| Candidate Name | Centre Number | Candidate Number |
|---|---|---|
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WJEC CBAC

# GCSE

247/01

# SCIENCE PHYSICS
## FOUNDATION TIER
## PHYSICS 3

A.M. FRIDAY, 27 May 2011

45 minutes

| For Examiner's use only | | |
|---|---|---|
| **Question** | **Maximum Mark** | **Mark awarded** |
| **1.** | **5** | |
| **2.** | **4** | |
| **3.** | **4** | |
| **4.** | **6** | |
| **5.** | **4** | |
| **6.** | **3** | |
| **7.** | **4** | |
| **8.** | **5** | |
| **9.** | **6** | |
| **10.** | **4** | |
| **11.** | **5** | |
| **Total** | **50** | |

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**ADDITIONAL MATERIALS**

In addition to this paper you may require a calculator.

**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 of the examination paper**. In calculations you should show all your working.

## EQUATIONS

speed = gradient of a distance-time graph

distance travelled = area under a velocity-time graph

acceleration = gradient of a velocity-time graph

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

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

where $u$ is the initial velocity,
$v$ is the final velocity,
$a$ is the acceleration,
$t$ is the time,
$x$ is the distance travelled,

momentum = mass × velocity

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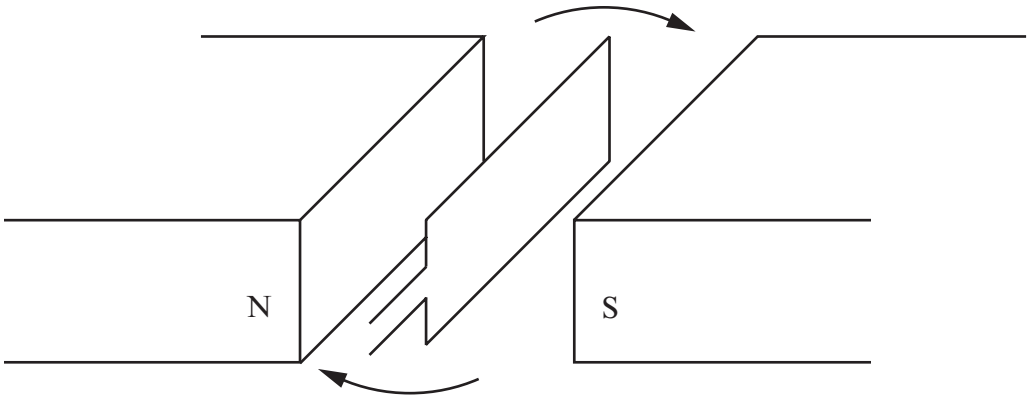
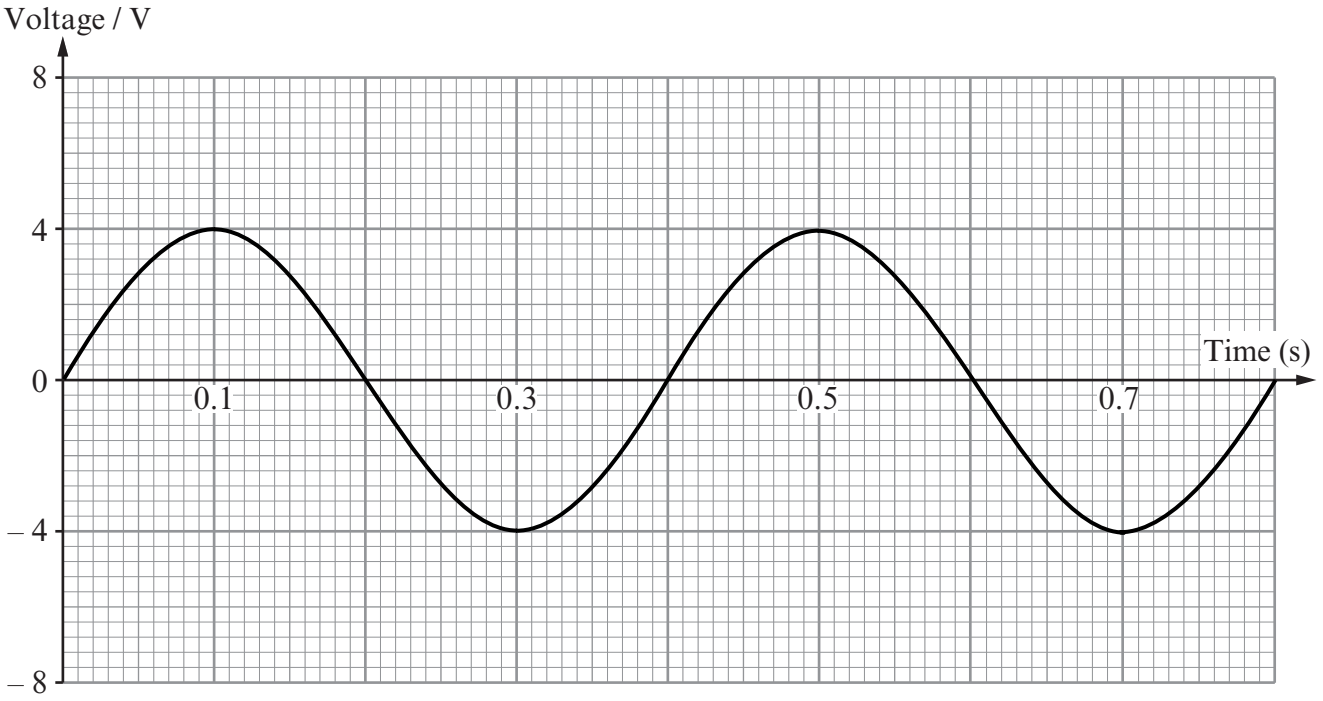
*Answer* **all** *questions.*

