Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2014

GCSE Physics

Unit 1

Higher Tier

[GPH12]

GPH12

THURSDAY 12 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.
Write your answers in the spaces provided in this question paper.
Complete in blue or black ink only. **Do not write in pencil or 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 **1(a)(iii)** and Question **3(a)(v)**.

Examiner Only	
Marks	Remark

1 (a) (i) In 2009 the sprinter Usain Bolt ran the 100 m sprint with an average speed of 10.44 m/s. Calculate the time he recorded for this race.

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

Time to run 100 m = _____ s [2]

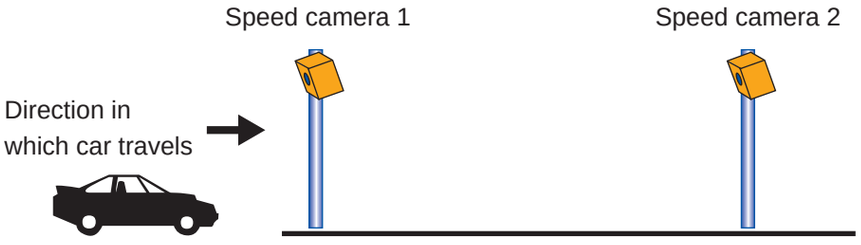
(ii) Explain why 10.44 m/s is his average speed.

_____

_____

_____ [1]

(iii) To detect speeding motorists speed cameras are located on the roadside. One type of speed camera measures the average speed of a motorist.
Those motorists who exceed this average speed are prosecuted.
The diagram below represents the layout of the system.



Explain carefully and in detail how this system of speed cameras measures the average speed of a car.

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

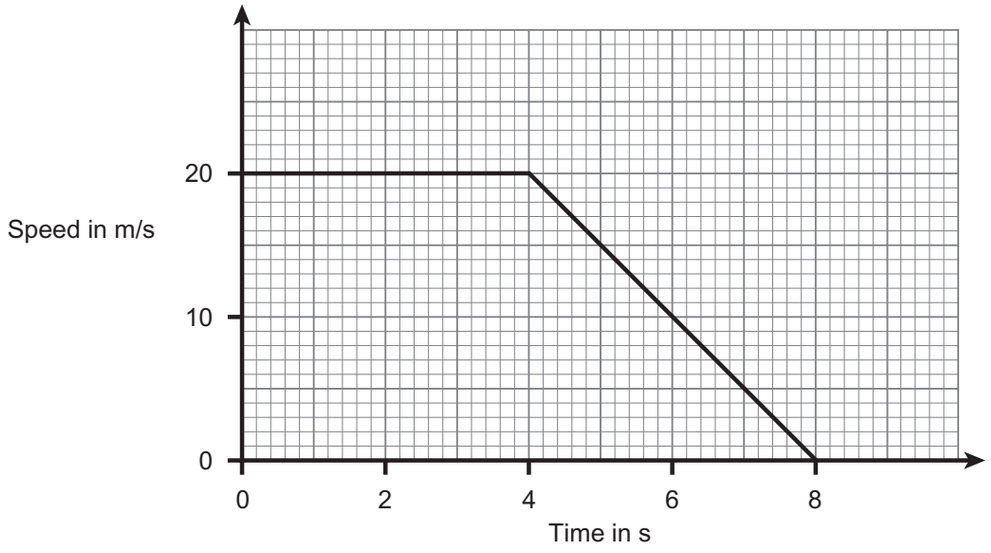
[6]

Examiner Only	
Marks	Remark

[Turn over

(b) The speed–time graph for the motion of a car as it approaches a set of traffic lights is shown below.

Examiner Only	
Marks	Remark



(i) Using the graph calculate the distance travelled by the car during the 8 s of its motion shown in the graph.

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

Distance = _____ m [4]

(ii) Calculate the deceleration of the car after the brakes have been applied.

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

Deceleration = _____ m/s^2 [2]

(iii) The car has a mass of 800 kg. Using your answer to **part (ii)** calculate the force acting on the car when the brakes are applied.

