Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2017

GCSE Physics

Unit 1

Higher Tier

[GPH12]

GPH12

MONDAY 19 JUNE, MORNING

TIME

1 hour 30 minutes.

INSTRUCTIONS TO CANDIDATES

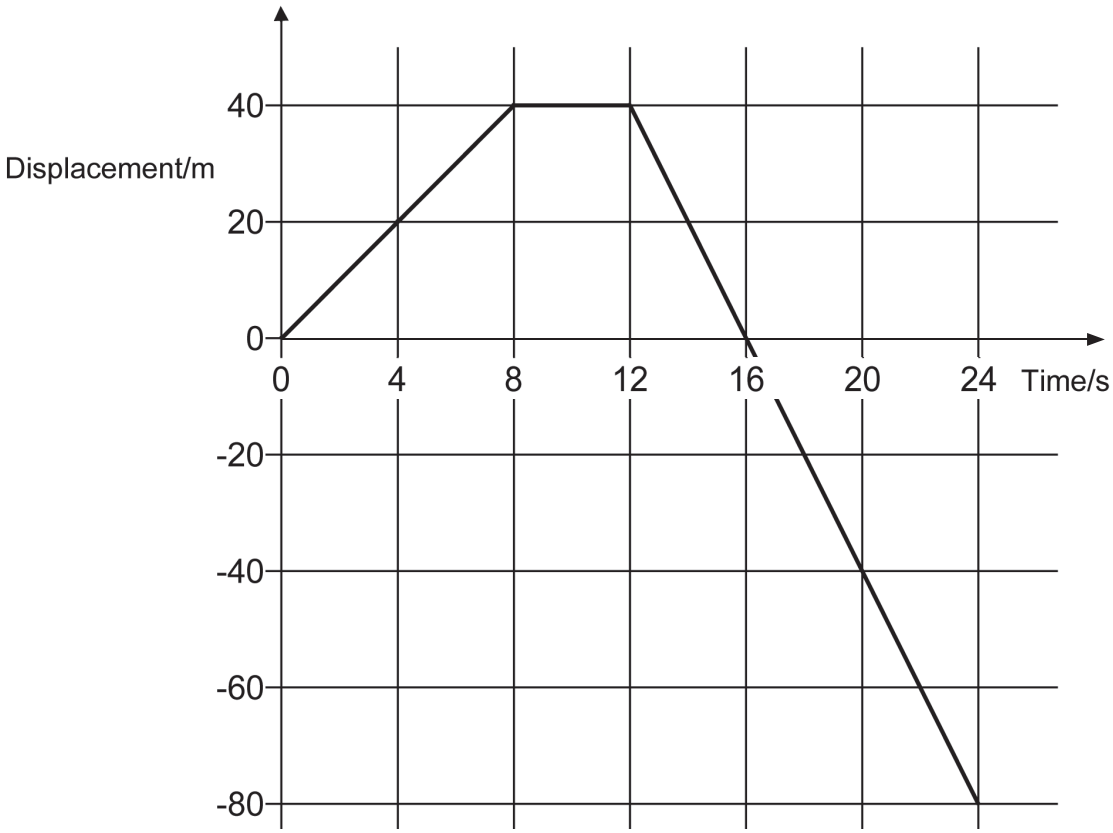
Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
You must answer the questions in the spaces provided.
Do not write outside the boxed area on each page or on blank pages.
Complete in black ink only. **Do not write with a gel pen.**
Answer **all six** questions.

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 **1(c)** and **6(a)**.

1 **(a)** A cyclist pedals away from a starting post.

The graph below shows how his **displacement** from the starting post varies with time.



(i) At what time does the cyclist return to the starting post? _____ s [1]

(ii) Complete the table below to show the position of the cyclist at 20 s.

Distance from the starting post/m	Left or right of the starting post

[2]

(iii) Calculate the average velocity of the cyclist for the 24 s journey. Remember velocity is a vector quantity.

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

Velocity = _____ m/s [4]

(b) (i) On another journey the cyclist is moving with a constant velocity and to maintain this constant velocity he exerts a forward thrust of 30 N.
What forward thrust must the cyclist exert to produce an acceleration of 0.2 m/s^2?

