O Level Centre/ Index Number /	Class	Name

新加坡海星中学

MARIS STELLA HIGH SCHOOL
PRELIMINARY EXAMINATION
SECONDARY FOUR

SCIENCE (PHYSICS, CHEMISTRY) **5076/01**

Paper 1 **24 August 2018**

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, index number and Centre number 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.

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.
A copy of the Periodic Table is printed on page 15.
The use of an approved scientific calculator is expected, where appropriate.

The total number of marks for this paper is 40.

For Examiner's Use
40

This document consists of **15** printed pages.

1 Figure 1a shows the zero reading of the micrometer screw gauge. Figure 1b shows the reading of the same micrometer screw gauge when it measures the thickness of a wire.

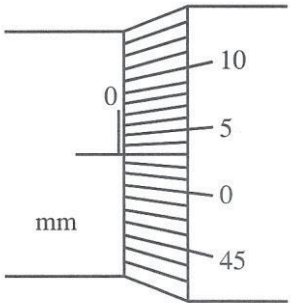


Figure 1a

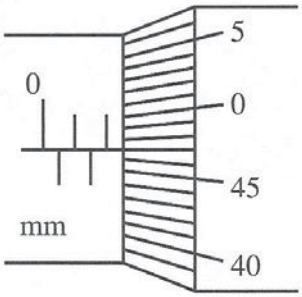


Figure 1b

What is the thickness of the wire?

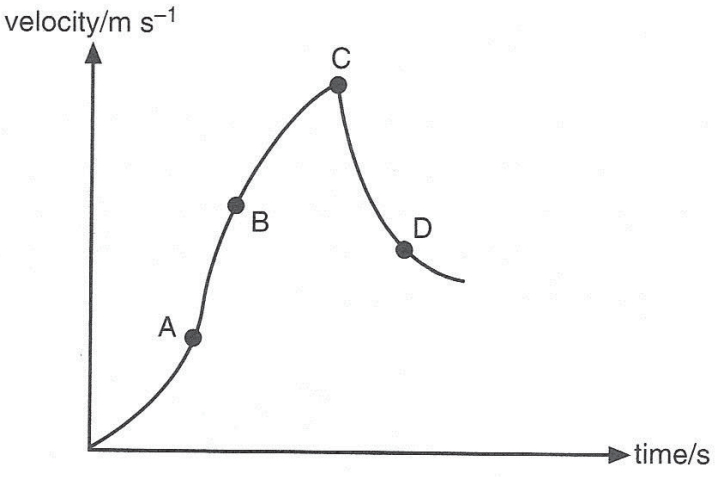
A 2.44 mm

B 2.47 mm

C 2.50 mm

D 2.97 mm

2 The graph shows how the velocity of an object changes with time. Which point on the graph shows the object moving with the greatest acceleration?



3 The weight of a piece of rock on a planet where the gravitational acceleration on the planet is 4 m/s^2 is 20 N. What is the weight of the rock on earth where the gravitational acceleration on earth is 10 m/s^2?

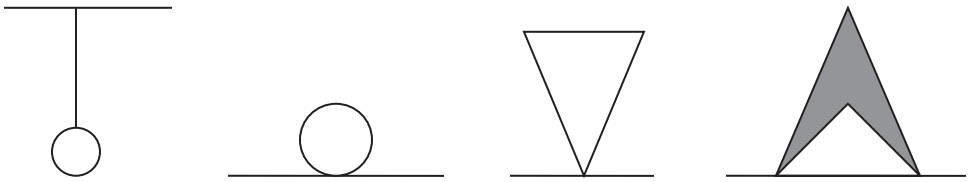
A 2 N

B 20 N

C 40 N

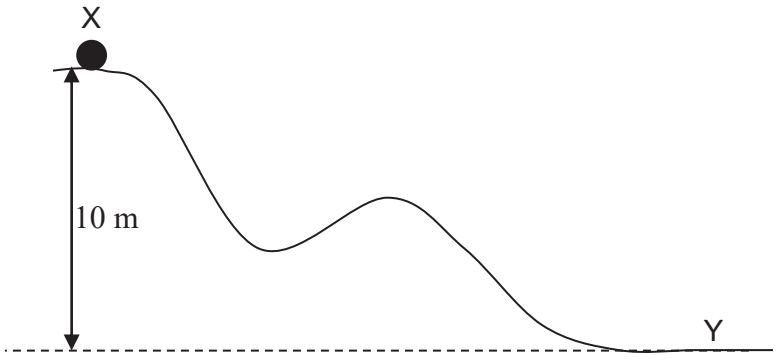
D 50 N

4 Which option best represents the stable equilibrium?



A **B** **C** **D**

5 A ball bearing is placed at point X on a smooth track as shown in the diagram below. The ball moves from rest down the track and passes a point Y which is 10 m below point X. Taking *g* as 10 ms^{-2}.



What is the speed of the ball at point Y?

A 10.0 m/s

B 14.1 m/s

C 100 m/s

D 141 m/s

6 Brownian motion of dust particles in the air is caused by

A convention current in the air.

B dust particles falling towards the ground.

C random collisions between the dust particles.

D random collisions of air molecules with the dust particles.

7 Internal energy of a body is

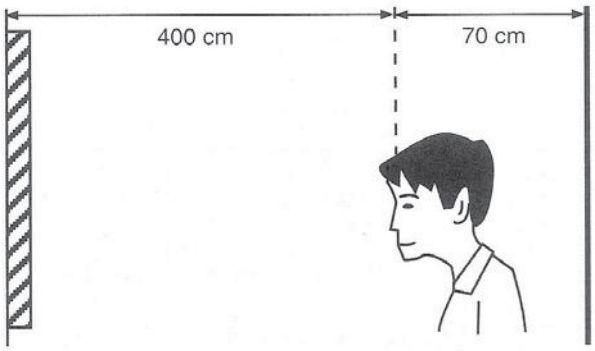
A the total kinetic energy of all the particles in the body.

B the total potential energy of all the particles in the body.

C the total kinetic energy and potential energy of all the particles in the body.

D the energy needed to keep the internal part of the body at room temperature.

8 The diagram below shows a plane mirror placed at a distance of 400 cm in front of a man.



If the doctor's test card is fixed at 70 cm behind the eyes of the man, what is the distance of the test card's image from the man?

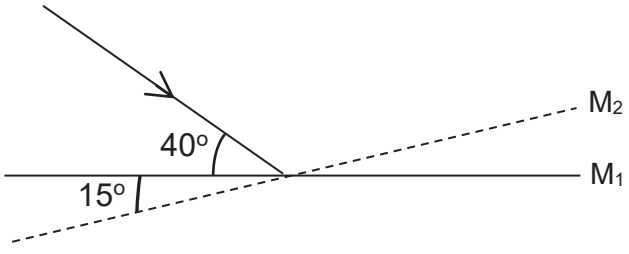
A 470 cm

B 800 cm

C 870 cm

D 940 cm

9 A ray of light strikes a plane mirror M_1 at an angle of 40°. The mirror is now rotated anticlockwise through an angle of 15° to a new position M_2 without changing the direction of the incident light ray.



What is the angle of reflection when the mirror is rotated to a new position M_2?

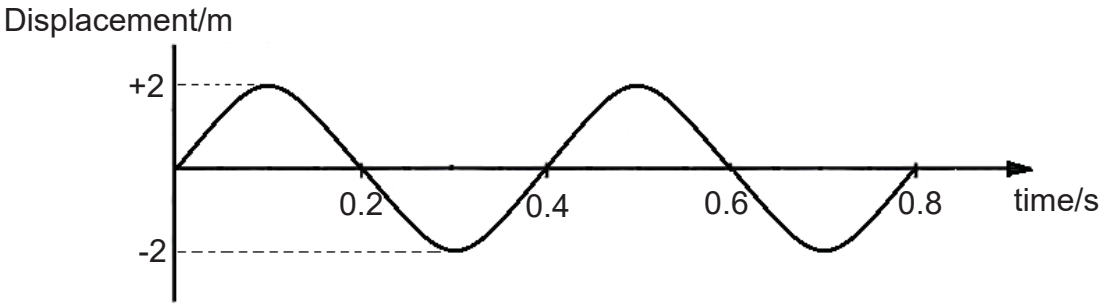
A 15°

B 35°

C 50°

D 55°

10 The graph represents the displacements of a particle that is along a transverse wave traveling at a speed of 5 m/s.



What is the frequency of the vibration of the particle?

A 1.25 Hz

B 2.5 Hz

C 5.0 Hz

D 12.5 Hz

11 The diagram shows different regions of the electromagnetic spectrum.

Gamma rays		**X**	Visible light		**Y**	Radio waves

What regions do **X** and **Y** represent?

	X	**Y**
A	Ultraviolet	Infrared
B	Infrared	X-ray
C	X-ray	Microwave
D	Ultraviolet	Microwave

12 One of the following devices does not make use of electromagnetic waves in its operation. Which one is it?

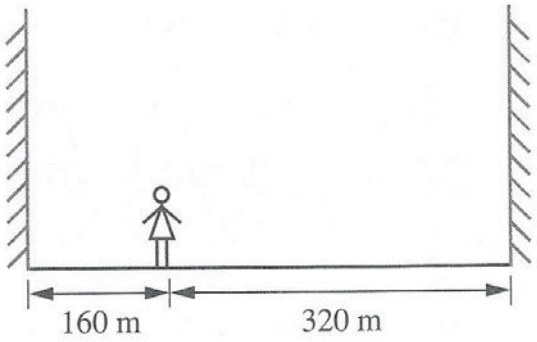
A A camera

B A radio set

C A loudspeaker

D A television set

13 A student stands between two walls and claps his hands once. The speed of sound in air is 320 m/s.



What is the time interval between the first echo and the second echo?