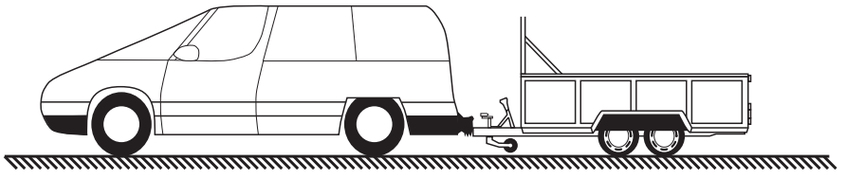
You are advised to show clearly how you get your answer.

Force = _____ N [3]

Examiner Only	
Marks	Remark

[Turn over

(iv) A car with the same mass (800 kg) is towing a trailer. This car and trailer are also travelling at 20 m/s.



The braking force remains unchanged from the value you calculated for **part (iii)**. Explain carefully why a driver should allow for a greater stopping distance when towing a trailer.

_____

_____

_____

_____ [2]

Examiner Only	
Marks	Remark
Total Question 1	

DO NOT WRITE ON THIS PAGE

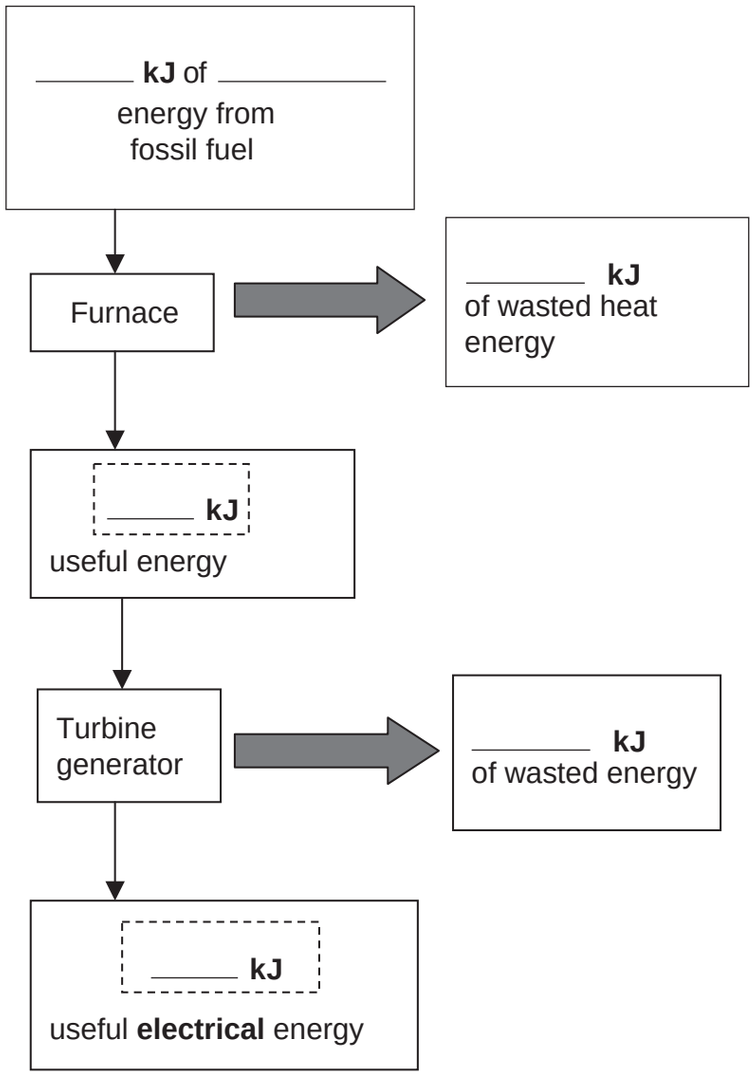
(Questions continue overleaf)

[Turn over

Examiner Only	
Marks	Remark

2 **(a)** Electrical energy can be obtained by burning fossil fuels. The simplified diagram below illustrates the energy changes that take place during this process. For every 120 kJ of input energy 80 kJ are wasted as heat from the furnace. Of the remaining useful energy 16 kJ are wasted as heat and sound in the turbine. The remainder of the useful heat energy is converted to electrical energy.

