SERANGOON SECONDARY SCHOOL
PRELIMINARY EXAMINATION
SECONDARY 4 EXPRESS

CANDIDATE NAME		CLASS			
INDEX NUMBER					

SCIENCE (PHYSICS, CHEMISTRY)

5086/01

Paper 1 Multiple Choice

28 August 2024
1 hour

Additional Materials: Multiple Choice Answer Sheet

Setter(s): Mr Jarrod Lim, Mr Tan Yong Khai

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 Answer Sheet in the spaces provided unless this has been done for you.

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.

A copy of the Data Sheet is printed on page 17.
A copy of the Periodic Table is printed on page 18.

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

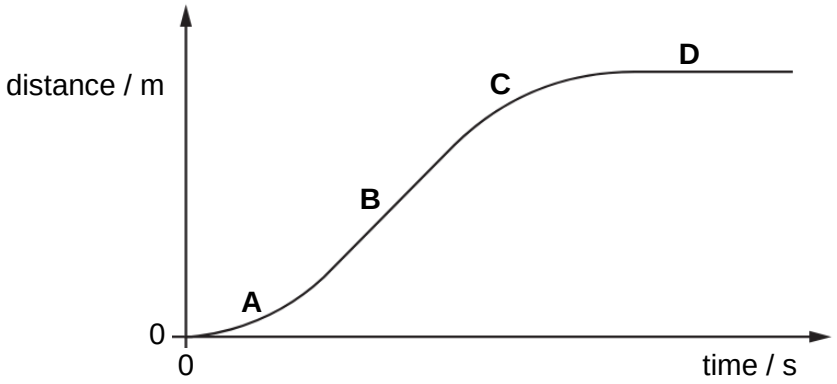
1 A length of copper wire is labelled: length 0.50 m and diameter 0.50 mm.

Which instruments are most suitable to measure accurately the length and the diameter of the wire?

	length	diameter
A	metre rule	digital calipers
B	metre rule	digital micrometer
C	digital calipers	metre rule
D	digital calipers	digital micrometer

2 The diagram shows a distance-time graph for a car travelling in a straight line.

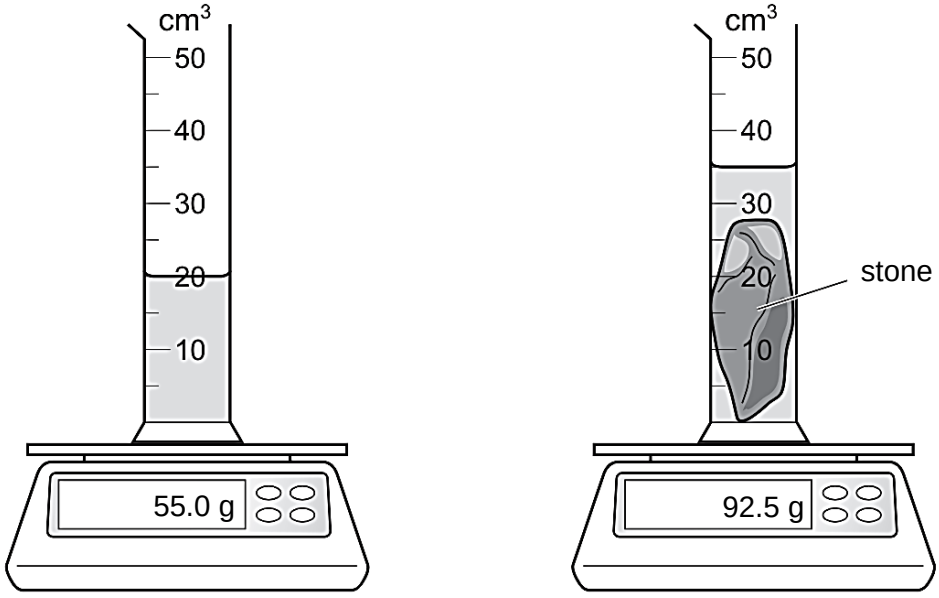
In which region is the car decelerating?



3 A measuring cylinder containing water is placed on a balance.

A stone is placed into the water.

The diagram shows the readings on the balance and on the measuring cylinder.



What is the density of the stone?

A 1.1 g/cm^3 **B** 1.5 g/cm^3 **C** 2.5 g/cm^3 **D** 2.6 g/cm^3

4 Newton's third law describes a pair of forces.

Which row shows whether the two forces are of the same type and whether they act on the same object?

	the type of forces in the pair	the objects which they act
A	different	different
B	different	same
C	same	different
D	same	same

5 Each tyre of a car has an area of 250 cm^2 in contact with the ground.

The car has a mass of 1600 kg. The weight of the car is equally distributed amongst the four tyres. What is the pressure exerted on the ground?

The gravitational field strength *g* is 10 N/kg.

A 4.0 N/cm^2 **B** 16 N/cm^2 **C** 40 N/cm^2 **D** 160 N/cm^2

6 Some water is heated from room temperature to its boiling point using an electric kettle.

What is the principal energy transfer taking place during this period?

A internal store to chemical potential store

B internal store to kinetic store

C chemical potential store to kinetic store

D chemical potential store to internal store

7 A 1 kW, 240 V electrical device is switched on.

How much energy does it use in 5.0 minutes?

A 5000 J

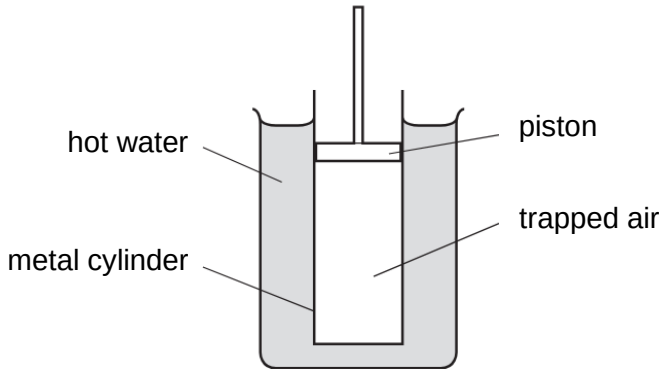
B 12 000 J

C 72 000 J

D 300 000 J

8 Air is trapped in a metal cylinder by a piston. The piston is free to move and the trapped air is at atmospheric pressure.

The cylinder is in hot water.



The cylinder is taken out of the hot water and left to cool.

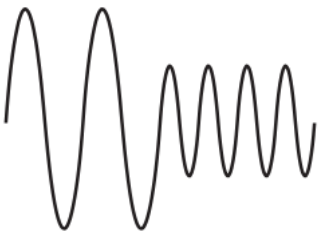
What happens to the mass of the air in the cylinder and the position of the piston as it cools?

	mass of air	position of piston
A	does not change	does not change
B	does not change	changes
C	changes	does not change
D	changes	changes

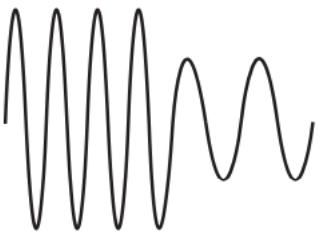
9 Sound waves are displayed as a trace on the screen of an oscilloscope.

Which trace shows a sound that becomes quieter with a higher pitch?

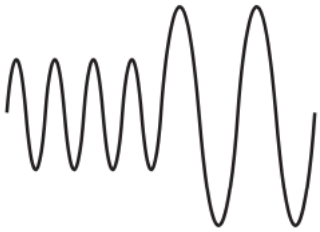
A



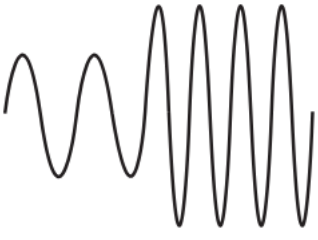
B



C



D

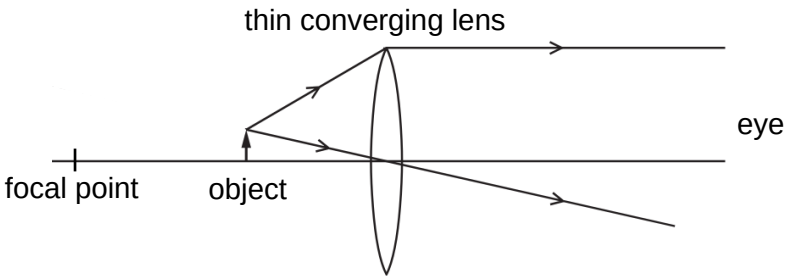


10 Which characteristics describe the image formed by a plane mirror?

A real and upside down
B virtual and upright
C real and larger than the object
D virtual and smaller than the object

11 An object is viewed through a thin converging lens.

The diagram shows the paths of two rays from the top of the object to an eye.