The mass of the cyclist and bicycle is 90 kg.

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

Forward thrust = _____ N [4]

[Turn over

(ii) The initial velocity of the cyclist is 4.0 m/s.
Calculate the velocity of the cyclist after moving for 4.0 s with this constant acceleration of 0.2 m/s^2.

Velocity = _____ m/s [3]

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(Questions continue overleaf)

(c) A student is asked to investigate how the **average speed** of a trolley that is allowed to move freely down a ramp is affected by the **mass of the trolley**. The trolley has a mass of 0.5 kg and the student is provided with a number of additional 0.5 kg masses. The student is also provided with a metre rule and a stop clock.

Describe how the student should carry out the investigation.

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

In your description you should state:

- what quantity has to be varied and how this is done

- what measurements need to be taken and what equipment is used to take them

- what measurement you would repeat

_____

_____

_____

- what calculations are made using the measurements

_____

_____

_____

- what graph should be drawn using the results of the investigation.

_____

_____ [6]

[Turn over

2 **(a)** **(i)** LED bulbs are more efficient than filament bulbs at changing electrical energy into light energy.

One LED bulb has an **efficiency of 0.95**.

Complete the energy flow diagram to show the amount of light and heat energy produced by this LED bulb.

LED bulb

© somchaisom / iStock / Thinkstock

Write your answers in the appropriate arrows.

[2]

(ii) A filament bulb produces only **9 J of light** energy for every **100 J of input** electrical energy.

Calculate the energy input to the above LED bulb needed to produce the same amount of light energy as a filament bulb.

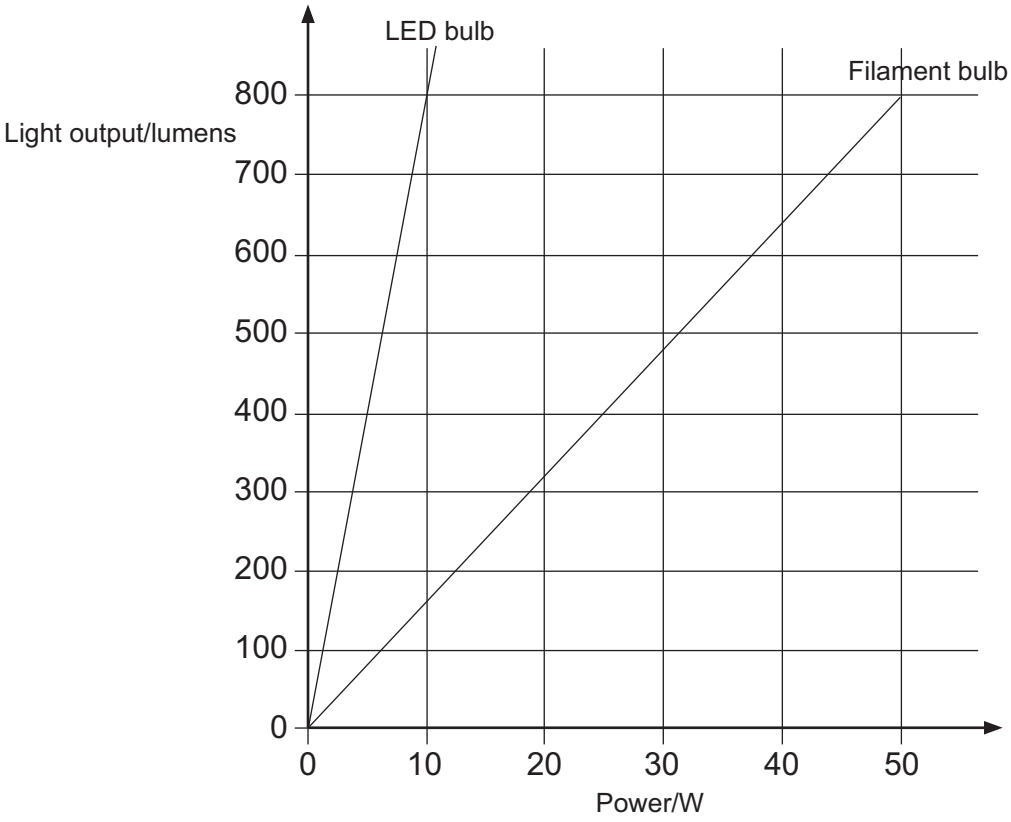
Energy input = _____ J [3]

(b) (i) Power is measured in watts (W). In terms of electrical energy explain the meaning of **one watt (1 W)**.