**1.** The diagram shows a simple a.c. generator. It is a coil of wire which is made to rotate in a magnetic field.
As the coil rotates it cuts through the magnetic lines and a voltage is induced across the ends of the coil.




The graph shows how the output voltage varies with time as the coil makes two rotations from the vertical position shown in the diagram.




*(a)* (i) Use the graph to find the maximum voltage. Maximum voltage = ..... V[1]

(ii) Use the graph to find the time for one rotation. Rotation time = ..... s [1]

(iii) The frequency of the output voltage is the number of rotations made in one second.
Calculate the frequency of the output voltage.

Frequency = ..... Hz [1]

*(b)* The coil is rotated more quickly.
State what effect this has on

(i) the frequency of the output; .....

(ii) the size of the output voltage. .....

[2]

5

**2.** The four balanced equations below represent reactions that occur in nuclear physics.

A $^{235}_{92}U \longrightarrow {}^{231}_{90}Th + {}^{4}_{2}He$

B $^{235}_{92}U + {}^{1}_{0}n \longrightarrow {}^{148}_{57}La + {}^{85}_{35}Br + {}^{1}_{0}n + {}^{1}_{0}n + {}^{1}_{0}n$

C $^{237}_{92}U \longrightarrow {}^{237}_{93}Np + {}^{0}_{-1}e$

D $^{2}_{1}H + {}^{3}_{1}H \longrightarrow {}^{4}_{2}He + {}^{1}_{0}n$

(i) Which reaction, **A**, **B**, **C** or **D**, represents a beta decay? .....

(ii) Which reaction, **A**, **B**, **C** or **D**, represents an alpha decay? .....

(iii) Which reaction, **A**, **B**, **C** or **D**, could lead to an uncontrolled chain reaction?

.....

(iv) Which reaction, **A**, **B**, **C** or **D**, requires massive temperature and pressure for it to take place?

.....

