Surname	Centre Number	Candidate Number
Other Names		0

GCSE

4503/01

S16-4503-01

PHYSICS

PHYSICS 3
FOUNDATION TIER

P.M. WEDNESDAY, 25 May 2016

1 hour

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**9**	
2.	**7**	
3.	**5**	
4.	**5**	
5.	**4**	
6.	**6**	
7.	**14**	
8.	**10**	
Total	**60**	

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ADDITIONAL MATERIALS

In addition to this paper you may require a calculator and a ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.
Write your name, centre number and candidate number in the spaces at the top of this page.
Answer **all** questions.
Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.
You are reminded of the necessity for good English and orderly presentation in your answers.
A list of equations is printed on page 2. In calculations you should show all your working.
You are reminded that assessment will take into account the quality of written communication (QWC) used in your answer to question **8**(*a*)(ii).

Equations

speed = $\dfrac{\text{distance}}{\text{time}}$	
u = initial velocity v = final velocity t = time a = acceleration x = displacement	$v = u + at$ $x = \frac{1}{2}(u + v)t$
momentum = mass × velocity	$p = mv$
pressure = $\dfrac{\text{force}}{\text{area}}$	$p = \dfrac{F}{A}$
	T / K = θ / °C + 273
density = $\dfrac{\text{mass}}{\text{volume}}$	$\rho = \dfrac{m}{V}$

SI multipliers

Prefix	Multiplier	
m	10^{-3}	$\dfrac{1}{1\,000}$
k	10^{3}	1 000
M	10^{6}	1 000 000

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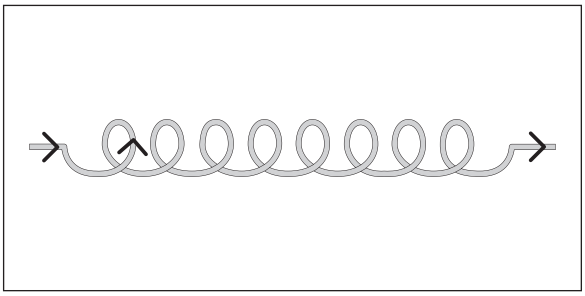
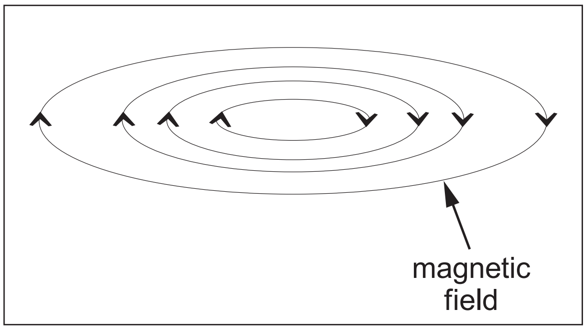
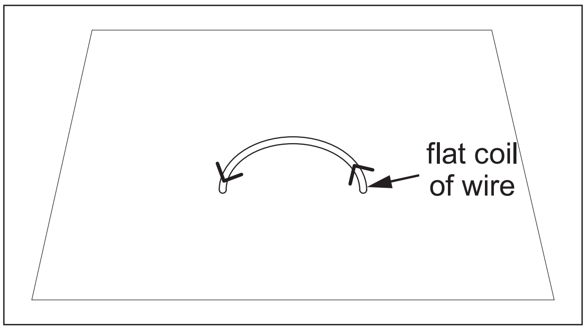
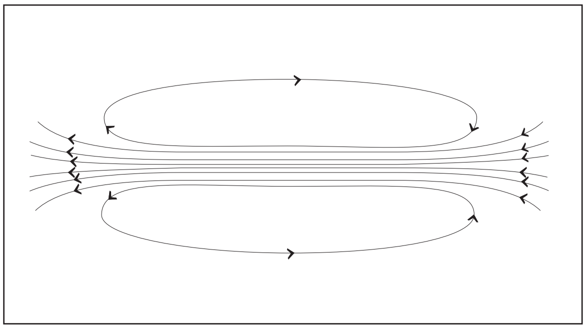
Answer **all** *questions.*