A 0.5 s

B 1.0 s

C 2.0 s

D 3.0 s

14 When an ebonite rod is rubbed with a duster, the rod becomes negatively charged. Why is this so?

A The duster loses electrons.

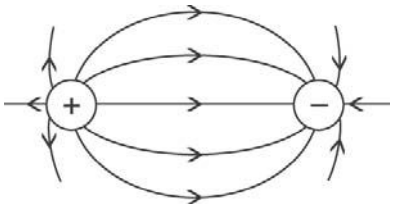
B The duster gains protons.

C The rod loses electrons.

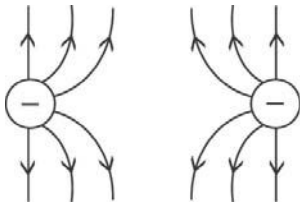
D The rod gains protons.

15 Which of the diagrams illustrating the electric field between two charged objects is **incorrect**?

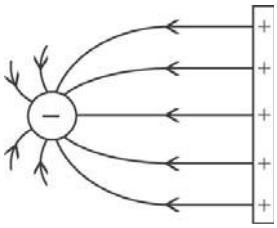
A



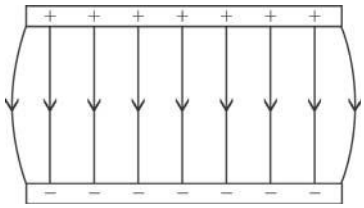
B



C



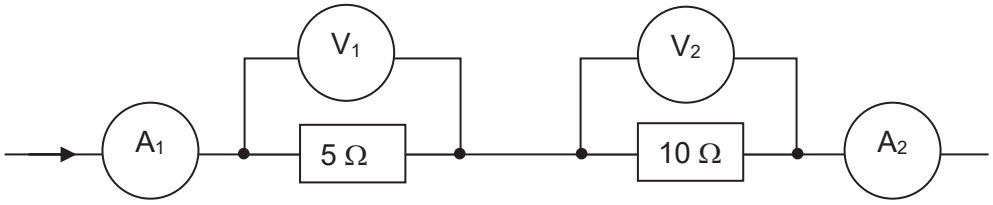
D



16 A piece of 0.50 m iron wire has a cross-sectional area of 1.0 mm^2. Which iron wire has twice the resistance?

	Length / m	Area / mm^2
A	0.25	2.0
B	0.50	2.0
C	0.50	0.5
D	1.00	2.0

17 Current flows in two resistors connected in series as shown in the diagram, A_1 and A_2 are the readings on the ammeters. V_1 and V_2 are the readings on the voltmeters.



Which of the following correctly describes the ammeter and voltmeter readings?

	Ammeter readings	Voltmeter readings
A	A_1 is less than A_2	V_1 is less than V_2
B	A_1 is less than A_2	V_1 is greater than V_2
C	A_1 is equal to A_2	V_1 is less than V_2
D	A_1 is equal to A_2	V_1 is equal to V_2

18 An electric heater is connected to a 3-pin socket. The current in the live wire is 1 A. The potential difference between the live and neutral wire is 240 V. Which of the following correctly describes the current in neutral wire and the potential difference between the neutral and earth wire?

	Current in neutral wire / A	Potential difference between neutral and earth wire / V
A	0	240
B	1	240
C	0	0
D	1	0

19 Which of the following methods is used to confirm that an object is a magnet?

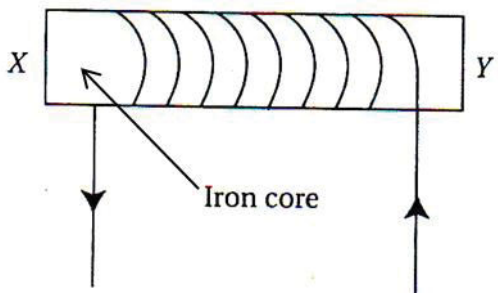
A It can attract an iron rod but not a wooden spoon.

B It can attract the north pole of another magnet.

C It can repel the south pole of another magnet.

D It can repel a magnetic material.

20 The figure below shows a current flowing through a solenoid wrapped around an iron core.



Which statement is **not** true?

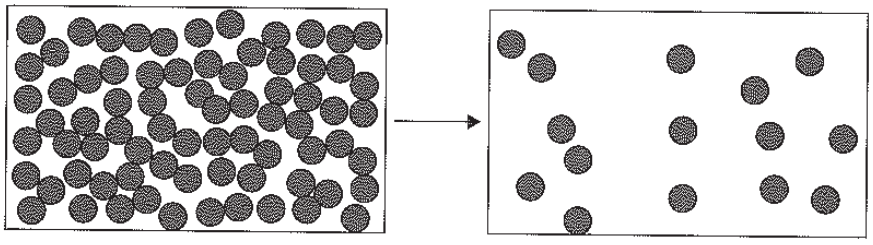
A The end X becomes a south pole.

B The increase in current can increase the strength of the magnetic field produced.

C The strength of the magnetic field becomes weaker if the iron core is replaced with an insulator.

D A compass placed near end X and later near end Y shows the same direction of deflection.

21 The diagram below represents a change in the arrangement of particles in two different physical states.



Which of the following statements is true about the change?

A The particles lose energy.

B The forces of attraction between the particles become weaker.

C The temperature of the surroundings rises due to the change.

D There is an increase in the orderliness of the particles.

22 An ion X^{2+} has a nucleon number 40 and 18 electrons.

What will the nucleus of the ion X^{2+}contain?

	number o f protons	number of neutrons
A	18	22
B	19	21
C	20	20
D	21	19

23 Element X has a proton number of 13. Element Y has a proton number of 8.

What is the chemical formula of the compound formed when X and Y react?

A XY_3

B X_2Y_3

C X_3Y

D X_3Y_2

24 Hydrogen sulfide burns in oxygen according to the following equation:

$$2H_2S(g) + 3O_2(g) \rightarrow 2H_2O(g) + 2SO_2(g)$$

48 dm^3 of hydrogen sulfide is burned.

Calculate the volume of oxygen needed to burn 48 dm^3 of hydrogen sulfide completely.

A 24 dm^3 **B** 48 dm^3

C 72 dm^3 **D** 96 dm^3

25 Which ionic equation represents the reaction between hydrochloric acid and magnesium ribbon?

A $Mg(s) + 2H^+(aq) \rightarrow Mg^{2+}(aq) + H_2(g)$

B $Mg^{2+}(aq) + 2Cl^-(aq) \rightarrow MgCl_2(aq)$

C $Mg^{2+}(aq) + 2HCl(aq) \rightarrow MgCl_2(aq) + 2H^+(aq)$

D $H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$

26 A salt is prepared by titrating an acid with a base.

Which of the following is correct about the acid and the base?

	acid	base
A	insoluble	insoluble
B	insoluble	soluble
C	soluble	insoluble
D	soluble	soluble

27 A red-brown precipitate was produced when an excess of aqueous sodium hydroxide was added dropwise to salt **B**.

In another experiment, a white precipitate was produced when dilute nitric acid and aqueous barium nitrate were added to salt **B**.

What is the identity of salt **B**?

A iron(II) chloride

B iron(II) sulfate

C iron(III) chloride

D iron(III) sulfate

28 What does **not** increase across a period of the Periodic Table?

A the nucleon number

B the number of protons

C the number of electron shells

D the number of valence electrons

29 Caesium is a Group I element in the Periodic Table and its relative atomic mass is greater than that of potassium.

Which of the following statements concerning caesium is **incorrect**?

A Caesium has a higher melting point than potassium.

B Caesium has a higher density than potassium.

C Caesium reacts with water more violently than potassium.

D Caesium corrodes in air to form an oxide, Cs_2O.

30 Brass is an alloy of copper and zinc.

Which statement is correct?

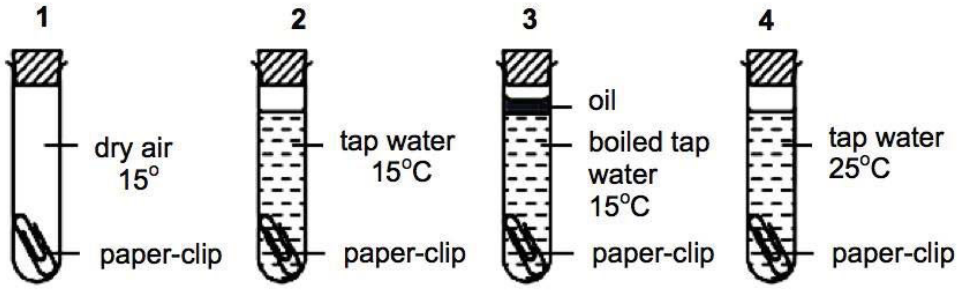
A Brass can be represented by a chemical formula.

B Brass has a fixed melting point and boiling point.

C Brass is formed by a chemical reaction between copper and zinc.

D Brass is stronger and harder than pure copper and pure zinc.

31 Four paper clips are placed in four different test-tubes as shown below.



Which two test-tubes can be used to show that oxygen is needed for iron to rust?