(i) Complete the diagram below by adding the appropriate numbers to the boxes. You should also name the type of input energy used in this process by adding the name to the first box.



[4]

(ii) Name and state the principle that allowed you to answer **part (a)(i)**.

_____

_____ [2]

(b) Every second a power station uses 800 MJ of input energy in the form of a fossil fuel. The efficiency of this power station is 0.35 (35%). Calculate the output electrical energy per second for this power station.

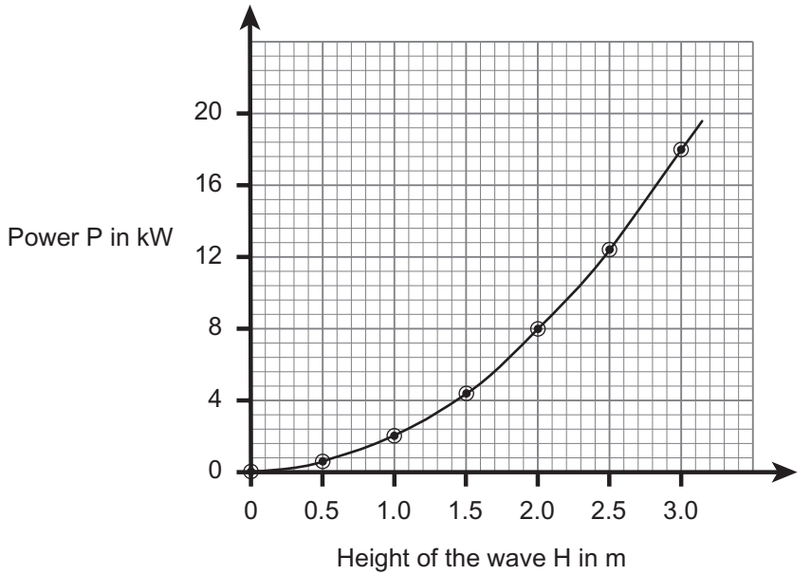
You are advised to show clearly how you get your answer.

Output electrical energy per second = _____ MJ [4]

Examiner Only	
Marks	Remark

[Turn over

(c) Many scientists are investigating the use of water waves to produce electrical energy. In one investigation the electrical power P extracted from water waves was measured when waves of different height were used. The graph below shows the results obtained from the investigation.



(i) The **power P** is directly proportional to the **square** of the **height H** of the wave. Use this information to complete, in the box below, the equation linking the power P, the height of the wave H and the constant of proportionality K.

P =

[2]

(ii) Using the equation and the graph, find the value of the constant of proportionality K.

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

K = _____ [3]

Examiner Only	
Marks	Remark
Total Question 2	

DO NOT WRITE ON THIS PAGE

(Questions continue overleaf)

[Turn over

Examiner Only	
Marks	Remark

3 **(a)** **(i)** The density of aluminium is 2.7 g/cm^3.
Explain, **without giving a formula**, what this means.

_____

_____ [1]

(ii) Calculate the number of cm^3 in 1 m^3.

_____ [1]

(iii) Calculate the mass in grammes of 1 m^3 of aluminium.

_____ g [1]

(iv) Calculate the density of aluminium in kg/m^3.

_____ kg/m^3 [2]

(v) You are given a block of metal as shown in the diagram below.

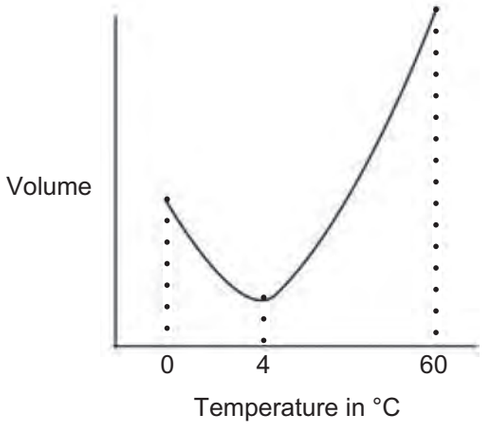
Describe how you would determine the density of the metal. In your answer you should state the measurements you would make and the calculations needed to find the density.