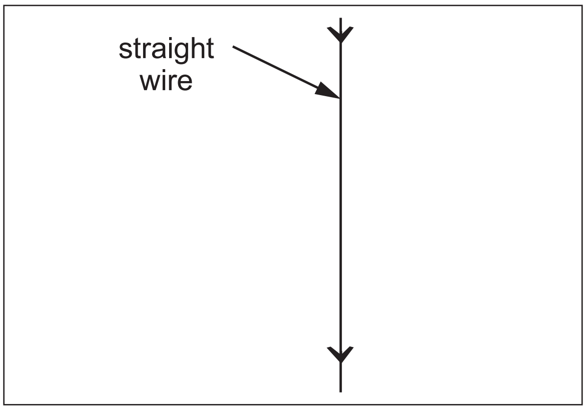
1. *(a)* The diagrams on the left below show currents flowing in wires of different shapes. The diagrams on the right show the shapes of the magnetic fields produced by currents in wires. **Draw lines** from the diagrams on the left to the correct field shapes on the right. [2]

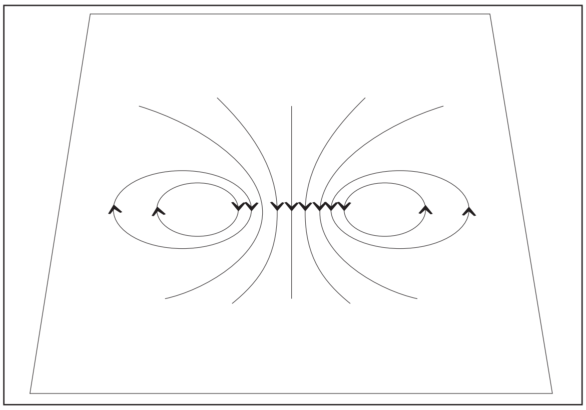












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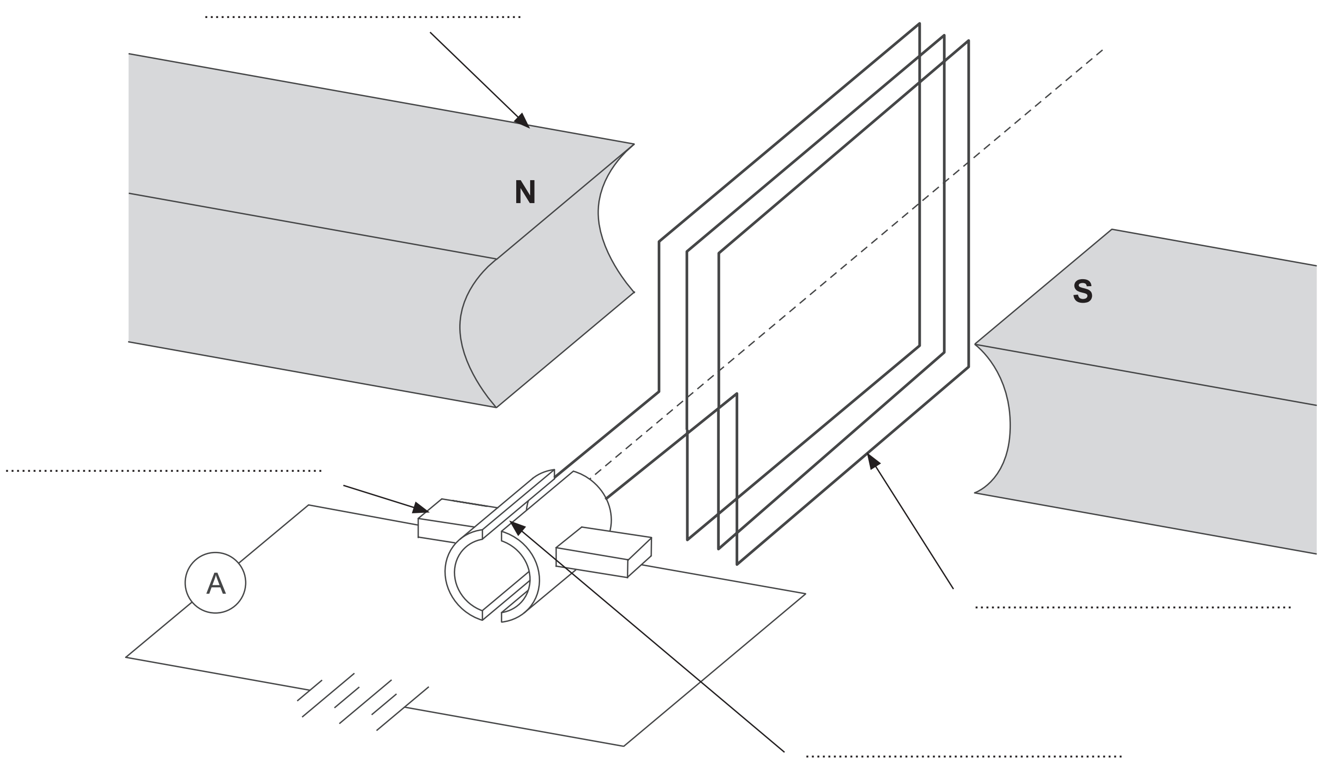
(b) Use the words from the box below to **label this diagram** of a simple d.c. motor. [3]