A 1 and 2 **B** 2 and 3

C 2 and 4 **D** 3 and 4

32 Equal masses of calcium carbonate was reacted with an excess of dilute hydrochloric acid at room temperature.

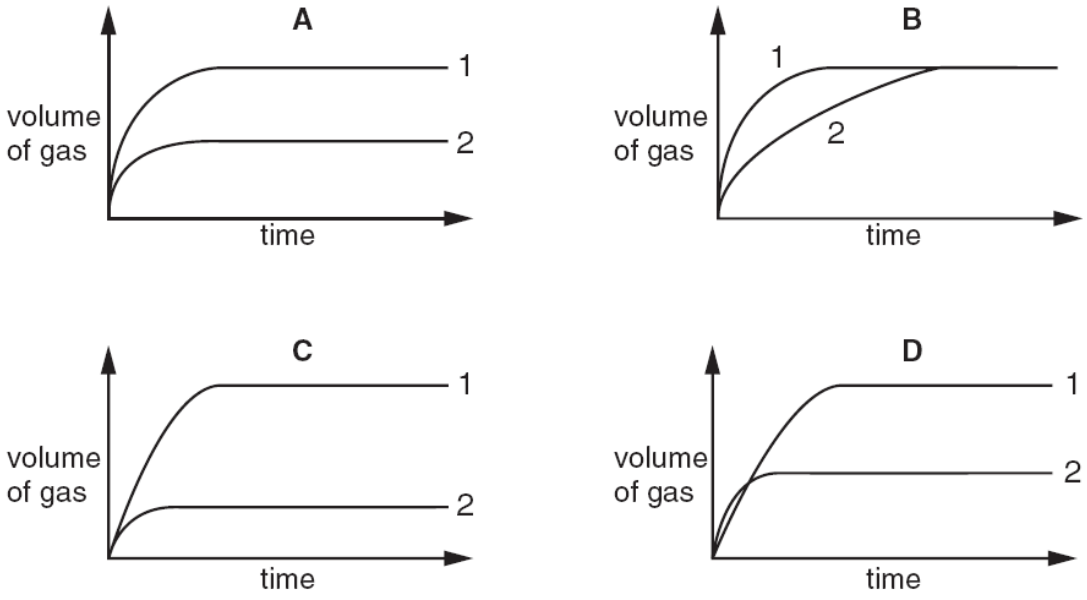
$$CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$$

Two experiments were carried out.

Experiment 1: 50 cm^3 of 0.200 mol/dm^3 hydrochloric acid was used.

Experiment 2: 50 cm^3 of 0.100 mol/dm^3 hydrochloric acid was used.

Which of the graphs best represents the results?



33 Four different solids Q, R, S and T, are dissolved in equal volumes of water at 25 ^{0}C. The table shows the change in temperature of the surrounding when each solid dissolves.

	Q	R	S	T
change in temperature of the surrounding / ^{0}C	-5	+7	+12	-8

Which row describes the energy changes when each solid is dissolved in water?

	solid which dissolves	type of energy change	solid which dissolves	type of energy change
A	S	endothermic	Q	exothermic
B	T	exothermic	R	endothermic
C	R	endothermic	Q	exothermic
D	S	exothermic	T	endothermic

34 Which underlined substance in the following reactions acts as an oxidising agent?

A $H_2 + \underline{CuO} \rightarrow H_2O + Cu$

B $\underline{2\ Fe^{2+}} + Cl_2 \rightarrow 2\ Fe^{3+} + 2\ Cl^-$

C $\underline{Zn} + Pb^{2+} \rightarrow Zn^{2+} + Pb$

D $2H^+ + \underline{MgO} \rightarrow Mg^{2+} + H_2O$

35 A sample of polluted air collected from a factory is bubbled through water. The pH of the solution formed is less than 7.

Which gas could have caused this?

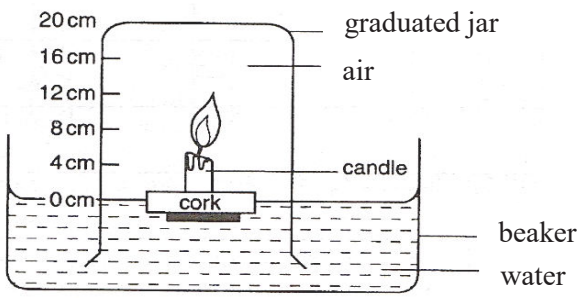
A methane

B carbon monoxide

C nitrogen dioxide

D unburnt hydrocarbon

36 A wax candle was fixed to a weighted piece of cork and floated on water. The candle was then lit and covered with a graduated jar.



What will be the water level when the flame extinguishes?

A 4 cm **B** 8 cm

C 12 cm **D** 16 cm

37 The table shows the boiling points of two fractions, X and Y, obtained when crude oil is distilled.

fraction	X	Y
boiling point / ^{0}C	35 – 75	higher than 250

Which statement regarding the two fractions is correct?

A Fraction X is less viscous than fraction Y.

B Fraction X is less flammable than fraction Y.

C Fraction X is in lower demand than fraction Y.

D Fraction X contains molecules of larger molecular size than fraction Y.

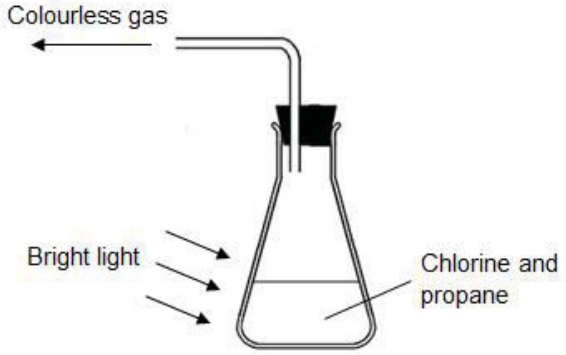
38 Long chain alkanes were cracked and the following useful products were obtained.

I **X** (used as a fuel)
II **Y** (used to make plastics)
III other products

What could be the possible identities for products **X** and **Y**?

	X	**Y**
A	methane	ethane
B	methane	ethene
C	naphtha	ethane
D	naphtha	ethene

39 A mixture of chlorine and excess propane was exposed to bright light. When the light was switched on, the mixture in the flask began to bubble, giving off a colourless gas.



What is the gas evolved?

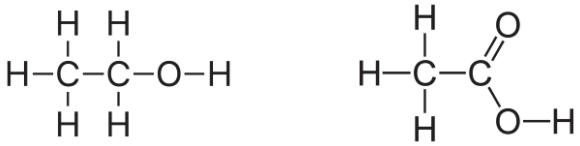
A chlorine

B propane

C hydrogen

D hydrogen chloride

40 The structural formulae of two compounds are shown below.



Which of the following substances can be used to distinguish the two compounds?

A limewater

B marble chips

C aqueous bromine

D aqueous sodium hydroxide

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9		Key proton (atomic) number atomic symbol name relative atomic mass									5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf Rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

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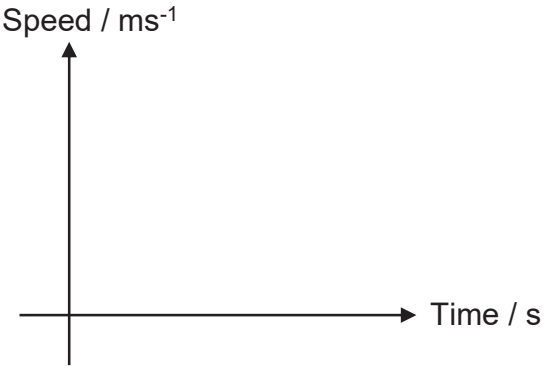
Section A

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

1 A tennis ball of mass 80 g moved up a smooth ramp with an initial speed of 12 m/s and stopped after 6 seconds.

(a) Sketch the speed-time graph for the first 6 seconds of the ball's motion. [1]



(b) Calculate the acceleration of the tennis ball as it moved up the ramp.

acceleration = …….. m/s^2 [2]

(c) Calculate the resultant force acting on the tennis ball as it moved up the ramp.

resultant force = …….. N [1]

(d) Calculate the greatest distance of the tennis ball from its starting point.

distance = …….. m [2]

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[Turn over

2 200 cm^3 of a sugar solution A of density 1 200 kg/m^3 is mixed with 300 cm^3 of another sugar solution B of density 1.10 g/cm^3.

(a) Calculate the mass of sugar solution A and another sugar solution B.

mass of sugar solution A = …….…….. g

mass of sugar solution B = …….…….. g [2]

(b) Hence, calculate the density of the mixture.

density of the mixture = …….…….. g/cm^3 [2]

3 Fig. 3.1 shows a man of mass 60 kg standing on one end of a plank, getting ready to cross a stream. The plank is pivoted at point X. The gravitational field strength is 10 N / kg.

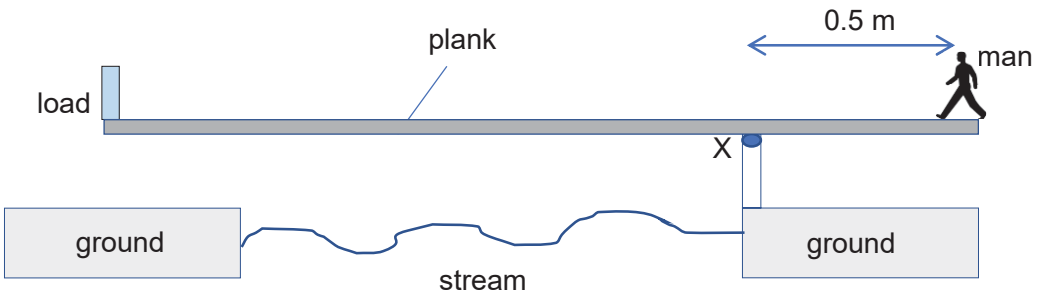

Fig. 3.1

The plank has a mass of 20 kg and is 2.5 m long with a uniform cross-section. One end is 0.5 m from the pivot at X. A load is placed on the other end to balance the plank horizontally.