How does the image compare with the object?

A It is larger and inverted.
B It is larger and upright.
C It is smaller and inverted.
D It is smaller and upright.

12 Ultraviolet radiation is a component of the electromagnetic spectrum.

Which application uses ultraviolet radiation?

A Bluetooth technology
B prenatal scanning
C sterilising water
D thermal imaging

13 When the flash on a camera is used, a charge of 1.5 C flows for 0.0030 s through the flash lamp.

The average voltage across the flash lamp is 3600 V.

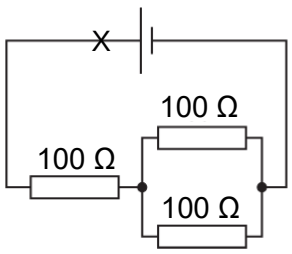
What is the energy supplied to the flash lamp and what is the average power supplied?

	energy / J	power / W
A	2400	7.2
B	2400	800 000
C	5400	16.2
D	5400	1 800 000

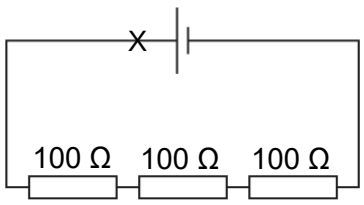
14 The diagrams show four circuits. Each circuit contains three 100 Ω resistors.

Which circuit has the largest current flowing at point X?

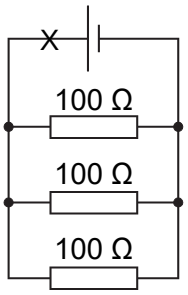
A



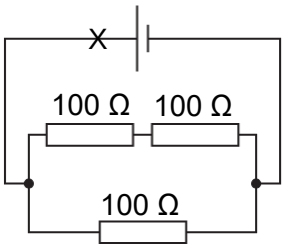
B



C



D



15 A metal wire of length l and cross-sectional area A has resistance R.

A second wire is made from the same material. It has a length of $2l$ and a cross-sectional area $4A$.

What is the resistance of the second wire?

A $8R$ **B** $2R$ **C** $\frac{R}{2}$ **D** $\frac{R}{8}$

16 The cost of electricity is $0.2989 per kWh.

It takes 0.060 hours and costs 4.0 cents to boil the water in a kettle.

What is the power rating of the kettle?

A 0.45 kW **B** 2.2 kW **C** 120 kW **D** 2000 kW

17 A three-pin mains plug contains a fuse. A device with double insulation has a cable connected to the plug.

Which part of the plug is **not** connected to the cable?

A earth pin

B fuse

C live pin

D neutral pin

18 One end of each of two bars is marked with an X or a Y, as shown.

bar 1 bar 2

End X of bar 1 is brought close to the N-pole and then to the S-pole of a magnet.

End Y of bar 2 is brought close to the N-pole and then to the S-pole of the magnet.

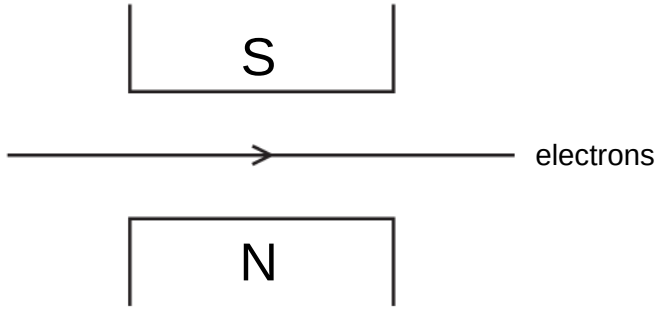
The table shows what happens.

	end X of bar 1	end Y of bar 2
N-pole of magnet	attracted	attracted
S-pole of magnet	attracted	repelled

What materials are bar 1 and bar 2 made from?

	bar 1	bar 2
A	iron	steel
B	copper	steel
C	steel	copper
D	steel	iron

19 A beam of electrons travels through a vacuum. The beam passes between the poles of a magnet as shown.



What are the directions of the conventional current, the magnetic field, and the force acting on the beam of electrons?

	direction of the conventional current	direction of the magnetic field	direction of the force
A	→	↓	into the page
B	→	↑	out of the page
C	←	↓	out of the page
D	←	↑	into the page

20 $^{14}_{6}C$ is a natural radioactive isotope of carbon and is present in all living things. It has a half-life of 5700 years.

The initial mass of this radioactive isotope of carbon in a sample of an old bone is thought to be 448 g.

How old is this sample of bone if the mass of the radioactive isotope of carbon in it is found to be 28 g?

A 5700 years

B 11 400 years

C 17 100 years

D 22 800 years

SSS 4E Sci Physics P1 Answers

Question	Answer
1	**A**
2	**C**
3	**C**
4	**C**
5	**B**
6	**D**
7	**D**
8	**B**
9	**A**
10	**B**
11	**B**
12	**C**
13	**D**
14	**C**
15	**C**
16	**B**
17	**A**
18	**A**
19	**D**
20	**D**

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SECONDARY 4 EXPRESS

CANDIDATE NAME					( )	CLASS		
CENTRE NUMBER	S					INDEX NUMBER		

SCIENCE PHYSICS

5086/02

Paper 2 **(Section A)**

26 Aug 2024
1 hour 15 minutes

Candidates answer on the Question Paper.

Setter(s):

READ THESE INSTRUCTIONS FIRST

Write your Centre number, index number and name 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 staplers, paper clips, 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.
Write your answers in the spaces provided on the 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	**55**

This question paper consists of **18** printed pages, including this **cover** page.

Section A [55 marks]

Answer **all** questions.

1 Fig. 1.1 shows a 9.6 m uniform beam that is in equilibrium. The beam is supported at its centre by a pivot.

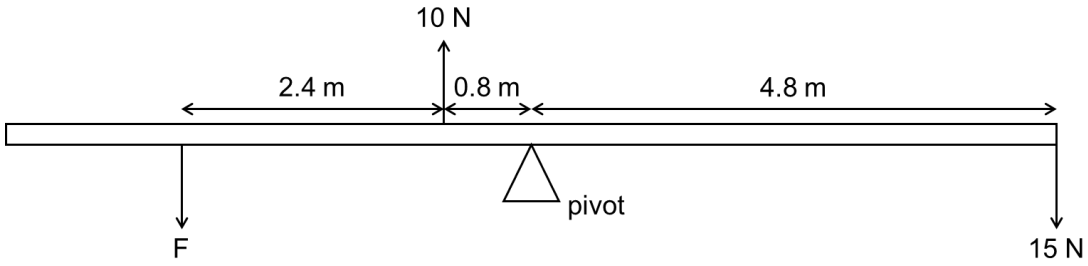


Fig. 1.1

(a) State the *principle of moments*.

……

……

……

…… [1]

(b) Calculate the value of F.

F = …… N [2]

[Total: 3]

2 Fig. 2.1 shows a ride at the amusement park. The carriage is pulled up the slope by an electric motor. Once the carriage reaches point A, the motor is switched off and the carriage will go through points B and C before coming to a stop at the bottom of the track.