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

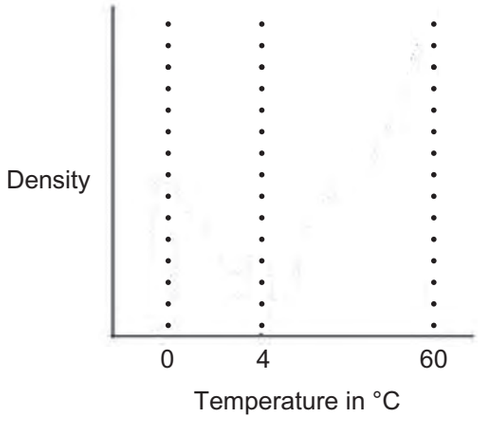
[6]

Examiner Only	
Marks	Remark

(b) Graph 1 shows how the volume of a **fixed mass** of water changes as it is cooled from 60 °C until it turns to ice at 0 °C.



Graph 1



Graph 2

(i) On Graph 2 draw the graph that would be found for the density changes that take place between 60 °C and 0 °C. [2]

Examiner Only	
Marks	Remark

(ii) Describe what is happening to the distance between the water molecules during the following temperature changes.

60 °C to 4 °C _____

_____

_____

4 °C to 0 °C _____

_____

_____ [2]

Examiner Only	
Marks	Remark
Total Question 3	

[Turn over

Examiner Only	
Marks	Remark

4 **(a)** The diagram shows an athlete who is moving a hammer in a circle. The hammer is a heavy metal ball attached to a steel wire. The athlete grips the steel wire at the other end as shown below.

© nickp37/iStock/Thinkstock.com

(i) What name is given to the force that keeps objects moving in a circle?

_____ [1]

(ii) In what direction does this force act?

_____ [1]

(iii) In the case shown in the diagram what provides this force?

_____ [1]

(iv) The hammer moves in a circle with constant speed. Explain why it would be **incorrect** to say it moves with a constant velocity.

_____

_____

_____ [1]

(v) The table below shows some of the factors that may affect the size of the force needed to move an object in a circle. Complete the table using the terms increases, decreases or has no effect. You should assume that only one factor at a time is changing.

Factor being changed	The effect on the size of the force
The speed is increased, the mass and radius remain constant	
The radius is increased, the mass and speed remain constant	
The direction of rotation is reversed, the speed, mass and radius remain constant	

[3]

(b) Golfers when hitting a golf ball sometimes want it to go as far as possible.
They achieve this by following through. This means the golf club exerts a force on the ball for as long as possible.

© iStock / Thinkstock

(i) Write down the equation that connects the momentum change that the ball experiences, the force acting on the ball and the time for which the force acts.

_____ [1]

Examiner Only	
Marks	Remark

(ii) A golfer exerts a force of 9 000 N on the golf ball for **1.2 milliseconds**.
Calculate the change in momentum of the golf ball.
(1 millisecond = 0.001 seconds)

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

Change in momentum = _____ kg m/s [3]

(iii) At a particular point in its motion the golf ball of mass 0.06 kg is moving with a velocity of 50 m/s. Calculate its momentum.

