Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2013

Science: Physics

Unit P1

Higher Tier

[GPH12]

GPH12

THURSDAY 13 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 box, around each page or on blank pages.
Complete in blue or 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 question **3(e)**.

Examiner Only	
Marks	Remark

1 **(a)** A boat is pulled up a slipway. It has a mass of 2000 kg and it moves at a steady speed of 3 m/s.

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(i) Calculate the kinetic energy of the boat.

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

Kinetic energy = _____ J [3]

(ii) To pull the boat 50 m up the slipway 50 000 J of work is needed.

Calculate the force needed to do this.

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

Force F = _____ N [3]

(iii) At the top of the slipway the boat has gained 30 000 J of potential energy.

Calculate the vertical height through which the boat has been raised.

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

Vertical height = _____ m [3]

(iv) At the top of the slipway the boat is allowed to slide down. On its way down it **loses 2000 J** of energy in the form of heat and sound.

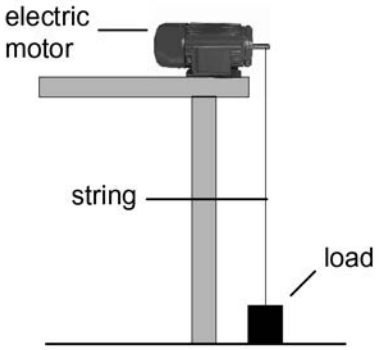
Calculate the speed of the boat as it enters the water at the bottom of the slipway.

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

Speed = _____ m/s [3]

Examiner Only	
Marks	Remark

(b) (i) To measure the output power of a small electric motor the apparatus shown opposite was set up. Describe the measurements that should be taken and the equipment used to make the measurements. State how the measurements are used to calculate the output power of the motor. Describe one step that should be taken to improve the reliability of the calculated value.



Examiner Only	
Marks	Remark

[6]

(ii) In order to determine the efficiency of the motor what additional piece of information is needed?

_____

_____ [1]

(iii) A student calculated the efficiency of a particular motor to be 1.5 (150%). Explain why this is **incorrect**.

_____

_____ [1]

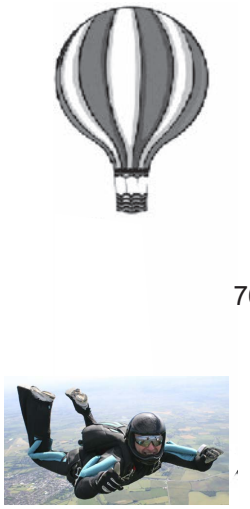
Examiner Only	
Marks	Remark
Total Question 1	

Examiner Only	
Marks	Remark

2 **(a)** A skydiver falls from a hot air balloon.
During the first 4 seconds she falls a distance of 76 m.

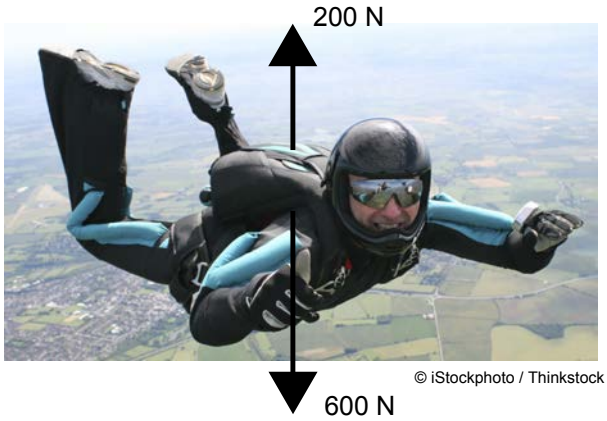
(i) Calculate her average speed during this time.

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



Average speed = _____ m/s [3]

(ii) The diagram below shows the two forces acting on the skydiver.
Using this information calculate the mass of the skydiver.



Mass of the skydiver = _____ kg [2]

(iii) Using your answer to part **(ii)** and information shown on the diagram calculate the acceleration of the skydiver.