[4]

4

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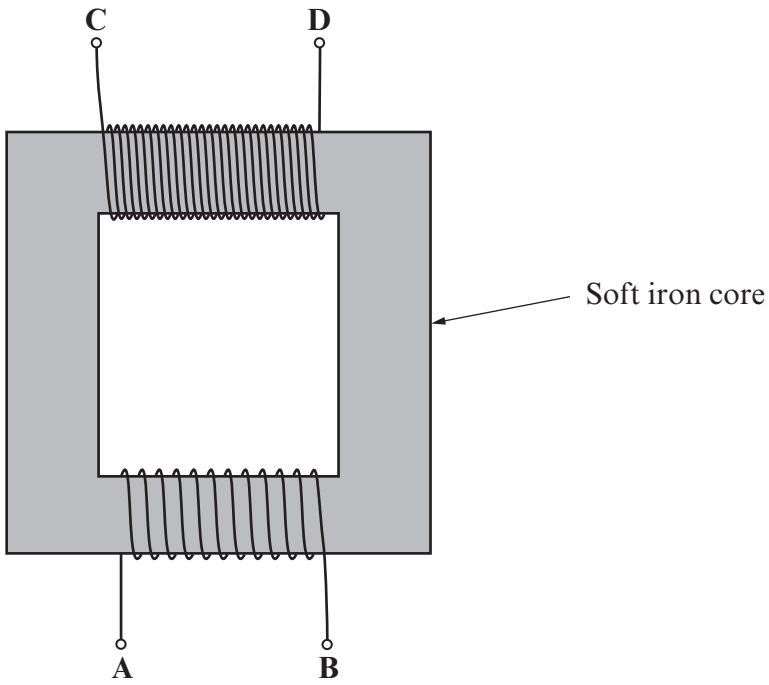
**3.** *(a)* State how a step-up transformer differs from a step-down transformer. [1]

.....

.....

*(b)* The diagram below shows a transformer.




(i) It is used to change the mains voltage of 230 V to 10 V.
To which **two** terminals, **A**, **B**, **C** or **D**, should the mains voltage be connected? [1]

..... and .....

(ii) Give a reason why the coils are wound on a soft iron core. [1]

.....

.....

(iii) Explain why transformers will not work with direct currents. [1]

.....

.....

4

**4.** *(a)* Waves are used to carry energy.
Some are described as **transverse waves** and others as **longitudinal waves**.
Explain how the vibrations producing transverse waves are different from those producing longitudinal waves. [2]

.....

.....

.....

*(b)* List **A** gives 4 energy-carrying waves.
List **B** describes the waves.

Draw one line from each wave in list **A** to its description in list **B**. [4]

| List **A** | List **B** |
|---|---|
| Ultrasound waves in echo sounding | Transverse waves |
| $\gamma$ radiation emitted by unstable nuclei | Longitudinal waves |
| Seismic waves from earthquakes | A mixture of transverse and longitudinal waves |
| Water waves in a ripple tank | |

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**5.** To take off from the deck of an aircraft carrier, a jet aircraft accelerates from rest along the deck at $32\,m/s^2$ for 2.5 seconds to attain its takeoff speed.

Use the equations

$$v = u + at, \text{ and}$$

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

to calculate

(i) the takeoff speed, $v$,

$v =$ ..... m/s

(ii) the length of deck, $x$, required for the jet to take off.

$x =$ .....

[4]

4

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**6.** $^{14}_{6}C$ represents a neutral carbon atom.

Draw a labelled diagram of a $^{14}_{6}C$ atom to show the number and arrangement of the protons, neutrons and electrons. [3]

Key:

Proton ●

Neutron ○

Electron ×

3

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**7.** Read the passage carefully before answering the questions that follow.

> Echo sounding, using sonar, is widely used for mapping the sea bed and for tracking undersea objects.
> Sonar is high frequency (50 000 Hz plus) sound, known as ultrasound, which is not audible to humans (cannot be heard).
> Ultrasound has a short wavelength which allows it to be concentrated into a narrow beam which can penetrate to greater depth than audible sound waves. The short wavelengths also allow small details and small objects to be 'seen' and located.

