



General Certificate of Secondary Education
2024

Centre Number

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Candidate Number

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Physics

Unit 2

Higher Tier

MV18

[GPY22]

TUESDAY 18 JUNE, MORNING

Time

1 hour 30 minutes, plus your additional time allowance.

Instructions to Candidates

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.

You must answer the questions in the spaces provided.

Do not write on blank pages.

Complete in black ink only.

Answer **all** questions.

Information for Candidates

The total mark for this paper is 100.

Figures in brackets printed at the end of each question indicate the marks awarded to each question or part question.

Quality of written communication will be assessed in

Question **1(d)**.

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1 (a) Waves can be classified as either, transverse or longitudinal.

(i) Describe, in detail, the difference between these two types of wave in terms of the motion of the particles of the medium through which the waves are moving.
[3 marks]

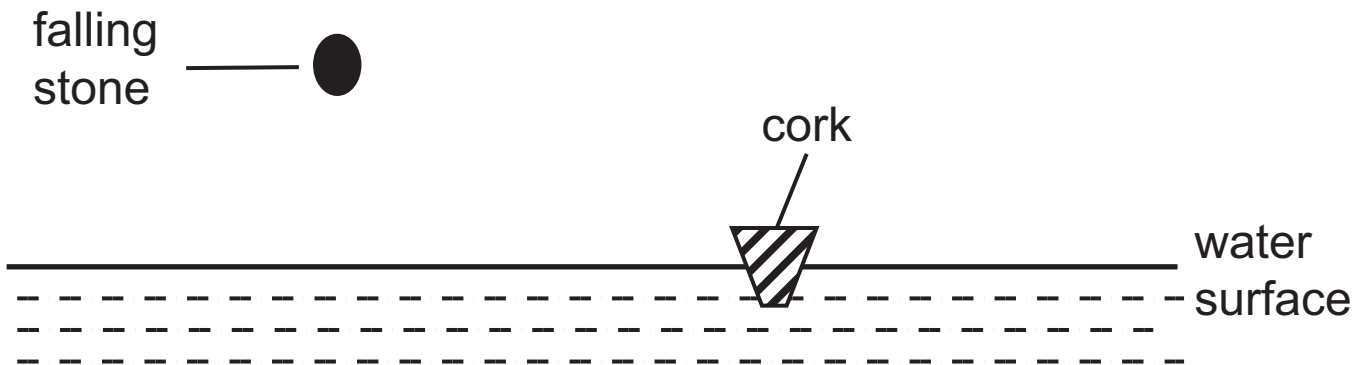
(ii) Arrange the following examples of electromagnetic waves in order of **decreasing** wavelength.
[2 marks]

gamma rays
microwaves
visible light
radio waves

Decreasing
wavelength



(b) When a stone is dropped into water a water wave is created.



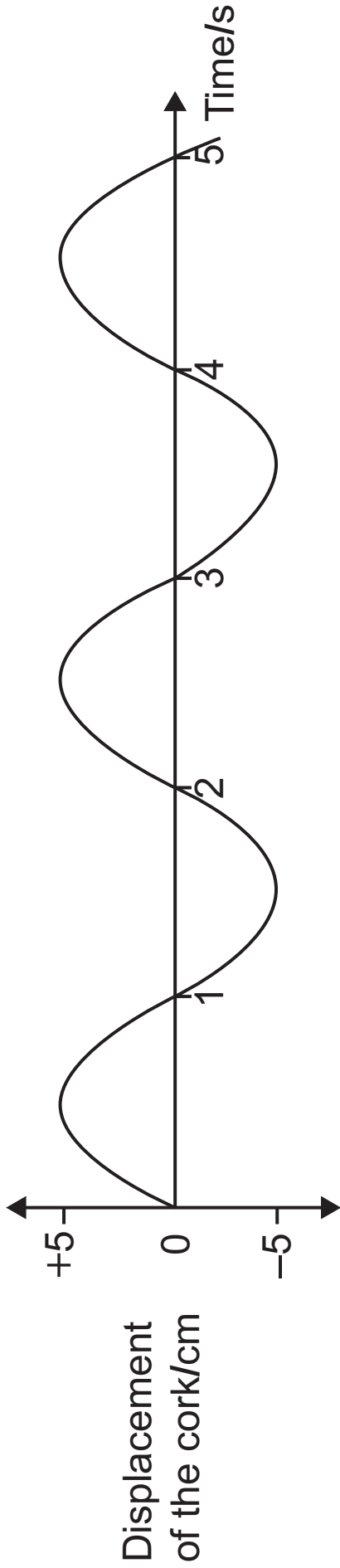
As the water wave passes, the graph opposite shows how the displacement of the cork in the water varies with time.

(i) Use the graph to find how long it takes a complete wave to pass the cork. [1 mark]

Time = _____ s

(ii) Calculate the frequency of the water wave. Include the **unit for frequency** with your answer. [2 marks]

