



Rewarding Learning

General Certificate of Secondary Education
2014

Centre Number

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Candidate Number

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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)**.

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- 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]

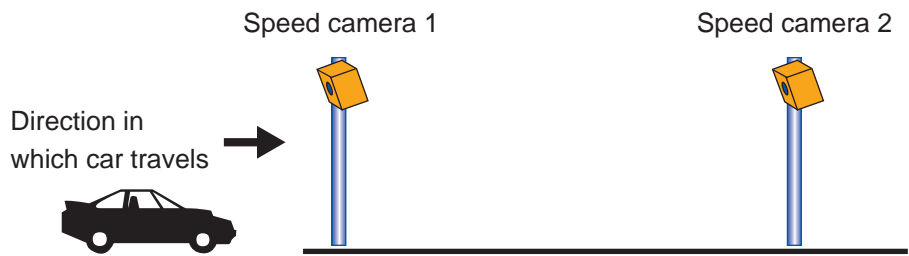
- (ii) Explain why 10.44 m/s is his average speed.

 [1]

Examiner Only	
Marks	Remark



- (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]

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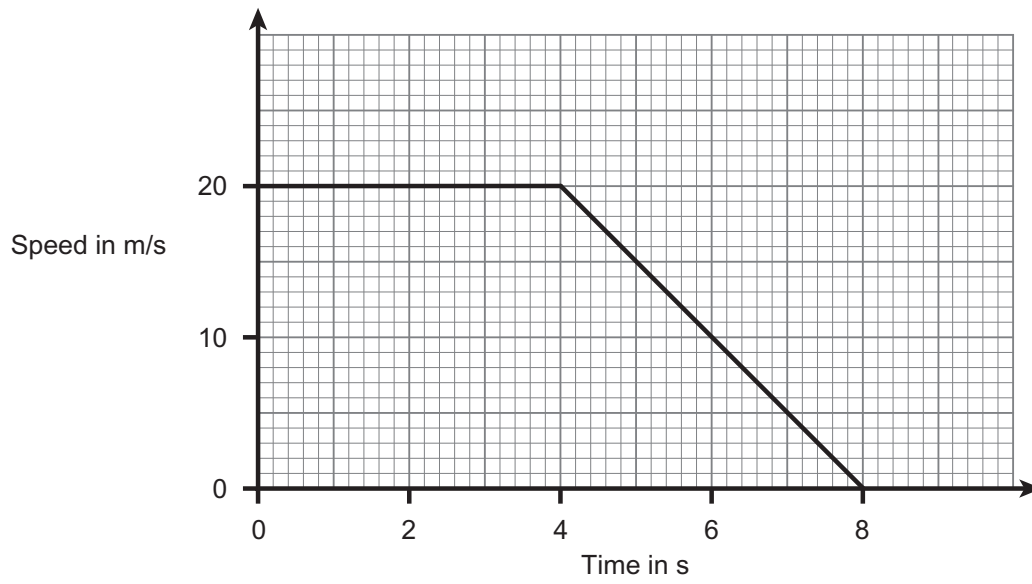
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(b) The speed–time graph for the motion of a car as it approaches a set of traffic lights is shown below.



(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]

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Marks	Remark

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

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

$$\text{Deceleration} = \text{_____} \text{ m/s}^2 \text{ [2]}$$

- (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.

$$\text{Force} = \text{_____} \text{ N [3]}$$

Examiner Only	
Marks	Remark

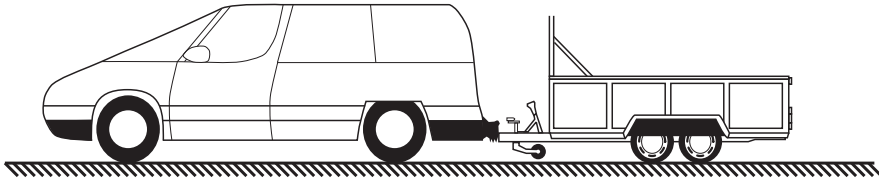
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(iv) A car with the same mass (800 kg) is towing a trailer. This car and trailer are also travelling at 20 m/s.



