\sin 35}{\sin r}$ $r = 22.80224$ $\approx 22.8^{o}$	 1 1
	(b)	Corn oil and glycerol have the <u>same refractive index</u> There is <u>no change</u> in the <u>speed</u> of light ray as it travels from corn oil to glycerol	1 1
	(c)	$\sin c = \frac{1}{n}$ $c = \sin^{-1}\frac{1}{1.48}$ $= 42.50664$ $\approx 42.5^{o}$	 1 1
	(d)	Angle of incidence will <u>not be greater</u> than critical angle / angle of incidence will be <u>smaller</u> than critical angle The maximum angle of incidence at corn oil-air interface is <u>equal</u> to the maximum angle of refraction at air-corn oil interface which has a maximum value of 42.5°	1 1

	(e)	 • correct reflected ray at mirror (*i* = *r* with no bending at glycerol-corn oil interface) • correct refracted ray (*r* for ray leaving corn oil is 35°)	 1 1

Q No.		Answers	Marks
10E	(a)		1
	(b)	Split ring commutator Function: <u>Changes the direction</u> of the current flow in the coil <u>every half a revolution</u> so that coil can rotate continuously	1 1
	(c)	Current in coil <u>produces a magnetic field</u> This field <u>interacts</u> with the permanent magnetic field to produce a force at the side of coil The forces at two sides are acting in <u>opposite directions</u> hence produces a moment about the axle to rotate coil	1 1 1
	(d)	As the slider shifts to the right, current has to flow through <u>longer</u> section of the resistance wire resistance <u>increases</u> and current <u>decreases</u> The force on the sides of coil due to the current and magnetic field <u>decrease</u> Hence speed of rotation <u>decreases</u>	1 1 1 1

Q No.			Answers	Marks
10O	(a)			1
	(b)	(i)	<u>Soft magnetic materials</u> form temporary magnets while <u>hard magnetic materials</u> form permanent magnets Soft magnetic materials are <u>easily magnetised and demagnetised</u> while hard magnetic materials are <u>hard to be magnetised and demagnetised</u>	1 1

		(ii)	Hard magnetic material	1
	(c)		As the magnetised tape approaches the recording head, there is a change in magnetic flux linking through the magnetic core to the coil of wire By Faraday's Law, an emf is induced in the coil of wire which is proportional to the rate of change of the magnetic flux (magnetic field lines linking the coil) Hence an electrical signal in the form of an induced current is produced	1 1
	(d)		The cassette player sends a strong alternating current to the coil of wire This produces a strong alternating magnetic field which causes the magnetisation on the tape to be disrupted as the tape passes the recording head **OR** The cassette player sends a strong direct current to the coil of wire This produces a strong magnetic field which causes the magnetisation on the tape to be reset to a single direction as the tape passes the recording head	1 1 **OR** 1 1
	(e)		• The cassette is exposed to heat causing the tape inside to be demagnetised • The cassette has been dropped / subjected to physical impact causing the tape inside to be demagnetised • Over time, Earth's magnetic field causes the direction of magnetisation to change • Different parts of the tape with different direction of magnetisation will affect one another, causing the directions to be altered *Any two*	1+1

– End of Paper –