Frequency = _____



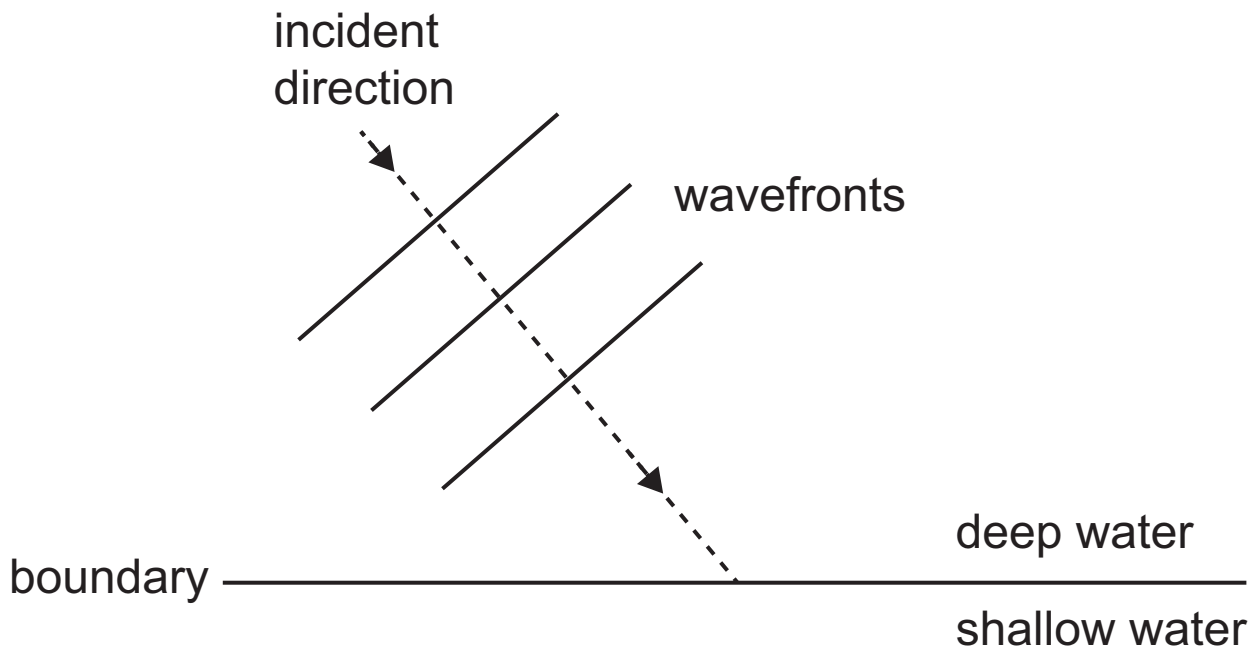
(iii) The horizontal distance between successive crests of the water wave is 0.8 m.
Using this information and your answer to part **(ii)**, calculate the speed of the water wave. [3 marks]
Show clearly how you get your answer, starting with the equation you plan to use.

Speed = _____ m/s

(c) The diagram below shows water waves moving from deep water to shallow water.

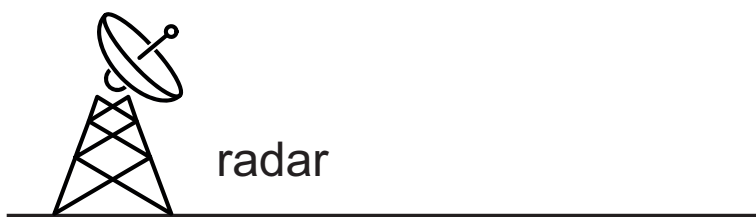
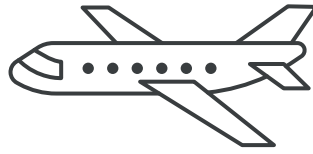
(i) Complete the diagram to show the direction the water waves take in the shallow water.

Draw three wavefronts to show what happens in the shallow water. [4 marks]



(ii) What property of the water waves does not change as the waves move from deep water to shallow water? [1 mark]

(d) Radar uses pulses of electromagnetic waves in the form of microwaves to calculate the distance to an aircraft. Describe, in detail, how this process is carried out.



In your answer you should explain the following points:

- why microwaves are used rather than sound waves;
- what happens to the microwaves when they reach the aircraft;
- why the microwaves are emitted as a short pulse rather than continuously;
- what measurement is made;
- what property of the microwaves is needed for the calculation of the distance to the aircraft;
- what calculation is carried out to determine the distance to the aircraft.

In this question you will be assessed on your written communication skills including the use of specialist scientific terms.

Write your answers in the spaces below and on page 10.
[6 marks]

Microwaves, not sound waves, are used

What happens at the aircraft?

What is the reason for short pulses?

Measurement made

Property of microwaves needed

Calculation to determine distance

2 (a) A student observes an image in a plane mirror.

(i) Which of the following properties are possessed by this image? [3 marks]

Tick (✓) the appropriate boxes to indicate your answers.

Diminished

Enlarged

Erect

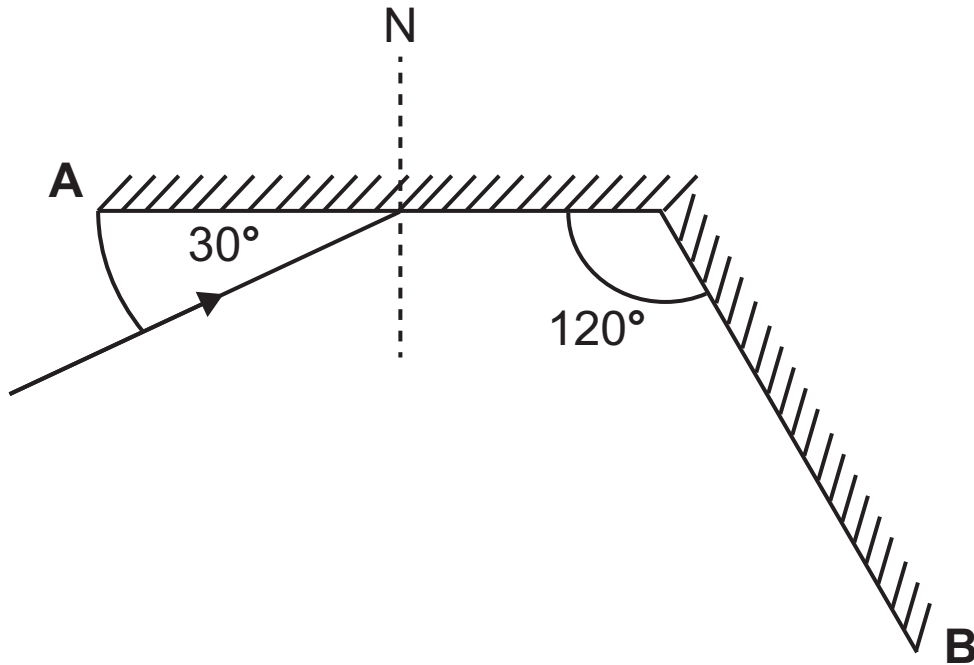
Upside down

Real

Same size as object

Virtual

The diagram shows two plane mirrors, A and B, set at an angle of 120° to each other. A ray of light is incident on mirror A and the angle between the mirror and the ray is 30° .