carbon brush	magnet	split ring	coil of wire



(c) **Draw an arrow on the diagram** to show the direction of the magnetic field (label this arrow as **D**). [1]

(d) State **two** ways of making the coil move more slowly. [2]

1. ....

2. ....

(e) State **one** way of reversing the direction the coil rotates. [1]

....

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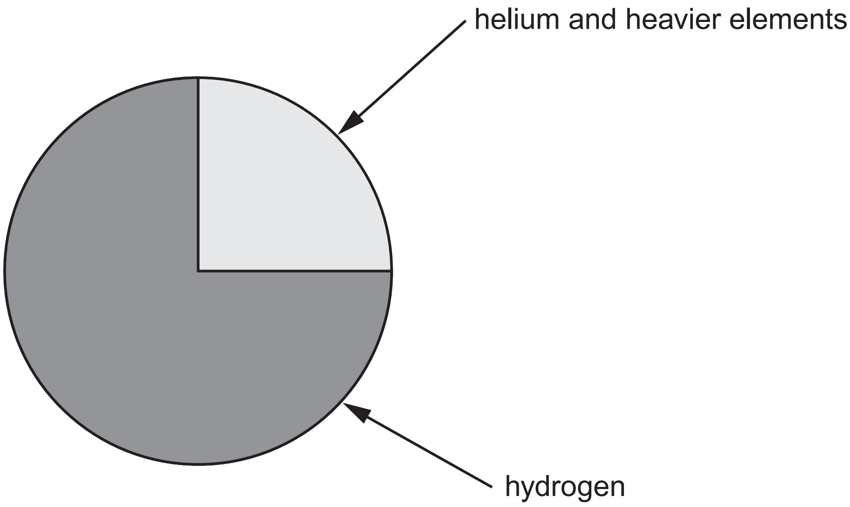
2. The substances in the early Universe are shown in the following pie chart.
The chart is drawn to scale.



(a) What percentage of the Universe was hydrogen? [1]

.... %

(b) The Big Bang theory suggests that helium was formed from hydrogen in the following way.

$$4\,{}^{1}_{1}\mathrm{H} \rightarrow {}^{4}_{2}\mathrm{He} + 2\,{}^{0}_{1}\mathrm{e}$$

(i) State the number of hydrogen nuclei in this reaction. [1]

....

(ii) State the number of protons involved in this reaction. [1]

....

(iii) State the name of the particle ${}^{0}_{1}\mathrm{e}$. [1]

....

(c) (i) Main sequence stars generate their energy in the reaction shown above. State the names of the two forces that are balanced in main sequence stars. [2]

.... and ....

(ii) State why our Sun will never produce uranium. [1]

....

....