(a) 1. Calculate the anticlockwise moment due to the weight of the plank.
2. Hence, using Principle of Moments to determine the weight of the load to balance the plank horizontally.

anticlockwise moment = …….. Nm
[2]
weight = …….. N

(b) Explain why the load touches the ground when the man walks towards the pivot at X.

……

……

……

……

…… [2]

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[Turn over

4 Fig. 4.1 shows an electric motor of power 100 W used to pull a load of 60 kg up an incline plane at a constant speed. The motor takes 30 s to move the load through a distance of 5.0 m on the incline and through a height of 4.0 m.

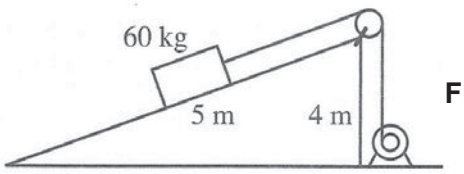

Fig. 4.1

(a) Calculate the energy dissipated by the motor.

energy = …….. J [2]

(b) Determine the gain in potential energy of the load.

potential energy = …….. J [2]

(c) Explain why there is a difference in the answers calculated in **(a)** and **(b)**.

……

…… [1]

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5 The interior of a refrigerator is shown in Fig. 5.1.

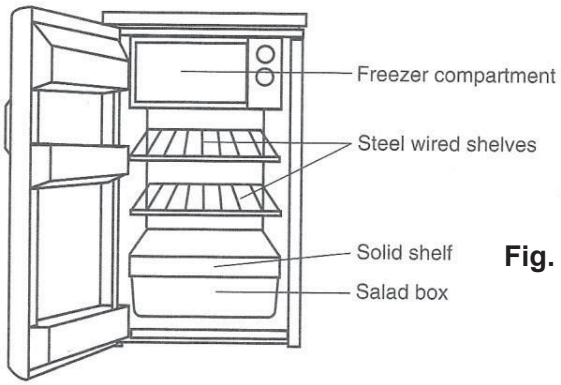

Fig. 5.1

(a) Explain how the refrigerator is cooled by convection.

……

……

……

……

…… [2]

(b) Give two reasons why steel wired shelves are used rather than solid shelves in the centre of the refrigerator.

……

……

……

…… [2]

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(c) The refrigerator walls are insulated using both expanded polystyrene and aluminium foil as shown in Fig. 5.2.

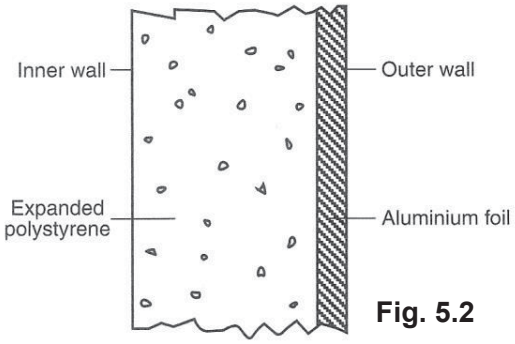

Fig. 5.2

Explain how these two materials reduce thermal energy entering the refrigerator.

……

……

……

…… [2]

6 Fig. 6.1 shows the path of light ray as it passes through a glass prism.

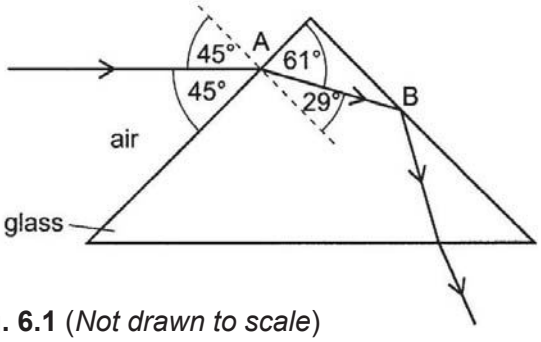

Fig. 6.1 (*Not drawn to scale*)

(a) Using angles from Fig. 6.1, calculate the refractive index of the glass.

refractive index = …… [1]

(b) Calculate the critical angle of the glass prism.

critical angle = ... [1]

(c) Explain why the ray does not emerge from the prism at **B**.

.....

.....

.....

.....

..... [2]

7 The potential difference against current characteristic graphs for three conductors P, Q and R are shown in Fig. 7.1.

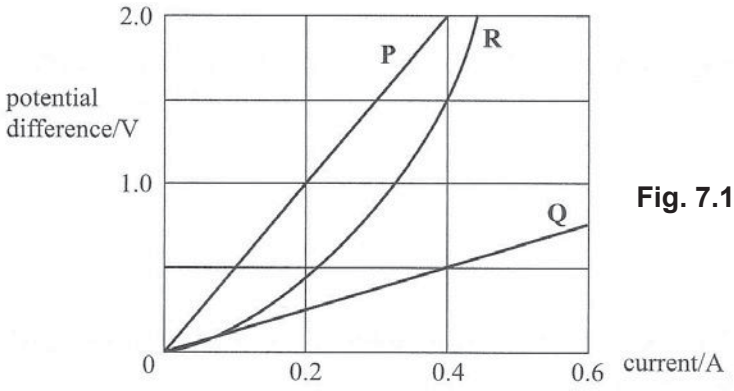

Fig. 7.1

(a) Using Fig. 7.1, state which of the conductor(s) obey(s) Ohm's Law. Explain your answer.

.....

.....

.....

..... [2]

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(b) Calculate the resistance of conductor P.

resistance = ... Ω [1]

(c) If the conductors R and Q are connected in series, with a current of 0.4 A flowing, state what would be the potential difference across

(i) R,
(ii) Q,
(iii) the series combination of R and Q.

potential difference across R = ... V

potential difference across Q = ... V

potential difference across the series combination of R and Q = ... V [1]

8 Fig. 8.1 shows an electric circuit.

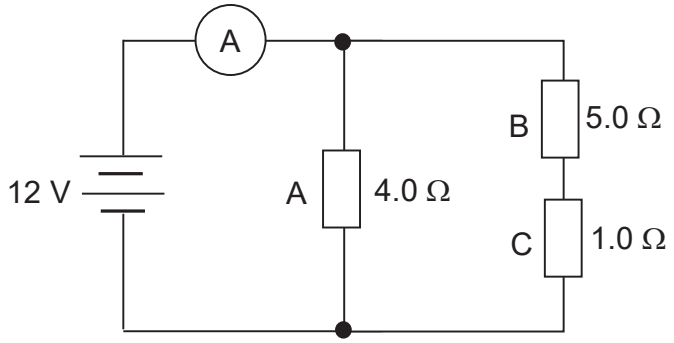

Fig. 8.1

(a) Determine the ammeter reading in the circuit.

ammeter reading = ... A [2]

(b) Find the current flowing through resistor C.

current = ……. A [1]

(c) Calculate the potential difference across resistor B.

potential difference = ……. V [1]

(d) Calculate the amount of charge flowing through resistor A in 30 s.

amount of charge = ……. C [2]

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9 **(a)** Fig. 9.1 shows a circuit breaker with the contact closed.

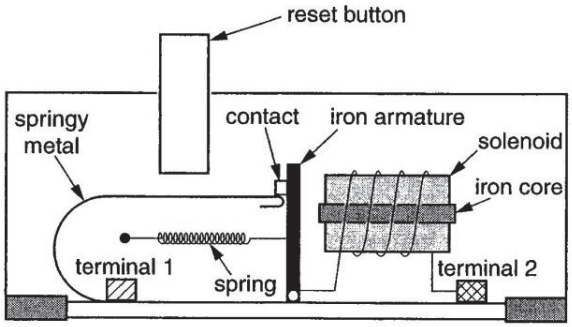

Fig. 9.1

Fig. 9.2 shows the same circuit breaker after a large current has passed through the circuit.

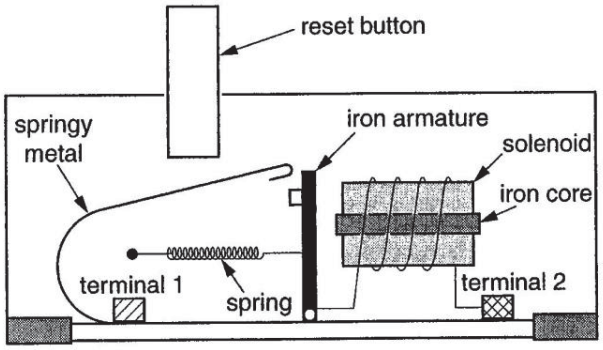

Fig. 9.2

Describe how the circuit breaker is able to switch off the current when a fault causes the current to become too large.

……

……

……

……

……

…… [3]

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(b) Fig. 9.3 shows a rigid wire is held between the poles of a magnet. When the current is switched on, there is a force on the wire in an upward direction as shown in Fig. 9.3.