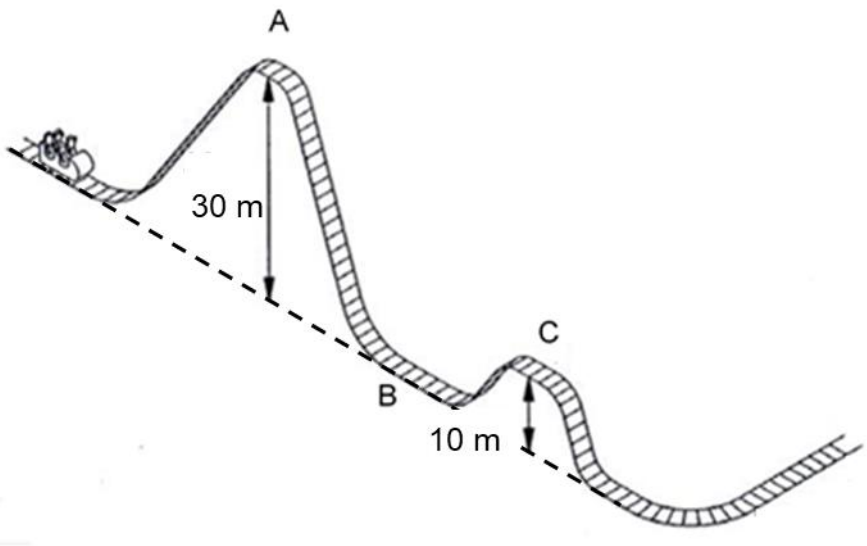


Fig. 2.1

The vertical height is 30 m at A and 10 m at C. The combined mass of the carriage and passengers is 450 kg. Assume that the friction between the carriage and track is negligible. The gravitational field strength *g* is 10 N/kg.

(a) Calculate the amount of energy transferred to the gravitational potential store of the carriage at point A.

gravitational potential energy = …… J [2]

(b) Calculate the amount of energy in the kinetic store of the carriage at point C.

kinetic energy = …… J [2]

(c) Hence, calculate the speed of the carriage at point C.

speed = …… m/s [2]

[Total: 6]

3 Fig. 3.1 shows the positions of particles in an undisturbed medium.

Fig. 3.2 and Fig. 3.3 shows the position of the particles at t = 0 s and t = 0.2 s respectively when a sound wave passes through the medium.

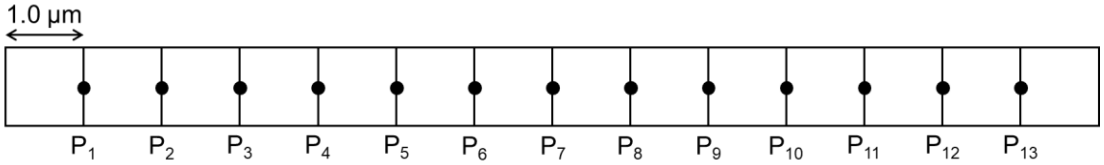


Fig. 3.1

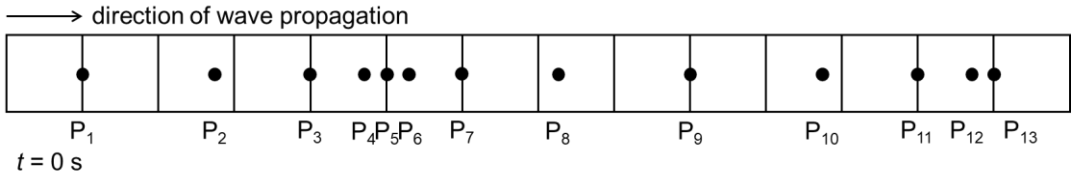


Fig. 3.2

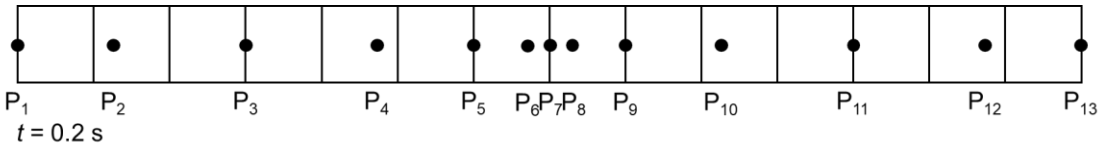


Fig. 3.3

(a) In terms of the direction of wave travel and the medium's particle vibration, describe how Fig. 3.2 shows that sound is a longitudinal wave.

……

…… [1]

(b) The particles executed a quarter of the oscillation between t = 0 s and t = 0.2 s. Calculate the frequency of the wave.

frequency = …… Hz [2]

(c) On Fig. 3.3, mark the wavelength of the sound wave using a double headed arrow "←→". Label it with the symbol λ. [1]

(d) Calculate the speed of the wave.

speed of wave = …… m/s [2]

[Total: 6]

4 Fig. 4.1 shows a ray of light travelling from air into a rectangular glass block with refractive index of 1.50.

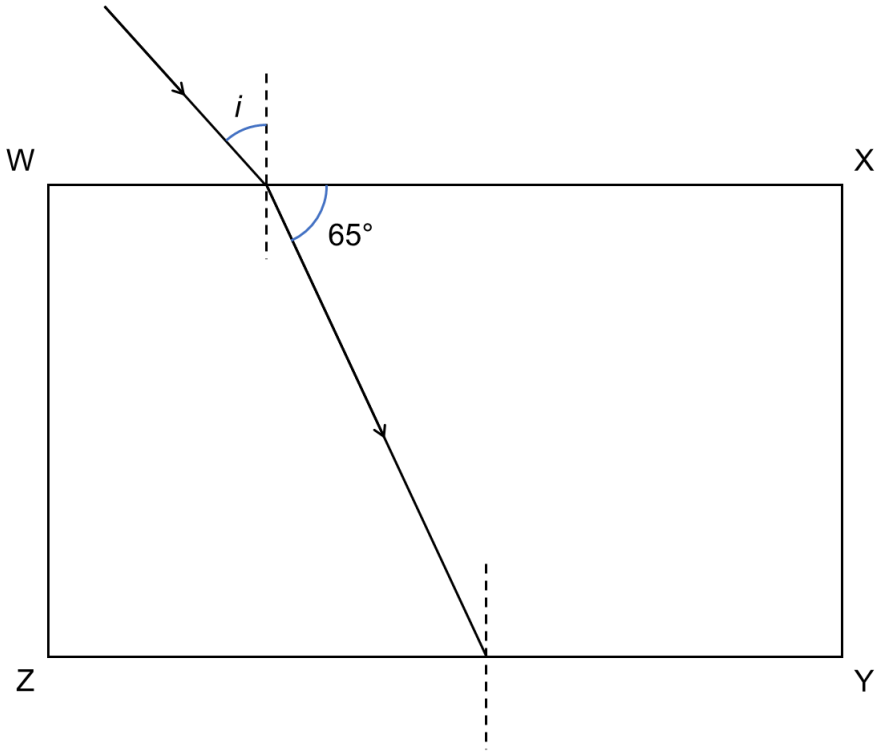


Fig. 4.1

(a) Calculate the angle of incidence, *i*.

angle of incidence, *i* = ……° [2]

(b) On Fig. 4.1, draw how the ray of light emerges from the side YZ. [1]

[Total: 3]

5 Fig. 5.1 shows an object placed at a distance of 40 cm in front of a converging lens with focal length 10 cm.

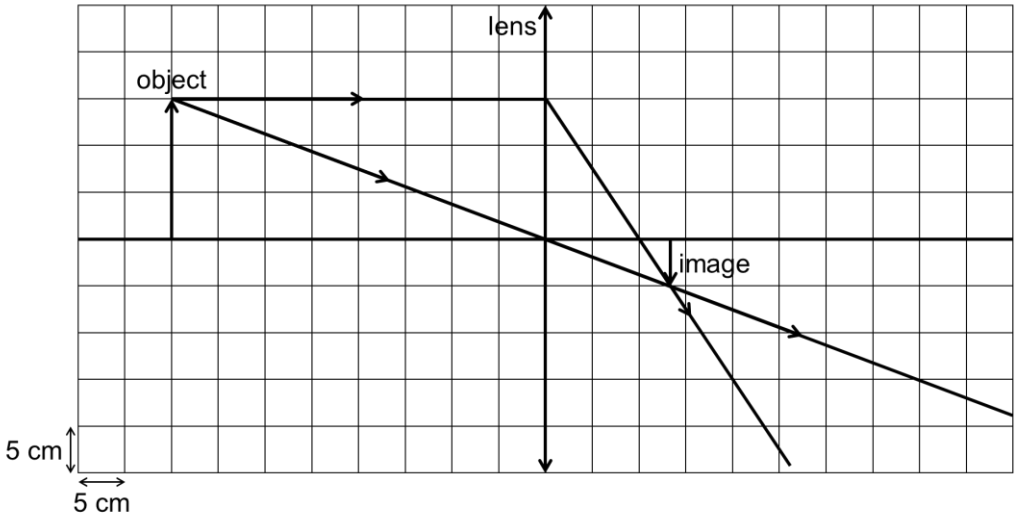


Fig. 5.1

(a) The magnification factor of a converging lens can be calculated using the formula

$$\text{magnification factor} = \frac{\text{size of image}}{\text{size of object}}$$

Using Fig. 5.1, determine the magnification factor of the converging lens.

magnification factor = …… [2]

(b) State a real world application for this lens in Fig. 5.1.

