



General Certificate of Secondary Education
2018

Centre Number

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Candidate Number

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GCSE Physics

Unit 1

Higher Tier



[GPH12]

GPH12

FRIDAY 15 JUNE, MORNING

TIME

1 hour 30 minutes.

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 outside the boxed area on each page or on blank pages.

Complete in black ink only. **Do not write with a gel pen.**

Answer **all six** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 100.

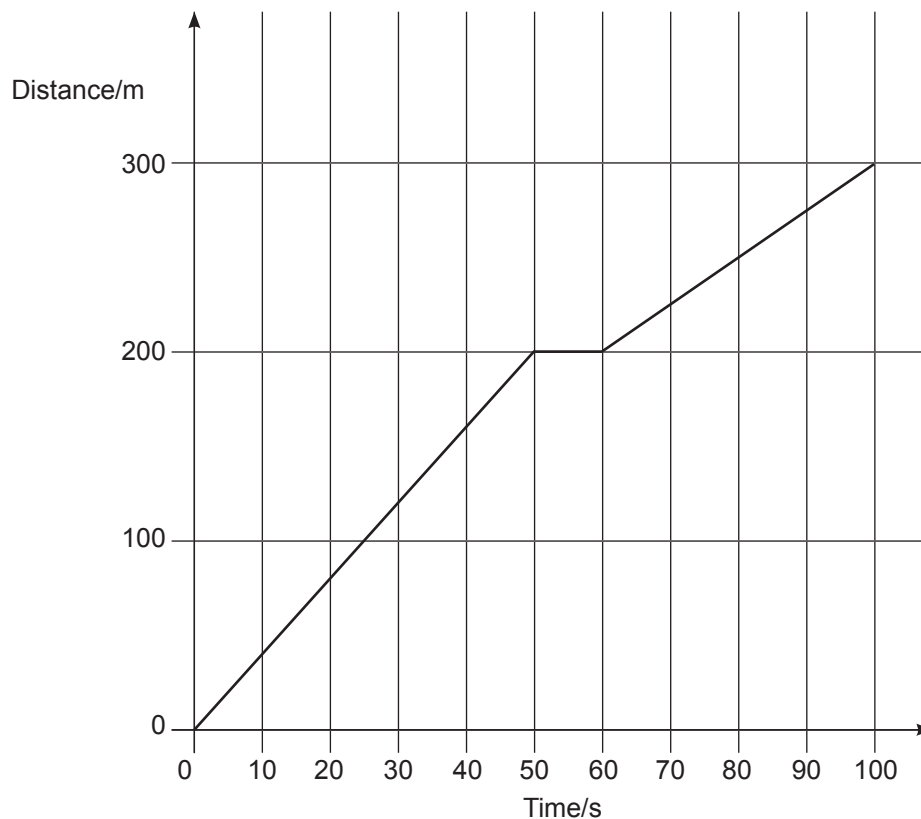
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.

Quality of written communication will be assessed in Questions **2(b)** and **4(a)**.



- 1 (a) The driver of a car goes on a journey.

The distance–time graph for this journey is shown below.



- (i) Calculate the average speed of the car for the whole journey.

Remember to include the correct unit in your answer.

You are advised to show clearly how you get your answer.

Average speed = _____ [4]



- (ii) On the grid opposite, draw the distance–time graph you would obtain if the car had been driven a distance of 200 m at constant speed in a time of 90 seconds.

[2]

- (b) A ball is allowed to roll down a slope several metres long.

The slope has markings **1 m apart** on its surface.