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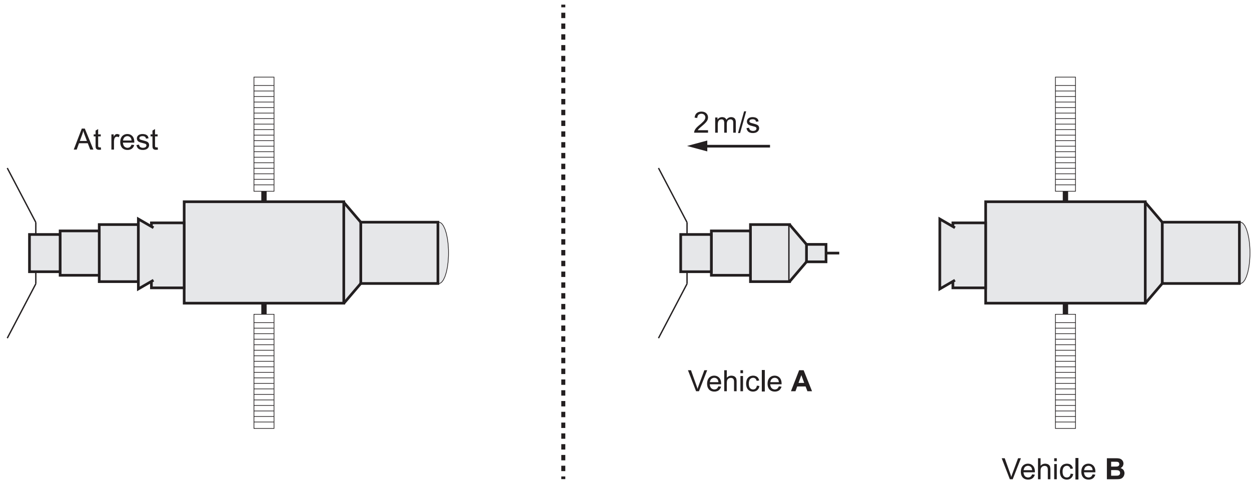
3. The diagrams show two stationary space vehicles in the act of separating.



Vehicle **A** has a mass of 50 000 kg.

Vehicles **A** and **B** are at rest before the separation. **The total momentum is zero**.
After the separation, vehicle **A** moves with a velocity of **–2 m/s**.

(i) Use the equation:

momentum = mass × velocity

to calculate the momentum of **A** after the separation. [2]

momentum = ... kg m/s

(ii) No momentum is lost when they separate.
Write down the momentum of **B** after they separate. [1]

momentum = ... kg m/s

(iii) Vehicle **B** has a mass of 80 000 kg. Use the equation:

$$\text{velocity} = \frac{\text{momentum}}{\text{mass}}$$

to find the velocity of vehicle **B** after the separation. [2]