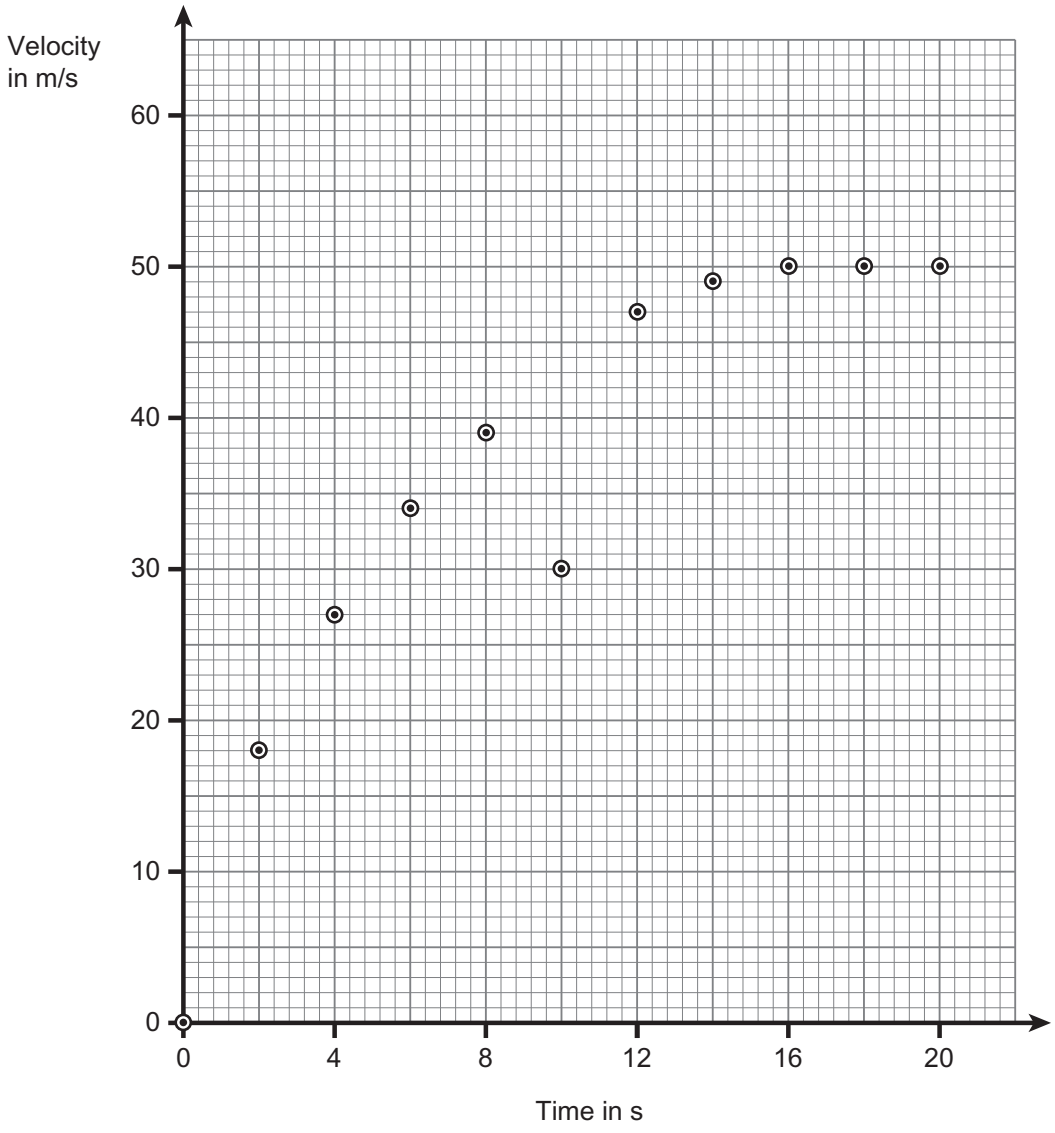
You are advised to show clearly how you get your answer.

Examiner Only	
Marks	Remark

Acceleration = _____ m/s^2 [3]

[Turn over

(b) The downward velocity of the skydiver is measured at intervals from the moment she begins to fall. The results are shown in the graph below.



(i) Circle the measurement plotted on the graph that appears to be in error. [1]

(ii) Draw the curve of best fit through the points. [1]

Examiner Only	
Marks	Remark

(iii) Calculate the skydiver's acceleration during the first 2 seconds of her fall.

Acceleration = _____ m/s^2 [2]

(iv) How does this graph show that the acceleration of the skydiver is decreasing?

_____

_____ [2]

(v) At what time did the acceleration of the skydiver become zero?