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

Momentum = _____ kg m/s [2]

Examiner Only	
Marks	Remark

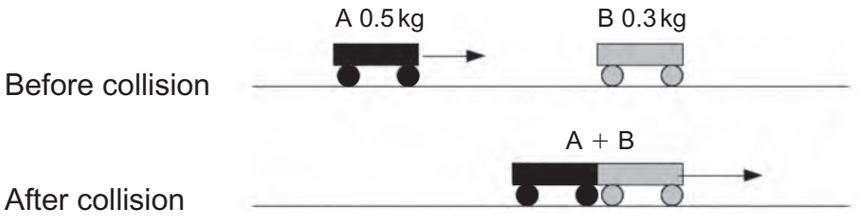
DO NOT WRITE ON THIS PAGE

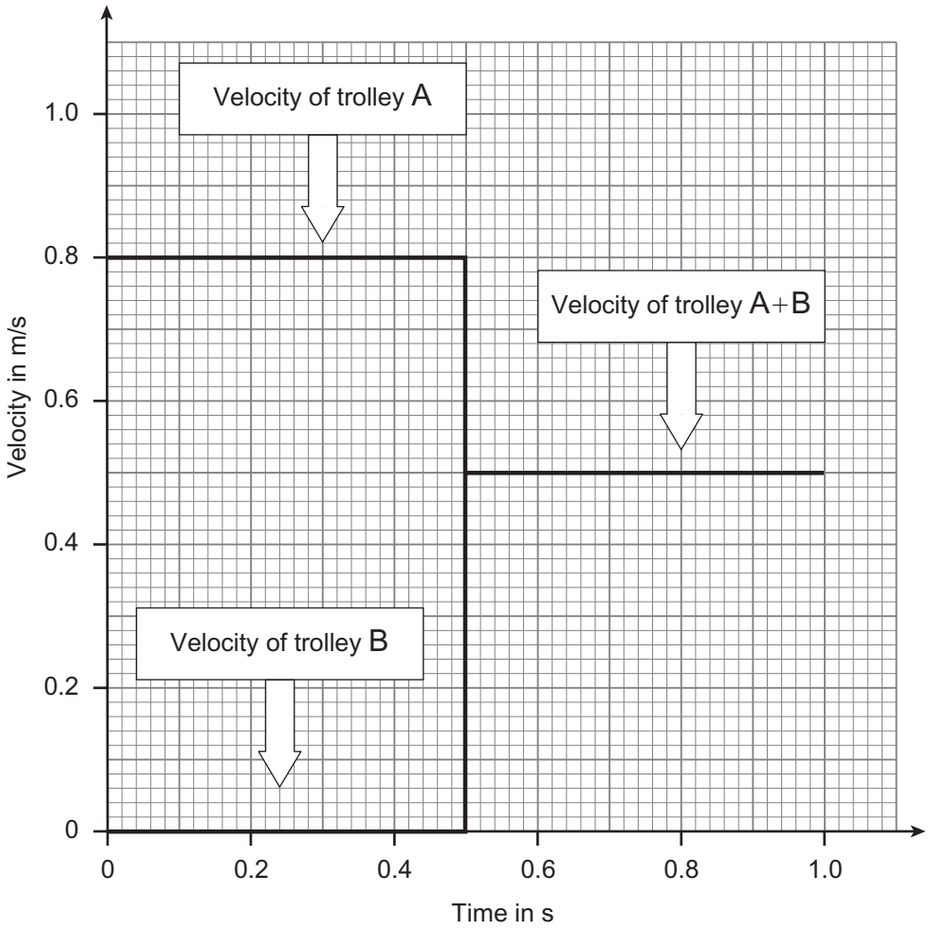
(Question 4 continues overleaf)

[Turn over

(c) In order to investigate momentum the following experiment was carried out. Trolley A was made to travel along a horizontal surface and collide with a **stationary** trolley B. After the collision the two trolleys stick to each other and move together. The velocities of the trolleys were measured and these are shown on the graph below.

Examiner Only	
Marks	Remark





(i) Using the data from the graph complete the table below.
Write your answers in the boxes that are **NOT** shaded

Before collision			After collision	
Velocity of trolley A				
Velocity of trolley B	0 m/s			
			Velocity of A + B	
Mass of trolley A	0.5 kg			
Mass of trolley B	0.3 kg			
			Mass of trolley A + B	0.8 kg
Momentum of trolley A				
Momentum of trolley B				
Total momentum =				
			Momentum of trolley A + B	

[6]

(ii) Explain how the results of the experiment verify the Principle of Conservation of Momentum.