*(a)* Give **two** reasons why ultrasound is preferred to audible sound for mapping the sea bed.

[2]

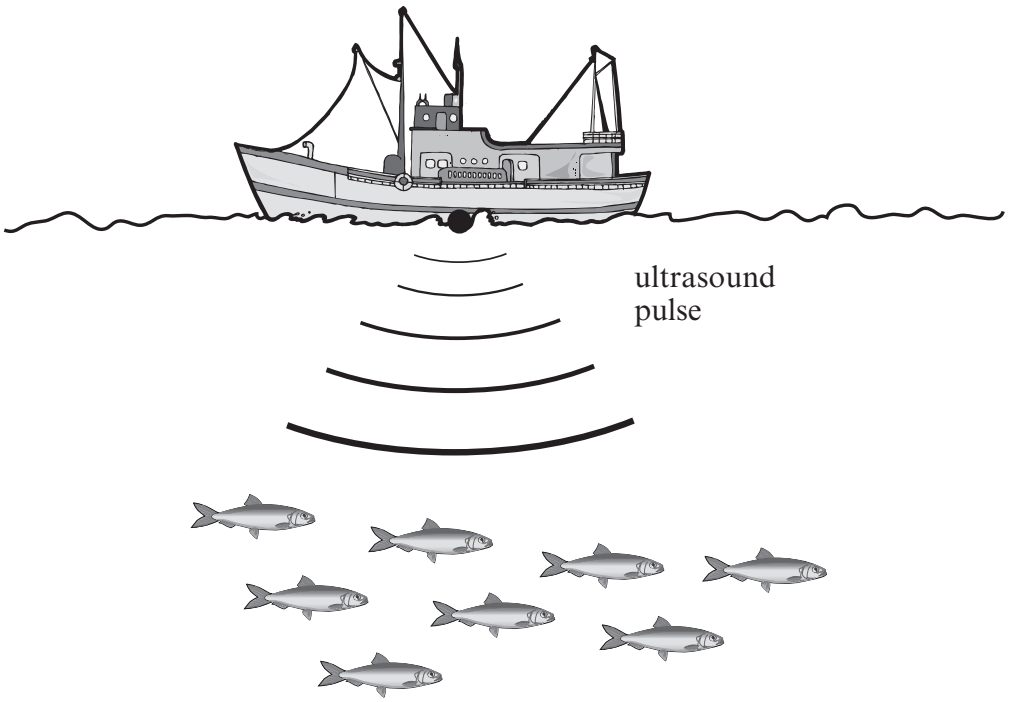
1. .....

.....

2. .....

.....

*(b)* A fishing boat, using sonar, sends out an ultrasound pulse into the water.



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Two echoes are received back, one later than the other.
Explain why. [2]

.....

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.....

.....