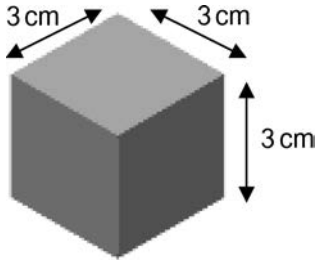
_____ [1]

Examiner Only	
Marks	Remark
Total Question 2	

[Turn over

Examiner Only	
Marks	Remark

3 **(a)** A metal **cube** has each side of length 3.0 cm and a mass of 240.3 grams.

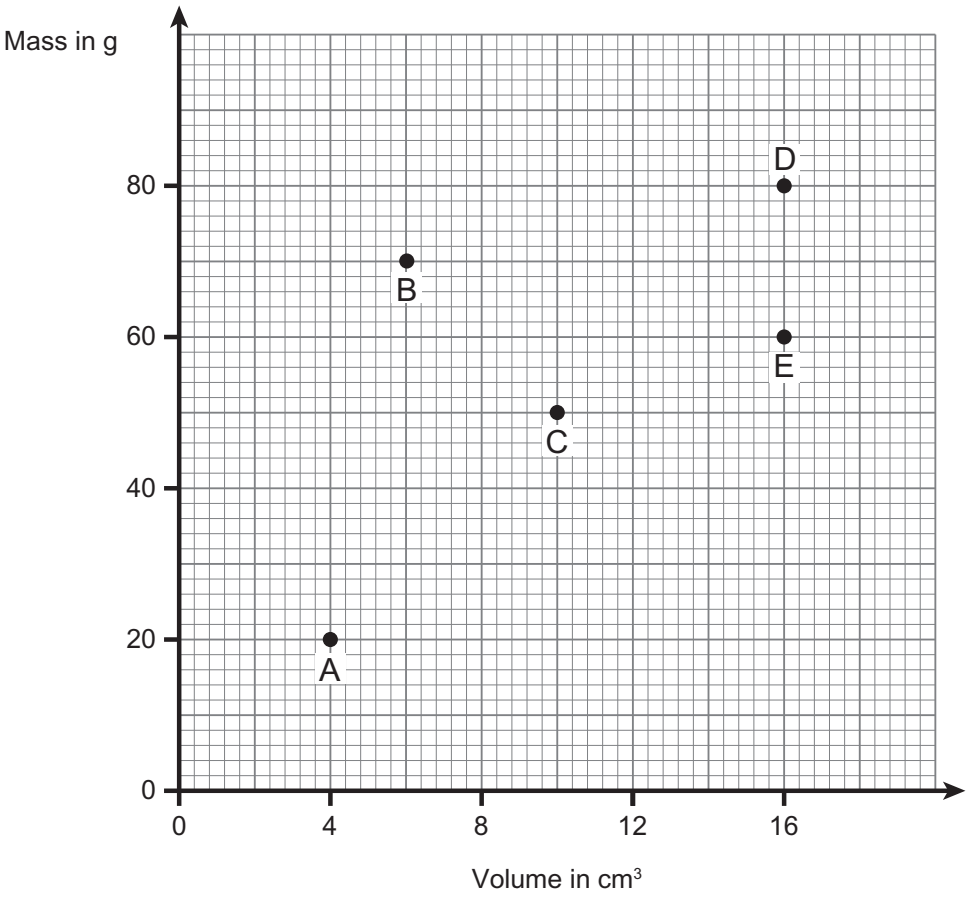


Calculate the density of the metal.

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

Density = _____ g/cm^3 [4]

(b) The mass and volume of five blocks were measured.
The values were then plotted on the grid shown below.
The letters correspond to each of the five blocks.



Which blocks are made of the same material?
Explain your answer **carefully**.

Blocks _____

Explanation _____

_____

_____

_____ [4]

Examiner Only	
Marks	Remark

[Turn over

(c) Describe briefly what happens to the molecules in a solid when it changes into a liquid.

_____

_____

_____ [2]

(d) A volume of 500 cm^3 of water has a mass of 500 g.
Pat was given a quantity of salt and told to add enough of the salt to the water to increase the density of water to 1.1 g/cm^3.
Calculate the mass of salt needed.
Assume that adding salt does not change the volume of the water.