_____

_____ [2]

The light output from a bulb is measured in units known as lumens. The graph below shows how the light output varies with power for a filament bulb and an LED bulb.



(ii) Another measure of efficiency used with bulbs is the number of lumens produced per watt. Calculate the lumens/watt efficiency for both the filament bulb and the LED bulb.

Filament bulb = _____ lumens/W

LED bulb = _____ lumens/W
[2]

[Turn over

It costs a consumer **6p per day** to use a **50 W filament bulb**.

(iii) Calculate the cost per day to use an LED bulb with the same light output as the 50 W filament bulb.

Cost = _____ pence [2]

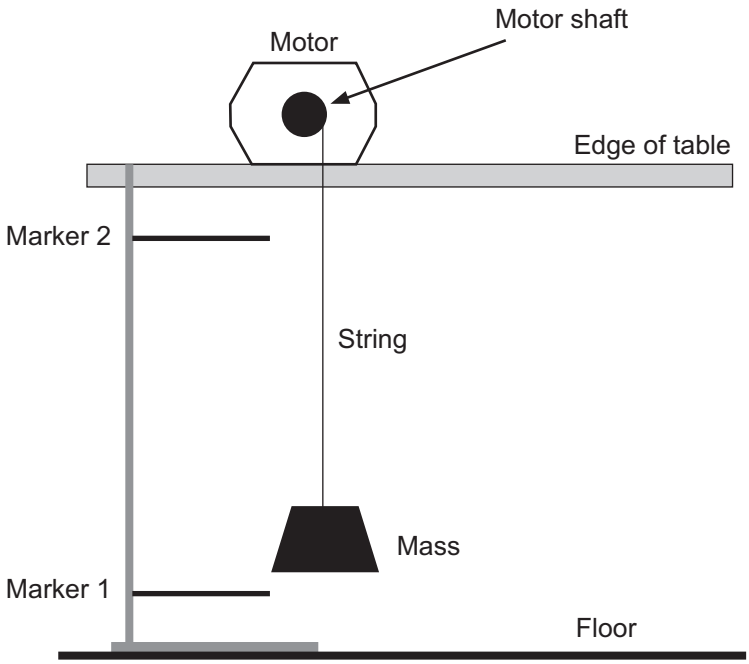
(iv) Calculate the saving in 1 year if the consumer were to use an LED bulb with the same light output as the filament bulb. The cost of using the filament bulb for 1 year is £21.90.

(1 year = 365 days)

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

Saving = £ _____ [3]

(c) To measure the power of an electric motor the apparatus shown below was used.



The following measurements were taken.

Mass of object raised = 0.5 kg
Distance between marker 1 and marker 2 = 0.75 m

(i) Calculate the potential energy gained by the mass as it moves from marker 1 to marker 2.

Potential energy gained = _____ J [3]

[Turn over

The experiment was carried out three times and the time to move the mass between the markers was recorded each time.

The times are shown in the table below.

Time to move between the markers/s	3.5	4.1	3.8

(ii) Using the values shown in the table calculate the most **reliable** value for the power produced by the motor.