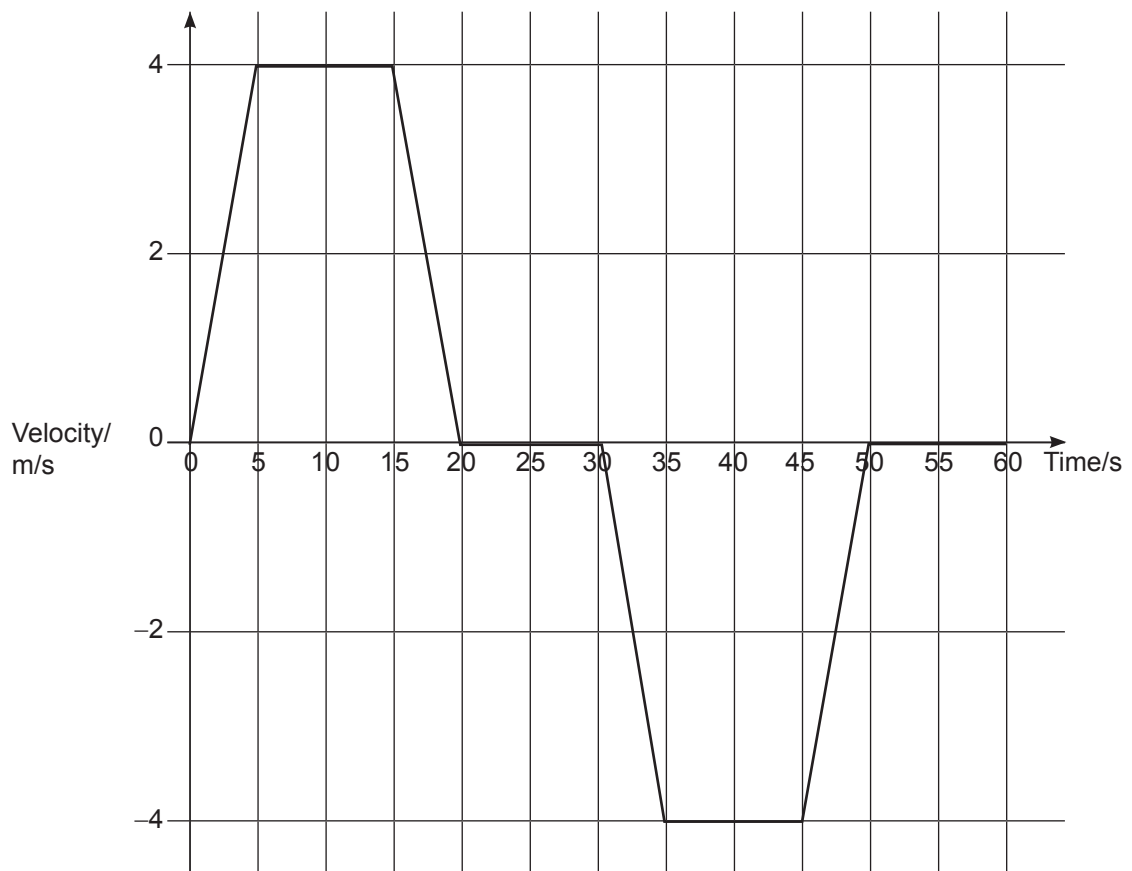
Describe how you would use a stopclock to show that the ball is accelerating.

State how your measurements would show that the ball is accelerating.
What would you do to improve the reliability of any measurements?

[3]



- (c) The graph below shows how the velocity of a lift changes as it moves from the ground floor of a building to the top floor and returns to the ground floor.



- (i) Using the graph calculate the acceleration of the lift during the first 5 s of the motion.

You are advised to show clearly how you get your answer.

Acceleration = _____ m/s² [2]



- (ii) Using the graph calculate the distance the lift travels from the ground floor to the top floor of the building.

You are advised to show clearly how you get your answer.

Distance = _____ m [3]

- (iii) Explain why the **average velocity** of the lift during the 60 s shown on the graph is zero.

[1]

[Turn over



(d) A car accelerates from rest at 1.2 m/s^2 .

(i) Calculate the velocity of the car after 8.0 s.

You are advised to show clearly how you get your answer.

Velocity = _____ m/s [2]

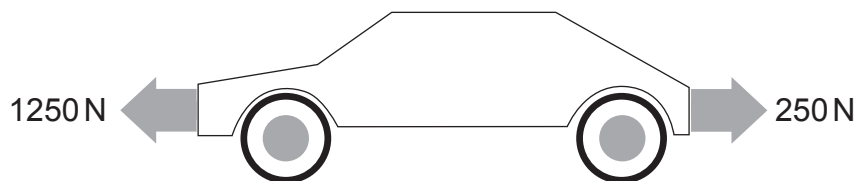
(ii) Calculate the distance the car has travelled after 8.0 s.

You are advised to show clearly how you get your answer.

Distance = _____ m [3]



- 2 (a) The diagram shows a car moving along a straight level road. The arrows show the two horizontal forces acting on the car. The mass of the car is 750 kg.