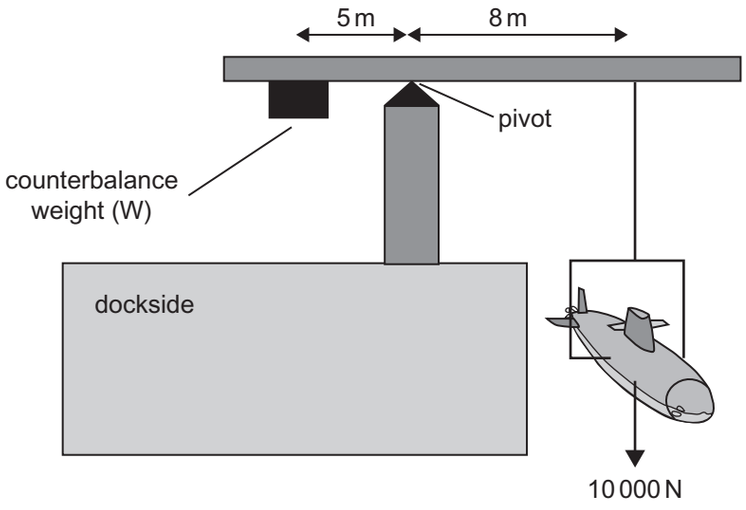
_____

_____ [1]

Examiner Only	
Marks	Remark
Total Question 4	

Examiner Only	
Marks	Remark

5 **(a)** The diagram below represents a crane lifting a small submarine. The submarine weighs 10 000 N.



(i) Calculate the value of the counterbalance weight, W, needed to prevent the crane from toppling over.

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

Counterbalance weight W = _____ [4]

(ii) To allow the crane to lift boats of different weights out of the water, the counterbalance weight can be moved to the left or right.
If a boat heavier than 10 000 N is to be lifted by the crane, in what direction should the counterbalance weight be moved? Explain your answer.

Direction of movement is _____

Explanation

_____

_____

_____

_____ [2]

Examiner Only	
Marks	Remark

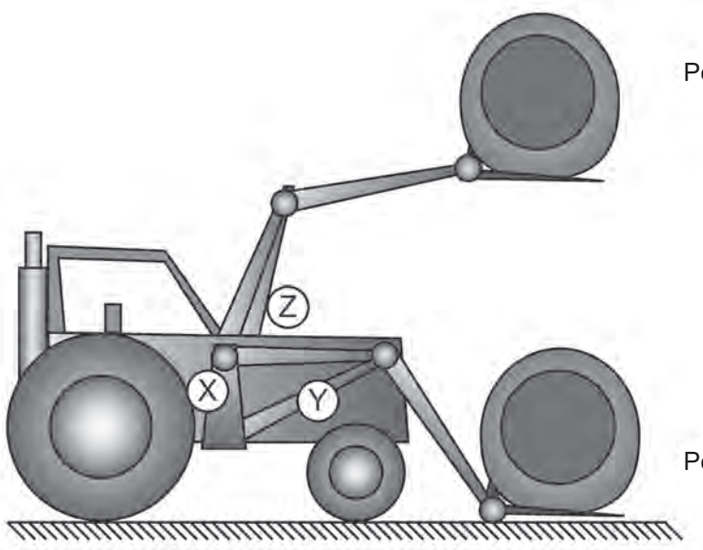
(b) (i) What is meant by the centre of gravity of an object?

_____

_____

_____ [2]

Many farmers use tractors to move large round bales as shown in the diagram below.



X is the position of the tractor's centre of gravity when it is not carrying any bale.
Y is the position of the centre of gravity when the bale is carried in the low position and Z is the position of the centre of gravity when the bale is carried in the raised position.

(ii) In which position of the bale is the tractor **least** stable? Explain your answer.