(ii) What name is given to the line marked N?
[1 mark]

(iii) Calculate the angle of reflection at mirror A.
[1 mark]

Angle of reflection = _____ $^\circ$

(iv) Using your answer to part (iii), calculate the angle of incidence at mirror B. [1 mark]

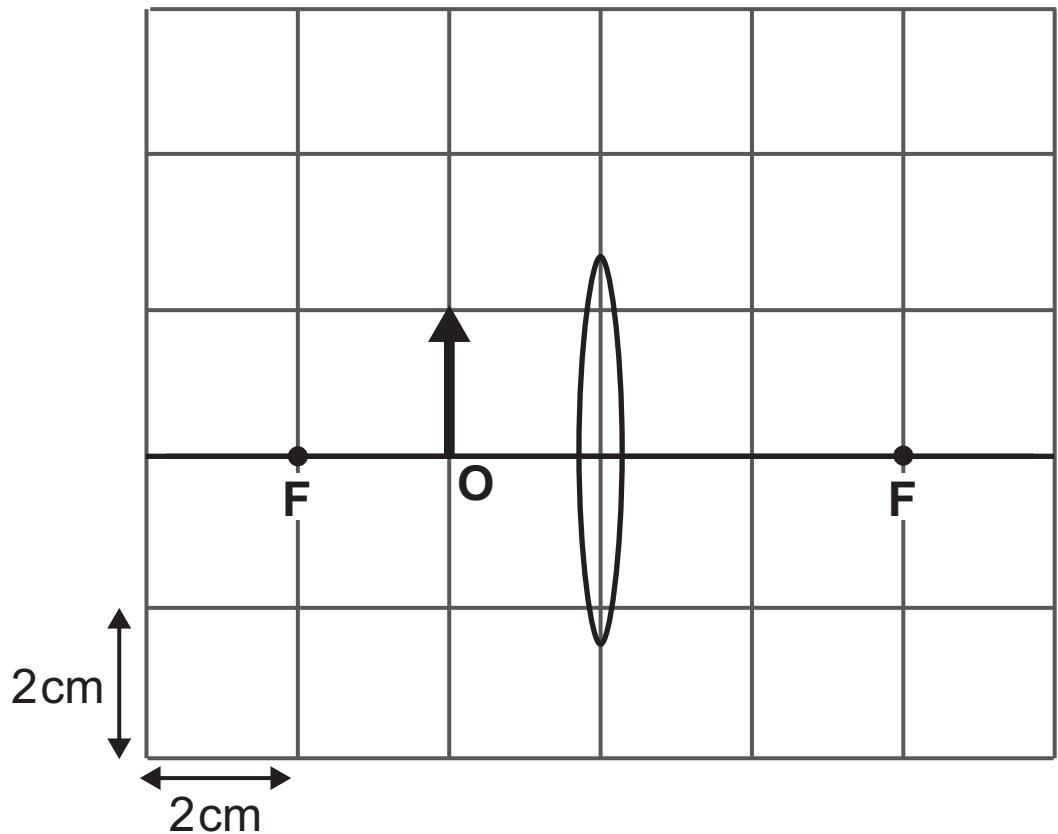
Angle of incidence = _____ $^\circ$

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(Questions continue overleaf)

(b) An object, O, is placed inside the focal point, F, of a converging lens.

- (i) Draw a ray diagram on the grid below to show how the image of the object O is formed. Using arrows show the direction of the rays of light. Show clearly on your diagram the location and orientation of the image. [5 marks]



- (ii) Use your ray diagram to measure the height of the image. [1 mark]

Height of image = _____ cm

Magnification of the image is calculated using the equation below.

$$\text{Magnification} = \frac{\text{Height of image}}{\text{Height of object}}$$

(iii) Use your ray diagram to find the magnification of this image. [1 mark]

Magnification = _____

(iv) Which one of the following uses the converging lens as illustrated by your ray diagram in **(b)(i)**? [1 mark]

Tick (✓) the correct box below.

camera

magnifying glass

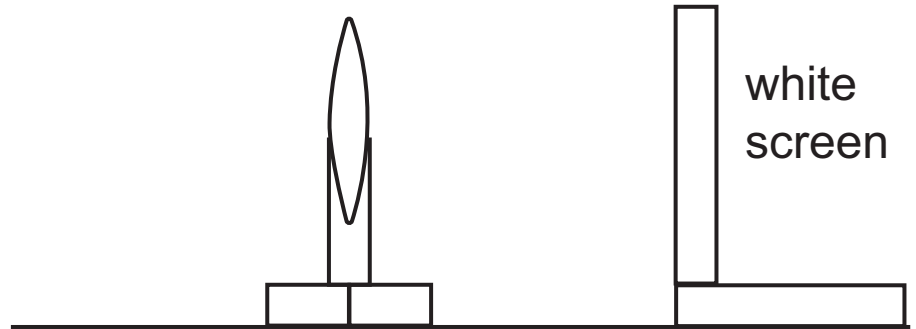
projector

(c) Describe how you could use a distant tree, a white screen and a ruler to measure the focal length of a converging lens. [3 marks]