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

Mass of salt = _____ g [4]

Examiner Only	
Marks	Remark

(e) Mary has a necklace which she believes to be gold.
To find if it is made of gold she decides to measure the density of the metal from which it is made.
Describe, in detail, what she needs to do to measure the density of the metal used to make the necklace.

In your description you should state one precaution she should take to ensure that the density she obtains is as accurate as possible.

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

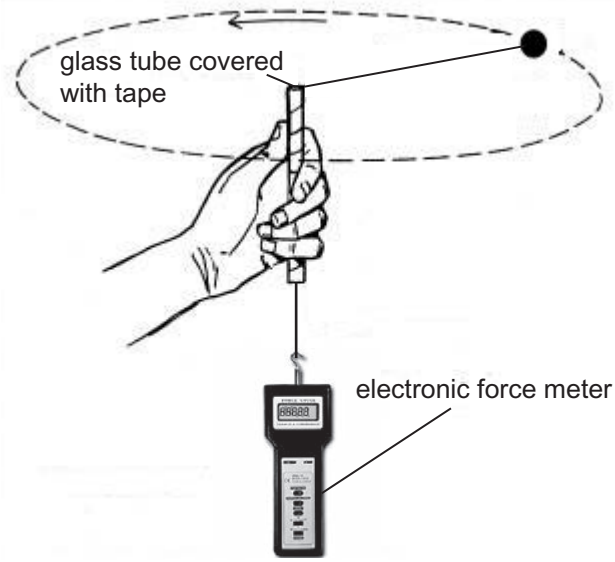
[6]

Examiner Only	
Marks	Remark
Total Question 3	

Examiner Only	
Marks	Remark

4 **(a)** To investigate circular motion pupils used the apparatus shown in the diagram.
An object is attached to a length of string the other end of which is attached to an electronic force meter.

The object is then whirled in a circle until it is moving with a constant speed. The time to complete one revolution is found and the reading on the force meter is noted. The speed is then changed and again the reading on the force meter and the time to complete one revolution is noted. This is carried out a number of times.



Source: http://www.eeprocess.com/Extech/instrument/images/products/451-499/475040.jpg
www.tealighthouse.org/science/images/hsphy_ucm_fig1.jpg

(i) During the investigation the radius of the circle is kept constant. Give another factor that affects the size of the centripetal force which should be kept constant during this investigation.

_____ [1]

(ii) The table below shows some of the results collected during the investigation.

Speed of the object in m/s	Reading on the force meter in N
9	32
6.4	16
4.5	8
3.2	4

Do the values in the table above show that the reading on the force meter is proportional to the speed of the object?
Explain your answer.

_____

_____

_____ [2]

Examiner Only	
Marks	Remark

[Turn over

Examiner Only	
Marks	Remark

(b) During a test of car safety a car of mass 1500 kg moving with a velocity of 20 m/s collides with a wall and comes to rest.

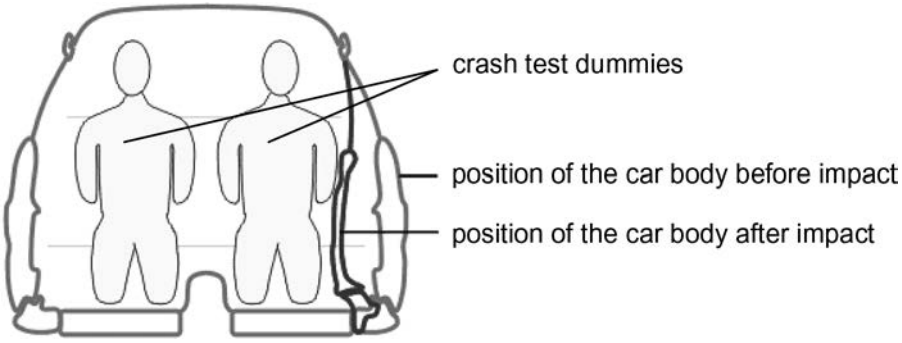
Source: http://static.howstuffworks.com/gif/car-testing1.jpg

(i) The crash lasts for 0.12 s. Calculate the average force exerted on the car during this crash.

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

Average force = _____ N [3]

Many car makers design their cars with side impact crumple zones. The diagram below shows the position of the side of a car before and after impact.



Source: http://www.bbc.co.uk/schools/gcsebitesize/science/images/ph_forces08.gif

(ii) Explain, **fully**, how this design of the car reduces the possibility of serious injury to the occupants of the car.
In your answer you may refer to the equation you have used to answer part **(b)(i)**.