_____

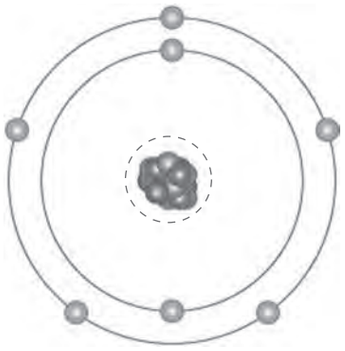
_____

_____ [2]

Examiner Only	
Marks	Remark
Total Question 5	

Examiner Only	
Marks	Remark

6 **(a)** The diagram shows the particles that make up the **atom** of an isotope of nitrogen.



© *Science Photo Library*

(i) Using information from the diagram above and your knowledge of the structure of a nucleus, complete the symbol below to show the composition of this nucleus of nitrogen.

$$^{15}_{\square}\mathrm{N}$$

[1]

(ii) What does the number 15 represent?

_____

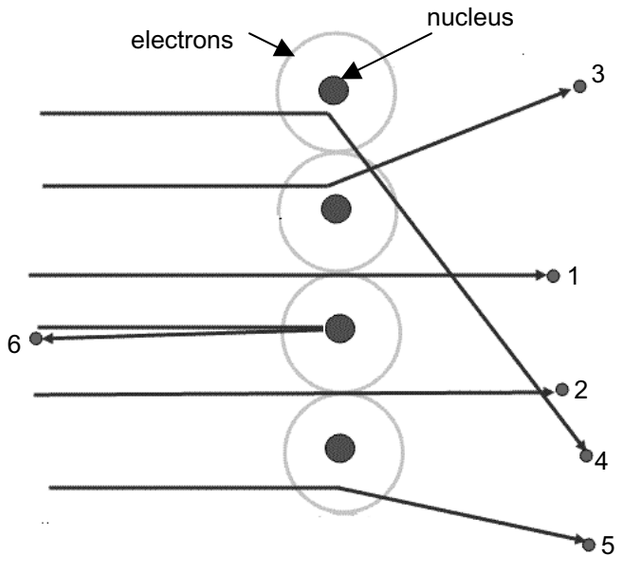
_____ [1]

(iii) How many neutrons are to be found in this nucleus of nitrogen?

_____ [1]

[Turn over

(b) The model of the atom shown in part **(a)** came about through observations of how alpha particles passed through a thin metal foil. Below is a simplified diagram showing the paths taken by some of the alpha particles.



Most alpha particles followed paths 1 to 5. What information **about the nucleus** of the atom did each of the paths taken by the alpha particles provide?

(i) Paths 1 and 2 _____

_____

_____ [1]

(ii) Paths 3, 4 and 5 _____

_____

_____ [1]

Examiner Only	
Marks	Remark

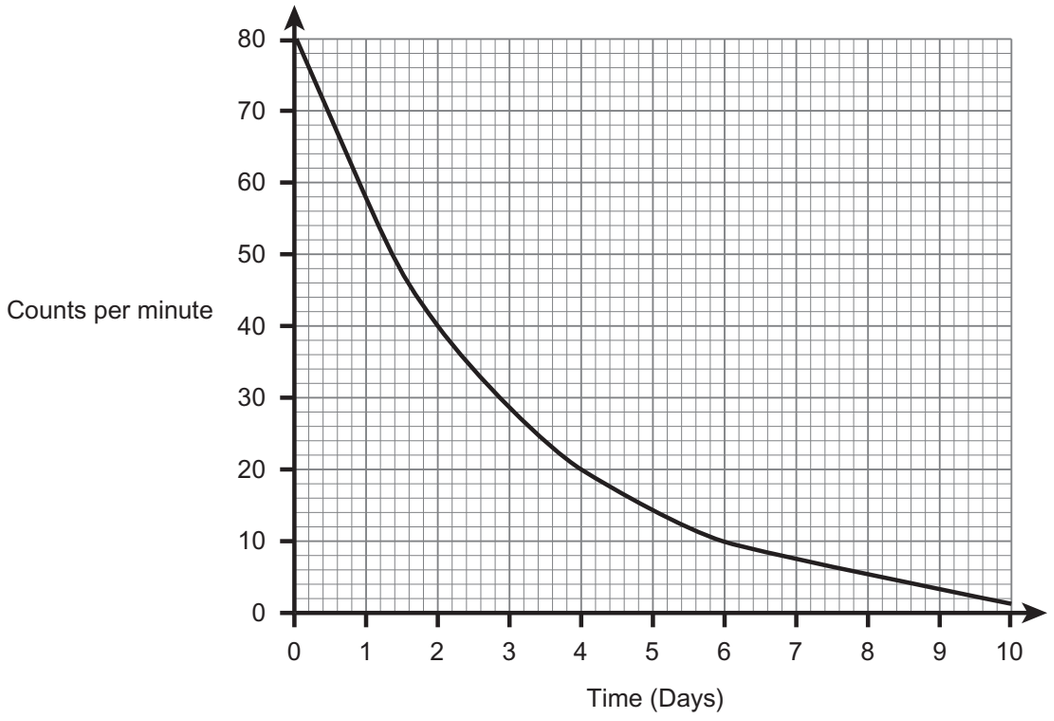
Path 6 is very different from the others. Path 6 was followed by very few of the alpha particles.