velocity = ... m/s

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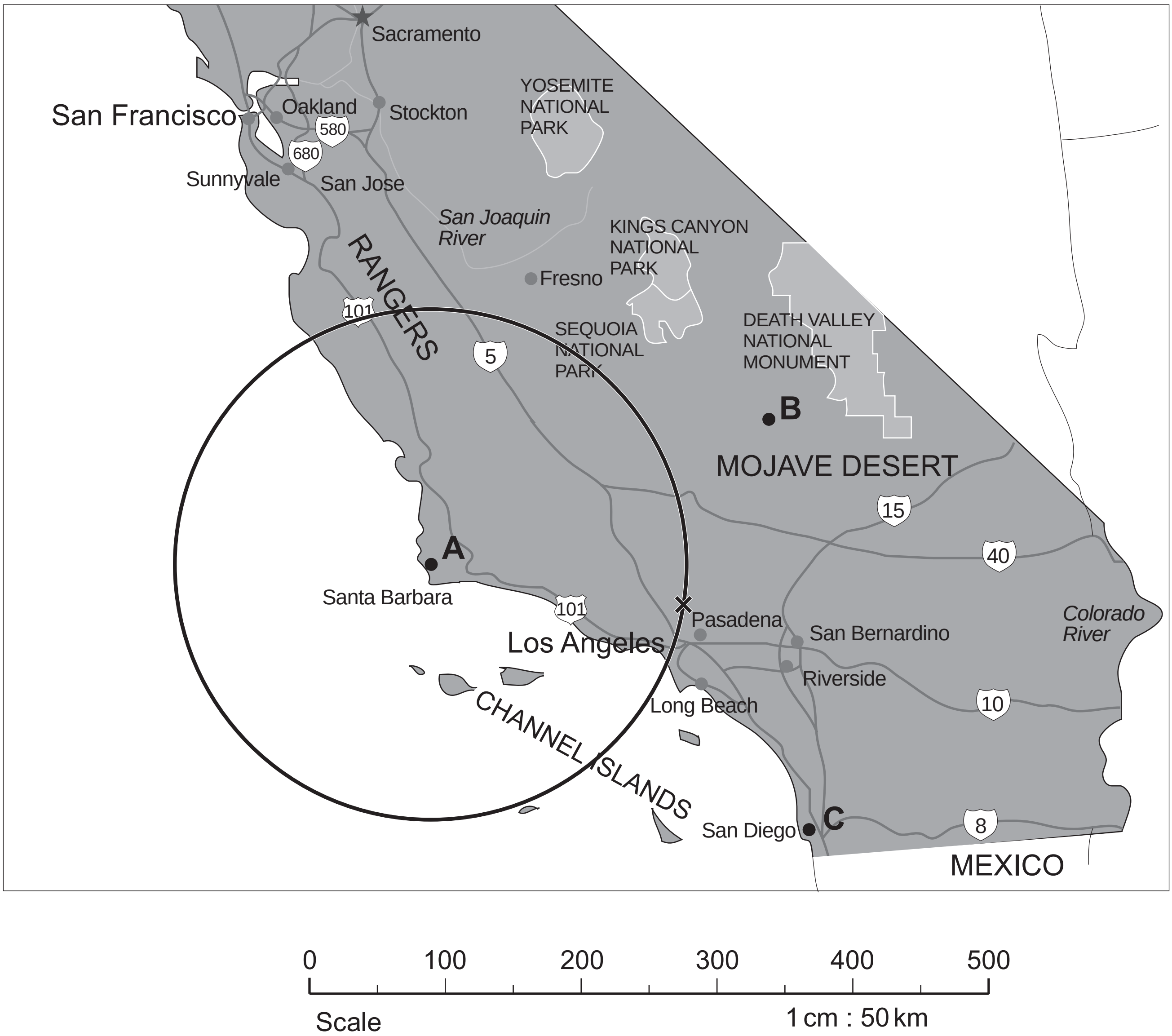
4. The map below shows the positions of two seismic recording stations **A** and **B** (in the American state of California). The epicentre of an earthquake lies somewhere on the circumference of the circle around **A**. Station **B** is used to locate two possible positions of the epicentre of the earthquake.



(a) (i) The P wave arriving at station **B** took 25 s to arrive from the epicentre. The speed of the P wave was 6 km/s. Use the equation:

distance = speed × time

to calculate the distance of **B** from the epicentre of the earthquake. [2]

distance = ... km

(ii) One of the possible positions of the epicentre is shown with an **X** on the circle. **Mark the other possible position** of the epicentre on the circle. [1]

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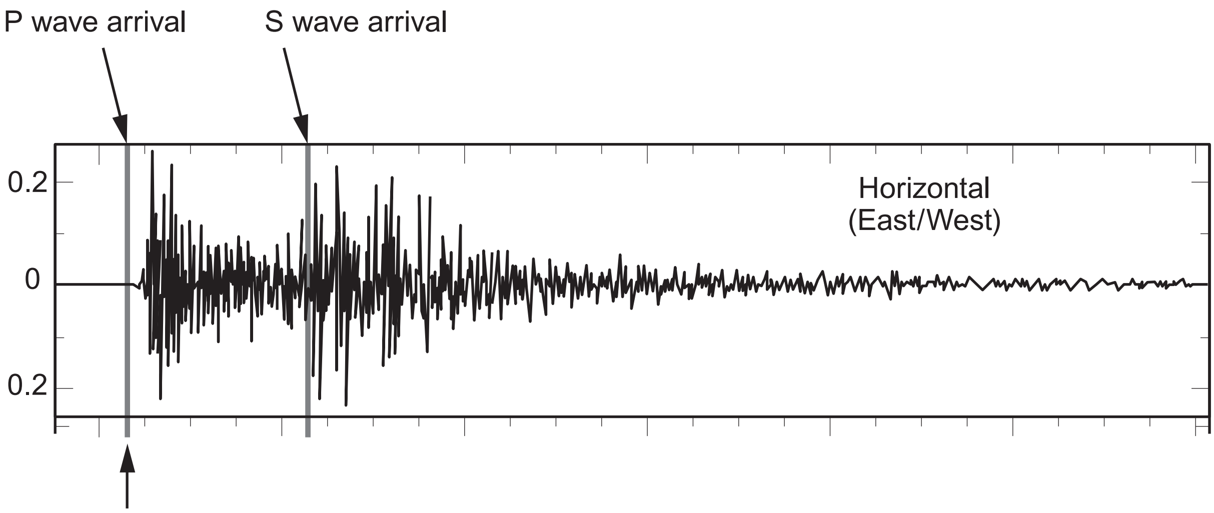
(b) The record of the P and S waves arriving at station **A** is shown below.
The S wave arrived at station A 20 s later than the P waves.