Source: Chief Examiner

- (i) Calculate the acceleration of the car.

You are advised to show clearly how you get your answer.

Acceleration = _____ m/s² [4]

When travelling at 20 m/s the car above, of mass 750 kg, collides with a stationary car of mass 1250 kg. After collision the two cars stick together and move along the road.

- (ii) Calculate the velocity of the two cars after collision.

You are advised to show clearly how you get your answer.

Velocity after collision = _____ m/s [4]

[Turn over]



(b) Modern cars are fitted with crumple zones at the front and at the rear.

In this question you will be asked to explain how crumple zones improve safety in cars during a collision. You should use the concepts stated below to explain your answers.



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

Why is it important that crumple zones are made from a flexible material?

Write down the equation that connects momentum change, force and time. Use the equation to explain how the forces that arise during the collision are affected by having a crumple zone.



A moving car has a lot of kinetic energy. During a collision the forces acting on the car work in stopping the car.

Write down the equation for work done.

Use the equation to explain how the forces that arise during the collision are affected by having a crumple zone.

When moving, the car has a lot of kinetic energy. When the car comes to a halt its kinetic energy is zero. State the Principle of Conservation of Energy and describe how it applies to this collision.

[6]

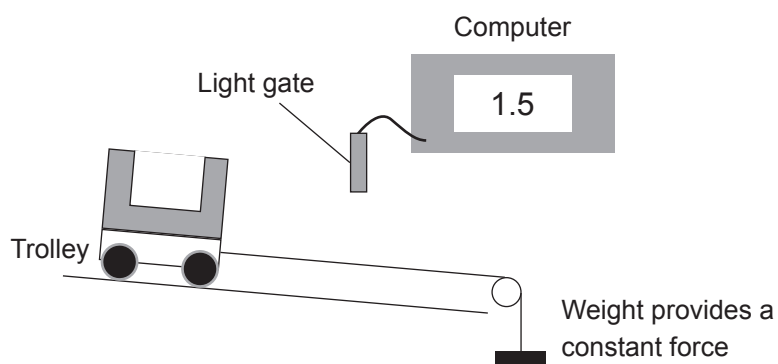
[Turn over



- (c) To investigate how the acceleration of a trolley down a slope depended on the mass of the trolley, the apparatus shown below was set up.

The trolley was pulled along by a constant force.

The acceleration was measured using a light gate connected to a computer.



Source: Chief Examiner

The results of the experiment are shown in the table below.

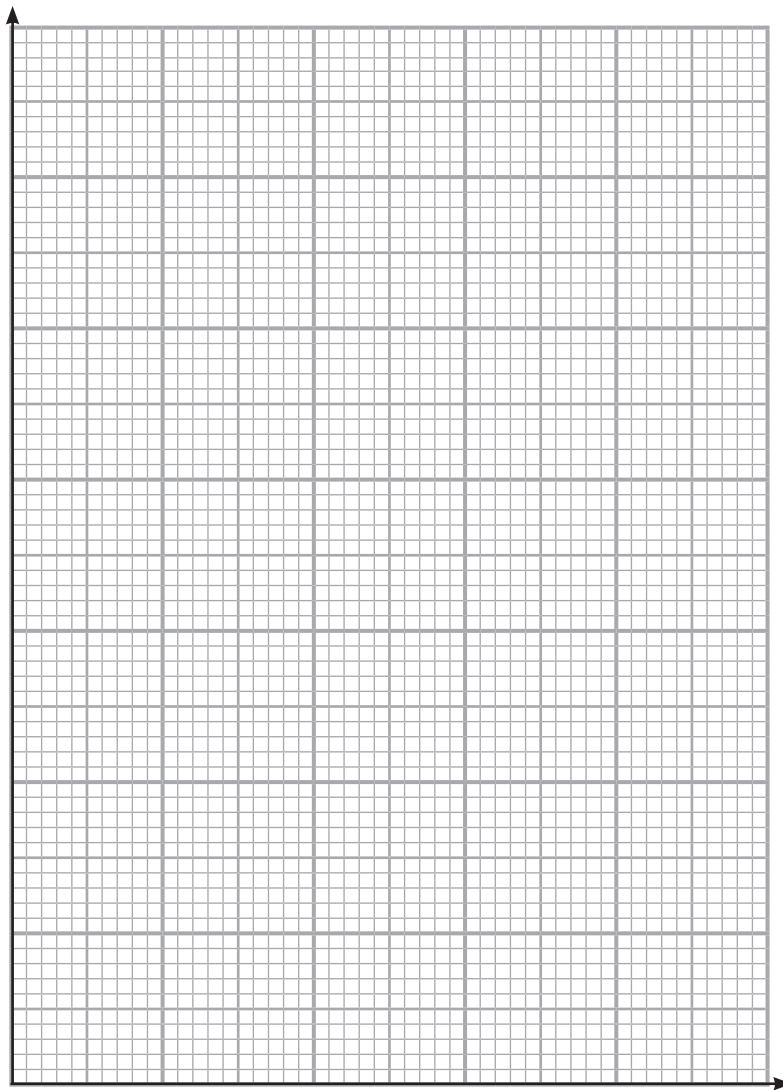
Mass of the trolley/kg	0.5	1.0	1.5	2.0
Acceleration/m/s ²	1.2	0.6	0.4	0.3