Power = _____ W [3]

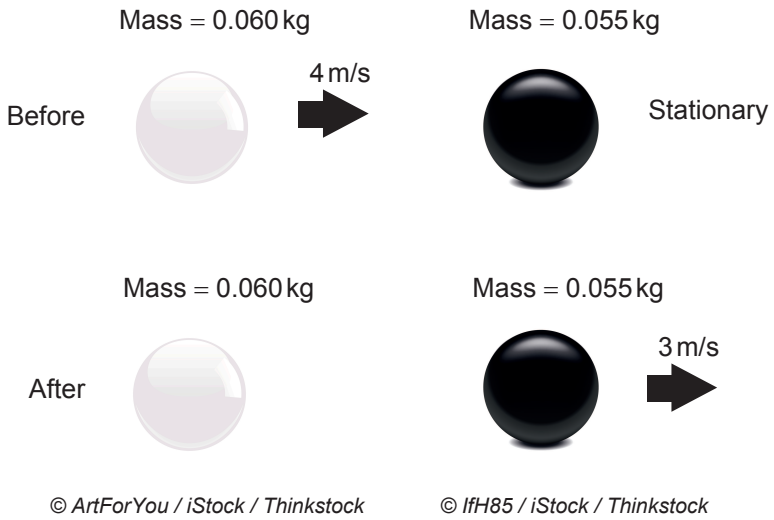
3 **(a)** State the Principle of Conservation of Momentum.

_____

_____

_____ [1]

(b) A white snooker ball of mass **0.060 kg** is moving from left to right at a speed of **4 m/s** when it collides head-on with a stationary black ball of mass **0.055 kg**. After the collision the black ball moves to the right with a speed of **3 m/s**.



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(i) Calculate the speed and direction of the white ball after the collision.

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

Speed of white ball = _____ m/s [4]

Direction of white ball _____ [1]

[Turn over

An elastic collision is one in which the **total kinetic energy** before the collision is equal to the **total kinetic energy** after the collision. If a collision is not elastic, it is said to be inelastic.

The kinetic energy of the white ball before the collision is **0.48 J**.

(ii) By calculating the kinetic energy of the white and black balls after the collision, determine whether the collision was elastic or inelastic.

White Ball	Black Ball
Kinetic Energy of white ball after collision = _____ J	Kinetic Energy of black ball after collision = _____ J

Tick the appropriate box below.

Collision was Elastic ☐ Collision was Inelastic ☐

[4]

(iii) A snooker ball collides with and rebounds from the side of the table.

The ball is in contact with the side of the table for 0.04 s.

The force exerted on the ball during this collision is 7.5 N.

Calculate the change in the ball's momentum due to this collision.

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

Include the unit for momentum change with your answer.

Change in momentum = _____ [4]

[Turn over

(c) (i) State the Principle of Conservation of Energy.

_____

_____

_____ [2]

A skier skies down a straight slope of vertical height **250 m** as shown in the diagram. At the top of the slope the skier has a gravitational potential energy of **175 kJ**.

During the descent **75 kJ** are lost due to the forces opposing the motion.

(ii) Use the Principle of Conservation of Energy to calculate the kinetic energy of the skier at the bottom of the slope.

Give your answer in **kilojoules**.

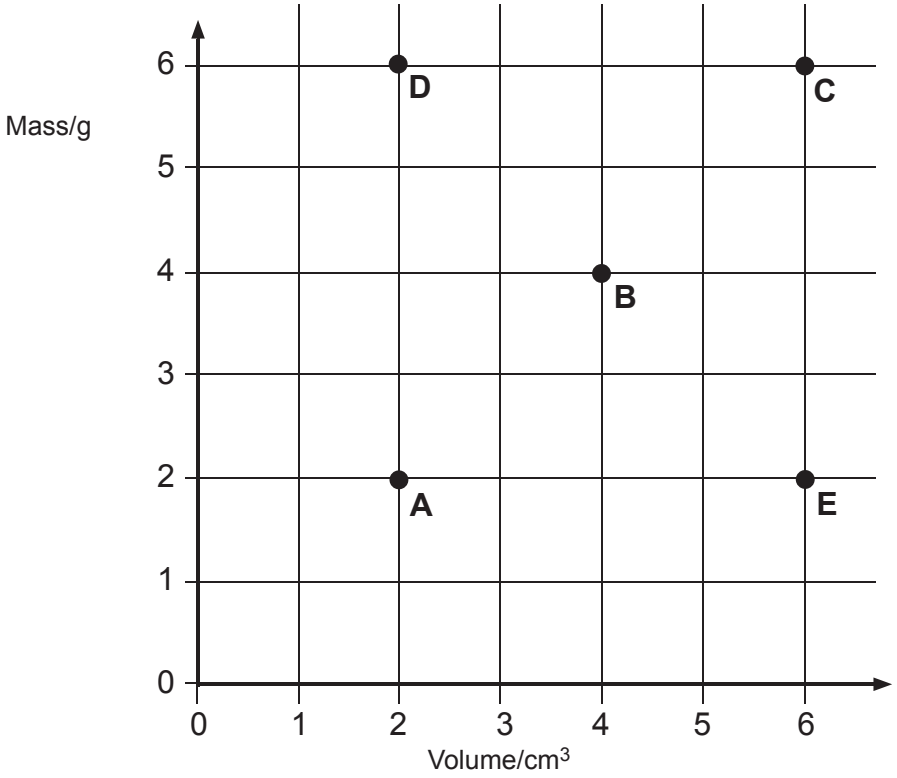
Kinetic energy of skier = _____ kJ [1]

