Candidate Name	Centre Number	Candidate Number
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WJEC CBAC

GCSE

247/02

SCIENCE PHYSICS
HIGHER TIER
PHYSICS 3

A.M. FRIDAY, 27 May 2011

45 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark awarded**
1.	**6**	
2.	**4**	
3.	**9**	
4.	**8**	
5.	**8**	
6.	**8**	
7.	**7**	
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

$$\text{speed} = \frac{\text{distance}}{\text{time}}$$

$$v = u + at$$

$$v^2 = u^2 + 2ax$$

$$x = ut + \tfrac{1}{2}at^2$$

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

where x = distance
u = initial velocity
v = final velocity
a = acceleration
t = time

$$\frac{V_1}{V_2} = \frac{N_1}{N_2}$$

where V_1 = voltage across the primary
V_2 = voltage across the secondary
N_1 = number of primary turns
N_2 = number of secondary turns

momentum = mass × velocity

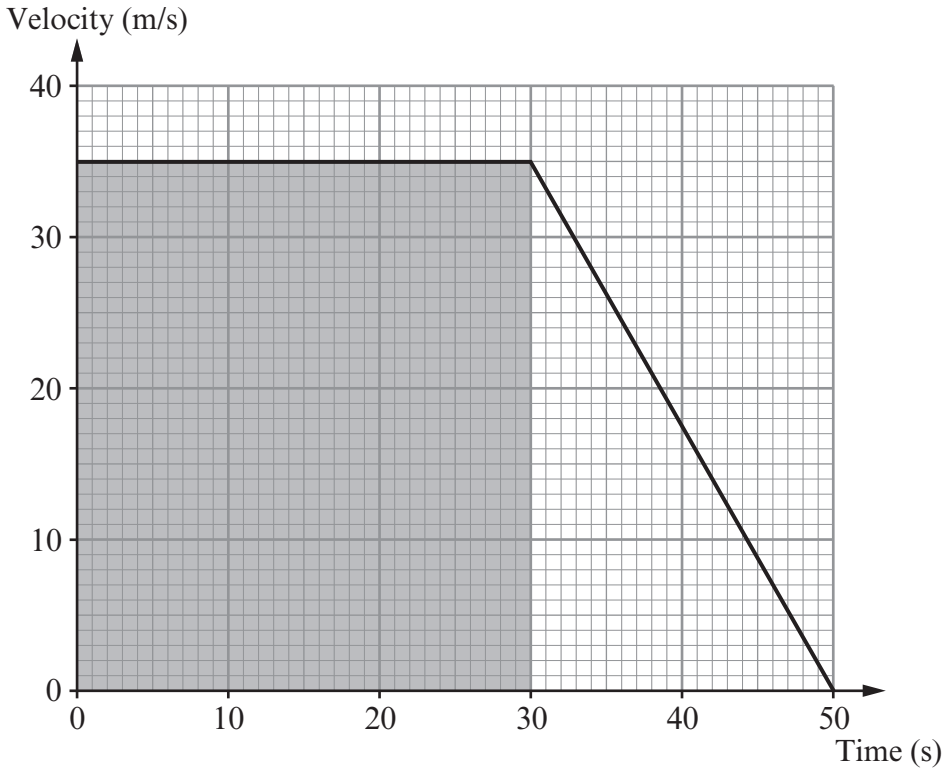
kinetic energy = $\frac{mv^2}{2}$, where m = mass,
v = velocity or speed.

$$\text{force} = \frac{\text{change in momentum}}{\text{time}}$$

wave speed = wavelength × frequency

Answer **all** *questions.*

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



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

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(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 50 s of the motion.

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

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2. 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]