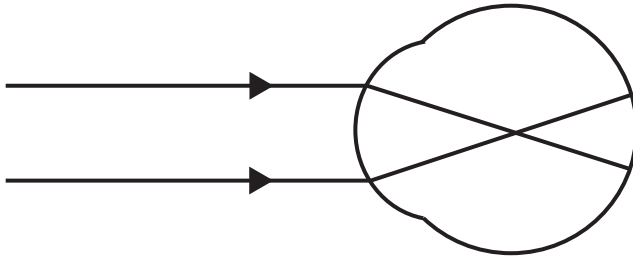


distant tree

converging lens



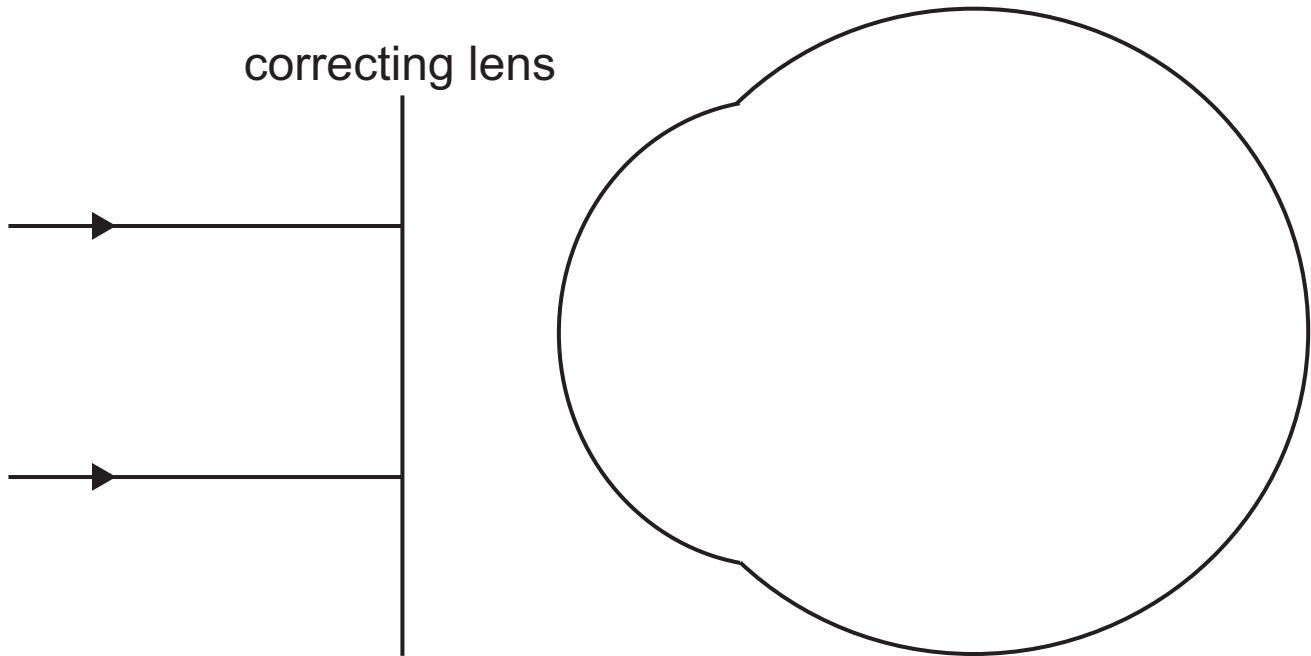
- (d)** Rays of light from a distant object are parallel. For a person with normal vision these rays are refracted by the eye and meet on the retina. The diagram below shows what happens when the eye is unable to focus the rays of light on the retina.



- (i)** What name is given to this defect of vision?
[1 mark]

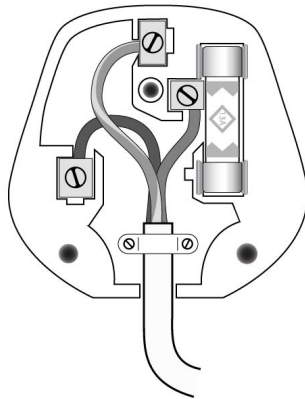
- (ii)** Name the type of lens used to correct this defect of vision. [1 mark]

(iii) Complete the ray diagram below to show the passage of the light through the lens to the eye and then through the eye until it is brought to a focus.
[3 marks]

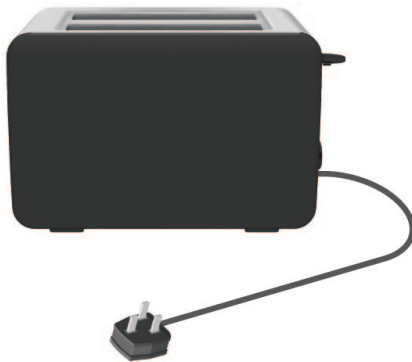


3 (a) The diagram shows a fused three-pin plug.

(i) On the diagram, mark clearly with a labelled arrow the earth pin and the fuse. [2 marks]



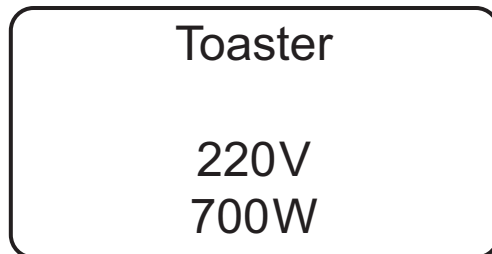
(ii) A toaster is connected to the mains supply using a lead fitted with a three-pin plug.



Describe how the earth wire and the fuse protect the user from electric shock if a fault develops and the live wire touches the metal casing of the toaster.
[3 marks]

(iii) As part of the safety associated with electrical appliances, the use of the correct fuse in the three-pin plug is essential.

The rating label for a toaster is shown below.



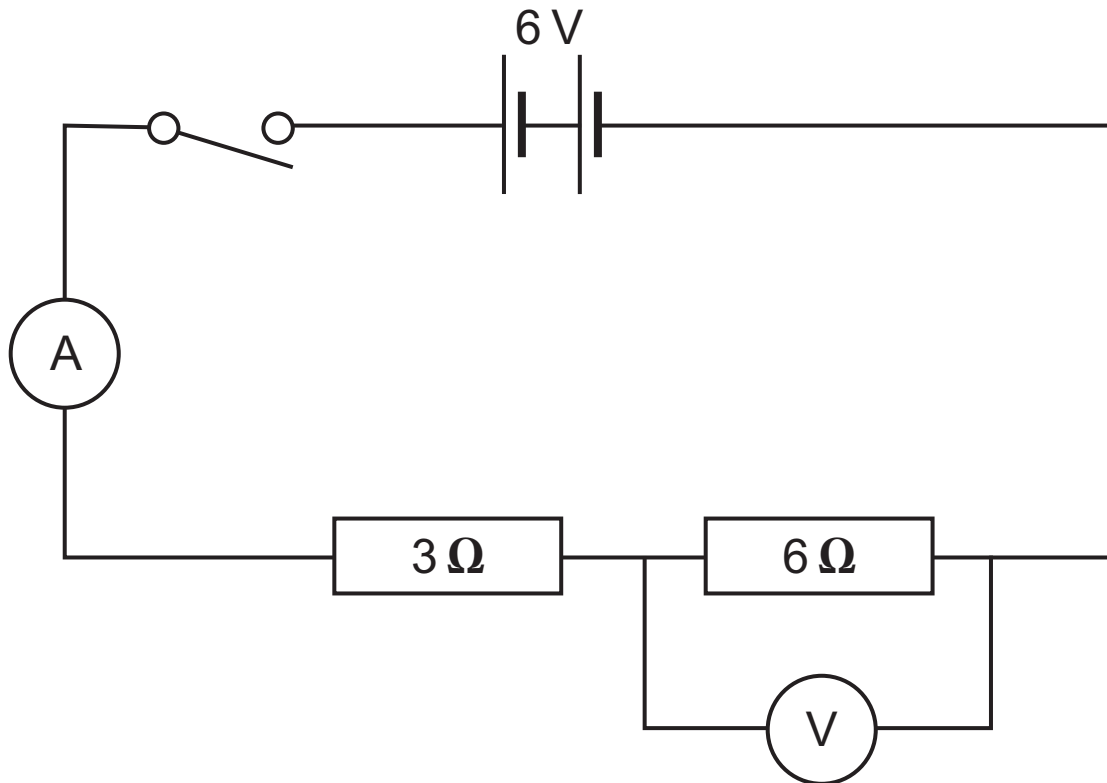
Using the information on the rating label, calculate the correct fuse to use. [4 marks]