(iii) Calculate the mass of the skier.

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

Mass of skier = _____ kg [3]

4 **(a)** The grid below shows the mass of five different solids and their volumes.



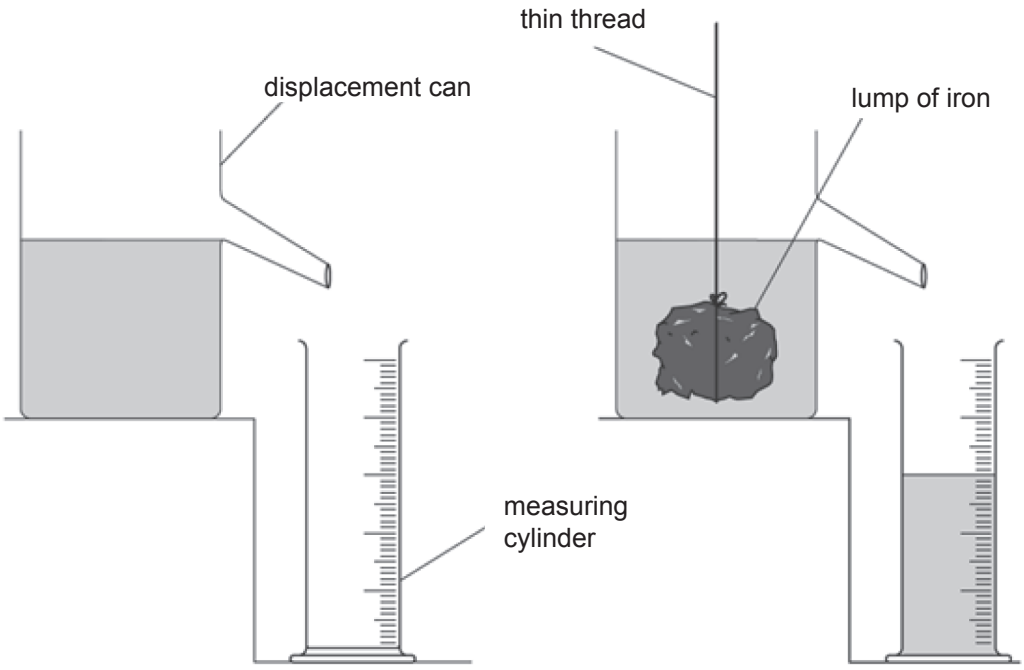
(i) Which one of the five solids (**A** – **E**) has the greatest density?

Solid _____ [1]

(ii) Name the three solids (**A** – **E**) which have the same density.

Solids _____ [1]

(b) Frances carries out an experiment on density using the apparatus shown below.



She records her results as shown below.

Mass of lump of iron = 794 g
Initial volume of water in cylinder = 0 cm^3
Final volume of water in cylinder = 105 cm^3

(i) Use the results to calculate the density of the iron.

Remember to give the correct unit for density.

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

Density = _____ [5]

[Turn over

When lowering the iron into the displacement can, Frances needs to take great care that no water is spilled as a result of splashing.

(ii) State and explain what the effect, if any, would be on her result for the density of iron if she did **not** take this precaution.