6 h 01 min 22 s – Arrival time at station **A**

(i) State why the S wave arrived later than the P wave. [1]

....

(ii) Fill in the gaps below.

The S wave arrived at station **A** at .... hours .... minutes .... seconds. [1]

5

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5. A fixed mass of gas is kept under conditions of constant volume. The table shows how the pressure of this gas changes with temperature when it is heated.

Temperature (°C)	Temperature (K)	Pressure (N/cm^2)
–273	....	0
–173	100	4
–123	150	6
–73	200	8
+27	300	....
+77	350	14
+127	400	16

(a) **Complete the table above.** [2]

(b) Explain in terms of molecules why the pressure increases as the temperature increases. [2]

....

....

....

4

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6. A small stone falls through the air. The table below shows how the velocity of the stone changes in the first 4 seconds.

Time (s)	Speed (m/s)
0	0
1	10
2	20
3	30
4	40

(a) State why the distance travelled between 2 seconds and 4 seconds is bigger than for the first two seconds. [1]

....

....

(b) (i) Use information from the table and the equation:

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

to calculate the acceleration. [2]

acceleration = ... m/s^2

(ii) Use information from the table and the equation:

$$x = \frac{1}{2}(u + v)t$$

to calculate the distance that the stone fell between 2 s and 4 s. [2]

distance = ... m

(c) If a feather were dropped instead, its velocity after 4 s would be less than that of the stone. Give a reason for the difference. [1]

....

....

6

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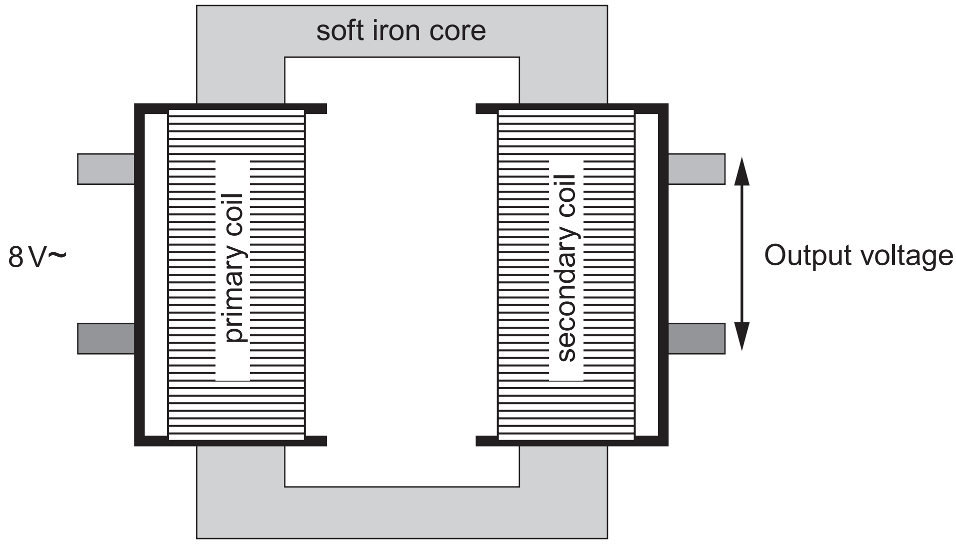
7. *(a)* State how the construction of a step-up transformer is different from a step-down transformer. [1]

....

....

The diagram shows a transformer that can be used for an investigation in a laboratory.