……

…… [1]

(c) State two changes that would be observed about the image when the object is placed at a distance of 15 cm in front of the lens.

……

…… [2]

[Total: 5]

6 Fig. 6.1 shows a circuit with a 12.0 V supply. All the resistors in the circuit are identical with a resistance of 5.0 Ω each.

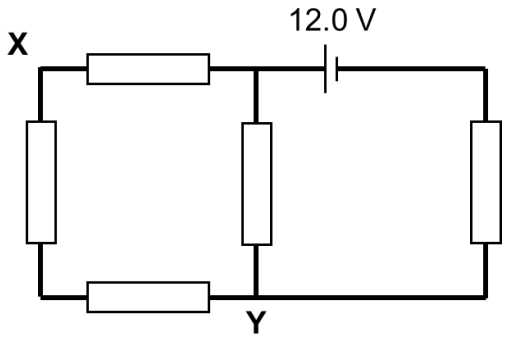


Fig. 6.1

(a) **(i)** Calculate the effective resistance of the whole circuit shown in Fig. 6.1.

effective resistance of whole circuit = …… Ω [2]

(ii) Calculate the current supplied by the battery.

current = …… A [2]

(b) Fig. 6.2 shows the same circuit with a wire added to connect points **X** and **Y**.

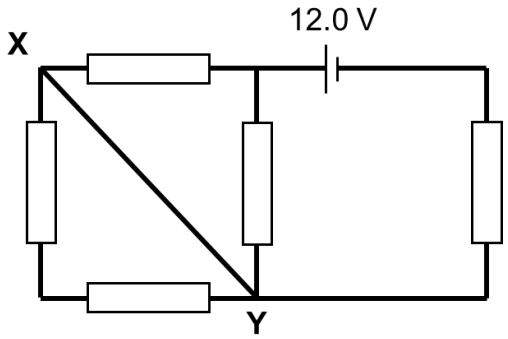


Fig. 6.2

Determine the effective resistance of the new circuit.

effective resistance of whole circuit = …… Ω [2]

[Total: 6]

7 Manganese arsenide is an electrical conductor.

It is also a magnetic material when its surrounding temperature, **T**, is lower than 45 °C. It becomes a non-magnetic material when its surrounding temperature is 45 °C or higher.

Fig. 7.1 shows a fire alarm that contains a permanent magnet held in its fixed position and a moveable slab of manganese arsenide when the surrounding temperature is at 30 °C.

No fire, T = 30 °C	**Fire occurs, T = 75 °C**

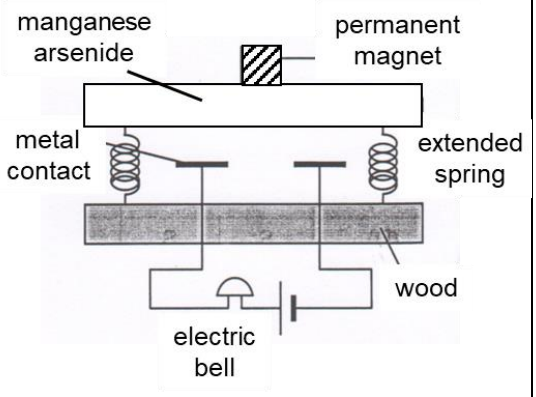
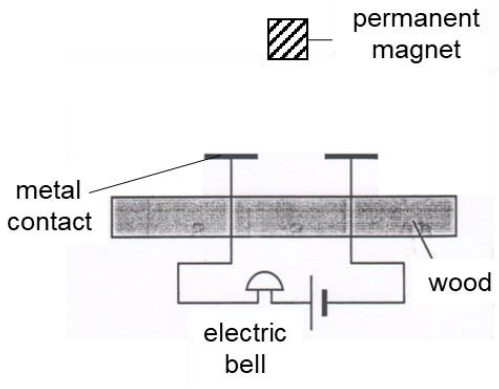

	

Fig. 7.1	**Fig. 7.2**

(a) In Fig. 7.2, complete the diagram of the fire alarm when there is a fire and the surrounding temperature is 75 °C. [1]

(b) Hence, explain how the fire alarm works during a fire which increases the surrounding temperature to 45 °C or higher.

……

……

……

…… [2]

[Total: 3]

8 Fig. 8.1 shows two identical cylindrical iron rods, **A** and **B**, placed inside a solenoid that has a circular cross section. The solenoid is connected to a battery and a switch.

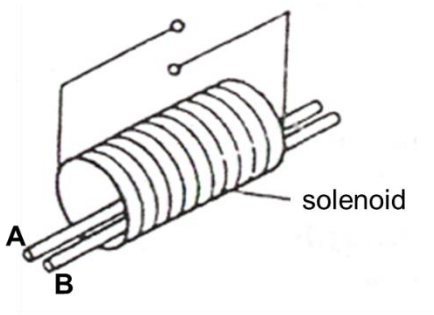


Fig. 8.1

(a) Describe and explain what happens to the iron rods when the switch is closed.

……

……

……

…… [2]

(b) Describe and explain what happens to the iron rods when the switch is opened.

……

……

……

…… [2]

[Total: 4]

9 Fig. 9.1 shows a diagram of a simple d.c. motor.

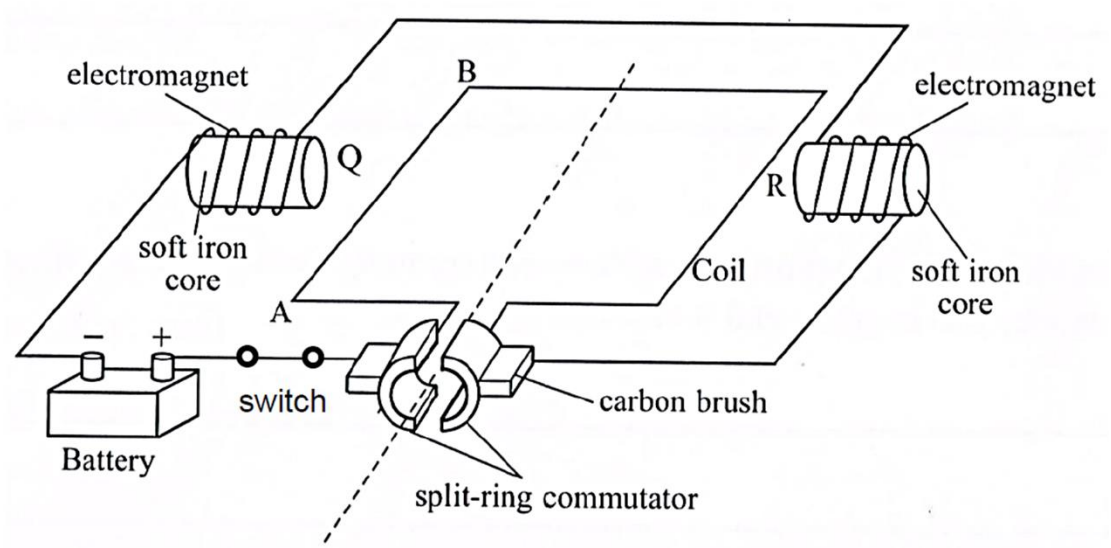


Fig. 9.1

Fig. 9.2 shows the front view of the d.c. motor.