4

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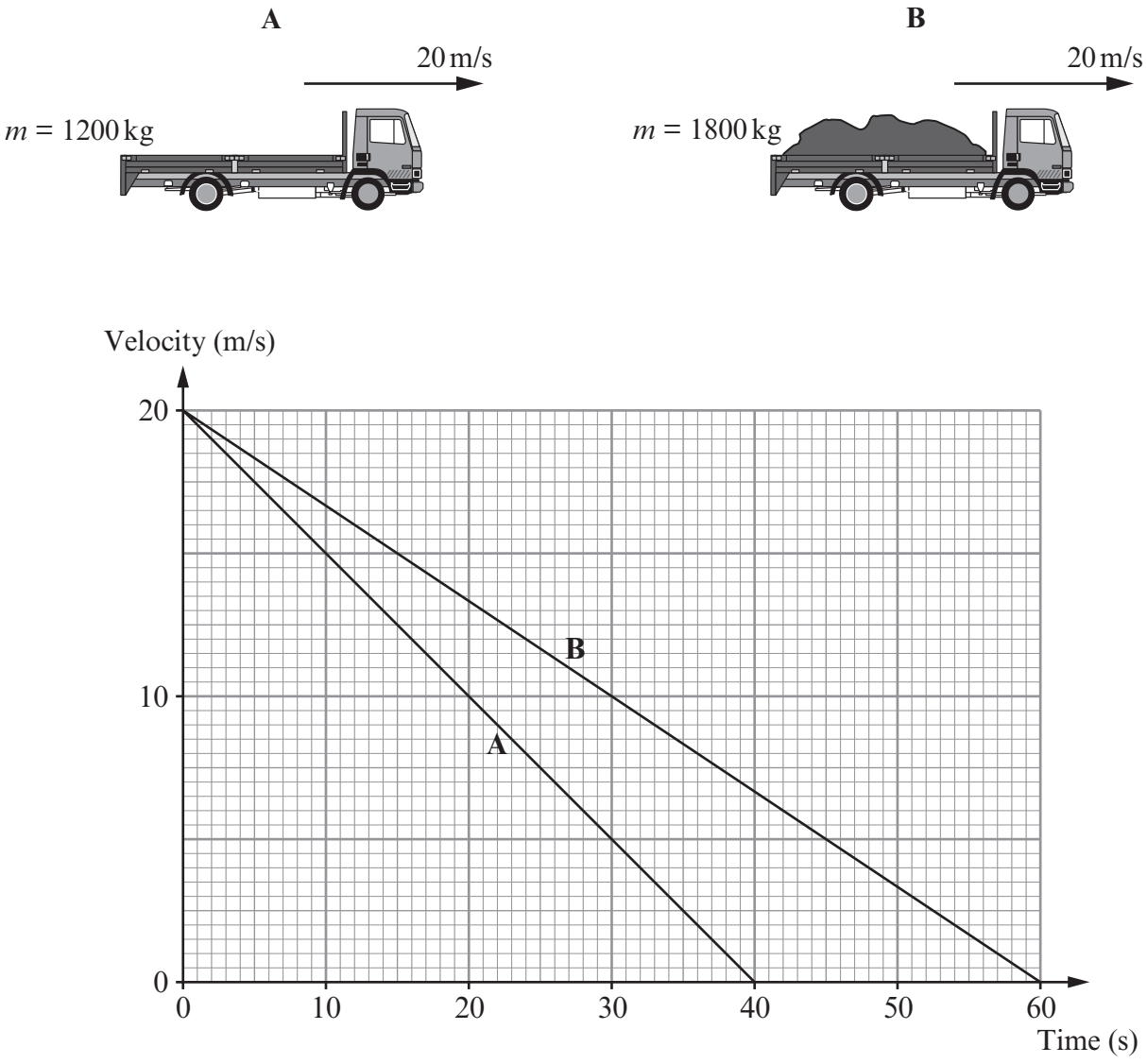
**8.** The diagrams and graphs give information about two lorries, **A** and **B**, coming to rest under the action of the same braking force.




*(a)* Use information from the diagrams and graphs to:

(i) calculate the change in momentum of lorry **B**; [1]

momentum = mass × velocity

Change in momentum of **B** = ..... kg m/s

(ii) explain why **B** took longer than **A** to be brought to rest. [1]

.....

.....

*(b)* Acceleration is the gradient of a velocity-time graph.

(i) Calculate the deceleration of **A**. [2]

Deceleration of **A** = ..... $m/s^2$

(ii) Explain how the graphs show that the deceleration of **B** is less than that of **A**. [1]

.....

.....