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]

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Total Question 1	





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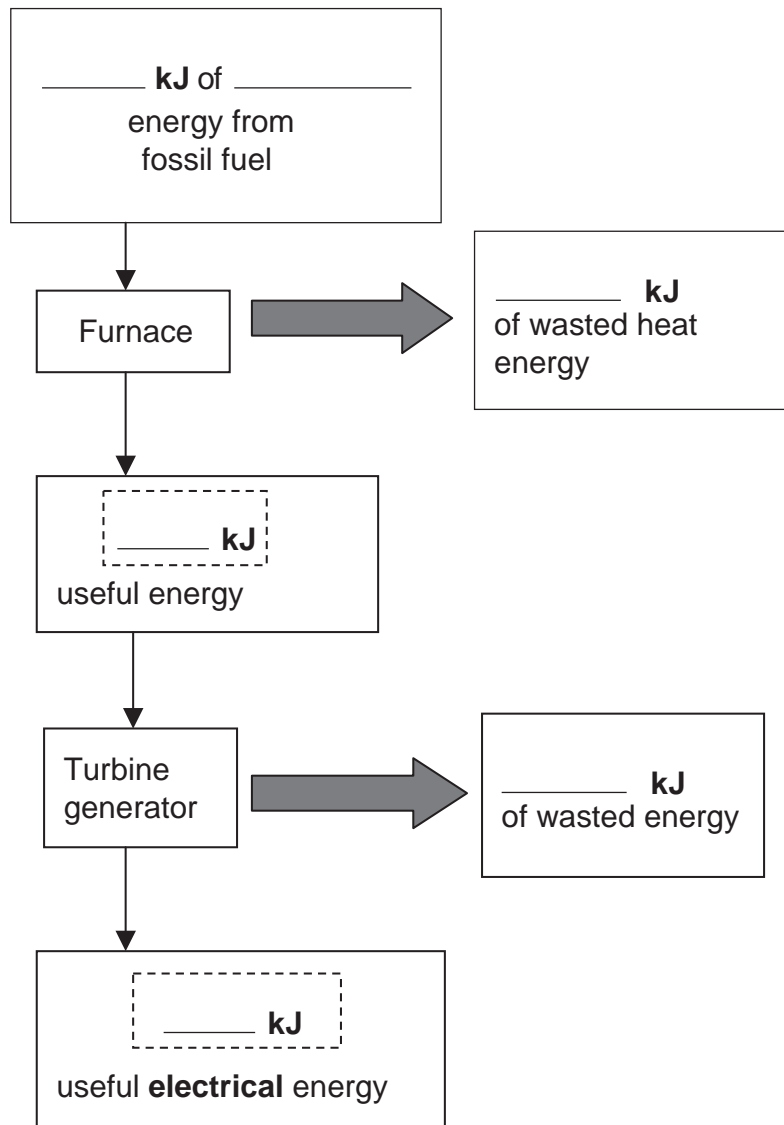
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2 (a) Electrical energy can be obtained by burning fossil fuels. The simplified diagram below illustrates the energy changes that take place during this process. For every 120 kJ of input energy 80 kJ are wasted as heat from the furnace. Of the remaining 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]

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Marks	Remark



(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

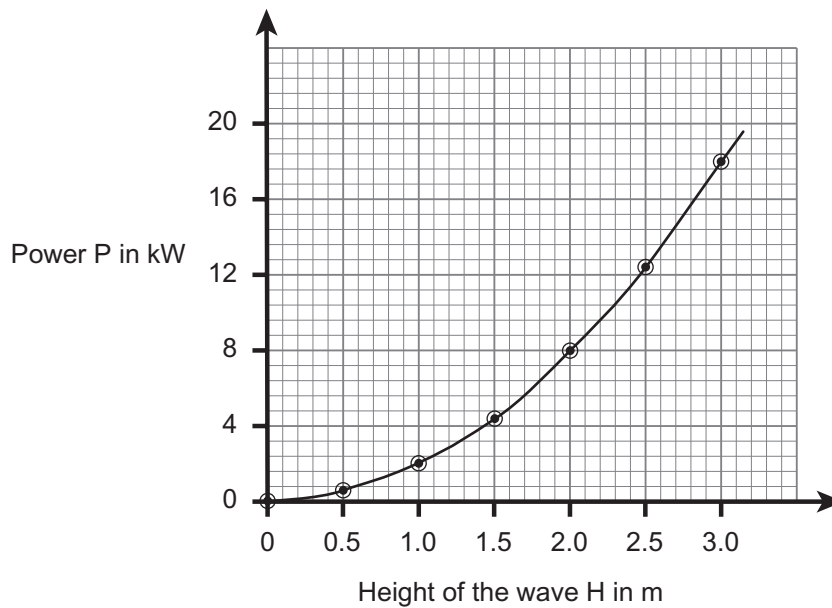
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- (c) Many scientists are investigating the use of water waves to produce electrical energy. In one investigation the electrical power P extracted from water waves was measured when waves of different height were used. The graph below shows the results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