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

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

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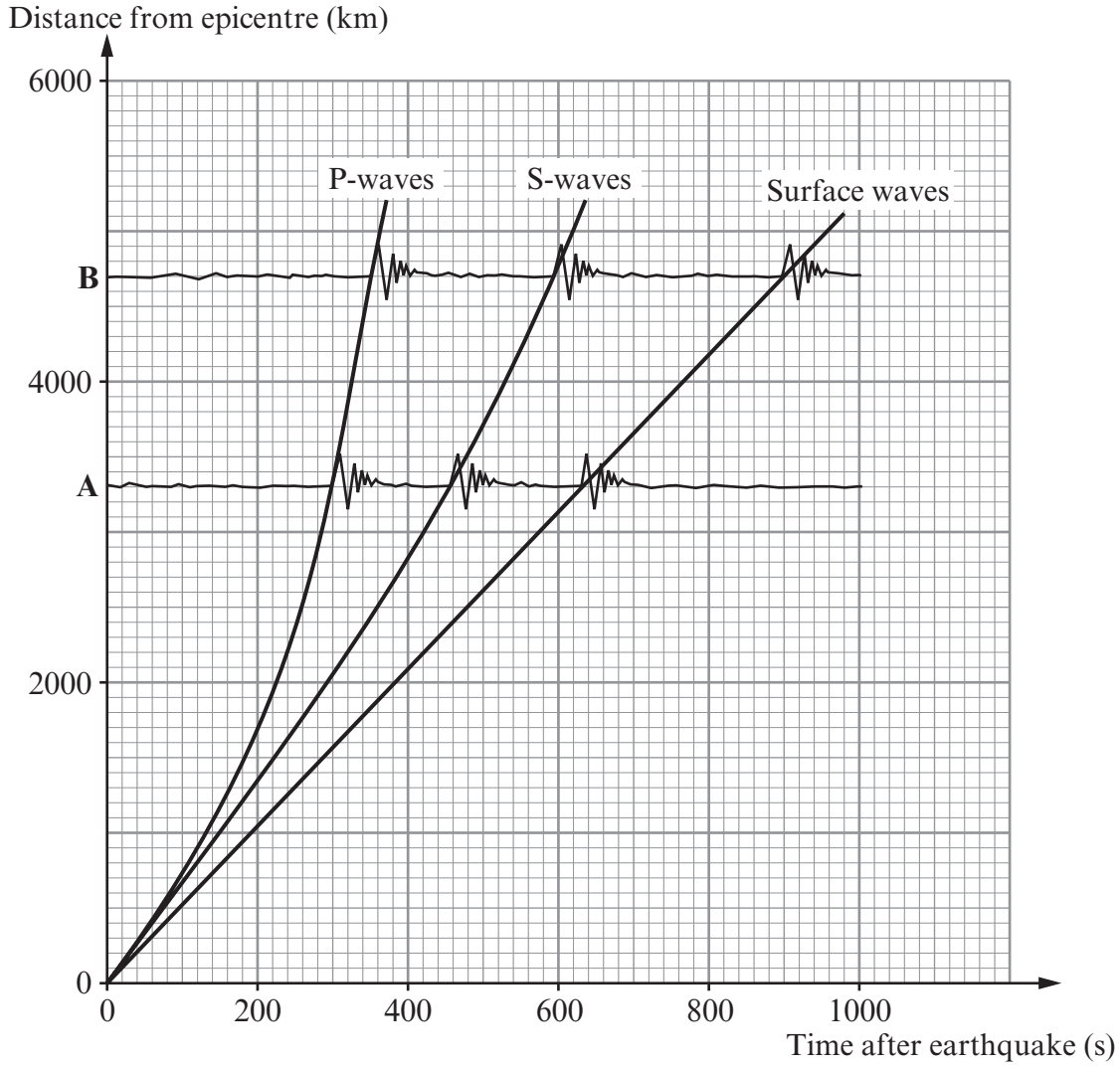
3. The graph shows how the **P**, **S** and **Surface waves** spread out from the epicentre of an earthquake.
A and **B** are seismic stations.



(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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Examiner only

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

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(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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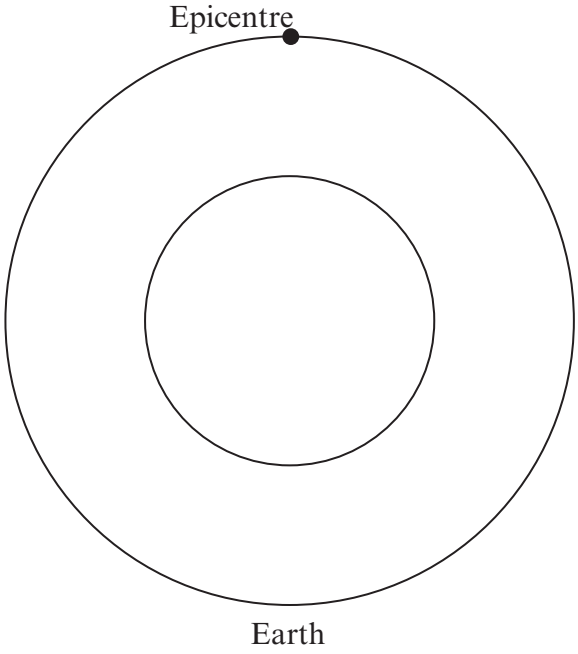
(c) Write a brief account of how the study of the paths of **P** and **S** waves through the Earth has enabled geophysicists to produce a model of the Earth's structure. [4]
[Credit will be given for adding appropriately to the diagram of the Earth to illustrate your answer.]