_____

_____

_____ [2]

One of Frances' friends used a heavier lump of iron.

(iii) Would her friend's result for the density of iron be smaller, larger or the same as that obtained by Frances?

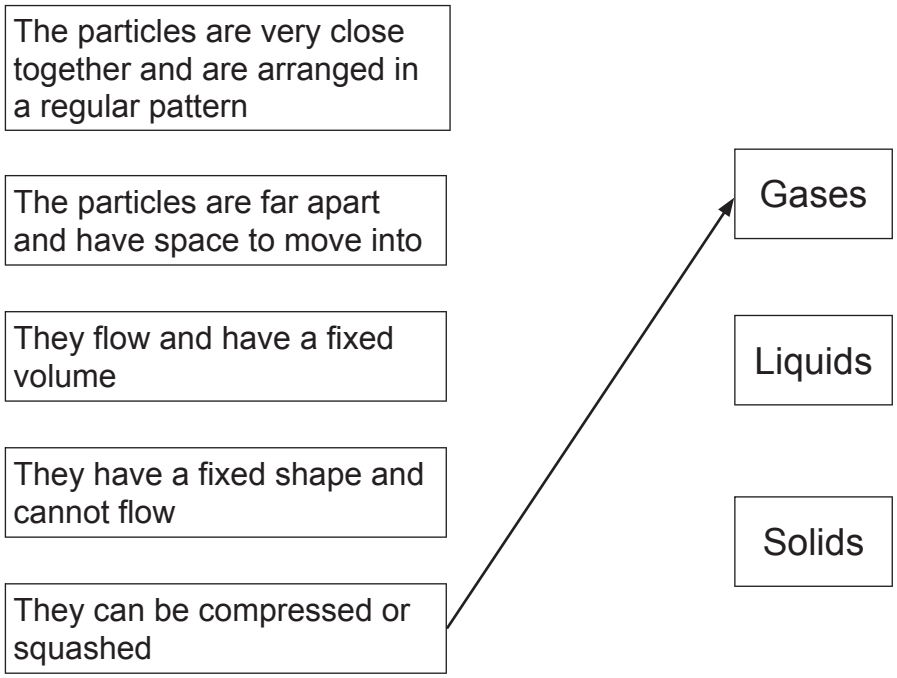
Give a reason for your answer.

_____

_____

_____ [2]

(c) Kinetic Theory helps us understand the properties of solids, liquids and gases by looking at the arrangements of the molecules and their motion. Join together with an arrow each property on the left-hand side of the diagram below with the correct state of matter (Gas, Liquid or Solid).
One has already been drawn for you as an example.



[4]

[Turn over

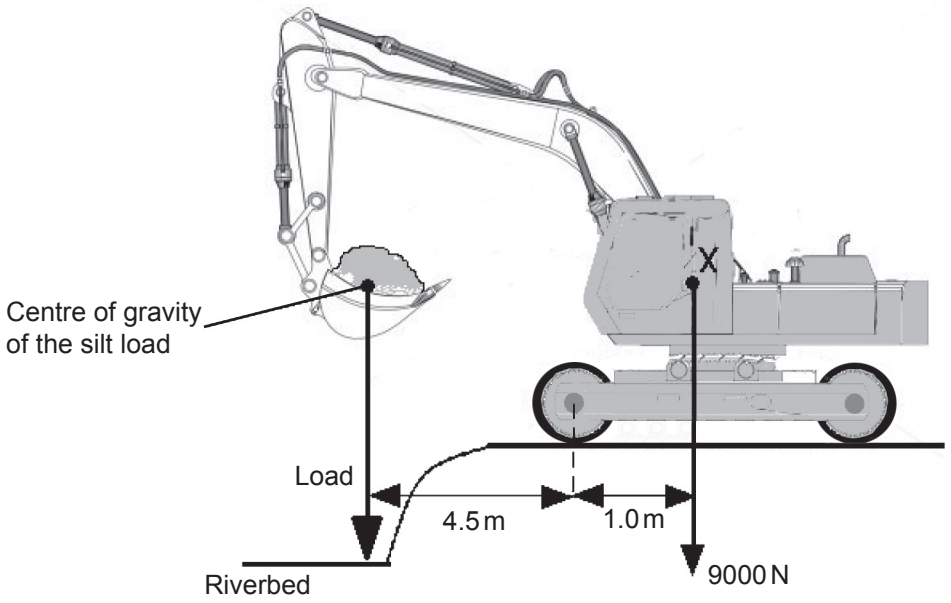
5 **(a)** **(i)** State the Principle of Moments.