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Marks Remark

Total Question 2





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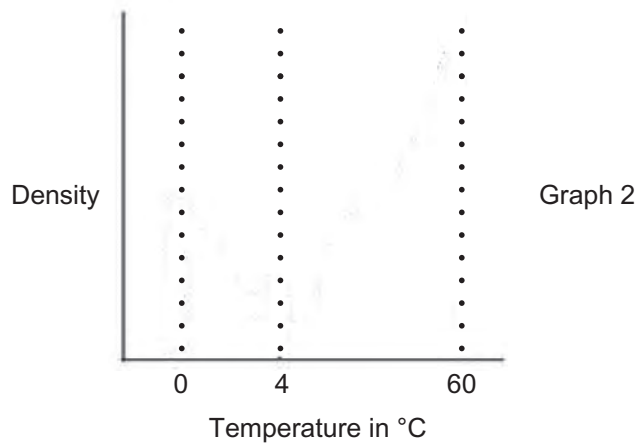
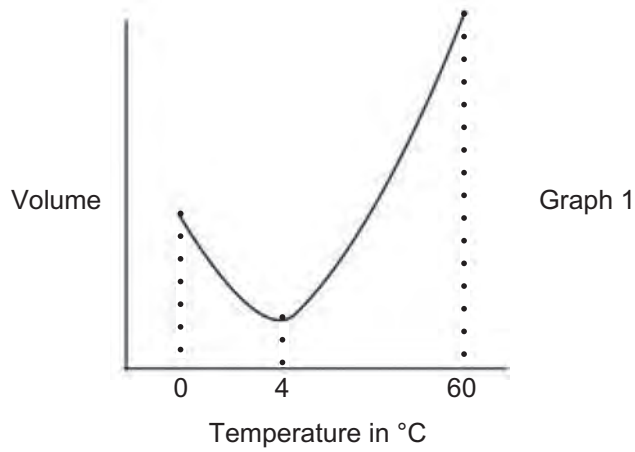
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(b) Graph 1 shows how the volume of a **fixed mass** of water changes as it is cooled from 60°C until it turns to ice at 0°C.



(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



- (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.



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- (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]