- (i) What could the person performing this experiment do to improve the reliability of the measurements?

_____ [1]

- (ii) On the grid opposite plot a graph of the mass of the trolley (x-axis) and acceleration (y-axis). Draw a curve of best fit through the points. [4]





- (iii) Which of the following relationships between the mass of the trolley and the acceleration of the trolley is indicated by this graph?

Tick (✓) the correct answer.

Acceleration increases as the mass of the trolley increases

☐

Acceleration decreases as the mass of the trolley increases

☐

Acceleration is not affected by the mass of the trolley

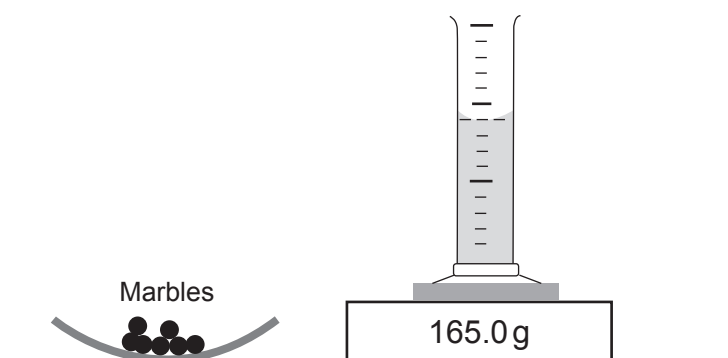
☐

[1]

[Turn over



- 3 (a) A student was asked to find the density of glass used in the manufacture of marbles. The student decided to measure the volume of the marbles using the Displacement of Water method and used the equipment shown below.



The measuring cylinder was partly filled with water and then placed on the electronic scales. Marbles were added to the cylinder. The measurements taken by the student are shown below.

Mass of the cylinder + water	= 165.0 g
Mass of the cylinder + water + marbles	= 265.0 g
Volume of water in the measuring cylinder	= 60.0 cm ³
Volume of water + marbles	= 100.0 cm ³

- (i) Using the measurements above calculate the density of the glass.

Include the unit for density with your answer.

You are advised to show clearly how you get your answer.

Density of glass = _____ [4]



- (ii) State how the student should accurately read the volume of water in the measuring cylinder.

[1]

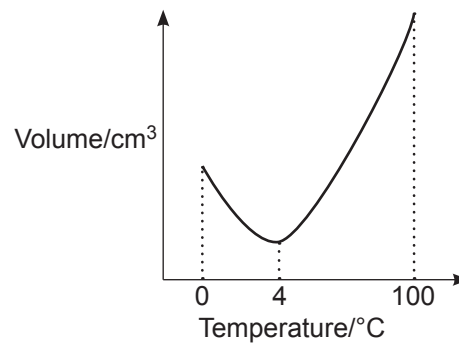
- (b) Using kinetic theory describe carefully the difference between the motion of the molecules in the water and in the glass.

[3]

[Turn over]



- (c) The volume of water was measured as it was cooled.
The results of this investigation are shown in the graph below.



- (i) Describe what happens to the volume of water as it cools from 100 °C to 0 °C.