_____

_____

_____

_____

_____

_____

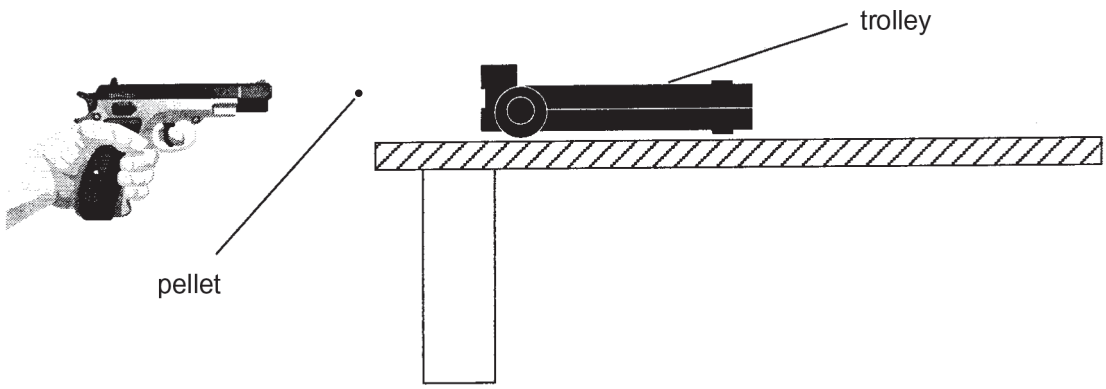
_____ [3]

Examiner Only	
Marks	Remark

[Turn over

Examiner Only	
Marks	Remark

(c) The apparatus shown below can be used to measure the velocity of a pellet from an air pistol. The pellet is fired at a stationary trolley and is embedded in the trolley.



The table shows the measurements taken during this experiment.

Mass of the pellet	3 g
Mass of the trolley	150 g
Velocity of trolley after collision	20 cm/s

(i) Calculate, in g cm/s, the momentum of the trolley **with** the embedded pellet.

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

Momentum = _____ g cm/s [3]

(ii) Using the Principle of Conservation of Momentum calculate the velocity of the pellet as it strikes the trolley.

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

Speed = _____ cm/s [3]

Examiner Only	
Marks	Remark
Total Question 4	

[Turn over

5 (a) (i) State the Principle of Moments.

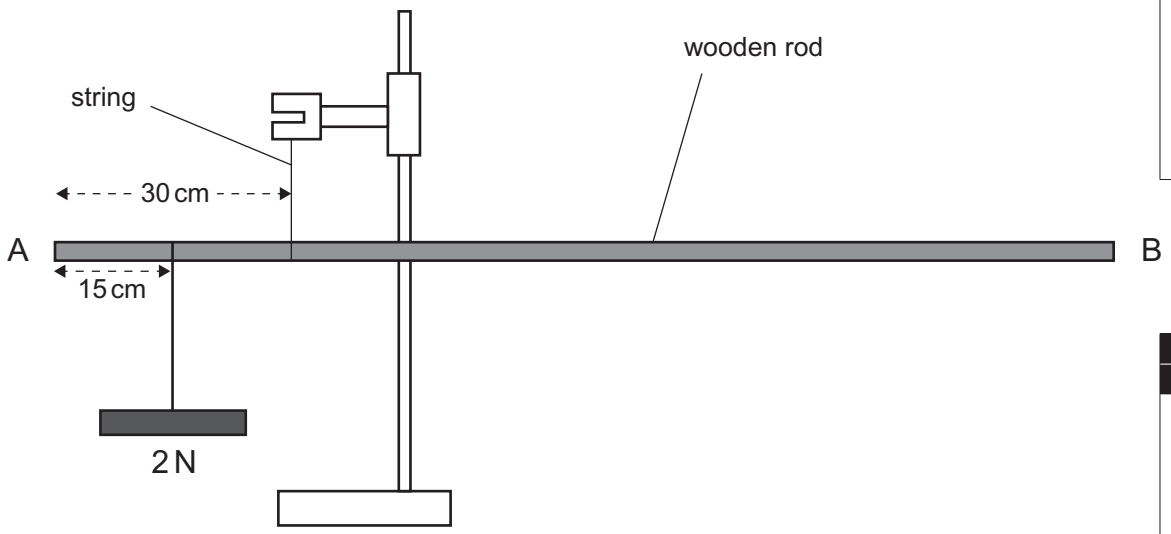
Examiner Only	
Marks	Remark

_____

_____

_____ [2]

To find the weight of a uniform length of wood Michael sets up the apparatus shown below.