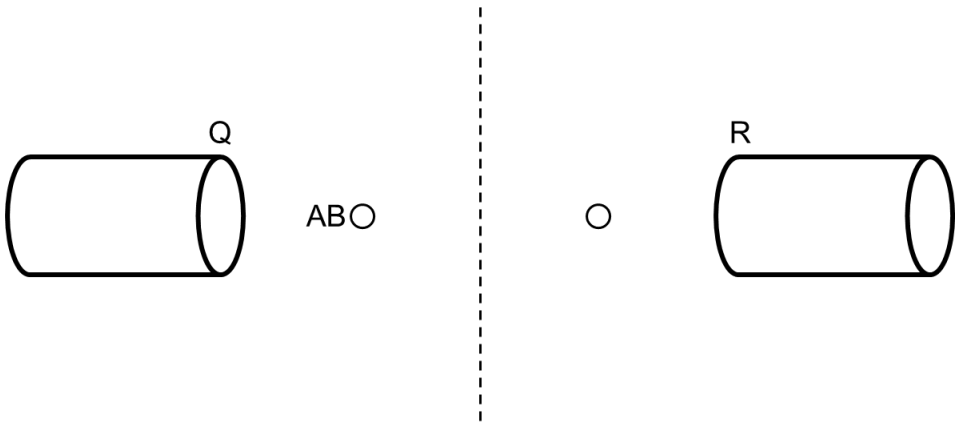


Fig. 9.2

(a) On Fig. 9.2, indicate the poles at Q and R. [1]

(b) On Fig. 9.2, draw an arrow to show the direction of the force acting on wire AB. [1]

(c) Explain why the coil turns when the switch is closed.

……

……

……

…… [2]

[Total: 4]

10 Household smoke alarms use alpha radiation sources to detect smoke. Fig. 10.1 shows an example of a smoke alarm. Radiation from the source passes through air and is detected by the detector. If the reading on the detector does not change, the alarm will not sound.

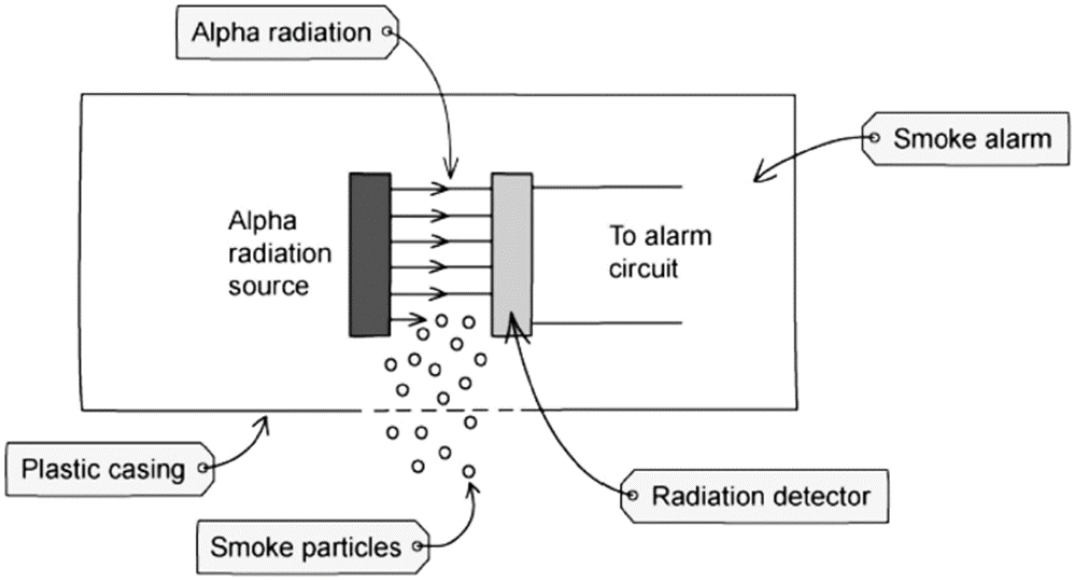


Fig. 10.1

(a) The nuclide notation for an α-particle is ${}^{4}_{2}\alpha$.

State the number of protons and neutrons in an α-particle.

protons = ……

neutrons = …… [1]

(b) Fig. 10.2 shows how the count rate of the alpha radiation source in the smoke alarm varies with time.

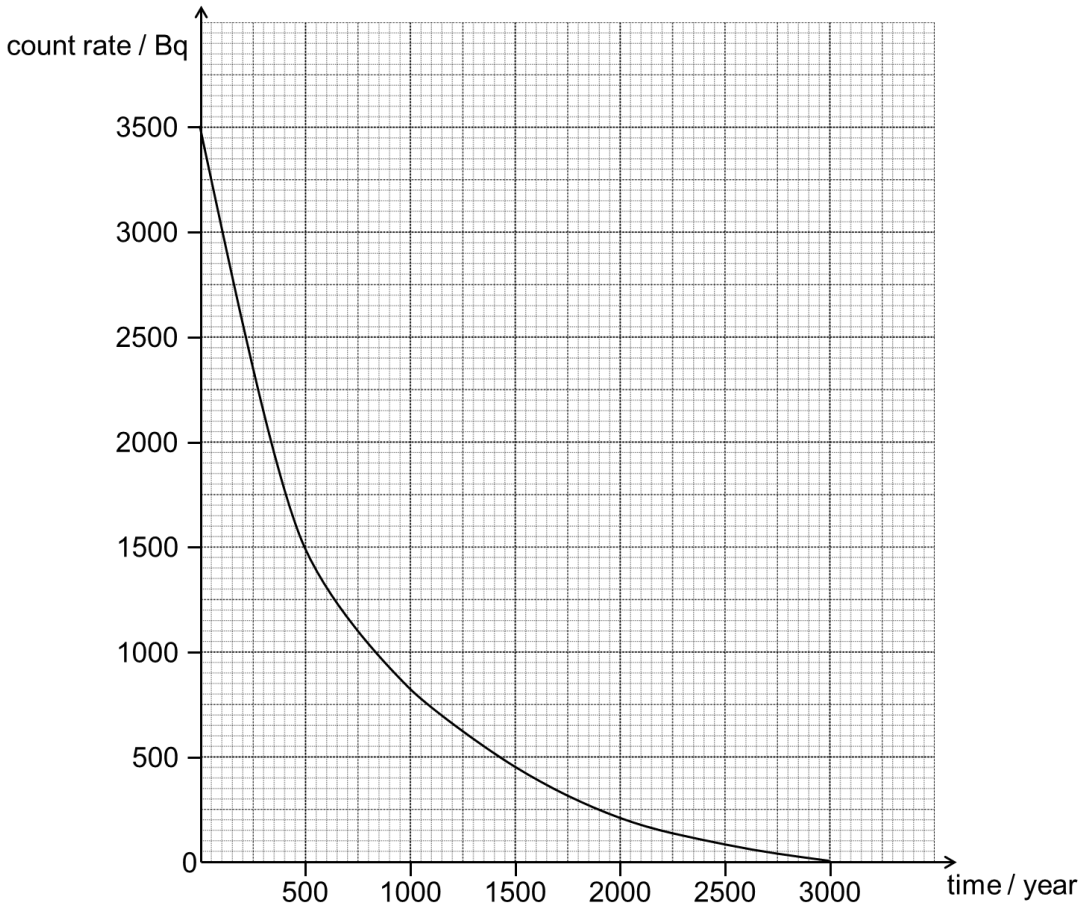


Fig. 10.2

(i) Determine the half-life of the alpha radiation source in the smoke alarm. Show on your graph how you arrive at your answer.

half life = …… years [2]

(ii) The smoke alarm will only sound when smoke particles are present and absorbs alpha radiation. This results in a change in the count rate detected by the radiation detector.

Explain why the smoke alarm would not work if the alpha radiation source were replaced by a beta or gamma radiation source.

……

……

……

…….. [2]

[Total: 5]

11 A heat sink is a passive heat exchanger that transfers the thermal radiation generated by an electronic device to a fluid medium, often air or a liquid coolant, where it is dissipated away from the device, thereby allowing regulation of the device's temperature at optimal levels. Fig. 11.1 shows two different types of heat sinks.

	
A heat sink transferring heat from an electronic board to air via a fan	A heat sink that has cooling fins

Fig. 11.1

(a) **(i)** State the process by which thermal energy is transferred from the electronic board to the heat sink.

…….. [1]

(ii) State the process by which thermal energy is transferred from the heat sink to the surrounding air.

…….. [1]

(b) The heat sink has three features that allow it to gain thermal energy faster from the electronic board and lose thermal energy faster to the surroundings.

(i) Explain why the heat sink has cooling fins (slices instead of a whole block).

…….

…….. [1]

(ii) Suggest a material that is suitable for manufacturing the heat sink. Explain your choice of material.

…….

…….

…….