The choice of fuses are 1A, 3A, 5A and 13A.

Show clearly your calculation(s), starting with the equation(s) you plan to use to get your answer.

Fuse = _____ A

(b) The circuit shown below was set up.



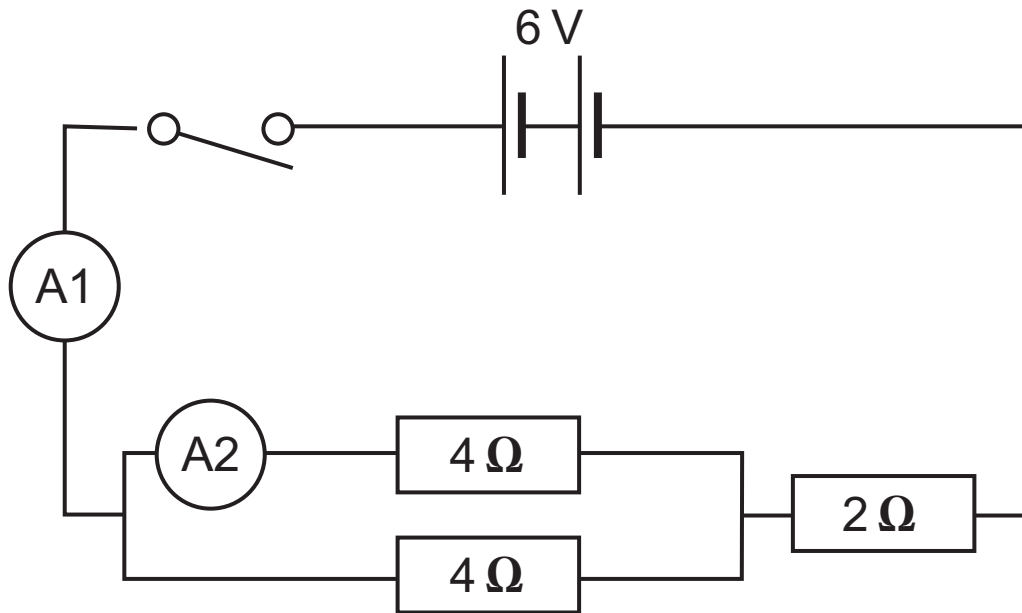
- (i) Calculate the current shown by the **ammeter** when the switch is closed. [4 marks]
Show how you get your answer, starting with the equation you plan to use.

Current = _____ A

- (ii) Calculate the reading on the **voltmeter** when the switch is closed. [2 marks]
Show how you get your answer, starting with the equation you plan to use.

Reading on voltmeter = _____ V

(c) A circuit with three resistors was set up as shown below.



- (i) Calculate the total resistance of this circuit.
[2 marks]
Show clearly how you get your answer.

Total resistance = _____ Ω

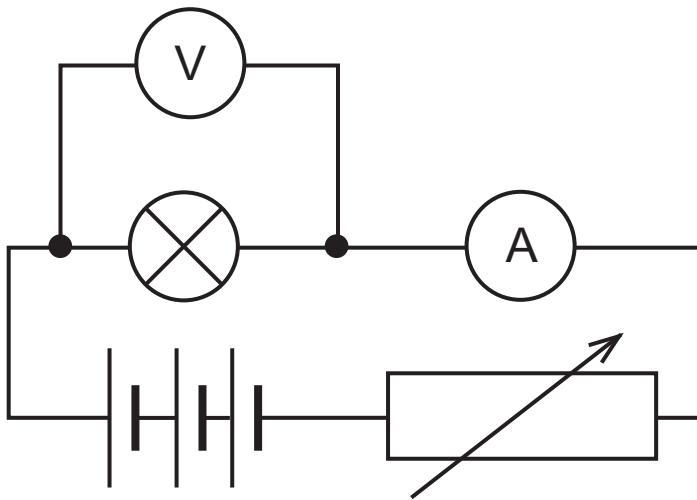
- (ii) Calculate the reading shown by the **ammeter** A1.
[2 marks]
Show clearly how you get your answer.

Reading on ammeter A1 = _____ A

(iii) Calculate the reading shown by **ammeter A2**.
[1 mark]

Reading on ammeter A2 = _____ A

(d) To obtain the voltage–current (V – I) graph for a filament lamp, the circuit shown below was set up.