The wooden rod has a length of 1.4 m and is suspended from a stand by a length of string attached 30 cm from the end A.
He moves the 2 N weight until the wooden rod is balanced horizontally.
The **2 N weight is 15 cm from the end A** when this happens.

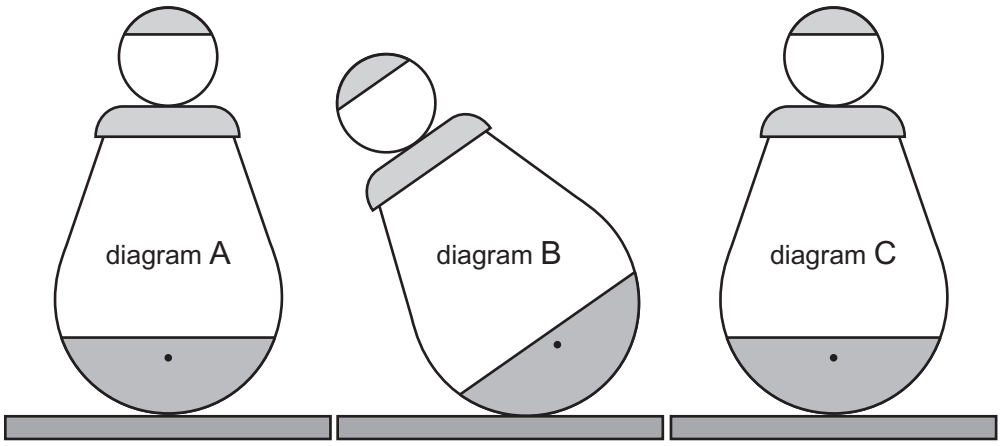
(ii) Use the Principle of Moments to find the weight of the wooden rod.

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

Examiner Only	
Marks	Remark

Weight = _____ N [3]

(b) The diagram below shows a toy. In diagram A it is shown at rest. When it is moved to one side (diagram B) and released it returns to the upright position as shown in diagram C. The dot shows the centre of gravity.



(i) On diagram A mark, **carefully**, the pivot with an X. [1]

(ii) On diagram B mark where the weight of the toy acts and the direction in which it acts. [1]

(iii) Explain carefully why the toy returns to the upright position when it is released.

_____

_____

_____

_____

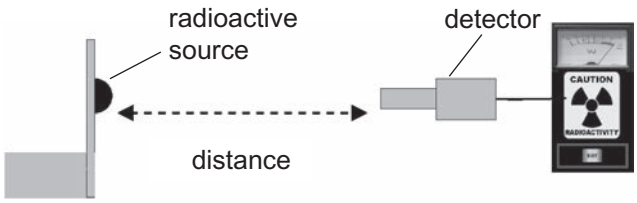
_____ [3]

Examiner Only	
Marks	Remark
Total Question 5	

[Turn over

Examiner Only	
Marks	Remark

6 **(a)** A radioactive source is placed in front of a detector. The detector measures the amount of radiation reaching it through the air from the radioactive source.



The readings on the detector are recorded for various distances.
The readings from the detector were then corrected for **background activity**.

(i) What is background activity?