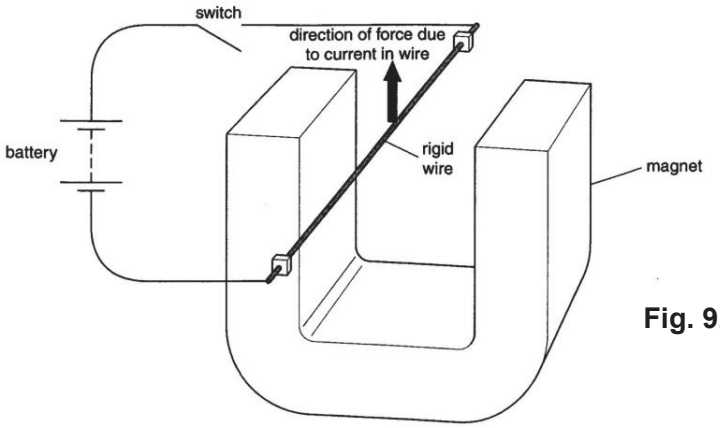

Fig. 9.3

(i) Explain why there is a force acting on the wire.

.....

.....

.....

.....

..... [2]

(ii) On Fig. 9.3, draw an arrow to show the direction of the current flowing in the rigid wire and label the north pole of the magnet with the letter **N**. [1]

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Section B

Answer any **two** questions in this section.

Write your answers in the spaces provided.

10 **(a)** A mass of weight 7.0 N hanging on the end of a string is pulled sideways so that the string makes an angle of 30° with the vertical as shown in Fig. 10. 1.

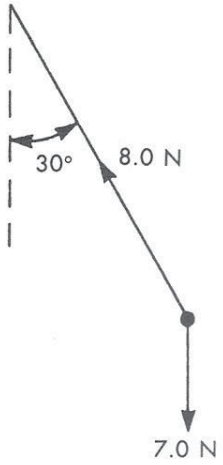

Fig. 10.1
(Not drawn to scale)

By means of a scale diagram, determine the resultant force due to the tension in the string and the weight of the mass.

resultant force = …….. [3]

(b) Fig. 10. 2 shows a block of mass of 4.0 kg resting on a table. A force of 5.0 N is applied to the block pulling it at a constant speed of 1.5 m/s. Assume that g = 10 N/kg.

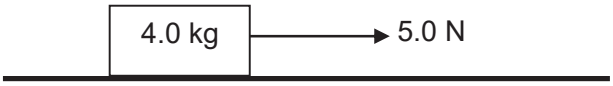

Fig. 10.2

(i) State the size of the frictional force acting on the block and explain how you obtain the answer.

……

……

……

……

…… [2]

(ii) State the direction of this frictional force.

……

…… [1]

(iii) The applied force is increased until the block moves at an acceleration of 2 m/s^2. Calculate the new applied force.

applied force = …….. [2]

(iv) Find the pressure of the block acting on the table if the dimension of the base of the block is 1.0 m by 0.5 m.

pressure = …….. [2]

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11 **(a)** Thermal energy is supplied at a constant rate using a 40 W electric heater to a liquid in a beaker. A graph of temperature recorded by the thermometer against the time is plotted as shown in Fig. 11.1.

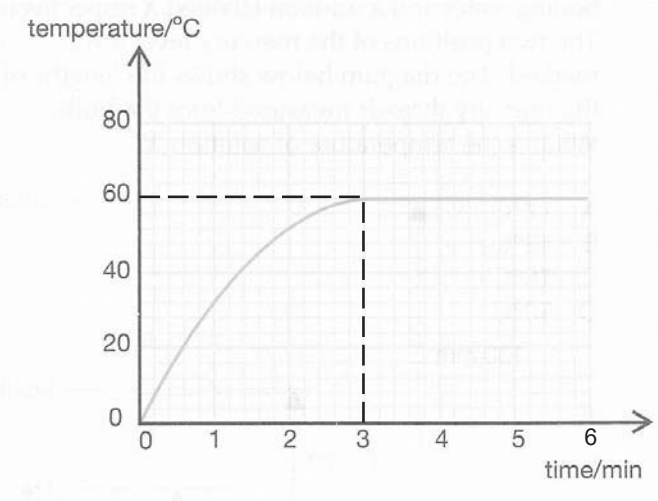

Fig. 11.1

(i) State the boiling point of the liquid in the beaker.

..... [1]

(ii) Explain why the temperature remained constant for the period between 3 min and 6 min.

.....

.....

.....

.....

..... [2]

(iii) State and explain whether there will be any change in the temperature recorded by the thermometer if the 40 W heater in the above experiment is replaced by a 80 W heater.

.....

.....

.....

.....

..... [2]

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(iv) State one difference between boiling and evaporation.

……

……

…… [1]

(b) A sound wave has a frequency of 400 Hz. The speed of sound in air is 320 m/s.

(i) Calculate the wavelength of the sound wave in air.

wavelength = …….. [2]

(ii) A sound wave of the same frequency is produced in water. Describe and explain how the wavelength of the wave will be different from that in part **(i)**.

……

……

…… [2]

12 **(a)** Fig. 12.1 shows the image **I** of an object **O** produced by a converging lens.

Fig. 12.1

On Fig. 12.1, complete the ray diagram by drawing two rays passing from the object to the image. Mark the positions of the lens **L** and the relevant focal point **F** on Fig. 12.1. [3]

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(b) Fig. 12.2 shows part of a household electric installation, where an electric heater is used to heat the water in a metal tank.

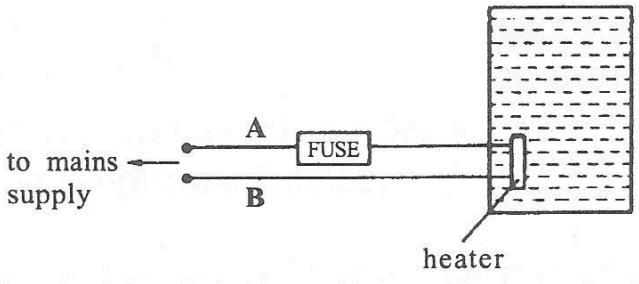

Fig. 12.2

(i) Explain which wire, **A** or **B**, should be the live wire of the supply.

……

…… [2]

(ii) Explain in detail how a fuse acts as a safety device.

……

……

……

……

…… [2]

(iii) When connected to the 240 V mains supply, the heater drew a current of 8.0 A. Calculate the rate of production of heat (power).

power = …… [1]

(iv) Hence, calculate the cost of using the heater for 6 hours if the cost of 1.0 kWh is $0.25.

cost = …… [2]

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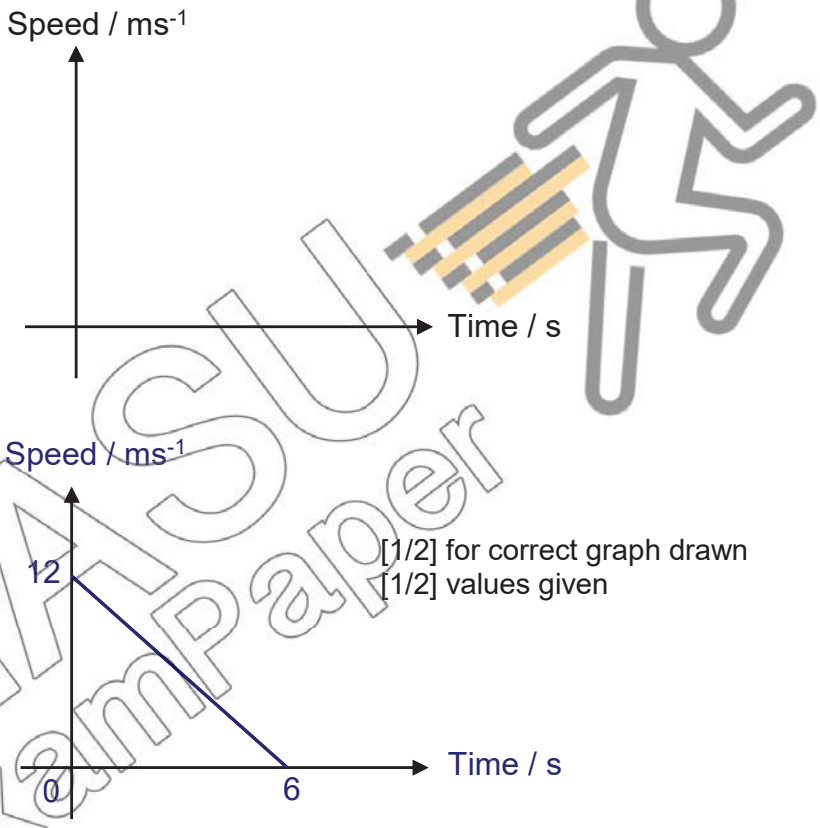
Section A

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

1 A tennis ball of mass 80 g moved up a smooth ramp with an initial speed of 12 m/s and stopped after 6 seconds.

(a) Sketch the speed-time graph for the first 6 seconds of the ball's motion. [1]



[1/2] for correct graph drawn
[1/2] values given

(b) Calculate the acceleration of the tennis ball as it moved up the ramp. [2]

$$a = \frac{v-u}{t}$$

$$a = \frac{(0-12)ms^{-1}}{6}$$

$$a = -2ms^{-2}$$

(c) Calculate the resultant force acting on the tennis ball as it moved up the ramp. [1]

$$F = ma$$

$$F = (0.08kg)(2ms^{-2})$$

$$F = 0.16N$$

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(d) Calculate the greatest distance of the tennis ball from its starting point. [2]

$$Distance = Area\ under\ speed-time\ graph \quad [1/2]$$

$$Distance = \frac{1}{2}\times 6\times 12 \quad [1]$$

$$Distance = 36m \quad [1/2]$$

2 200 cm^3 of a sugar solution A of density 1 200 kg/m^3 is mixed with 300 cm^3 of another sugar solution B of density 1.10 g/cm^3.