…….. [2]

(iii) Suggest a colour that is suitable for painting the heat sink. Explain your choice of colour.

…….

…….

…….

…….. [2]

(c) Every heat sink is rated by its thermal resistance. This indicates how much the temperature of the heat sink will increase for every 1 W of power it gains from the electronic device.

A heat sink has a thermal resistance of 4 °C per watt. The electronic board dissipates 100 J of energy in 20 s.

Calculate the increase in temperature of the heat sink.

increase in temperature = …… °C [2]

(d) Although the electronic board emits thermal energy continuously, the temperature of the heat sink stops increasing after some time. Using your knowledge of the principle of conservation of energy, explain why this happens.

……

……

……

…… [1]

[Total: 10]

SERANGOON SECONDARY SCHOOL
PRELIMINARY EXAMINATION
SECONDARY 4 EXPRESS

CANDIDATE NAME					( )	CLASS		
CENTRE NUMBER	S					INDEX NUMBER		

SCIENCE PHYSICS

5086/02

Paper 2 **(Section B)**

26 Aug 2024
1 hour 15 minutes

Candidates answer on the Question Paper.

Setter(s):

READ THESE INSTRUCTIONS FIRST

Write your Centre number, index number and name 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 staplers, paper clips, 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 B
Answer **one** question.
Write your answers in the spaces provided on the question paper.

The number of marks is given in brackets [ ] at the end of each question or part question.

For examiner's use	
Section B	
Total	**10**

This question paper consists of **7** printed pages, including this **cover** page.

Section B [10 marks]

Answer **one** question from this section.

12 Fig. 12.1 shows a space rocket bring launched at sea level. The space rocket has a main engine and boosters that help the shuttle to lift off from the Earth. For the rocket to escape Earth's gravitational field, it has to reach its breaking speed.

Fig. 12.1

The combined mass of the space rocket remains constant at 22 500 kg throughout the launch. It accelerates uniformly over a distance of 825 km before it reaches its breaking speed of 10 km/s.

(a) **(i)** On Fig. 12.2, sketch a speed-time graph of the rocket from launch to reaching its breaking speed.
Label all relevant values on your graph. [2]

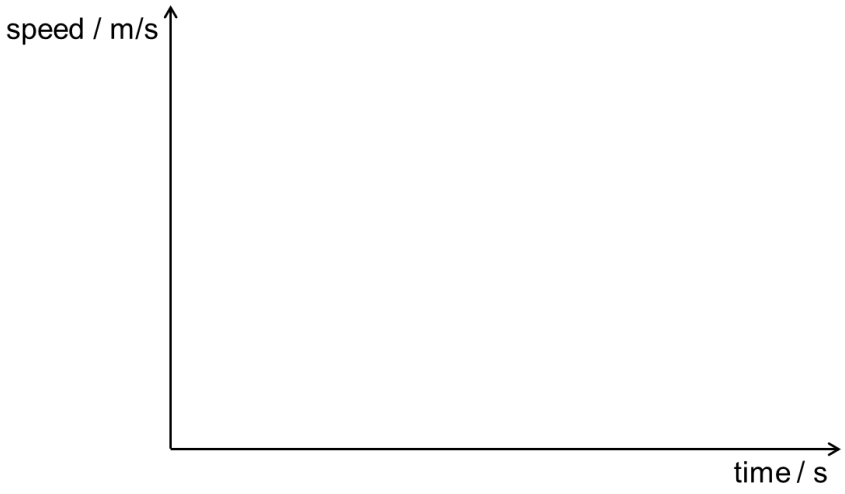


Fig. 12.2

(ii) Determine the time taken for the rocket to reach its breaking speed.

time taken = …… [2]

(iii) Determine the acceleration of the rocket.

acceleration = …… [2]

(iv) Assuming no air resistance, calculate the upward thrust of the rocket.
The gravitational field strength *g* is 10 N/kg.

upward thrust = …… [2]

(b) In reality during launch, the space rocket will burn solid fuel that is inside the fuel compartment until it reaches its breaking speed to escape Earth's gravitational field. Once the compartment is empty, it will be detached from the main body. The main engine will be cut off as the rocket continues to travel through outer space with no air resistance.

Explain how this affects the acceleration and the speed of the rocket.

……

……

……

…… [2]

[Total: 10]

13 Fig. 13.1 shows an electric kettle labelled “240 V, 1200 W”.

Fig. 13.1

(a) On Fig. 13.1, draw suitable wires to connect the electric kettle to the mains supply. [2]

(b) On Fig. 13.1, draw and label a fuse and a switch for the electric kettle on the appropriate wire(s). [1]

(c) The kettle is switched on at time t = 0 s. Fig. 13.2 shows how the temperature of the water changes with time t.

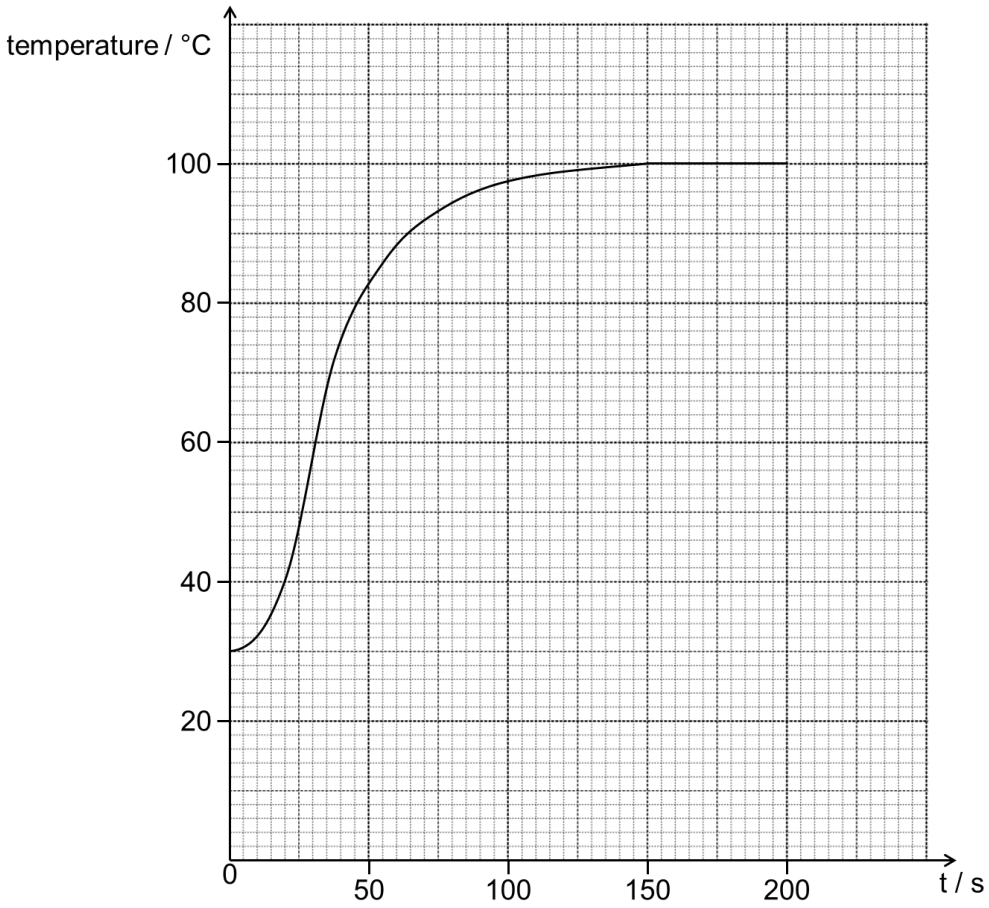


Fig. 13.2

(i) Determine the amount of electrical energy consumed by the kettle to raise the temperature of water from 30 °C to 100 °C.

amount of electrical energy = …… [2]

(ii) Describe the changes, if any, in the movement and arrangement of the water molecules when the temperature of water in the kettle is raised from 30 °C to 100 °C.

movement ……..

…….

arrangement ……..

…….. [2]

(iii) On Fig. 13.1, draw an arrow to indicate the movement of water in the kettle when its temperature is raised from 30 °C to 100 °C. [1]

(iv) When the temperature of water reaches 100 °C, the kettle is still operating with electrical energy supplied continuously until t = 200 s. The water boils as bubbles are formed and rise to the surface.
Explain, in terms of the molecules, why the temperature of the water remains constant at 100 °C.