_____

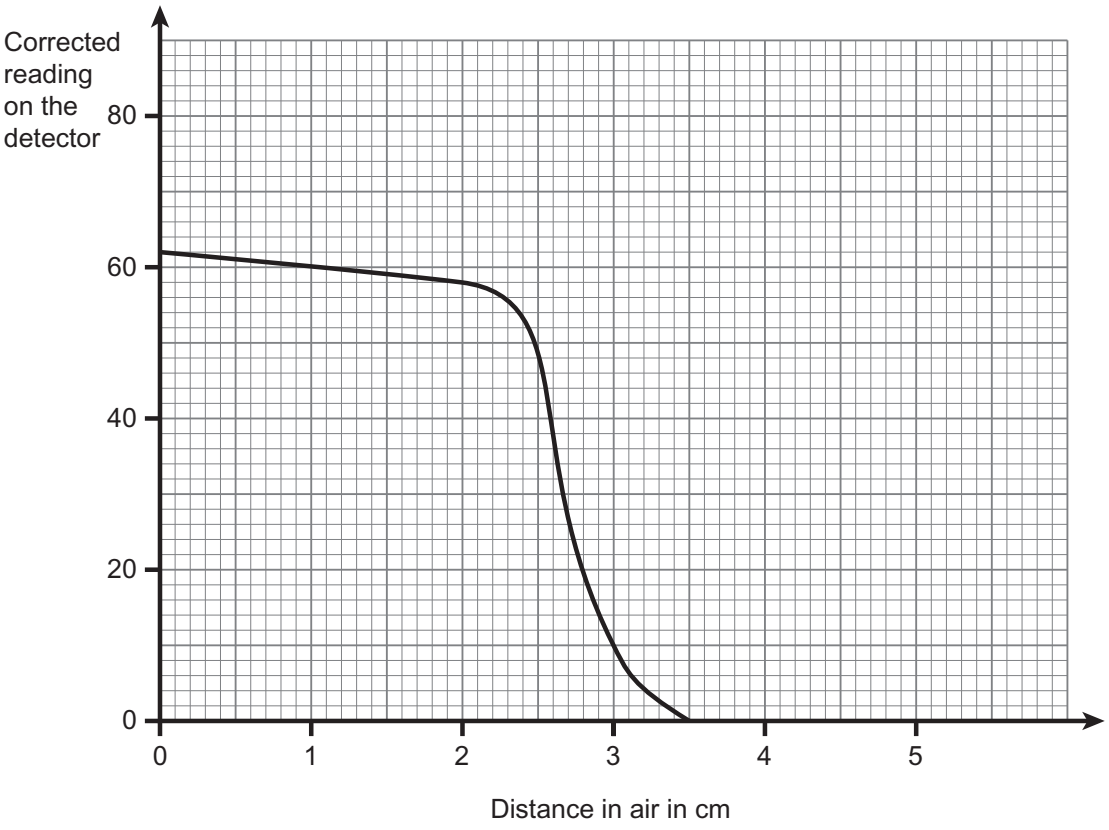
_____ [1]

(ii) How are the measurements corrected for background activity?

_____

_____ [1]

The corrected measurements are plotted on a graph and a smooth curve drawn through them as shown below.



(iii) Using the graph obtain a value for the range of this radiation in air. Explain how you arrived at your answer.

Range = _____

_____

_____ [2]

(iv) What radiation is being emitted by the radioactive source? Explain your answer.

_____

_____

_____ [2]

Examiner Only	
Marks	Remark

[Turn over

(v) When the radiation from the radioactive sources passes through the air it causes ionisation. What is ionisation?

_____

_____

_____ [1]

(vi) Those who work with radioactive materials take a number of precautions to reduce the risks associated with such materials. A radioactive substance in the form of a powder can be especially dangerous to work with. Explain why this is.