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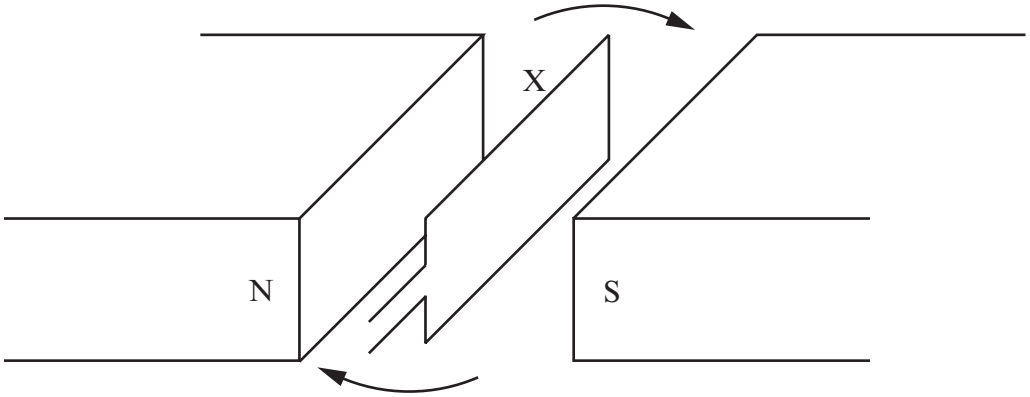
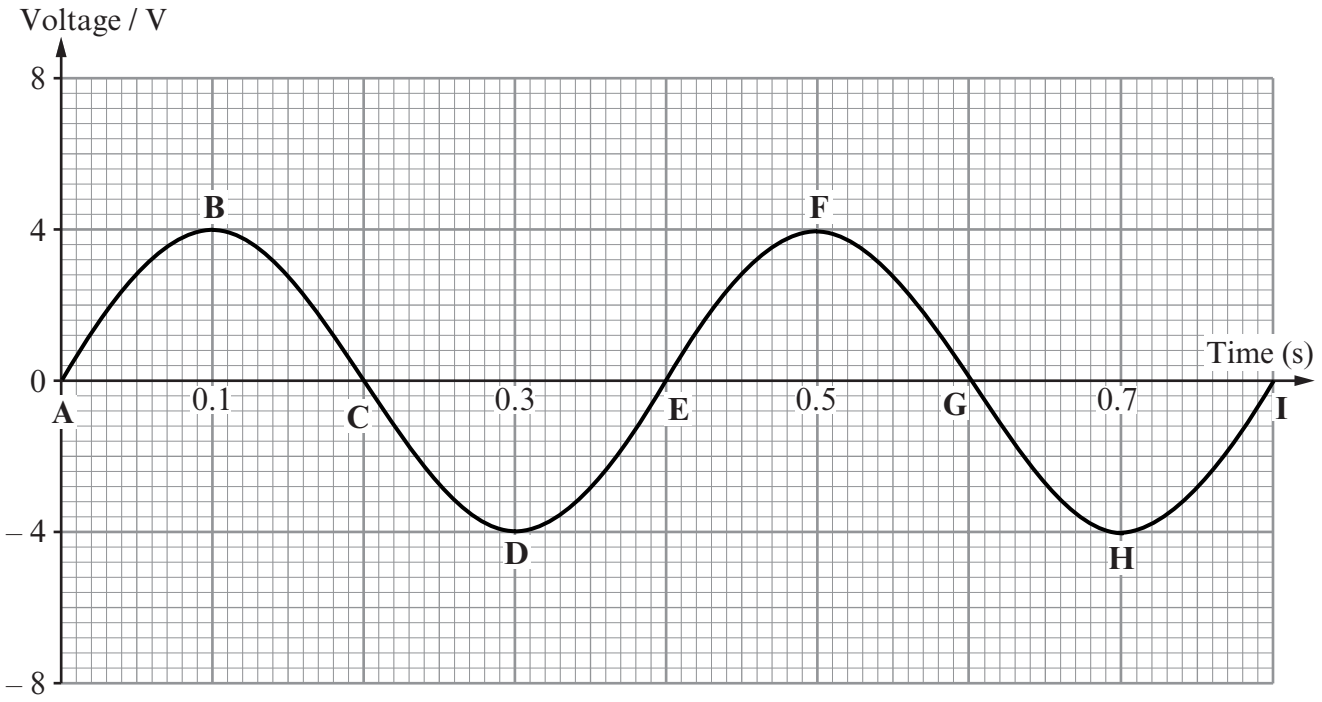
4. The diagram shows a simple a.c. generator. It is a coil of wire which is made to rotate clockwise at constant speed in a magnetic field.