_____

_____

_____ [2]

The diagram below represents a digger being used to remove silt from a riverbed.



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(ii) If the digger was to become unstable due to the silt being lifted in the bucket, mark clearly with the letter **P** the point about which it would topple.

[1]

(iii) The point marked **X** on the diagram opposite represents the centre of gravity of the digger. If the weight of the digger is 9000 N calculate the maximum load of silt that can be lifted safely for the conditions shown.

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

Safe load of silt is _____ N [3]

(b) A workman on the site suggested it would be best to use smaller tyres (smaller diameter) on the digger, to lower the centre of gravity of the digger.

(i) In what way would the stability of the digger change, if at all? Circle the appropriate answer.

Increase Decrease Stay the same

[1]

(ii) How would such a change affect the digger's ability to lift safely heavier loads? Circle the appropriate answer.

More safe Less safe No change

[1]

[Turn over

(iii) If the driver wished to lift safely a heavier load, in what direction should he move the bucket?

Carefully explain your answer.

Direction _____ [1]

Explanation

_____

_____

_____

_____ [1]

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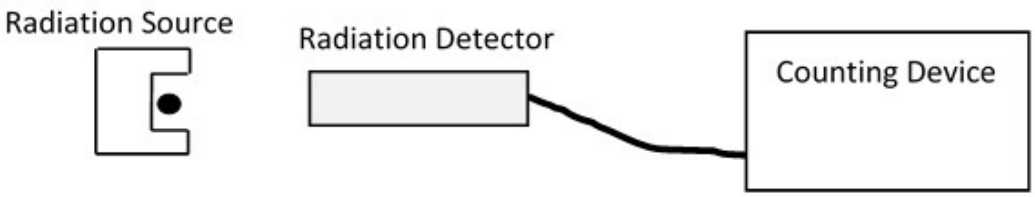
(Questions continue overleaf)

6 **(a)** A Physics teacher is given a radioactive source. The type of radiation emitted by the source is known to be alpha (α), beta (β) or gamma (γ). He is also provided with three absorbers: a thin sheet of paper, a thin sheet of aluminium and lead block.

He sets up the apparatus as shown below.



Describe how he would use the apparatus and the absorbers to determine which one of the three radiations is emitted by the radioactive source.

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

In your description you should state the following:

- How the background count rate (background activity) is measured

- How the background count rate (background activity) is used to correct the activity of the radioactive source

- Why the distance between the radioactive source and the detector should be kept constant

- How each absorber is used

- How the measurements allow the type of radiation emitted by the radioactive source to be identified.

[6]

(b) The corrected count rate obtained from a radioactive source was measured and recorded at various times. The results are shown in the table below.

Time/days	Corrected counts/minute
0	160
3	95
6	57
9	34
12	20

(i) Use the data and the grid opposite to plot a decay graph for the source. Draw a curve of best fit through the points.

