Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2015

GCSE Physics

Unit 1

Higher Tier

[GPH12]

GPH12

FRIDAY 12 JUNE, AFTERNOON

TIME

1 hour 30 minutes.

INSTRUCTIONS TO CANDIDATES

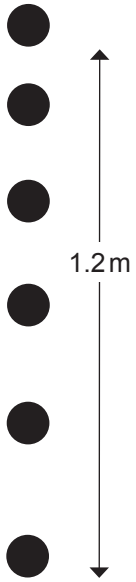
Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
You must answer the questions in the spaces provided.
Do not write outside the boxed area on each page or on blank pages.
Complete in blue or black ink only. **Do not write with a gel pen.**
Answer **all six** 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 Questions **2(c)** and **5(b)**.

9307

1 **(a)** To investigate the motion of a ball falling from rest a series of photographs were taken at regular intervals. The diagram on the right was copied from the photographs obtained.



(i) Describe the motion of the ball and explain how the diagram supports your answer.

_____

_____

_____

_____

_____

_____

_____ [2]

(ii) Each photograph is taken 0.1 s apart. Using the diagram calculate the **average velocity** of the ball when it has fallen 1.2 m from rest.
Do **not** assume a value for the acceleration due to gravity in your answer.

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

Average velocity = _____ m/s [3]

(iii) Using the equation below and your answer to **(a)(ii)**, calculate the **final velocity** of the ball when it has fallen 1.2 m.

$$\text{Average velocity} = \frac{\text{initial velocity + final velocity}}{2}$$

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

Remember the ball falls from rest.

Final velocity = _____ m/s [3]

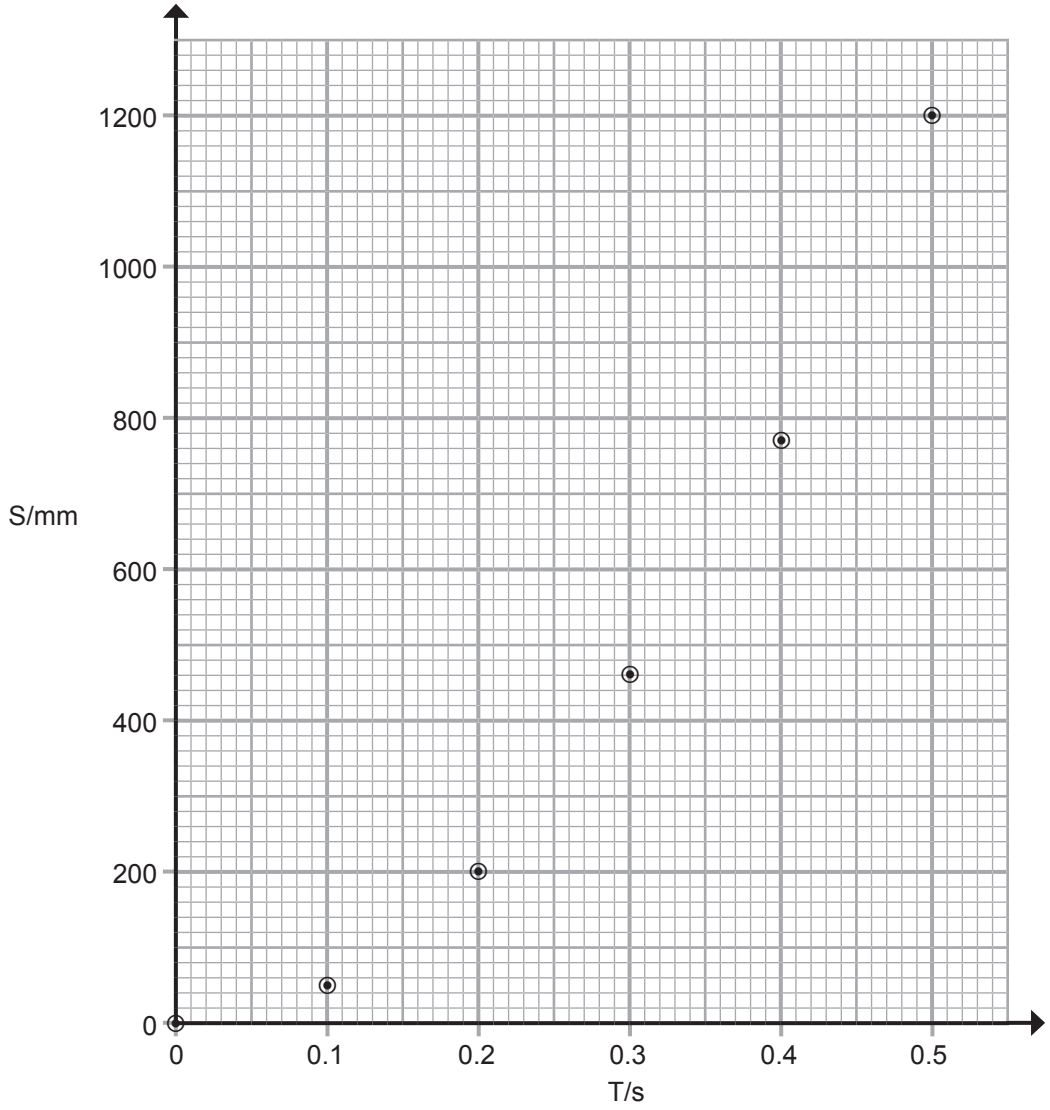
(iv) Calculate the acceleration of the ball as it falls.