…….

…….

…….

…….. [2]

[Total: 10]

END OF PAPER

2024 SSS 4E Sci(Phy) Prelim Paper 2 Section A & B Marking Scheme

Section A

1 **(a)** When a body is in equilibrium, the sum of clockwise moments about a pivot is equal to the sum of anticlockwise moments about the same pivot. [1]

(b) About the pivot,

sum of clockwise moments = sum of anticlockwise moments

$$(10 \times 0.8) + (15 \times 4.8) = (F \times 3.2)$$ --- [1]

$$3.2F = 8 + 72 = 80$$

$$F = 25 \text{ N}$$ --- [1]

Only 1m to be awarded if perpendicular distance value(s) is/are incorrect

0m to be awarded if student mixed up ACW vs CW moments [2]

[Total: 3]

2 **(a)** $GPE = mgh = (450)(10)(30)$ --- [1]

$GPE = 135000$ J --- [1] [2]

(b) Gain in KE = loss in GPE (20 m)

$GPE = mgh = (450)(10)(20)$ --- [1]

$KE = 90000$ J --- [1] [2]

(c) $KE = \frac{1}{2}mv^2$

$v = \sqrt{\frac{2KE}{m}} = \sqrt{\frac{2(90000)}{450}}$ --- [1]

$v = 20$ m/s --- [1]

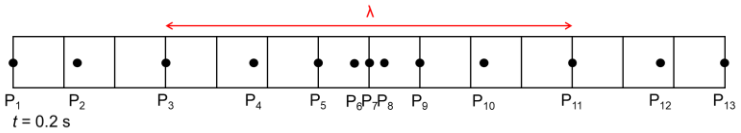
[Total: 6]

3 **(a)** The wave travels <u>parallel</u> to the direction of the medium's particle vibration [1]

(b) $f = \frac{1}{T} = \frac{1}{0.2 \times 4} = \frac{1}{0.8}$ --- [1]

$f = 1.25$ Hz --- [1] [2]

(c)



[1]

(d) $v = f\lambda = 1.25 \times (8.0 \times 10^{-6})$ --- [1]

$v = 10 \times 10^{-6} = 0.000010$ m/s --- [1] ECF allowed [2]

[Total: 6]

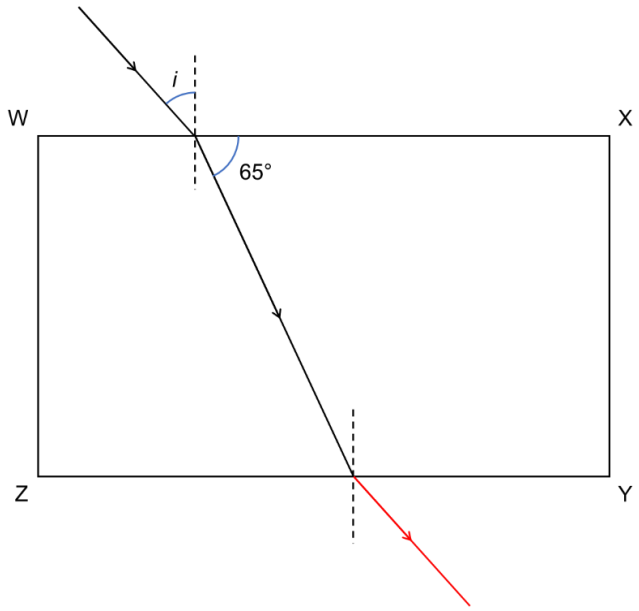
4 **(a)** $n = \frac{\sin i}{\sin r}$

$1.50 = \frac{\sin i}{\sin 25}$

$i = \sin^{-1}(1.50)(\sin 25)$ --- [1]

$i = 39.340 = 39°$ (2 s.f.) OR $39.3°$ (3 s.f.) --- [1] [2]

(b) 1m for correctly drawn emerging light ray parallel to light ray incident on side WX



-1m for missing arrow head [1]

[Total: 3]

5 **(a)** $M = \frac{size\ of\ image}{size\ of\ object} = \frac{5}{15}$ --- [1]

$M = \frac{1}{3} = 0.33333 = 0.33$ (2 s.f.) OR 0.333 (3 s.f.) --- [1] [2]

(b) Camera / eye [1]

(c) The image will be magnified and the distance between the image and the lens will increase (image will be further behind the lens) [2]

[Total: 5]

6 **(a)** **(i)** Effective resistance of whole circuit $= \left(\frac{1}{5} + \frac{1}{15}\right)^{-1} + (5)$ --- [1]

$= 8.75\ \Omega$ (3 s.f.) --- [1] [2]

(ii) $V = IR$

$I = \frac{V}{R} = \frac{12.0}{8.75}$ --- [1]

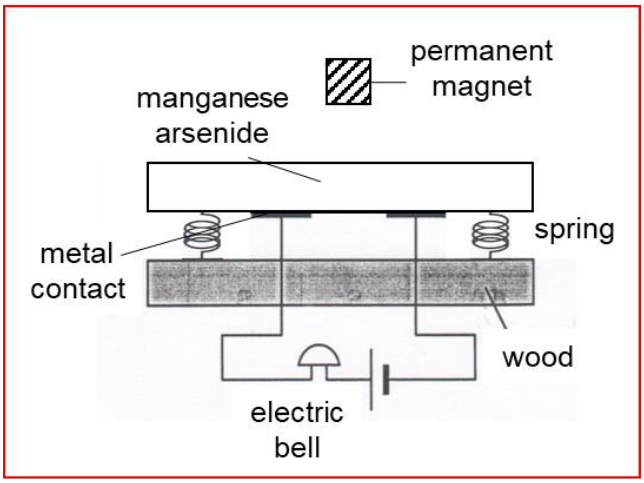
$I = 1.3714 = 1.37$ A (3 s.f.) --- [1] [2]

(b) Effective resistance of whole circuit $= \left(\frac{1}{5} + \frac{1}{5}\right)^{-1} + (5)$ --- [1]

$= 7.50\ \Omega$ (3 s.f.) --- [1] [2]

[Total: 6]

7 **(a)** [1] manganese arsenide dropped away from magnet touching both metal contacts (close circuit)



[1]

(b) When the surrounding temperature is 45 °C or higher, manganese arsenide becomes non-magnetic and is no longer attracted by the magnet.

[1] the weight of the slab of manganese arsenide and the tension in the springs pull it down to touch both metal contacts.

[1] This closes the circuit which causes the electric bell to ring. [2]

[Total: 3]

8 **(a)** [1] when the switch is closed, the solenoid will become a temporary magnet / electromagnet. The iron rods will be magnetized by induction such that the same ends will have the same polarity (pole).

[1] Since like poles repel, the iron rods will repel from each other.

0m awarded for “iron rods will be magnetised by current” / “iron rods will become electromagnets” [2]

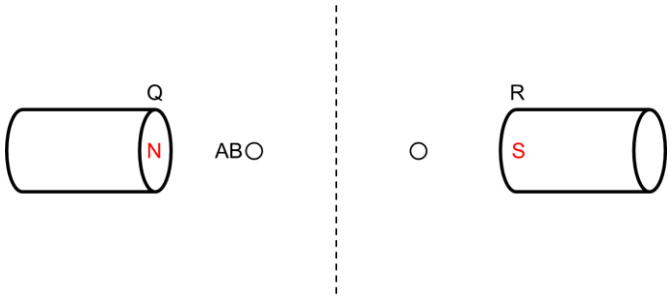
(b) [1] when the switch is opened, the iron rods will lose its magnetism easily (since iron is a soft magnetic material).

[1] the iron rods will drop to the bottom of the solenoid / return to their original positions (due to their weight).