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



(a) Explain why the output varies as the coil rotates. [3]

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(b) When wire X is in the position shown in the diagram the output voltage produced is shown by points **A**, **E**, and **I**.

(i) State **one** point of the voltage graph which gives the output voltage when the coil is horizontal with wire X near the South pole.

..... [1]

(ii) Describe the position of the coil and wire X that gives an output voltage that corresponds to point **G**. [1]

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(c) **Draw a graph on the same grid** to show the output voltage produced when the speed of rotation of the coil is doubled. [3]

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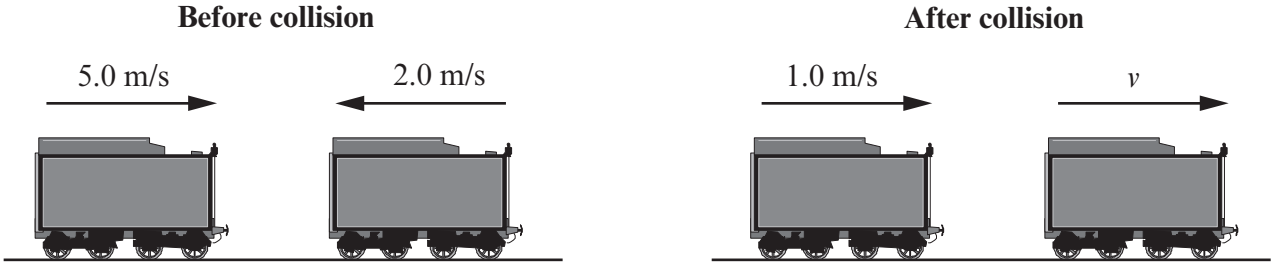
5. Two trucks, **A** and **B**, each of mass 5 000 kg, collide as shown in the diagrams.



(a) (i) The momentum of a body is given by

$$\text{momentum} = \text{mass} \times \text{velocity}.$$

State the law of conservation of momentum and use it to calculate the velocity, v, of truck **B** after the collision. [3]

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v = ... m/s

(ii) The duration of the collision is 0.4 s.
Use the equation

$$\text{Force} = \frac{\text{change of momentum}}{\text{time}}$$

to calculate the force exerted by truck **A** on truck **B** during the collision. [2]

Force = ... N

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(b) (i) Calculate the kinetic energy lost by truck **A** during the collision. [1]

$$\text{Kinetic energy} = \frac{\text{mass} \times \text{velocity}^2}{2}$$

Kinetic energy lost = ... J

(ii) Explain what has happened to this lost kinetic energy. [2]

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6. *(a)* The equation represents the decay of iodine-131 by β emission to Xenon-131.

$$^{131}_{53}\mathrm{I} \longrightarrow {}^{131}_{54}\mathrm{Xe} + {}^{0}_{-1}\beta$$

Compare the nuclei of I-131 and Xe-131 in terms of their charge, mass and their constituent particles. [3]

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(b) The table shows a decay series for radon-222.

Element	Nuclear Symbol	Radioactive emission
Radon	$^{222}_{86}\mathrm{Rn}$	α
Polonium	$^{218}_{84}\mathrm{Po}$	α
Lead	.....$_{82}\mathrm{Pb}$	β
Bismuth	^{214}..... Bi	.....
Polonium	.....$_{84}\mathrm{Po}$	α
Lead	$^{210}_{82}\mathrm{Pb}$	stable

(i) **Complete the table** by filling in the gaps. [4]

(ii) Two of the nuclei in the series are isotopes of Polonium.
Explain the meaning of the term *isotope*. [1]

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QUESTION 7 IS ON PAGE 14

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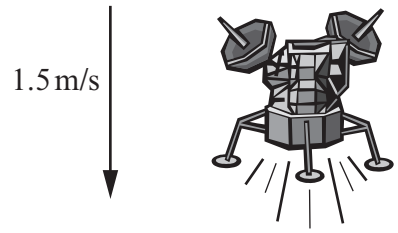
7. The diagram shows a lunar module descending at a constant speed of 1.5 m/s under the action of retrorockets.



surface of the moon

Three seconds before landing, the retrorockets are switched off and the lunar module falls to the surface with an acceleration of 1.6 m/s^2.