- (i) Describe how different values for the voltage across the bulb can be obtained using this circuit.
[1 mark]

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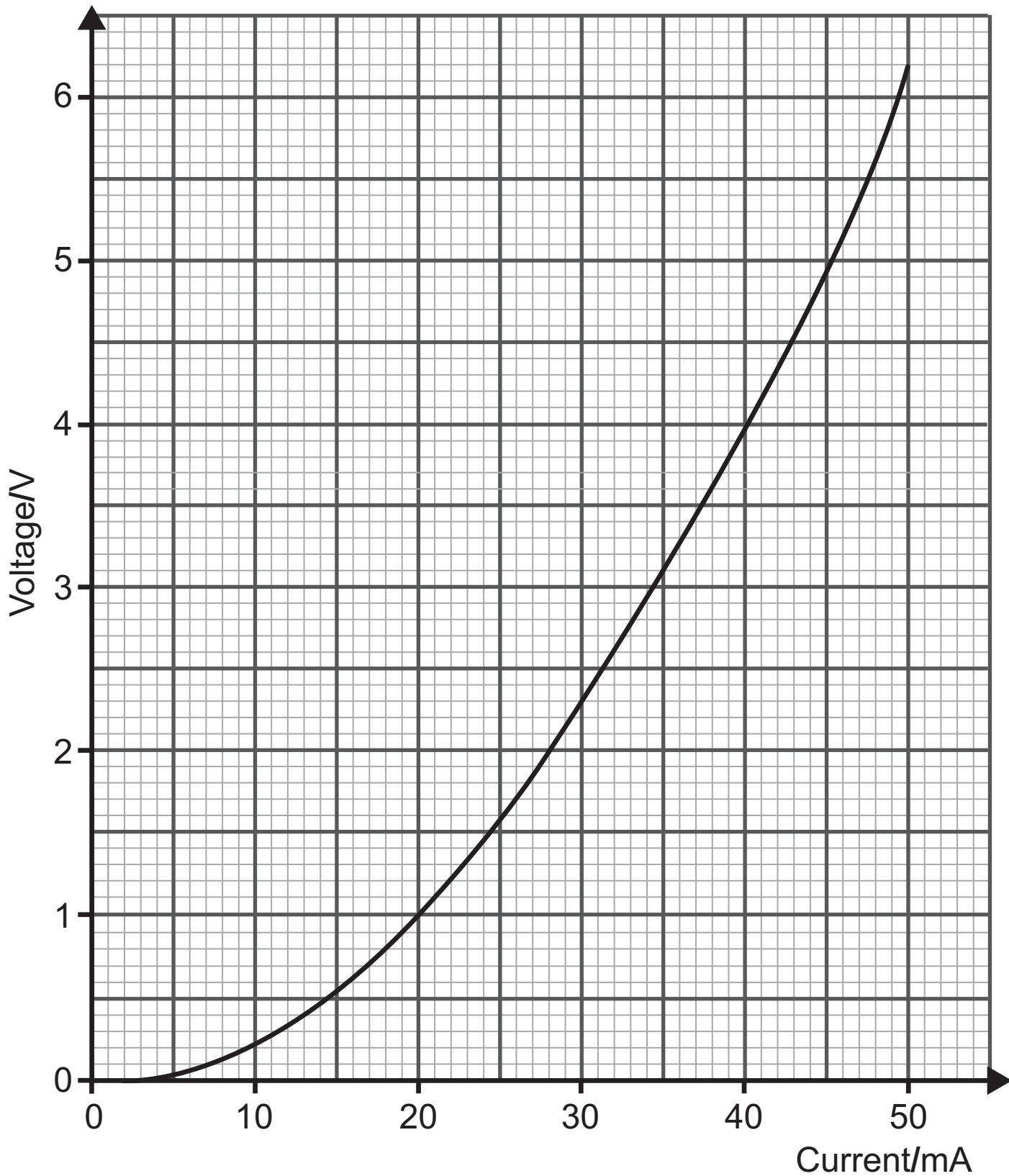
(Questions continue overleaf)

The graph opposite shows the results obtained.

- (ii) By taking values from the graph at 1 V and 4 V show that the resistance of the filament of the bulb increases as the current passing through the filament increases. [4 marks]
Show your calculations clearly.

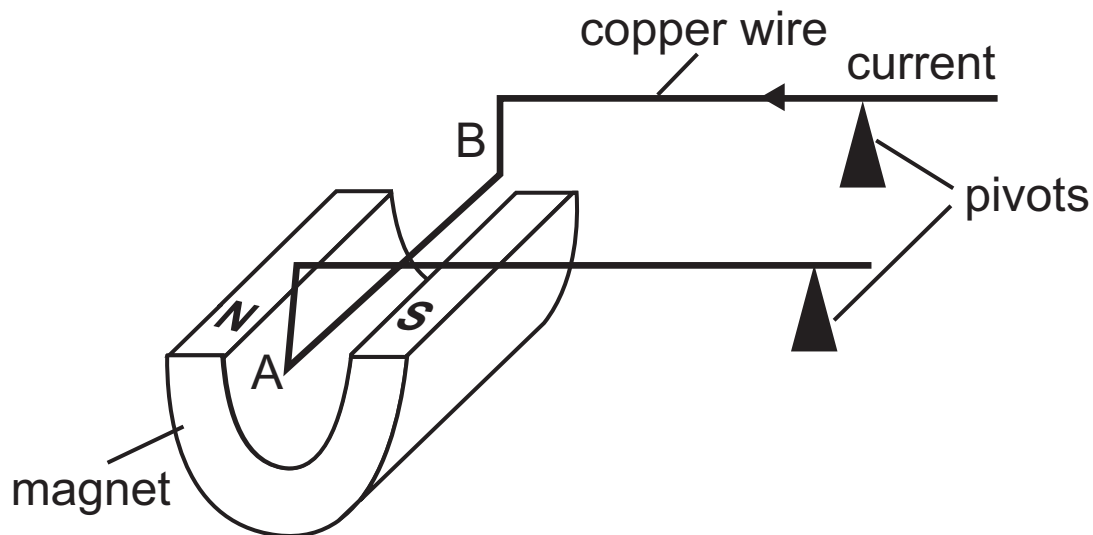
Resistance at 1 V = _____ Ω

Resistance at 4 V = _____ Ω



(iii) Describe, in terms of collisions, why an electrical current flowing through the metal wire of the filament generates heat. [1 mark]