(b) Put a **tick (✓)** in the boxes next to the statements that would cause the output voltage to increase. [2]

Increasing the number of turns on the primary coil	☐
Decreasing the number of turns on the primary coil	☐
Decreasing the input voltage	☐
Increasing the number of turns on the secondary coil	☐
Decreasing the number of turns on the secondary coil	☐

(c) Explain why there must be an alternating input voltage for the transformer to work. [2]

....

....

....

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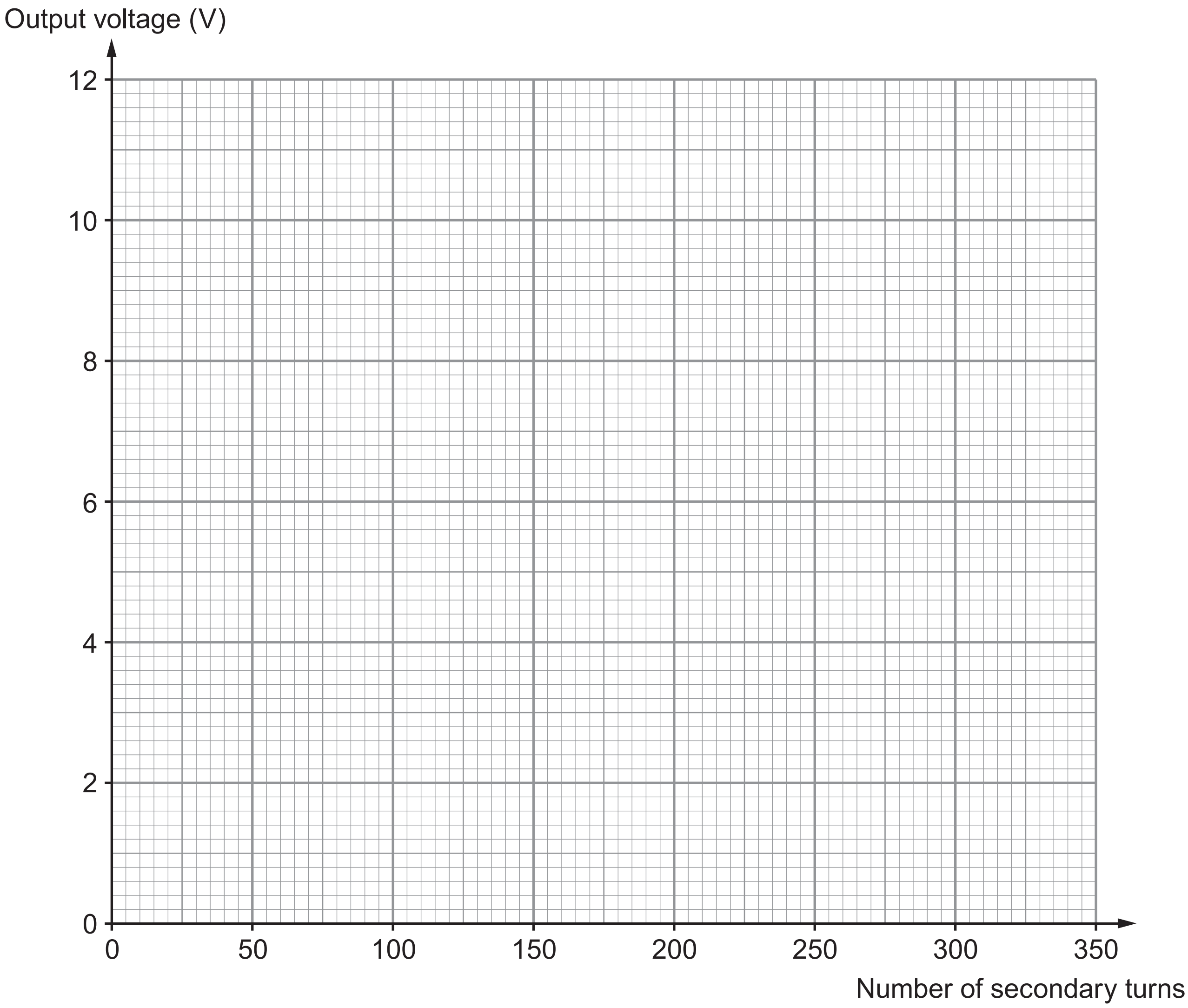
(d) An investigation is carried out to determine how the output voltage depends on the number of turns on the secondary coil. The input voltage (8 V) and the number of turns on the primary coil (200) are kept constant throughout the investigation.