[2]

- (ii) Use your answer to (i) to describe what happens to the density of water as it cools from 100 °C to 0 °C.

[2]



- 4 (a) Describe, in detail, how you would measure the personal power of a student of known weight.

In your description you should state:

- what apparatus you would use;
- what measurements you would make;
- how you would use these measurements to calculate the student's power.

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

Apparatus:

Measurements:

Calculation:

[6]

[Turn over



The production of methane gas from grass in biodigesters is increasing in Northern Ireland. The methane gas produced is then burned to produce heat energy.

One advantage of producing methane from grass is that it conserves fossil fuels.

- (b) (i) State another advantage, not related to cost, of producing methane from grass.

_____ [1]

- (ii) State an environmental disadvantage of producing methane from grass.

_____ [1]

- (iii) What type of energy is possessed by methane gas?

_____ [1]

The methane produced is sometimes burned in a gas-fired boiler to produce hot water. A particular boiler produces 2.4 MJ of useful heat energy.

- (iv) Calculate the amount of energy in the methane which is **wasted** if the efficiency of the boiler is 0.8.

You are advised to show clearly how you get your answer.

Wasted energy = _____ MJ [4]



- (c) A moving train has a kinetic energy of $8.1 \times 10^6 \text{ J}$.

The train makes an emergency stop.

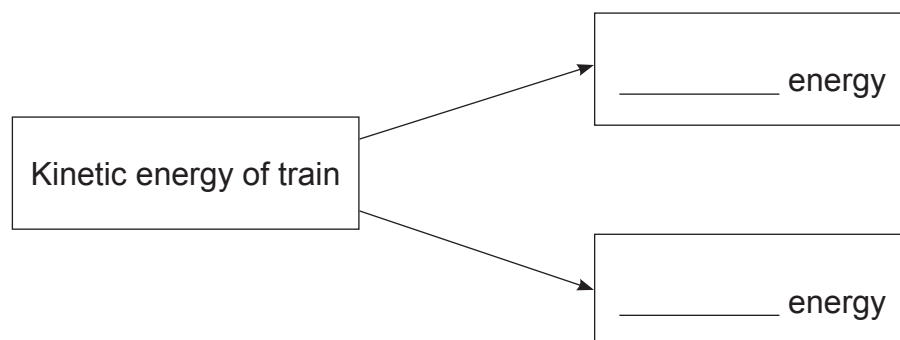
It decelerates to rest in a distance of 270 m.

- (i) Calculate the average friction force provided by the brakes.

You are advised to show clearly how you get your answer.

Average friction force = _____ N [4]

- (ii) Complete the energy flow diagram below to show the **main** energy changes taking place in the brakes.



[1]

[Turn over]



- 5 (a) Complete the sentence below to explain what physicists mean by the centre of gravity of an object.

The centre of gravity is the point where

_____ [1]

- (b) A student writes:

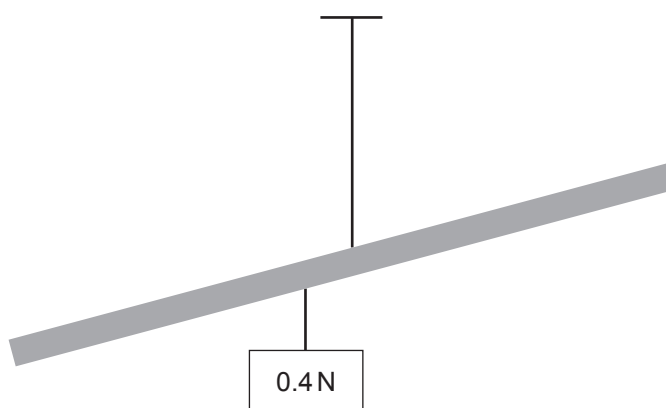
“The Principle of Moments states that the sum of the clockwise moments is always equal to the sum of the anticlockwise moments.”

The student has made two significant omissions.