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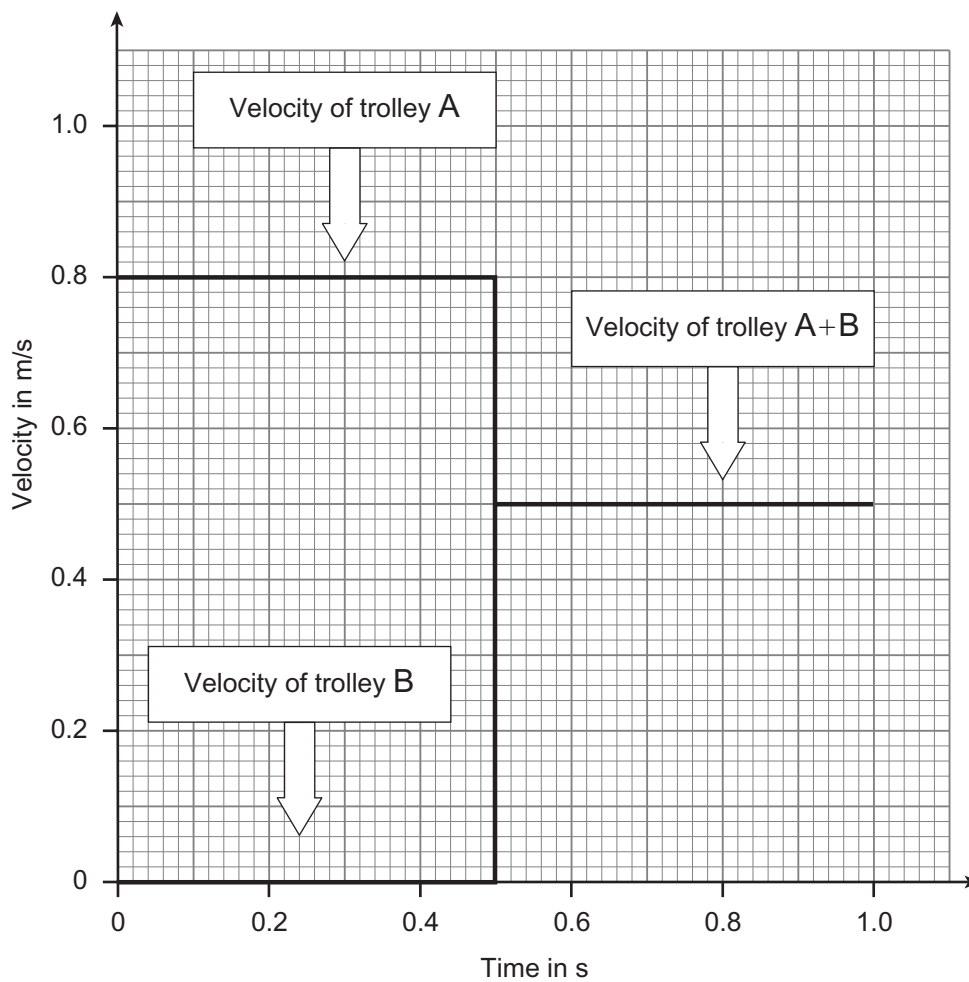
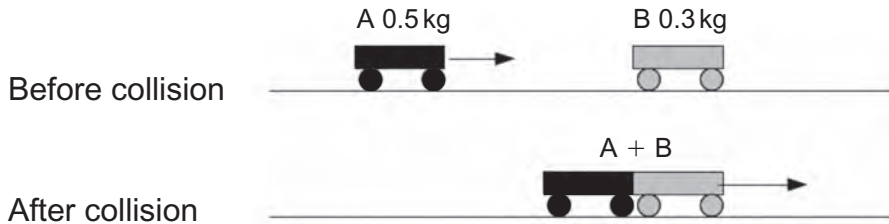
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(c) In order to investigate momentum the following experiment was carried out. Trolley A was made to travel along a horizontal surface and collide with a **stationary** trolley B. After the collision the two trolleys stick to each other and move together.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



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Marks	Remark

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- (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]

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Marks Remark

Total Question 4

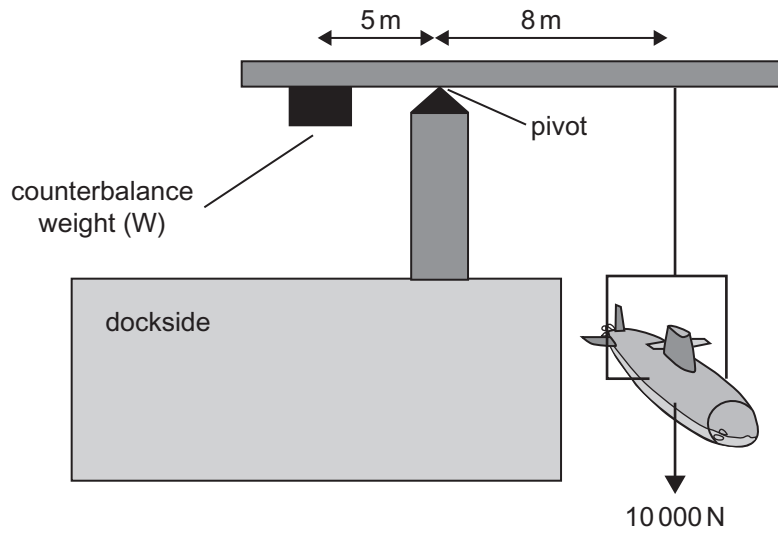
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32GPH1221

- 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]

Examiner Only

Marks Remark





(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]