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

Acceleration = _____ m/s^2 [4]

[Turn over

(b) Some of the data from the series of photographs is plotted on the grid below. **S** is the distance fallen in millimetres and **T** is the time in seconds.



(i) Complete the graph by drawing either a curve or a straight line by deciding which one **best fits** the data points.

[1]

The relationship between the distance fallen **S** and the time **T** is given by the equation $\mathbf{S} = k\mathbf{T}^2$ where k is a constant.

(ii) Using values taken from the graph you have drawn calculate the value of k.

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

k = _____ mm/s^2 [3]

[Turn over

(c) The diagram below shows some of the forces acting on a car.
The car is accelerating at 0.5 m/s^2.
The car has a mass of 1 600 kg.
The driving force on the car is 1 000 N.

© ancroft/ iStock/ Thinkstock

(i) Calculate the resultant force acting on the car.

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

Resultant force = _____ N [2]

(ii) Calculate the frictional force acting on the car.

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

Frictional force = _____ N [2]

2 **(a)** Wind turbines provide some of our energy needs.

©Jezperklauzen/ iStock/ Thinkstock

The kinetic energy of moving air is converted to kinetic energy of the moving rotor blades. This in turn is converted to electrical energy by a generator.

(i) Calculate the kinetic energy of 1 kg of air moving at 15 m/s.

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

Kinetic energy = _____ J [3]

[Turn over

After passing through the rotor blades the velocity of 1 kg of air is reduced to 9 m/s. However, **only half of this loss** of kinetic energy of the air is turned to kinetic energy of the moving rotor blades.

(ii) Calculate the kinetic energy of the moving rotor blades.

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

Kinetic energy of the rotor blades = _____ J [3]

(iii) The overall efficiency of a wind turbine is 0.3.
For every 1 000 J of kinetic energy from the moving air, calculate the useful electrical output energy of the wind turbine.

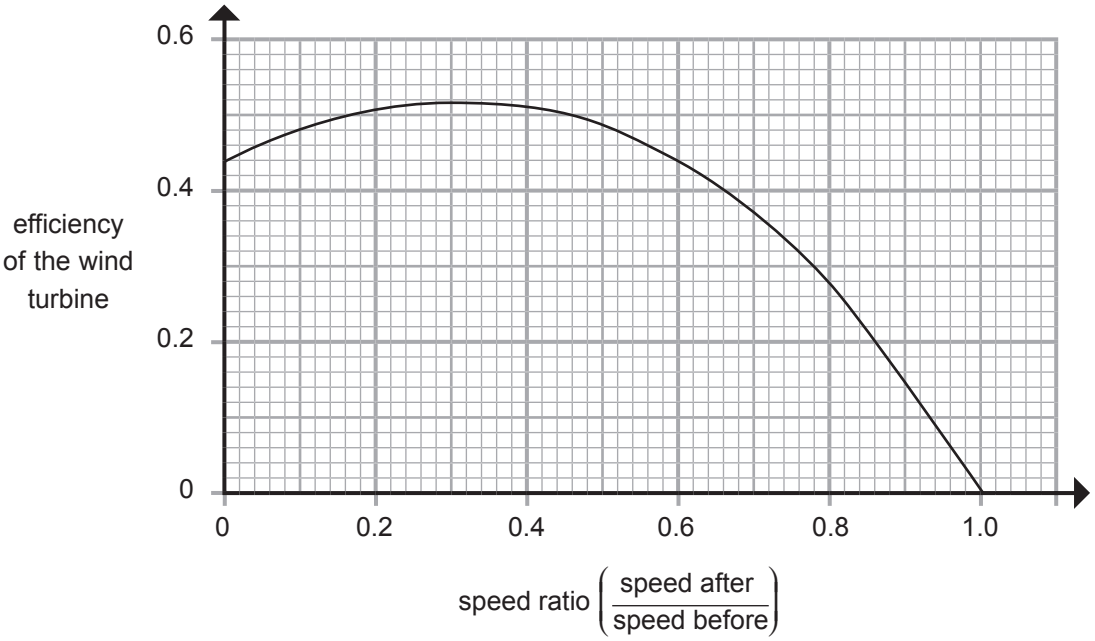
You are advised to show clearly how you get your answer.