(a) Calculate the mass of sugar solution A and another sugar solution B. [2]

Mass of sugar solution A = density × volume
= 1.20 gcm^{-3} × 200 cm^3
= 240 g

Mass of sugar solution B = density × volume
= 1.10 gcm^{-3} × 300 cm^3
= 330 g

(b) Hence, calculate the density of the mixture. [2]

Density of Mixture = Total mass / Total volume
= (240 + 330) g / (200 + 300) cm^3
= **1.14 gcm^{-3}**

3 Fig. 3.1 shows a man of mass 60 kg standing on one end of a plank, getting ready to cross a stream. The planl is pivoted at point X. The gravitational field strength is 10 N / kg.

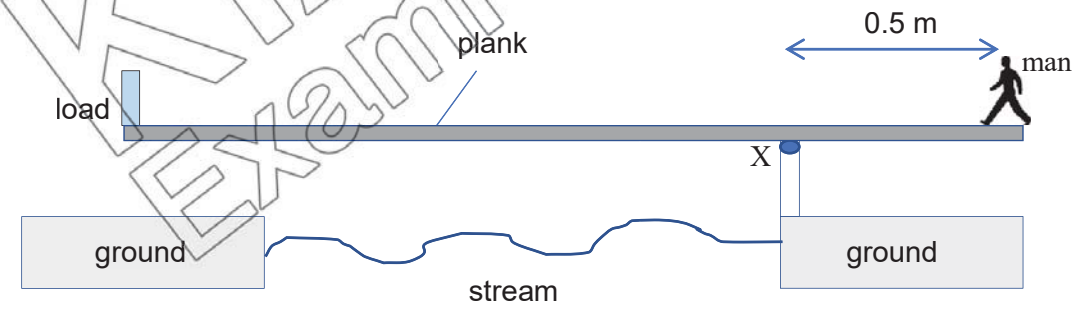

Fig. 3.1

The plank has a mass of 20 kg and is 2.5 m long with a uniform cross-section. One end is 0.5 m from the pivot at X. A load is placed on the other end to balance the plank horizontally.

(a) 1. Calculate the anticlockwise moment due to the weight of the plank. [2]
2. Hence, using Principle of Moments to determine the weight of the load to balance the plank horizontally.

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Anticlockwise moment due to weight of the plank
= F × d
= 200 × 0.75 m [1/2]
= 150 Nm

In equilibrium, taking moment about the pivot,
Sum of anticlockwise moments = Sum of clockwise moments [1/2]
$W \times 2$ m + 150 Nm = 600 N × 0.5 m [1/2]
W = 75 N [1/2]

(b) Explain why the load touches the ground when the man walks towards the pivot at X. [2]

As the man walks towards X, the **clockwise moment about the pivot decreases** [1/2] as the **perpendicular distance from the line of action of force to the pivot decreases**.[1/2]
Thus the **sum of anticlockwise moments about the same pivot is larger than the clockwise moment**,[1/2] causing the **plank to turn anticlockwise**.[1/2]

4 Fig. 4.1 shows an electric motor of power 100 W used to pull a load of 60 kg up an incline plane at a constant speed. The motor takes 30 s to move the load through a distance of 5.0 m on the incline and through a height of 4.0 m.

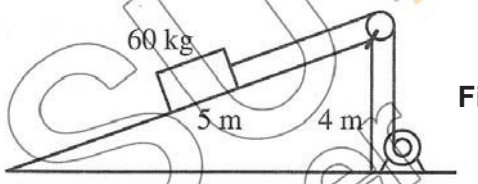

Fig. 4.1

(a) Calculate the energy dissipated by the motor. [2]

Energy dissipated = P × t
= 100 W × 30 s
= **3 000 J**

(b) Determine the gain in potential energy of the load. [2]

Gain in potential energy = mgh
= 60 kg × 10 ms^{-1} × 4 m
= **2 400 J**

(c) Explain why there is a difference in the answers calculated in **(a)** and **(b)**. [1]

There is energy lost as heat and work done against friction.

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5 The interior of a refrigerator is shown in Fig. 5.1.

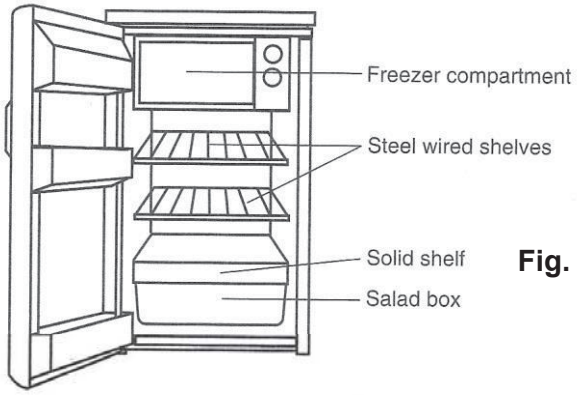

Fig. 5.1

(a) Explain how the refrigerator is cooled by convection. [2]

Cold air being denser at the top of freezer compartment sinks while the warm and less dense air at the bottom rises to the freezer compartment to be cooled. This sets up a convection current due to difference in densities and the whole process is repeated until the refrigerator is cooled.

(b) Give two reasons why steel wired shelves are used rather than solid shelves in the centre of the refrigerator. [2]

It is to allow for the convection current to flow through. As steel is a better conductor of heat, so it conducts the heat present in the refrigerator away, keeping the refrigerator cool.

(c) The refrigerator walls are insulated using both expanded polystyrene and aluminium foil as shown in Fig. 5.2.

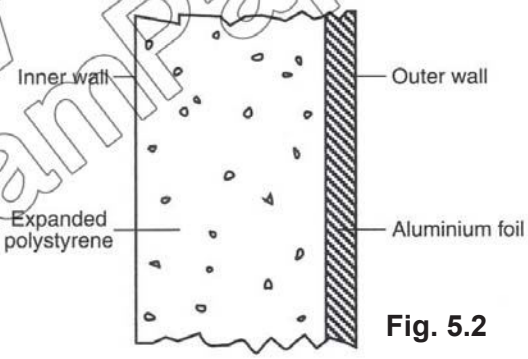

Fig. 5.2

Explain how these two materials reduce thermal energy entering the refrigerator. [2]

Aluminium foil is a poor absorber / good reflector of radiant heat so rate of heat gain is reduced due to radiation.
Expanded polystyrene traps air, which is a poor conductor of heat, so it reduces heat gain due to conduction and convection.

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6 Fig. 6.1 shows the path of light ray as it passes through a glass prism.

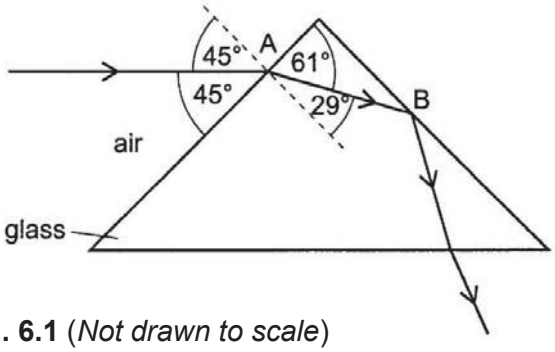

Fig. 6.1 (*Not drawn to scale*)

(a) Using angles from Fig. 6.1, calculate the refractive index of the glass. [1]

n = sin i / sin r
= sin 45° / sin 29° [1/2] with formula
= 1.46 [1/2]

(b) Calculate the critical angle of the glass prism. [1]

sin c = 1 / n
= 1 / 1.46 [1/2] with formula
c = 43° [1/2]

(c) Explain why the ray does not emerge from the prism at **B**. [2]

Total internal reflection occurs at B. [1/2]
The **angle of incidence in glass at B [1/2] is greater than the critical angle of glass**.[1/2] The light ray is travelling **from optically denser medium to optically less dense medium.** [1/2]

7 The potential difference against current characteristic graphs for three conductors P, Q and R are shown in Fig. 7.1.

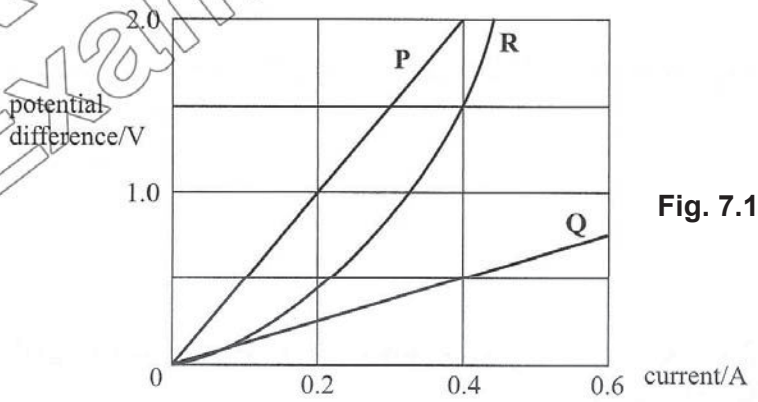

Fig. 7.1

(a) Using Fig. 7.1, state which of the conductor(s) obey(s) Ohm's Law. Explain your answer. [2]

Conductors P and Q obey Ohm's Law. It is because the graphs are straight lines passing through the origin showing the current flowing through is directly proportional to the potential difference across its ends.