_____

_____

_____

_____

_____ [2]

Examiner Only	
Marks	Remark

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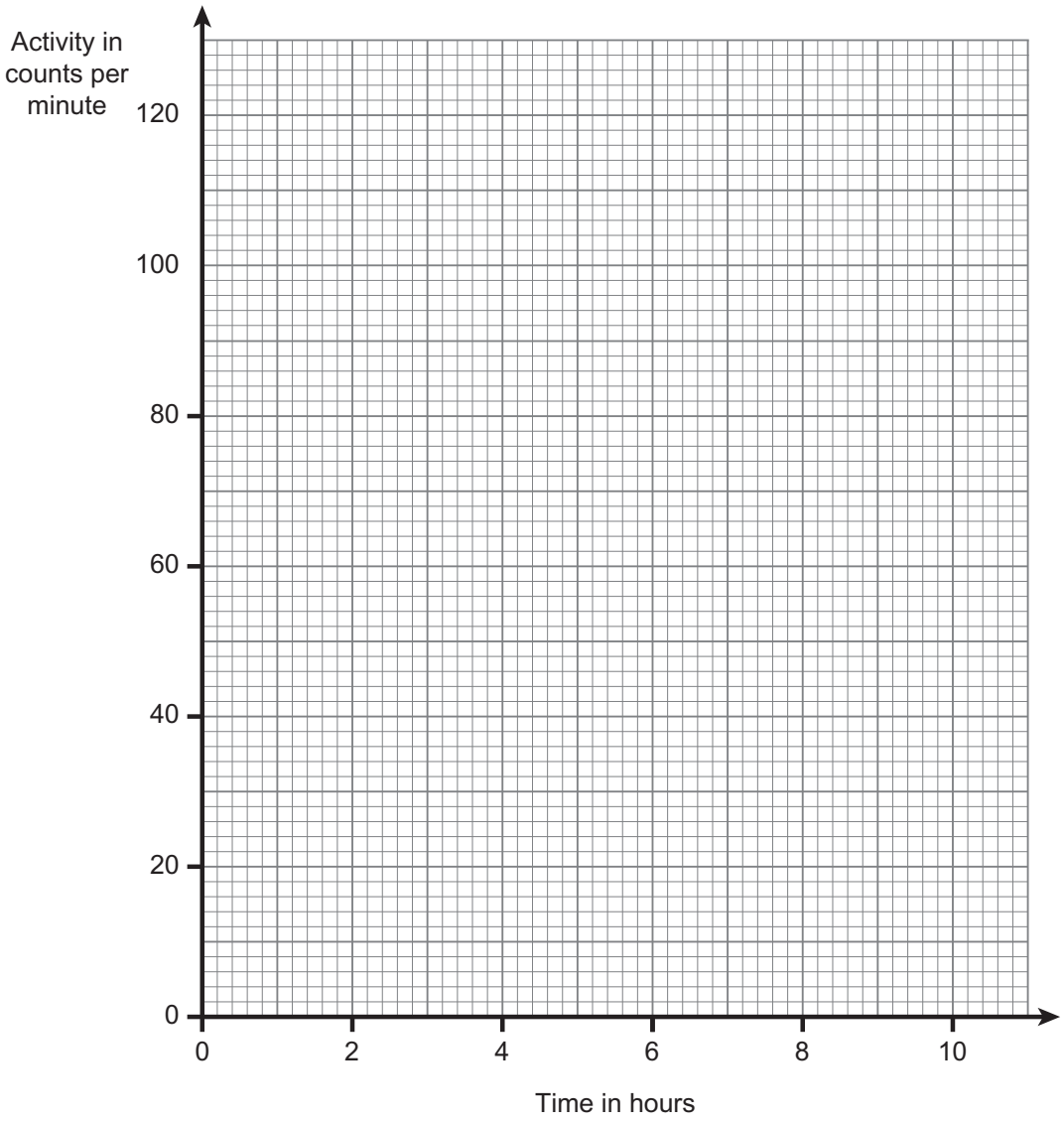
(Question 6 continues overleaf)

(b) In an experiment to measure the half-life of a radioactive source, the activity of the source is measured at regular intervals. The results obtained are shown below.

Activity in counts per minute	118	68	41	23	12	8
Time in hours	0	2	4	6	8	10

(i) Using the grid below plot a graph of activity (y-axis) against time (x-axis). [2]

(ii) Draw the curve of best fit through the points. [1]



Examiner Only

Marks	Remark

(iii) Explain the meaning of the term half-life.

_____

_____

_____ [1]

(iv) Using the graph you have plotted and the curve you have drawn, obtain the half-life of the radioactive source.

Half-life = _____ hours [1]

Measurements of activity from a radioactive source are variable even when the measuring equipment is working properly.

(v) Give a reason why measurements of activity are variable.

_____

_____ [1]

(c) Nuclear fission and nuclear fusion are two nuclear reactions that are important sources of energy.

(i) Which one is already being used in the large scale generation of electrical energy?

_____ [1]

(ii) Name one nuclear fuel that is used in nuclear power stations.

_____ [1]

Examiner Only	
Marks	Remark

(iii) State one environmental advantage of using nuclear energy to generate electrical energy.

_____

_____ [1]

(iv) The other nuclear reaction is the source of the Sun's energy but it has not yet been possible to use this reaction for the large-scale generation of electricity. What **two** important advantages would result if this nuclear reaction were used for the generation of electricity?

1. _____

_____

2. _____

_____ [2]

Examiner Only	
Marks	Remark
Total Question 6	

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Question Number	**Marks**
1	
2	
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Total Marks	

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