5

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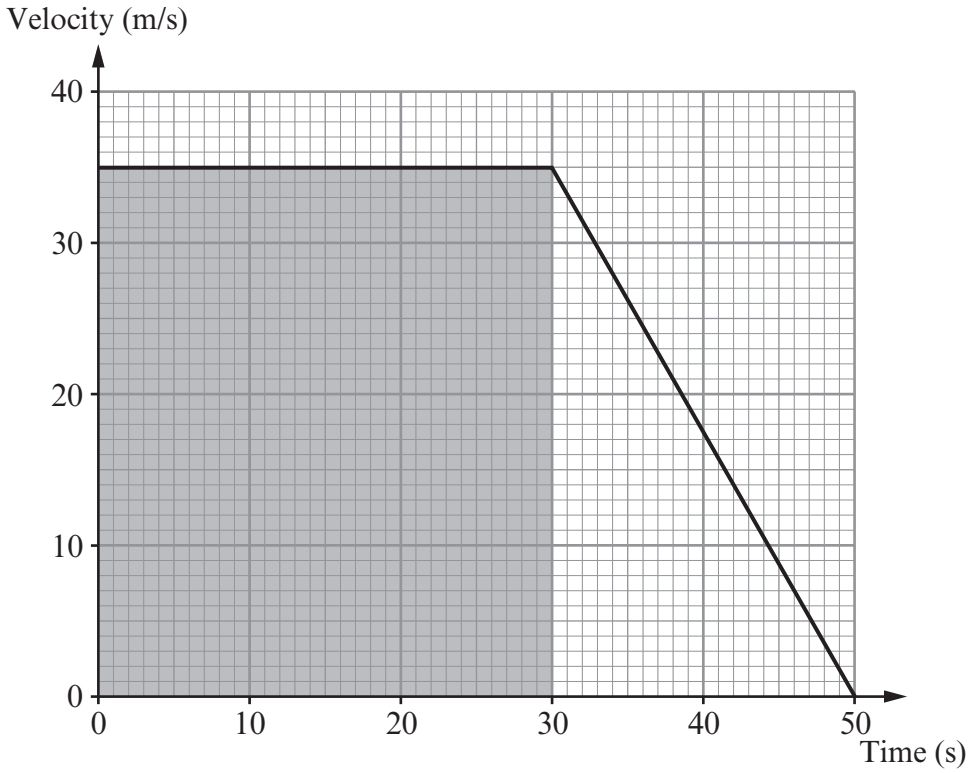
**9.** The graph shows the motion of a motor cyclist along a straight road.




*(a)* Describe clearly what the shaded area represents. [2]

.....

.....

.....

*(b)* (i) Calculate the **total area** under the graph.

Area = ..... m

(ii) Use the equation

$$\text{mean speed} = \frac{\text{distance travelled}}{\text{time taken}}$$

to find the mean speed of the motor cyclist during the 50s of the motion.

Mean speed = ..... m/s
[4]

6

Examiner only

**10.** Read the information carefully before answering the questions.

In a nuclear reactor, uranium-235 undergoes fission by capturing a slow-moving neutron. Large amounts of energy are released together with a number of very fast-moving neutrons. Under certain conditions, the neutrons can keep the reaction going.
The rate of fission can be controlled by raising or lowering boron rods, which readily absorb neutrons. The fuel rods are surrounded by graphite, which slows down the neutrons produced during fission.

*(a)* Explain how the boron rods are used to **increase** the rate of fission in the reactor. [2]

.....

.....

.....

.....

*(b)* (i) What causes uranium-235 to undergo fission? [1]

.....

.....

(ii) Explain why graphite is necessary to the fission process. [1]

.....

.....