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(b) Calculate the resistance of conductor P. [1]

R = V / I
= 1.0 V / 0.2 A
= 5.0 Ω

(c) If the conductors R and Q are connected in series, with a current of 0.4 A flowing, state what would be the potential difference across [1]
(i) R,
(ii) Q,
(iii) the series combination of R and Q.

R, **1.5** V
Q, **0.5** V
the series combination of R and Q? **2.0** V

8 Fig. 8.1 shows an electric circuit.

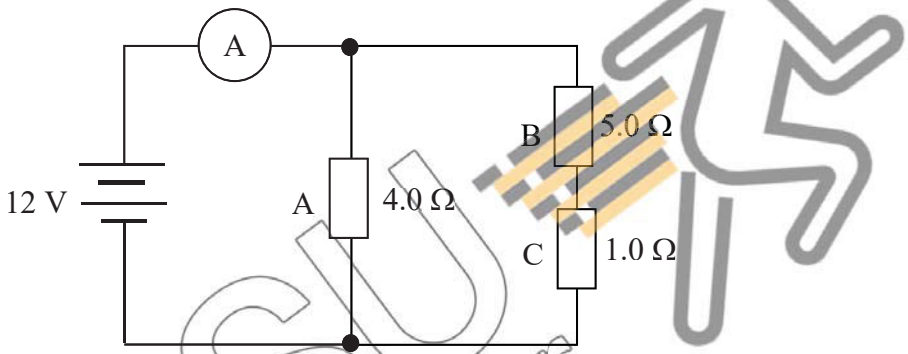

Fig. 8.1

(a) Determine the ammeter reading in the circuit. [2]

$$\frac{1}{R_T} = \frac{1}{4.0} + \frac{1}{6.0}$$

$$\frac{1}{R_T} = \frac{5}{12}$$

$$R_T = \frac{12}{5} = 2.4\Omega$$

Ammeter reading = V / R
= 12 V / 2.4 Ω
= **5.0 A**

(b) Find the current flowing through resistor C. [1]

I = V / R
= 12 V / 6.0 Ω
= **2.0 A**

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(c) Calculate the potential difference across resistor B. [1]

Potential difference across resistor B = IR
= 2.0 A × 5.0 Ω
= **10 V**

(d) Calculate the amount of charge flowing through resistor A in 30 s. [2]

Current flowing through resistor A = 5.0 A – 2.0 A
= 3.0 A

Q = It
= 3.0 A × 30 s
= **90 C**

9 **(a)** Fig. 9.1 shows a circuit breaker with the contact closed.

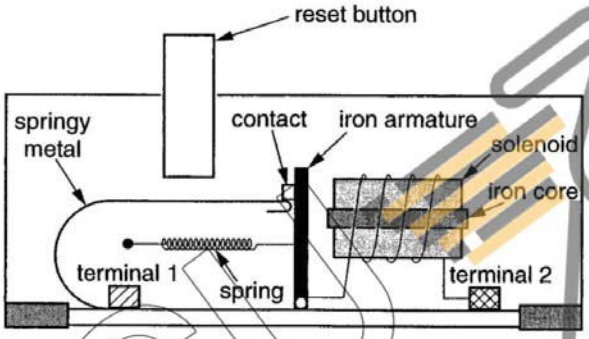

Fig. 9.1

Fig. 9.2 shows the same circuit breaker after a large current has passed through the circuit.

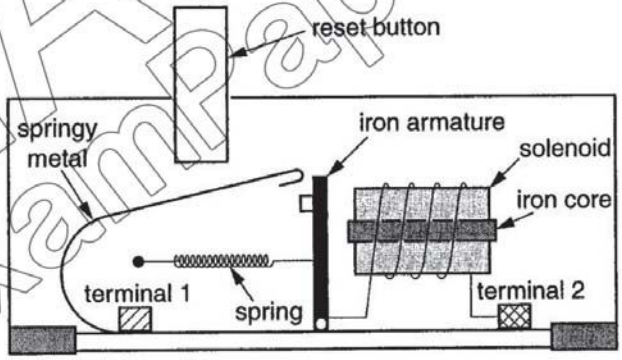

Fig. 9.2

Describe how the circuit breaker is able to switch off the current when a fault causes the current to become too large. [3]

When the current becomes too large, the **iron core/ solenoid becomes a strong electromagnet [1/2]**. This causes the **iron armature to be attracted to the electromagnet.** [1/2] This **releases the springy metal** [1/2] and **disconnects from the contact on the iron armature**.[1/2] There is an open circuit between terminal 1 and terminal 2 [1/2] and the **current stops flowing**. [1/2]

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(b) Fig. 9.3 shows a rigid wire is held between the poles of a magnet. When the current is switched on, there is a force on the wire in an upward direction as shown in Fig. 9.3.

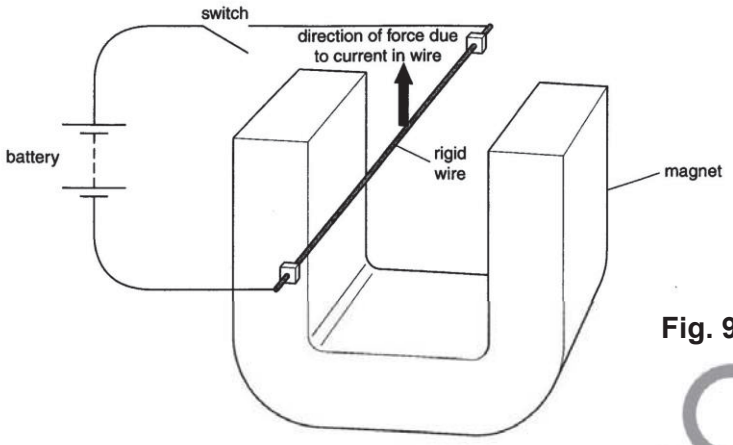
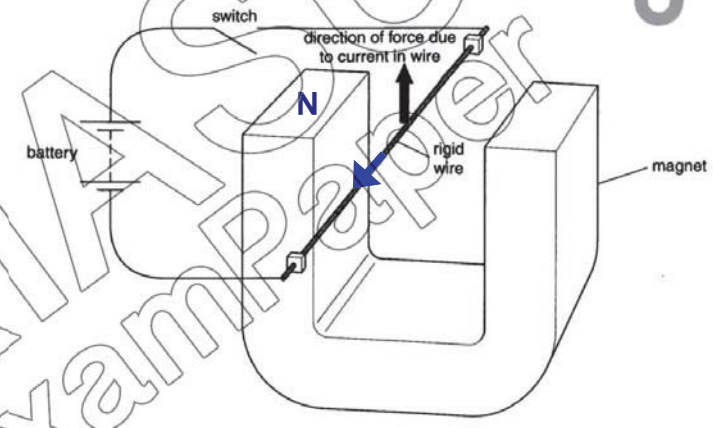


Fig. 9.3

(i) Explain why there is a force acting on the wire. [2]

There is an i**nteraction of two magnetic fields [1/2] due to current-carrying wire and permanent magnet** [1/2] and an unbalanced magnetic field is produced around the wire**.** A **force will act in the direction of a stronger magnetic field to a weaker magnetic field**. [1]

(ii) On Fig. 9.3, draw an arrow to show the direction of the current flowing in the rigid wire and label the north pole of the magnet with the letter **N**. [1]



[1/2] for correct N labelled
[1/2] for correct current drawn

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Section B

Answer any **two** questions in this section.

Write your answers in the spaces provided.

10 **(a)** A mass of weight 7.0 N hanging on the end of a string is pulled sideways so that the string makes an angle of 30° with the vertical as shown in Fig. 10. 1.

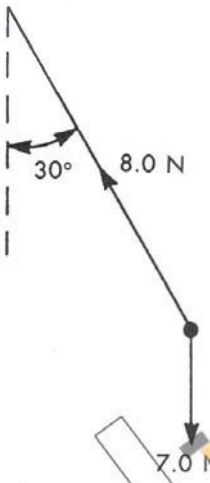
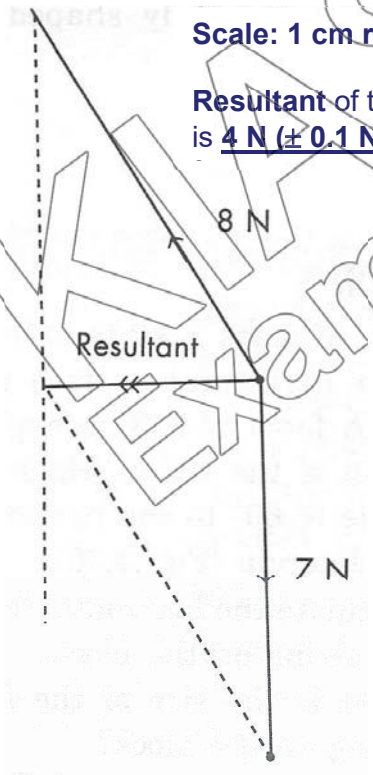


Fig. 10.1
(Not drawn to scale)

By means of a scale diagram, determine the resultant force due to the tension in the string and the weight of the mass. [3]

Scale: 1 cm represents 2 N

Resultant of the tension in the string and the weight of mass is **4 N (± 0.1 N)** and is 61° to 8.0 N force OR 88° to 7.0 N



[1/2] appropriate Scale given
[1/2] correct diagram
[1/2] draw arrows (resultant force must indicate by double arrows)
[1/2] label necessary angle(s)
[1/2] label forces on diagram
[1/2] answer for resultant force

(b) The figure below shows a block of mass of 4.0 kg resting on a table. A force of 5.0 N is applied to the block pulling it at a constant speed of 1.5 m/s. Assume that g = 10 N/kg.