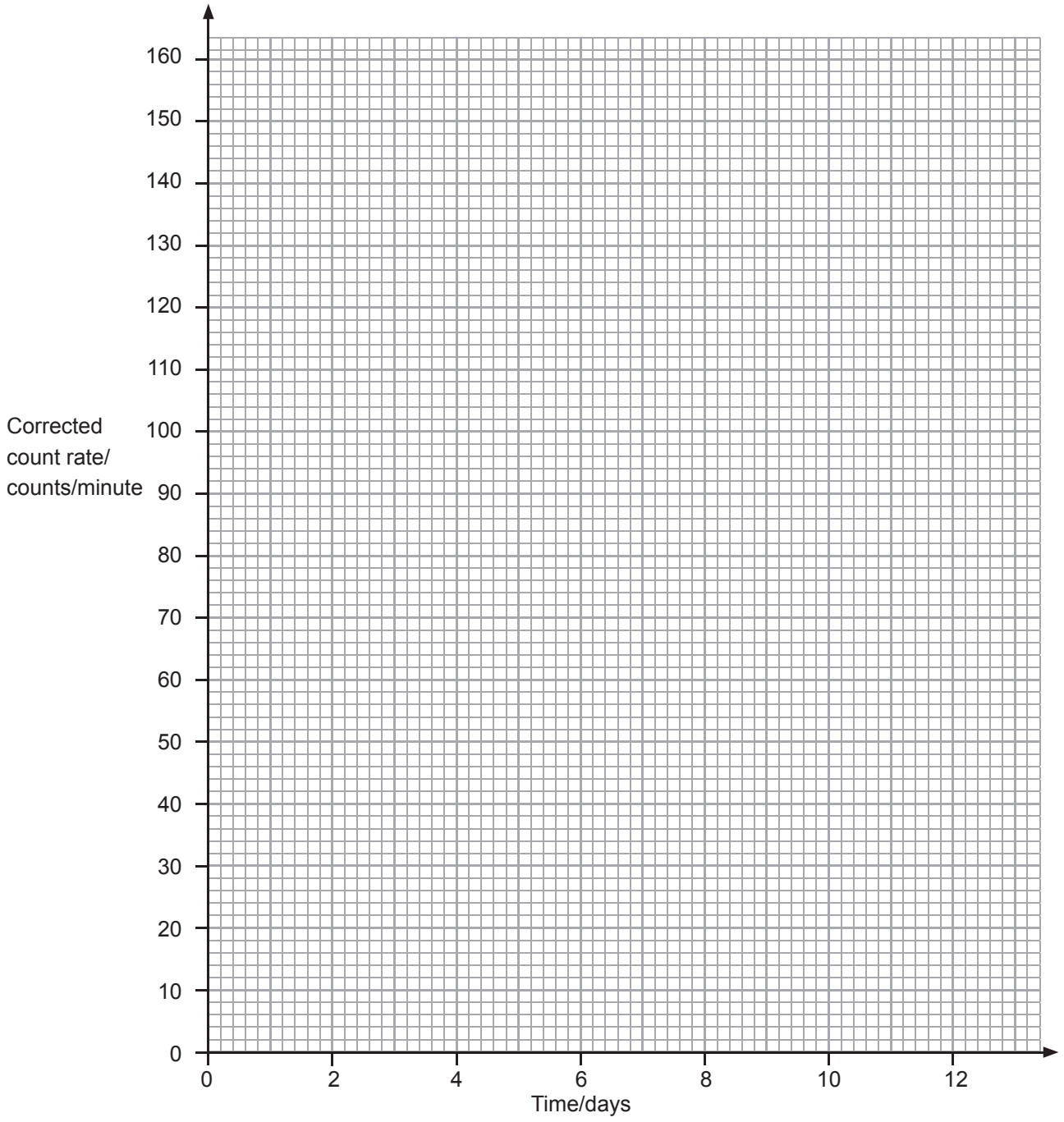
[3]

(ii) Use the graph to estimate the half-life of the source.

Half-life = _____ days [1]

(iii) On the graph sketch the shape of line you would expect to obtain for a different source which had an initial count rate of 160 counts per minute but a shorter half-life.

[1]



[Turn over

(c) To treat a patient suffering from cancer of the thyroid a radioactive isotope known as iodine-131 is used.

This isotope has a half-life of 8 days.

When it is first produced its activity is eight times the safe value to be used in a patient.

Calculate the number of days that must pass before the isotope can be safely given to a patient.

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

Number of days = _____ [2]

(d) The incomplete nuclear decay equation below represents the alpha decay of the chemical element radium (Ra) to radon (Rn).

Complete the equation by filling in the missing numbers in the boxes.

$$\square\!\!\underset{88}{\square}\,Ra \rightarrow {}^{222}Rn + \underset{\square}{}He(\alpha)$$

[2]

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For Examiner's use only	
Question Number	**Marks**
1	
2	
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Total Marks	

Examiner Number