(iii) What additional piece of information about the nucleus did this observation provide?

_____

_____ [1]

(c) The graph below shows how the activity of a radioactive substance changes with time.



(i) What is the half-life of this radioactive substance?

_____ [1]

(ii) On the grid plot **three values** for the activity of another substance with a half-life of 1 day.
This substance had an initial activity of 80 counts per minute.
Draw a smooth curve through your points. [3]

Examiner Only	
Marks	Remark

[Turn over

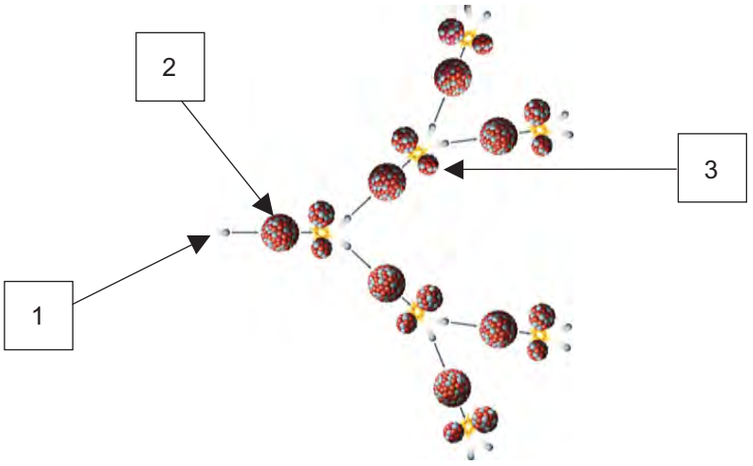
Examiner Only	
Marks	Remark

(d) The element sodium (symbol Na) has an unstable isotope which is radioactive and decays to the element magnesium (symbol Mg). Complete the decay equation below for this change.

$$\square^{24}_{\square}\mathrm{Na} \rightarrow \square^{\square}_{12}\mathrm{Mg} + \square^{\square}_{\square}\mathrm{e}$$

[4]

(e) The diagram below illustrates a nuclear reaction that results in the release of a large amount of energy.



© PeterHermesFurian/iStock/Thinkstock.com

(i) What is the name of this nuclear process?

_____ [1]

(ii) Name the particle marked 1. _____ [1]

(iii) Particle 1 is absorbed by nucleus 2.
State what nucleus 2 is and explain how nucleus 3 is formed.

_____

_____

_____

_____ [2]

(iv) An important part of this process is the creation of a chain reaction. Describe what this is.

_____

_____

_____ [2]

THIS IS THE END OF THE QUESTION PAPER

Examiner Only	
Marks	Remark
Total Question 6	

DO NOT WRITE ON THIS PAGE

DO NOT WRITE ON THIS PAGE

DO NOT WRITE ON THIS PAGE

For Examiner's use only	
Question Number	**Marks**
1	
2	
3	
4	
5	
6	
Total Marks	

Examiner Number