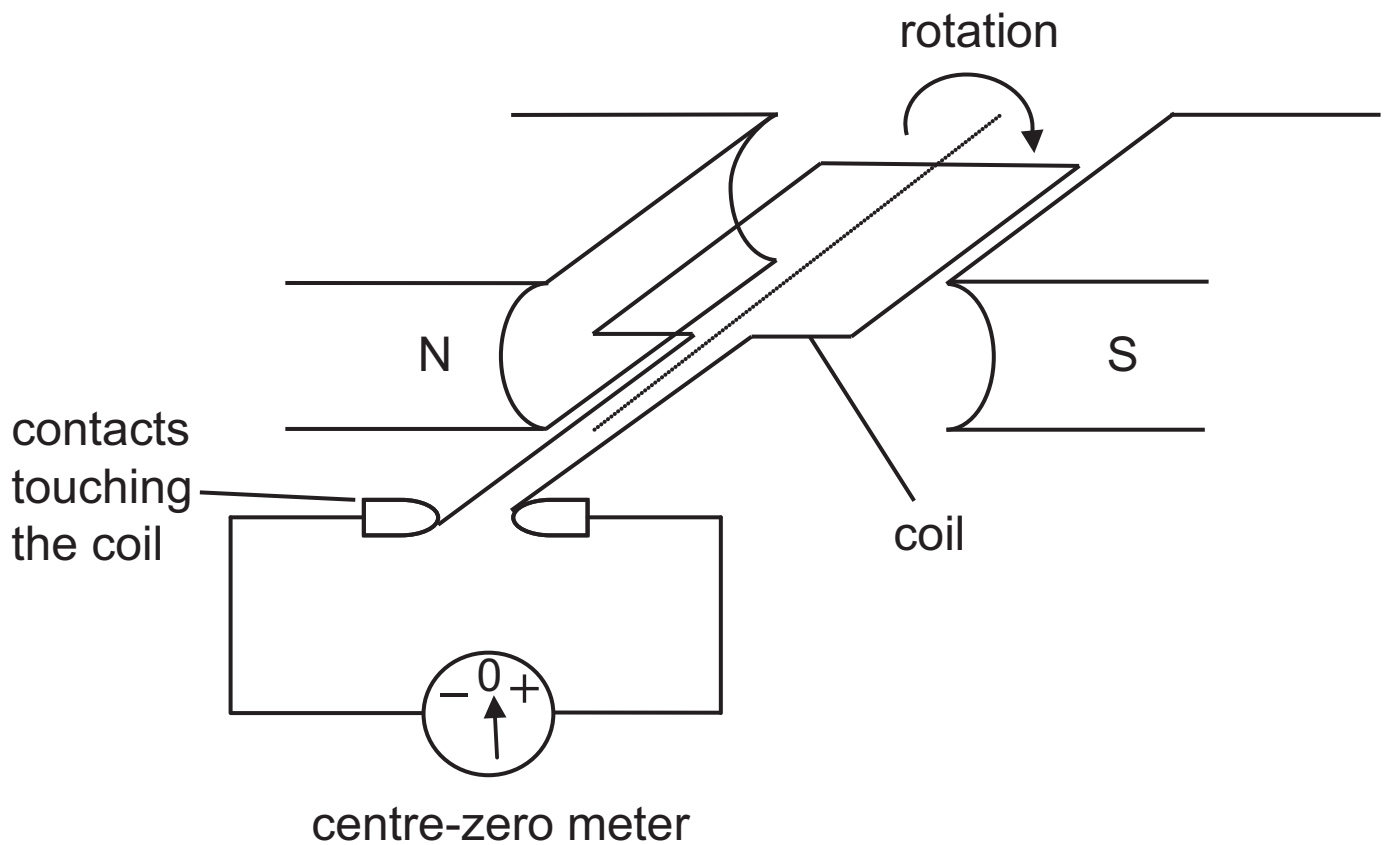
- 4 (a) The diagram shows a copper wire resting on two pivots. The copper wire is balanced horizontally. The section of the wire labelled AB sits in a magnetic field.



- (i) Describe, in detail, what happens to the wire AB when a current passes along the wire in the direction shown. [2 marks]

- (ii) Name the rule you used to answer part (i). [1 mark]

(b) The diagram below shows an a.c. generator.



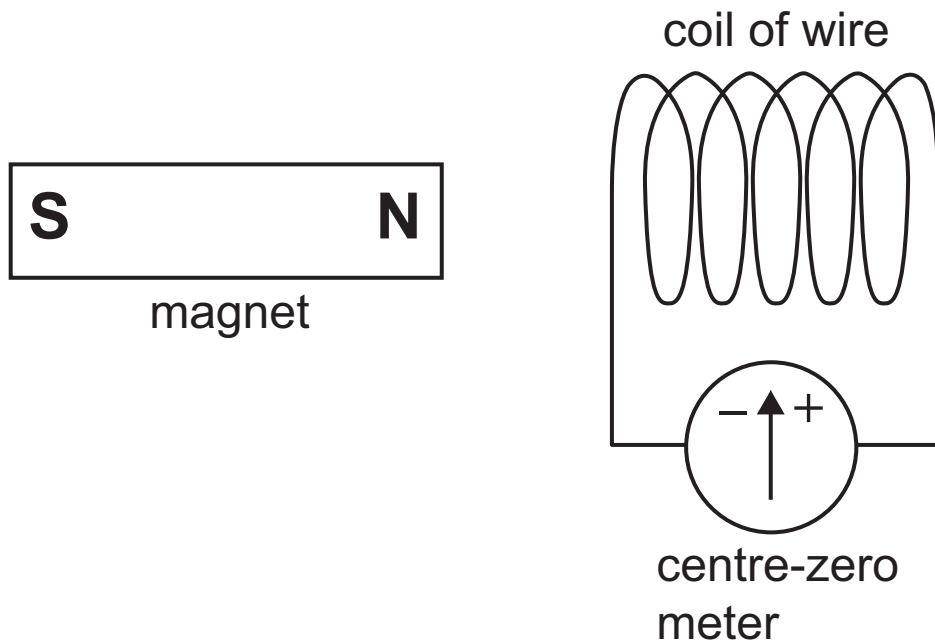
(i) State what happens in the coil of wire when the coil rotates continuously. [1 mark]

(ii) Describe, carefully, the motion of the pointer in the centre-zero meter when the coil is rotated. [2 marks]

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(Questions continue overleaf)

(c) Electromagnetic induction can be demonstrated using the apparatus shown below.