The results of the investigation are recorded in the table below.

Input voltage (V)	Primary turns	Secondary turns	Output voltage (V)
8	200	50	2
8	200	....	4
8	200	150	6
8	200	200	8
8	200	300	12

(i) **Complete the table.** [1]

(ii) Plot a graph of the output voltage against the number of secondary turns on the grid below and draw a suitable line. [3]



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(iii) Describe the relationship between the output voltage and the number of secondary turns. [2]

....

....

(iv) Use the graph to find the number of secondary turns required to give an output voltage of 5 V. [1]

number of turns = ...

(v) Explain how the graph would be different if the investigation were repeated with a primary coil containing 400 turns. [2]

....

....

....

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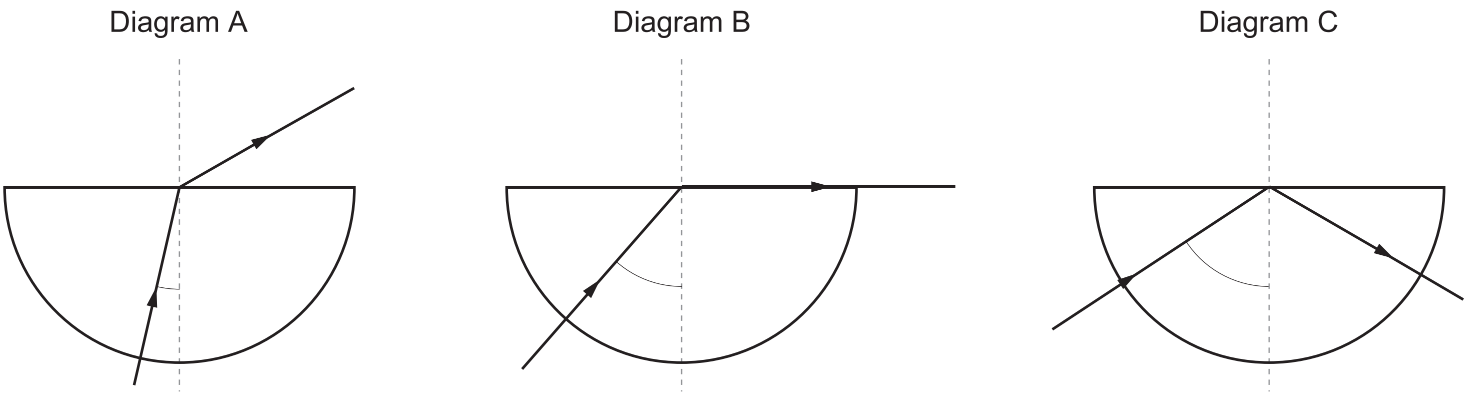
8. *(a)* The diagrams below are drawings made by a student investigating how light rays pass through a semi-circular glass block.



(i) **Label the critical angle (*c*)** on the appropriate diagram above. [1]

(ii) Describe and explain the observations shown in the drawings as fully as you can. [6 QWC]

You should:

- describe what happens to the light ray in each of the diagrams above;
- explain why the light ray follows the path shown in each diagram.

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....

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TURN OVER FOR THE LAST PART OF THE QUESTION

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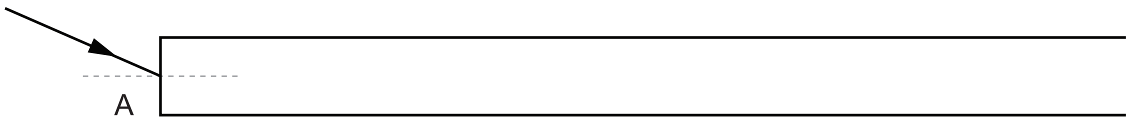
....

....

....

....

(b) Complete the diagram below to show how the light entering at A travels along the optical fibre. [3]



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END OF PAPER