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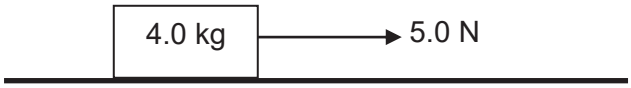

Fig. 10.2

(i) State the size of the frictional force acting on the block and explain how you obtain the answer. [2]

The frictional force acting on the block is 5.0 N [1/2]. It is because the block moves with a constant speed of 1.5 ms^{-1} [1/2] so the acceleration is zero [1/2] and according to Newton's Second Law, the resultant force is zero as F = ma.[1/2] Therefore, frictional force is equal to the pulling force.

(ii) State the direction of this frictional force. [1]

The direction of the frictional force is opposite to the pulling force. [1]
OR
The direction of the frictional force is towards the left as the block is pulled towards the right.

(iii) The applied force is increased until the block moves at an acceleration of 2 m/s^2. Calculate the new applied force. [2]

F = ma [1/2]
New applied force – frictional force = ma
New applied force – 5 N = 4 kg × 2 ms^{-2} [1]
New applied force – 5 N = 8 N
New applied force = 13 N [1/2]

(iv) Find the pressure of the block acting on the table if the dimension of the base of the block is 1.0 m by 0.5 m. [2]

P = F / A [1/2]
Pressure = weight of block / area
Pressure = (4 kg × 10 N/kg) / (1.0 × 0.5) m^2 [1]
Pressure = 80 Pa or 80 Nm^2 [1/2]

11 (a) Thermal energy is supplied at a constant rate using a 40 W electric heater to a liquid in a beaker. A graph of temperature recorded by the thermometer against the time is plotted as shown in Fig. 11.1.

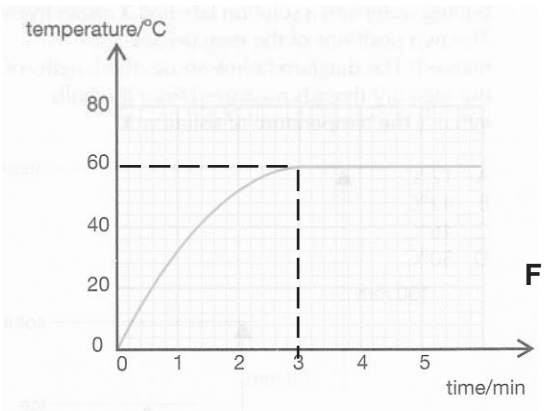

Fig. 11.1

(i) State the boiling point of the liquid in the beaker. [1]

The boiling point is 60 °C. [1]

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(ii) Explain why the temperature remained constant for the period between 3 min and 6 min. [2]

The temperature remained constant because latent heat of vaporisation / thermal energy is absorbed [1/2] to separate the water molecules [1/2], as well as provide energy for the molecules to push back on the surroundings [1/2] to escape into the air as there is a change of state from liquid to gaseous. [1/2] The average kinetic energy of the particles remains constant and hence the substance remains at the same temperature.

(iii) State and explain whether there will be any change in the temperature recorded by the thermometer if the 40 W heater in the above experiment is replaced by a 80 W heater. [2]

There will be no change in the temperature [1/2] recorded by the thermometer because the boiling occurs at a fixed temperature, boiling point. [1/2] A higher power heater will only decrease the time [1/2] needed to change its state from liquid to gaseous.[1/2]

(iv) State one difference between boiling and evaporation. [1]

Boiling	**Evaporation**
Occurs at a particular temperature	Occurs at any temperature
Relatively fast	Relatively slow
Takes place throughout the liquid	Takes place only at liquid surface
Bubbles are formed	No bubbles are formed
Temperature remains constant	Temperature may change
External thermal energy source required	External thermal energy source not required

(b) A sound wave has a frequency of 400 Hz. The speed of sound in air is 320 m/s.

(i) Calculate the wavelength of the sound wave in air. [2]

$v = f\lambda$ [1/2]
$320 \text{ m/s} = 400 \text{ Hz} \times \lambda$ [1/2]
$\lambda =$ **0.80 m [1/2] + [1/2] unit**

(ii) A sound wave of the same frequency is produced in water. Describe and explain how the wavelength of the wave will be different from that in part **(i)**. [2]

The **speed of sound in water is higher than speed of sound in air**.[1] Therefore, the **wavelength of the sound wave in water is longer than that in air [1/2]** using **$v = f\lambda$.[1/2]**

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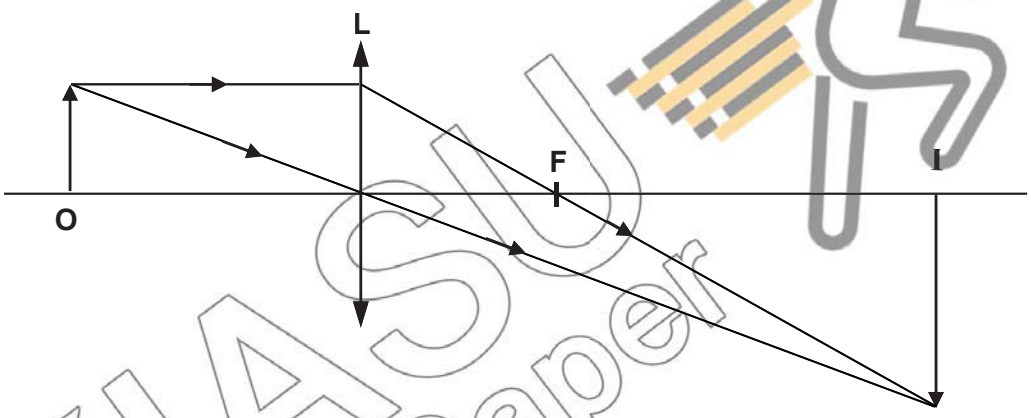
12 **(a)** Fig. 12.1 shows the image **I** of an object **O** produced by a converging lens.

Fig. 12.1

On Fig. 12.1, complete the ray diagram by drawing two rays passing from the object to the image. Mark the positions of the lens **L** and the relevant focal point **F** on Fig. 12.1. [3]



(b) Fig. 12.2 shows part of a household electric installation, where an electric heater is used to heat the water in a metal tank.

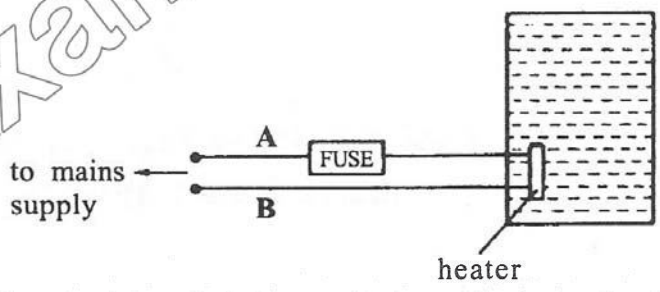


Fig. 12.2

(i) Explain which wire, **A** or **B**, should be the live wire of the supply. [2]

Wire A. [1] It is because fuse should be placed along the live wire. [1]

(ii) Explain in detail how a fuse acts as a safety device. [2]

The fuse melts and breaks the circuit [1/2] and disconnect from the high voltage of the main supply [1/2] when the current flowing in the appliance exceeds the fuse rating.[1/2] This can prevent overheating / damage to the electrical appliance.[1/2]

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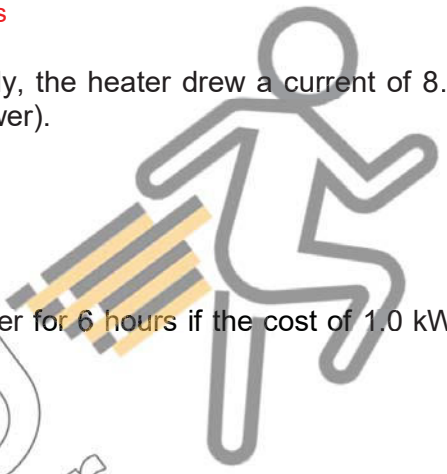
(iii) When connected to the 240 V mains supply, the heater drew a current of 8.0 A. Calculate the rate of production of heat (power). [1]

P = VI
= 240 V × 8 A [1/2] with formula
= **1920 W [1/2]**

(iv) Hence, calculate the cost of using the heater for 6 hours if the cost of 1.0 kWh is $0.25. [2]

Cost = energy x rate
= P × t × rate [1/2]
= (1.92 kW × 6 h) × 0.25 [1]
= **$ 2.88 [1/2]**



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Science Physics Paper 1

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
A	***A***	***D***	***A***	***B***	***D***	***C***	***C***	***B***	***B***
Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20
D	***C***	***B***	***A***	***B***	***C***	***C***	***D***	***C***	***A***