(a) Select an equation from page 2 and use it to show that the height of the lunar module above the surface when the retrorockets are switched off is 11.7 m.

Equation: .....

..... [1]

Calculation: [2]

(b) Complete the table and graph to show how the height of the lunar module changes in the last 3 seconds of its motion. [4]

Time after rockets switched off (s)	0.0	1.0	2.0	3.0
Distance moved by lunar module towards moon's surface (m)	0.0	.....	.....	11.7
Height above surface (m)	11.7	.....	.....	0.0

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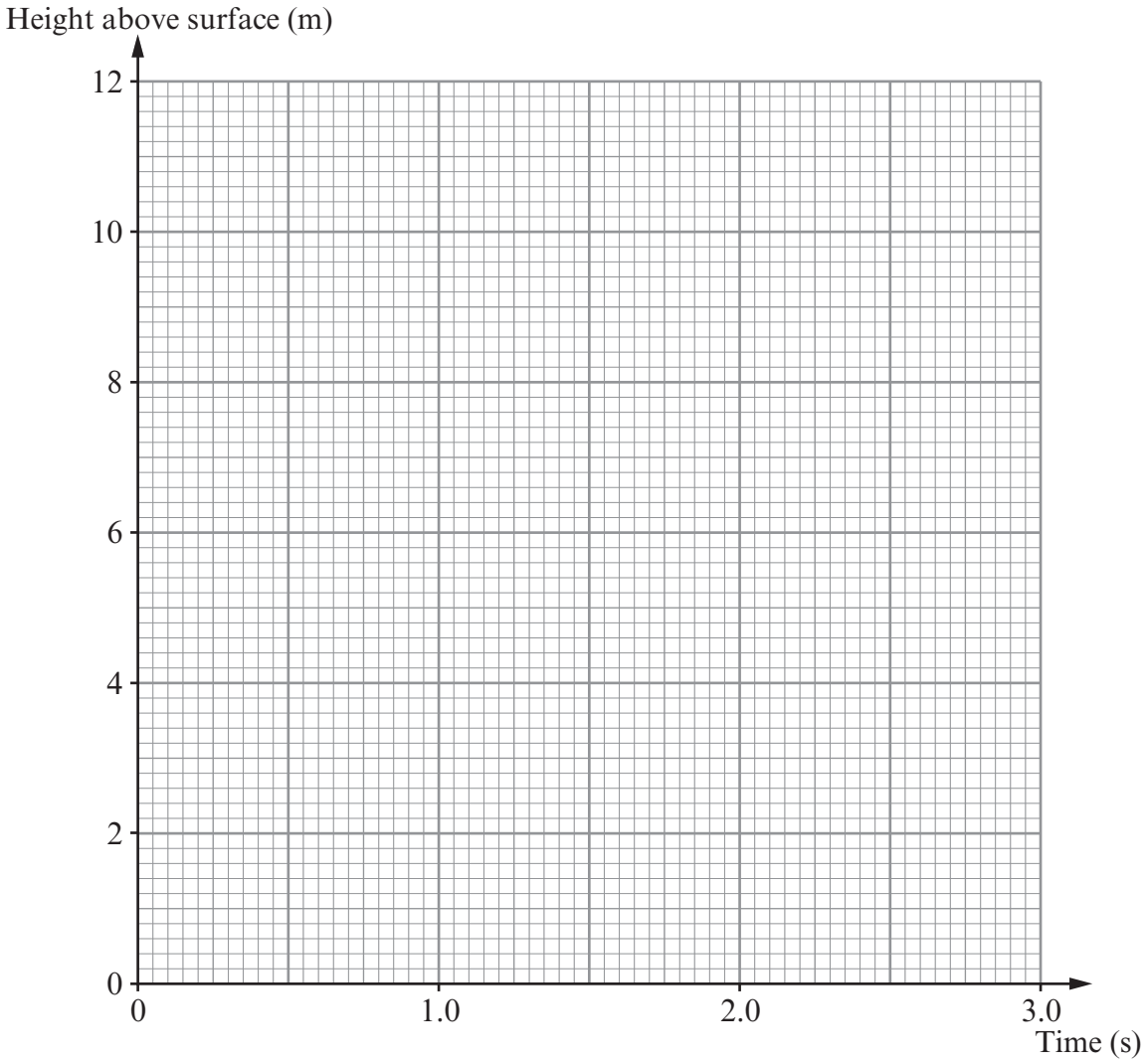

Space for working:

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