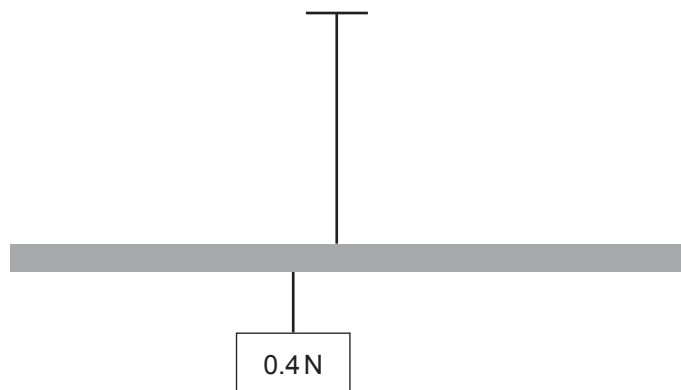
Rewrite the Principle of Moments correcting these mistakes.

_____ [2]

- (c) A weight of 0.4 N is suspended from a uniform metre rule at the 40 cm mark. The rule is suspended **from its midpoint** by a short length of string as shown in the diagram below.



The point of suspension is now moved 2 cm from the midpoint and the metre rule settles in equilibrium.



- (i) State the distance between the position of the 0.4 N weight and the new point of suspension.

Distance = _____ cm [1]

- (ii) Use the Principle of Moments and your answer to (i) to calculate the weight of the metre rule.

You are advised to show clearly how you get your answer.

Weight of metre rule = _____ N [3]

- (iii) Use your answer to (ii) to find the tension in the string supporting the metre rule.

Tension = _____ N [1]

[Turn over



(iv) The string supporting the 0.4 N weight is now cut using a pair of scissors.

Calculate the resultant moment on the rule about the point of suspension and give its unit.

State also the direction of the moment.

You are advised to show clearly how you get your answer.

Moment = _____ [3]

Direction = _____ [1]



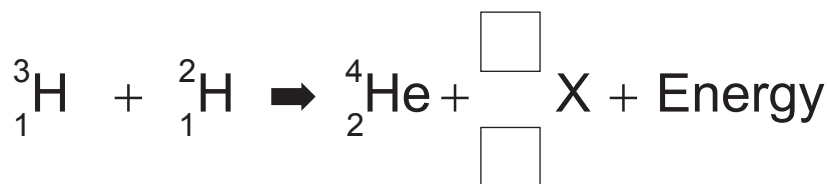
- 6 (a) (i) Name the two processes by which energy can be produced using nuclear reactions.

1. _____

2. _____

[2]

One of the nuclear processes is represented by the nuclear equation shown below.



- (ii) Complete the nuclear equation by filling in the missing numbers in the boxes.

[2]

- (iii) Name the particle labelled X in the equation.

Particle X is _____ [1]

- (iv) ${}^3_1\text{H}$ and ${}^2_1\text{H}$ are both isotopes of hydrogen.

Explain, in terms of the particles that make up the nuclei of hydrogen, what an isotope is.