DNA “iron rods will be demagnetised” / “the rods will be attracted to each other” [2]

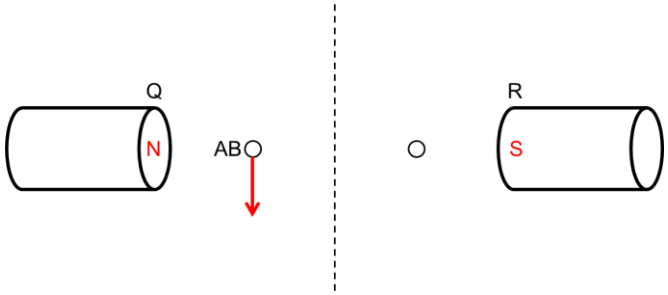
[Total: 4]

9 **(a)** Q: North, R: South (no ½ mark)



[1]

(b) downward force



[1]

(c) [1] When current flows through the coil, the magnetic field of the electromagnets interact with the magnetic field of the wire AB. Based on Fleming's Left Hand rule, (the direction of the force is perpendicular to the direction of magnetic field and current).

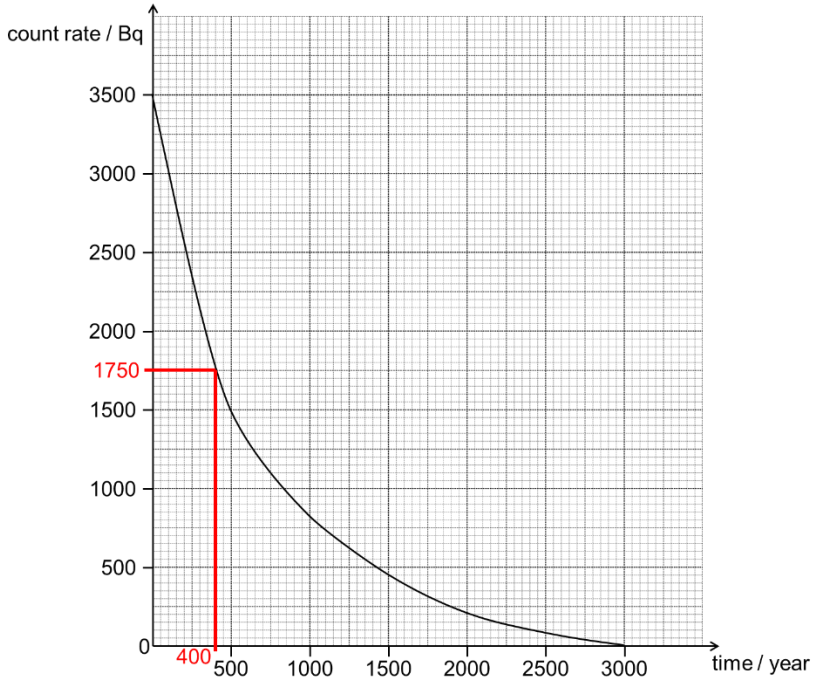
[1] hence, an downward force acts on wire AB and a upward force acts on the other side of the coil, producing a turning effect. [2]

[Total: 4]

10 **(a)** protons = 2, neutrons = 2 --- [1] for both correct [1]

(b) **(i)** [1] half of 3500 = <u>1750</u> Bq

[1] half life = <u>400</u> years



-1m if no line drawn on graph to show how answer is determined [2]

(ii) [1] beta and gamma radiation will penetrate smoke

[1] no change in the count rate would be detected (alarm will not sound) [2]

[Total: 5]

11 **(a)** **(i)** Conduction [1]

(ii) Convection / radiation [1]

(b) **(i)** Cooling fins <u>increase the surface area</u> to gain / lose thermal energy faster. [1]

(ii) [1] aluminium OR any other metals
[1] metals are <u>good conductors of thermal energy / radiation</u> which gain / lose thermal energy faster. [2]

(iii) [1] black OR any other dark colour
[1] dark colours are <u>good emitters of radiation</u> which lose thermal energy faster. [2]

(c) $P = \frac{E}{t} = \frac{100}{20} = 5$ W --- [1]
For every 1 W of power, temperature increases by 4 °C
Hence, for 5 W of power, temperature increases by 5×4
$= 20$ °C --- [1] [2]

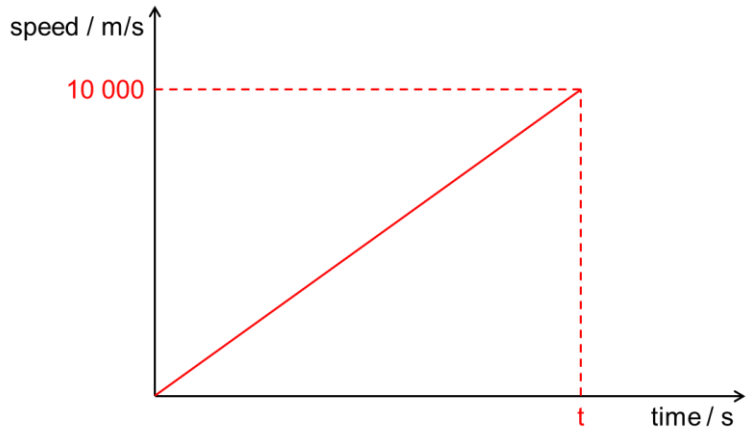
(d) The temperature stops increasing after some time because the gain in thermal energy from electronic board = loss in thermal energy to surrounding air [1]

[Total: 10]

Section B

12 **(a)** **(i)** [1] for correct shape of graph (straight line diagonal = constant gradient = constant acceleration)

[1] label 10000 m/s (breaking speed)



[2]

(ii) Distance travelled = area under speed-time graph

$825000 = \frac{1}{2} \times 10000 \times t$ --- [1]

$t = 165$ s --- [1] [2]

(iii) $a = \frac{v-u}{t} = \frac{10000-0}{165}$ --- [1]

$a = 60.606 = 60.6$ m/s^2 (3 s.f.) --- [1] [2]

(iv) $F_R = ma = (22500)(60.606) = 1363635$ N --- [1]

$F_R = thrust - W$

$thrust = F_R + W$

$thrust = ma + W = 1363635 + (22500)(10) = 1588636.36 =$

1590000 N (3 s.f.) --- [1] [2]

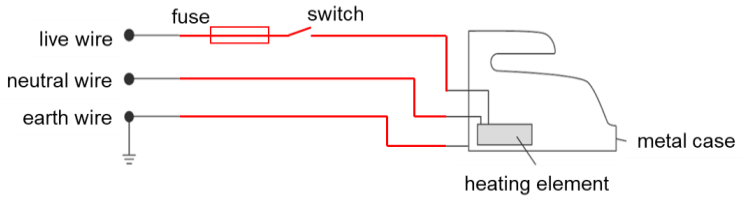
(b) [1] when there is no engine thrust and air resistance, the resultant force acting on the rocket is 0 N.

[1] since $F_R = ma$, the acceleration of the rocket is 0 m/s^2 (no acceleration) and its speed remains constant. [2]

[Total: 10]

13 **(a)** Live and neutral wire connected to heating element &
Earth wire connected to metal case
2m for all 3 wires drawn correctly
1m for earth wire drawn correctly OR both live and neutral wires drawn correctly
0m for no wires drawn correctly OR only one live or neutral wire drawn correctly [2]

(b) 1m for correctly drawn symbols for both components & both MUST be located on the live wire
0m for any mistakes

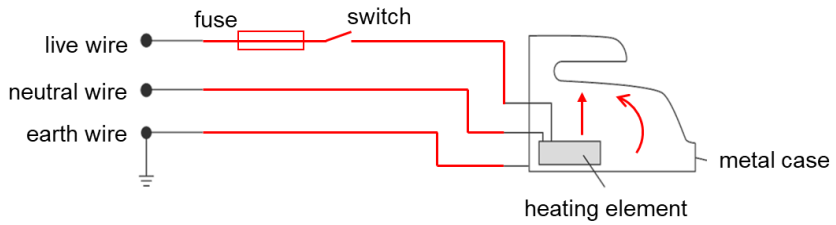


No ½ mark [1]

(c) **(i)** $E = Pt = (1200)(150)$ --- [1]
$E = 180000$ J --- [1] [2]

(ii) [1] movement: the water molecules will change <u>from sliding over one another freely to moving randomly at high speeds</u>
[1] arrangement: the water molecules will change <u>from closely packed in random manner to very far apart in random manner</u> [2]

(iii) [1] for either one upward pointing arrow



[1]

(iv) [1] since the temperature of water remains constant, the average kinetic energy of the water molecules remains constant

[1] work is done to overcome intermolecular attractive forces between the molecules and provide energy to push back on the atmosphere for the water particles to escape. The potential energy increases, as separation between particles increases. [2]

[Total: 10]