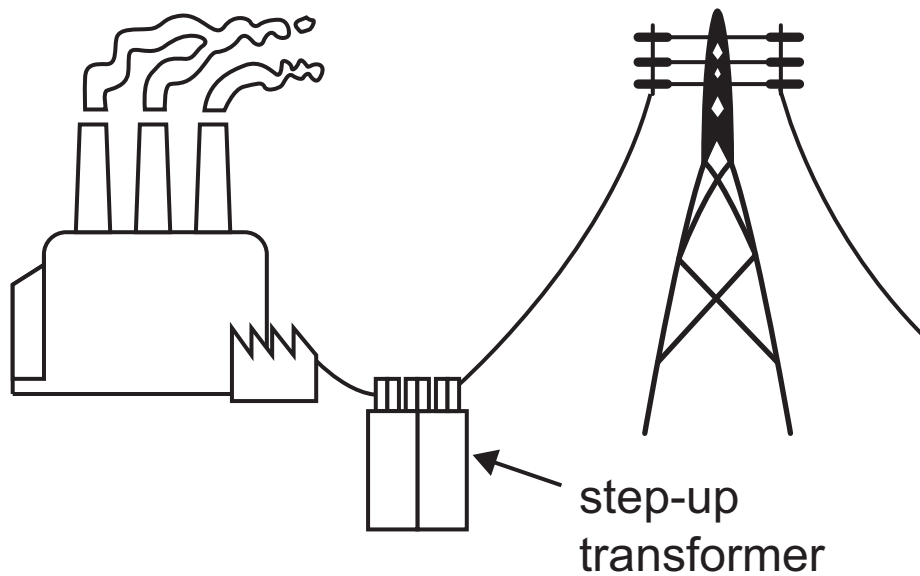
Various actions are carried out using the apparatus shown above.

For each of the actions described below, write the letter that corresponds to the observation in the boxes provided opposite. [4 marks]

- A. No deflection**
- B. Small deflection of the pointer and returns to zero.**
- C. Large deflection of the pointer and returns to zero.**
- D. Pointer moves to one side then to the other continuously.**

		Observation (A to D)
Step 1	The north (N) pole of the magnet is moved slowly towards the coil and stops.	
Step 2	The north (N) pole of the magnet is moved quickly towards the coil and stops.	
Step 3	The north (N) pole of the magnet is moved repeatedly towards and away from the coil.	
Step 4	The north (N) pole is held at rest outside the coil.	

- (d) The output from a power station is connected to a step-up transformer, which in turn is connected to the transmission lines.



- (i) Explain the advantage of using a step-up transformer to distribute electricity. [2 marks]

(ii) The power station generates electricity at a voltage of 25 kV.

The primary coil of the transformer has 500 turns. Calculate how many turns are on the secondary coil if the output voltage is to be stepped up 125 kV.

[3 marks]

Show clearly how you get your answer, starting with the equation you plan to use.

Number of turns on the secondary coil = _____

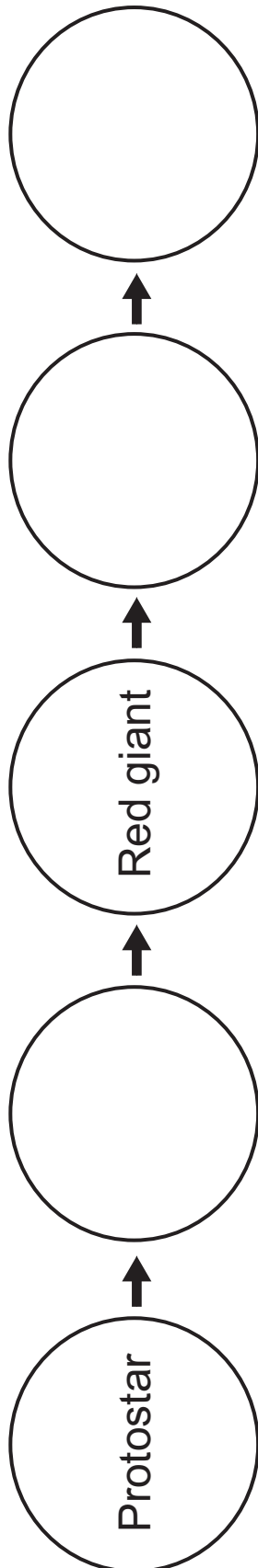
5 Light from distant galaxies shows red-shift.

(a) (i) In terms of wavelength, explain what is meant by red-shift. [1 mark]

(ii) What causes the red-shift? [1 mark]

(b) (i) By what process do stars generate heat and light energy? [1 mark]

- (ii) Complete the sequence below to show the life cycle of a star with the same mass as our Sun. Write the names in the circles provided. [3 marks]
Two stages have been completed for you.



The final stage in the life of some stars is a black hole.

(iii) What is the major difference between these stars and stars like our Sun? [1 mark]

(c) It is very unlikely that humans will be able to visit planets outside our Solar System in the next hundred years.

(i) Suggest two practical reasons why this is so. [2 marks]

1. _____

2. _____

(ii) What is a light year? [2 marks]

The closest planet to Earth outside the Solar System is called Alpha Centauri Bb and it is 3.8×10^{13} km away.

(iii) How many light years is Alpha Centauri Bb away from Earth? [4 marks]

Give your answer to the **nearest whole number**.

You may assume that there are 3.15×10^7 seconds in one year and that light travels through space at a speed of 3×10^8 m/s.

Number of light years = _____

This is the end of the question paper

SOURCES

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Q3(a)(i) . . . © CCEA

Q3(a)(ii) . . . © Getty Images

Q4(d) . . . Adapted from National Energy Education Development Project (Public Domain) <https://www.eia.gov/energyexplained/electricity/delivery-to-consumers.php>

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Question Number	Marks
1	
2	
3	
4	
5	
Total Marks	

Examiner Number

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