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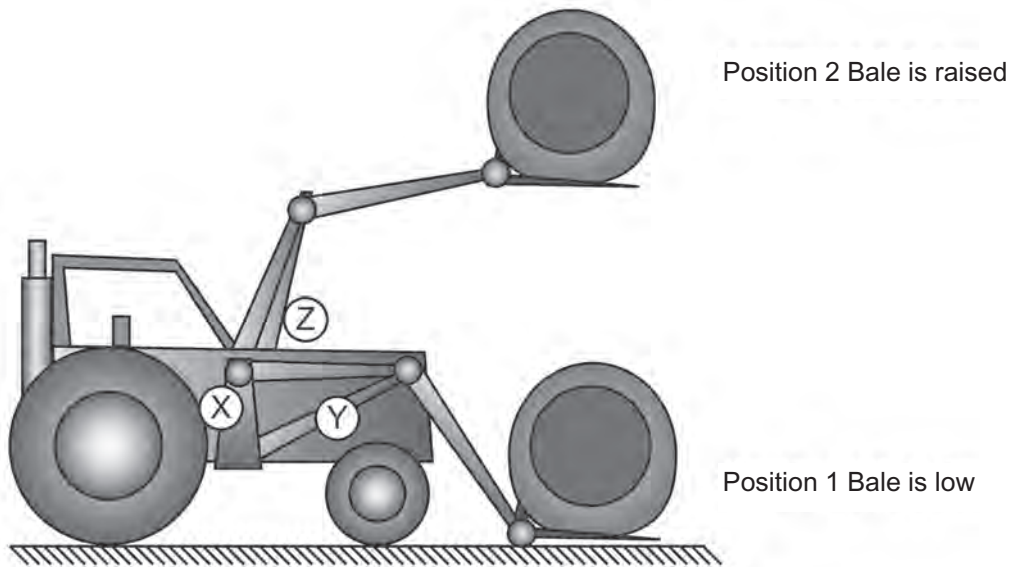


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(b) (i) What is meant by the centre of gravity of an object?

_____ [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]

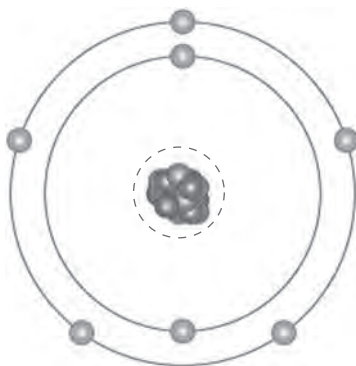
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Total Question 5



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



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- (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.



[1]

- (ii) What does the number 15 represent?

_____ [1]

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

_____ [1]

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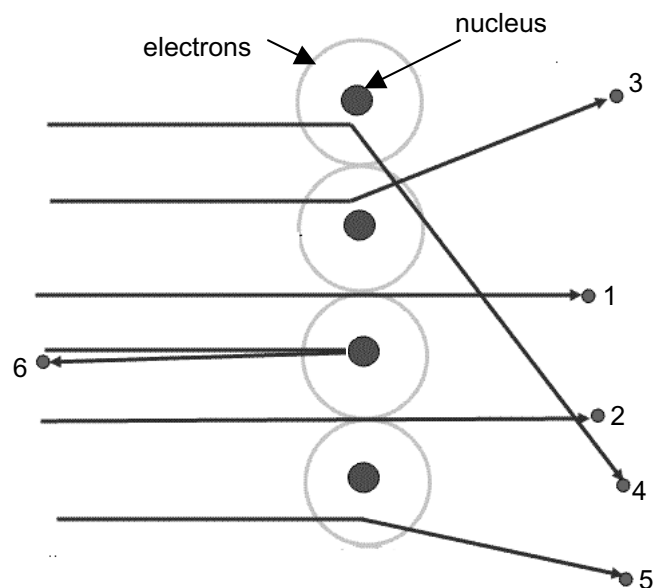
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(b) The model of the atom shown in part (a) came about through observations of how alpha particles passed through a thin metal foil. Below is a simplified diagram showing the paths taken by some of the alpha particles.



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]