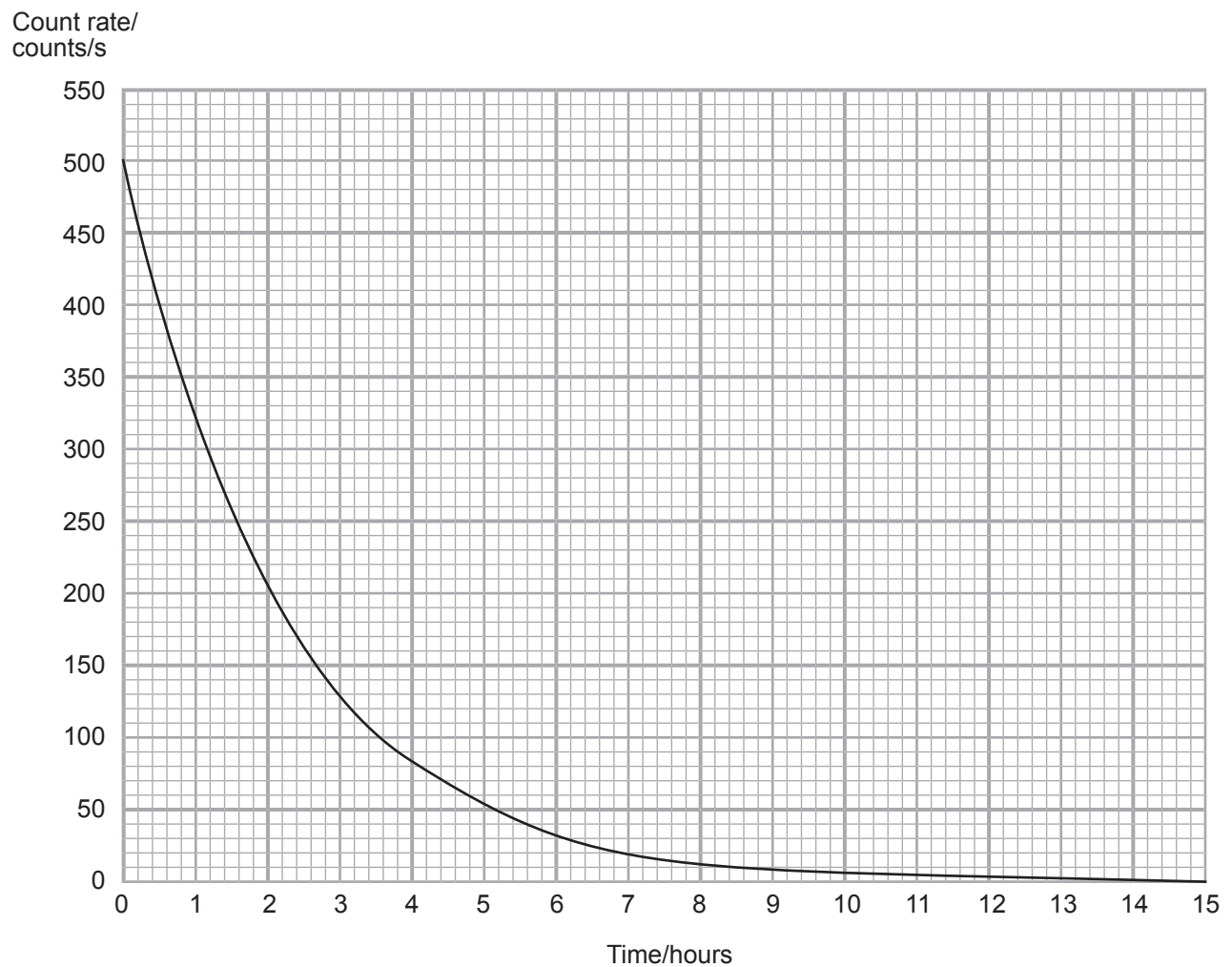
_____ [2]

[Turn over]



(b) An experiment was completed to measure the half-life of a radioactive source.

The count rate in counts per second was recorded at set time intervals and used to plot a decay graph as shown below.



- (i) Explain how the readings would have been adjusted to allow for background count.

[1]

- (ii) Using the graph find a value for the half-life of the radioactive source.

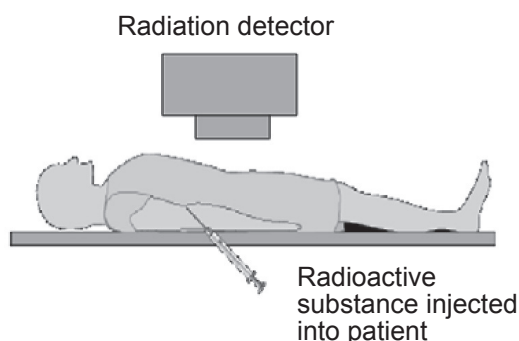
You are advised to show clearly how you get your answer.

Half-life = _____ hours [3]

[Turn over]



- (c) All of the organs in the human body are supplied with blood. Unfortunately, on occasion, some blood vessels rupture and internal bleeding occurs. If this happens it is necessary to locate the bleed and have it attended to.



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One of the techniques used in hospital is to inject a radioactive substance into the blood and scan the body with a radiation detector.

- (i) Which type of radiation (alpha, beta or gamma) should be used?
Give a reason for your answer.

Type of radiation _____

Explanation _____

_____ [2]



- (ii) How would the hospital technician know the region in which the bleed is occurring?

 [1]

Several radioactive substances are available with different half-lives.
They are listed in the table below.

Radioactive substance	Half-life
A	30 seconds
B	6 hours
C	20 days

- (iii) Which source would you recommend to be used?
Give an explanation for your choice.

Radioactive substance _____

Explanation _____

 [3]

[Turn over



(iv) State one precaution that should be taken when working with a radioactive substance before it is injected into the patient.

[1]

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Question Number	Marks
1	
2	
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Examiner Number

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