4



**Turn over.**

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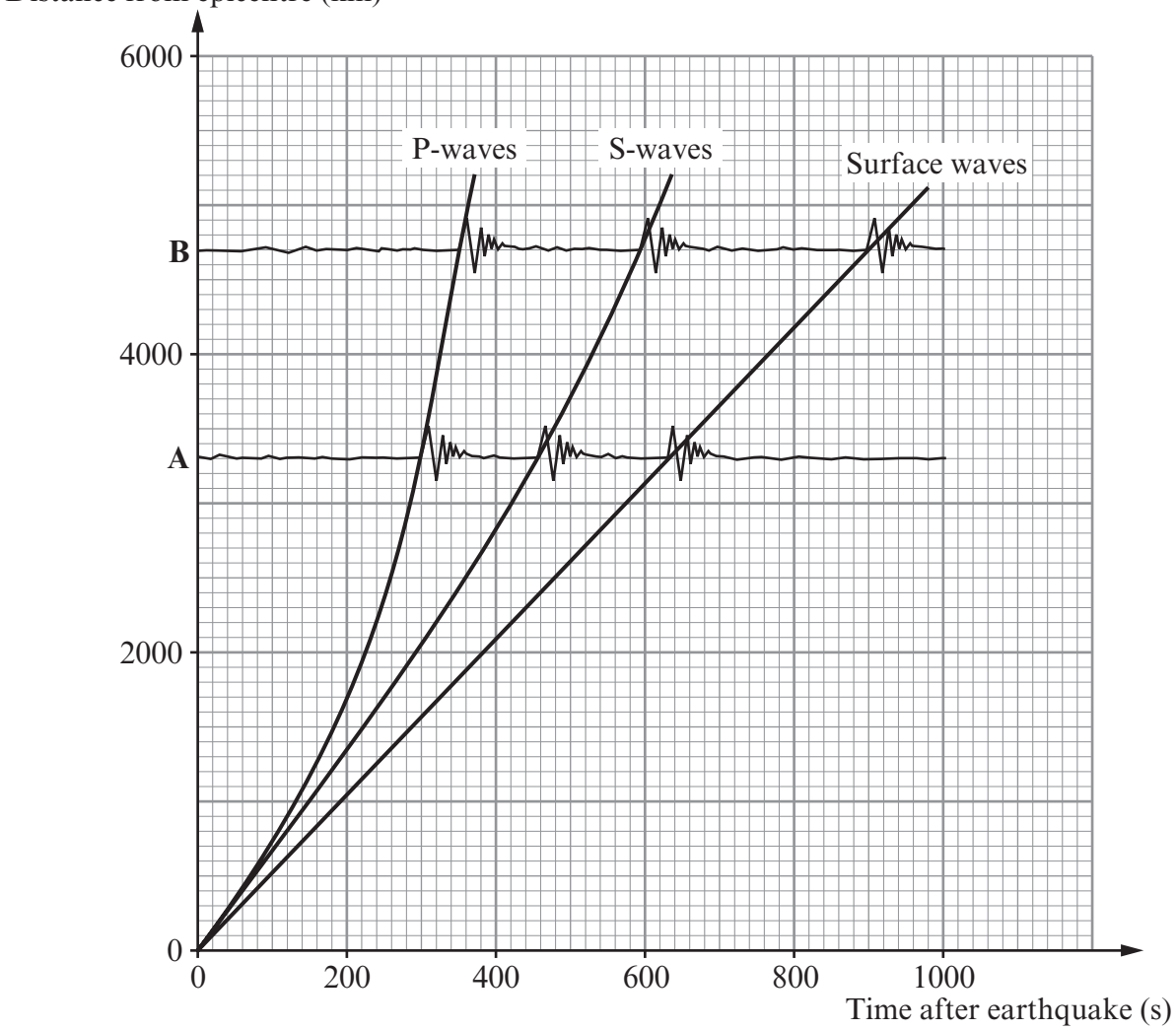
**11.** The graph shows how the **P**, **S** and **Surface waves** spread out from the epicentre of an earthquake.
**A** and **B** are seismic stations.




*(a)* (i) Use the graph to find the time delay between the arrival of the **P** and **S** waves at station **A**, [1]

Time delay = ..... s

(ii) Explain why there is a time delay between the arrival of the **P** and **S** waves at station **A**. [1]

.....

.....

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*(b)* (i) Explain how the graphs show that the speed of the surface waves is constant. [1]

.....

.....

(ii) Explain why **P** and **S** waves change speed as they travel from the epicentre to stations **A** and **B**. [2]

.....

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.....

.....

5