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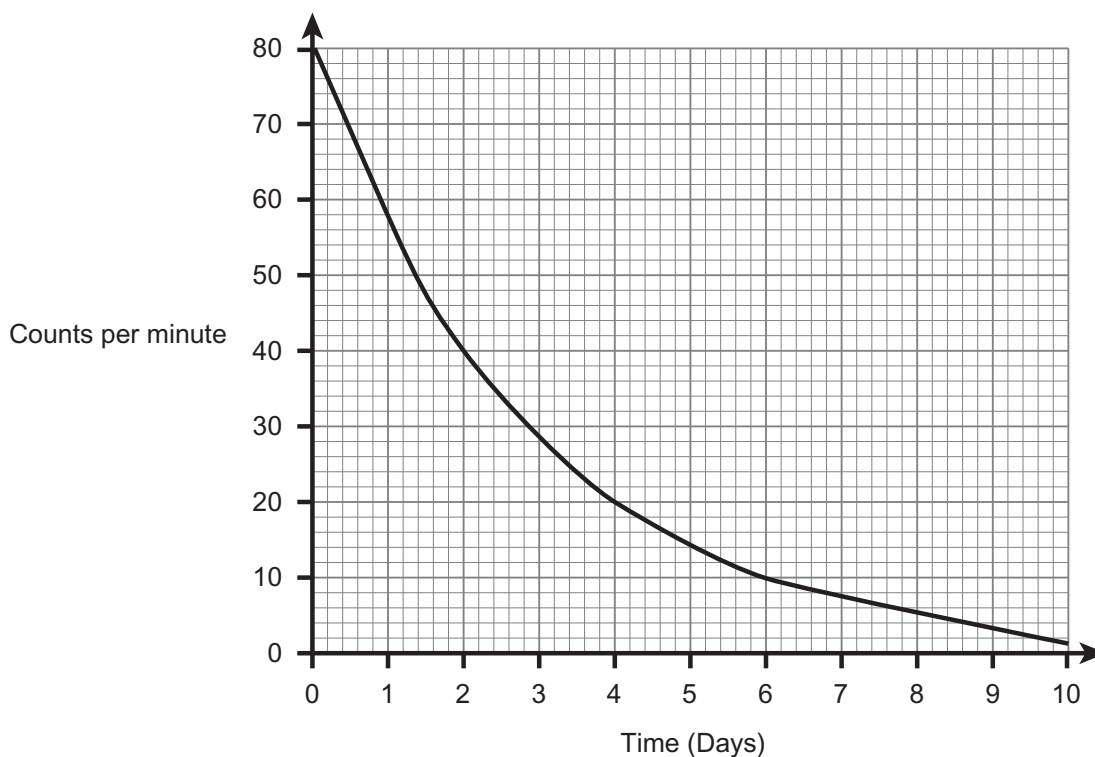


Path 6 is very different from the others. Path 6 was followed by very few of the alpha particles.

(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]

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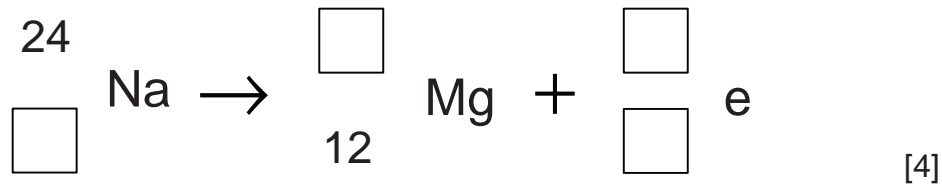
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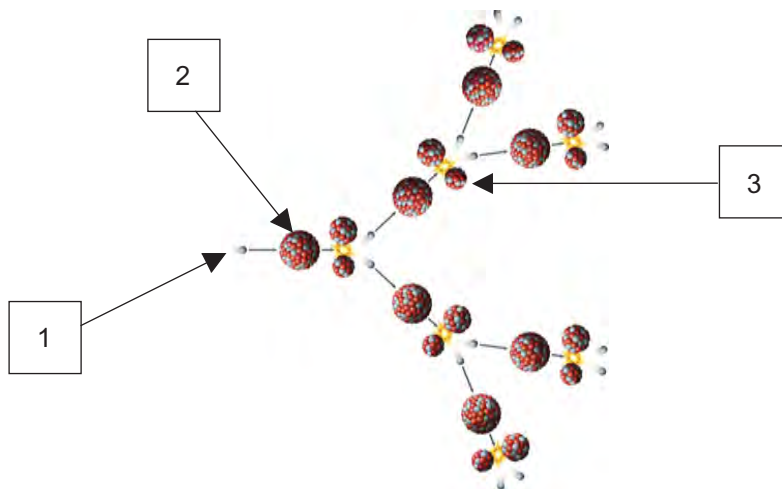


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- (d) The element sodium (symbol Na) has an unstable isotope which is radioactive and decays to the element magnesium (symbol Mg). Complete the decay equation below for this change.



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



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

_____ [1]

- (ii) Name the particle marked 1. _____

[1]

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(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]

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