Useful output electrical energy = _____ J [2]

(b) The efficiency of the wind turbine depends on the ratio of the speed of the air after it has passed through the rotor blades to the speed of the air before it passes through the rotor blades.

© *Jezperklauzen/ iStock/ Thinkstock*

The graph below shows how the efficiency of the wind turbine depends on the ratio of these two speeds.



(i) What is the maximum efficiency of the wind turbine and the ratio of the two speeds at which it happens?

Maximum efficiency = _____

Speed ratio $\left(\frac{\text{speed after}}{\text{speed before}}\right)$ = _____

[2]

[Turn over

(ii) Describe the motion of the air after it has passed through the rotor blades of the turbine if the speed ratio $\left(\frac{\text{speed after}}{\text{speed before}}\right) = 0$

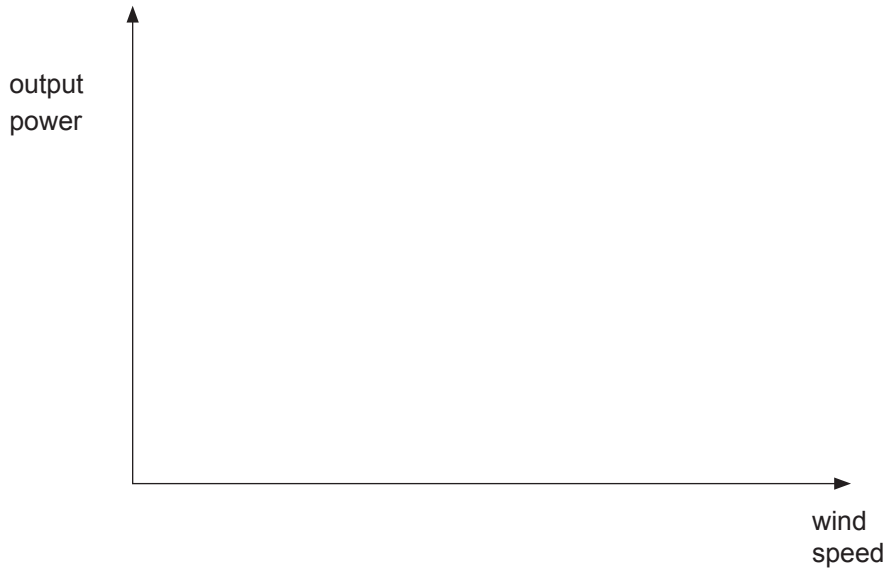
_____

_____

_____ [1]

(iii) A wind turbine does not produce any output electrical power until the wind speed reaches a value called the **Cut-In** speed. As the wind speed increases so does the output power until a particular wind speed is reached after which the output power remains constant. However if the wind speed exceeds a value known as the **Cut-Off** speed the rotation of the wind turbine is stopped, to prevent damage, and the power output as a result falls to zero.

On the axes below sketch how the output power varies with wind speed. On your graph mark and label the Cut-In and Cut-Off wind speeds.



[3]

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(Questions continue overleaf)

[Turn over

(c) The photograph below shows the type of weight lifting machine found in most gyms.

© Алексей Многосмыслов/ iStock/ Thinkstock.

Describe, in detail, how this machine could be used to measure the personal power of the person using it. In your answer you should state the measurements to take and the calculations needed to find the personal power of the person using the machine.

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

[6]

[Turn over

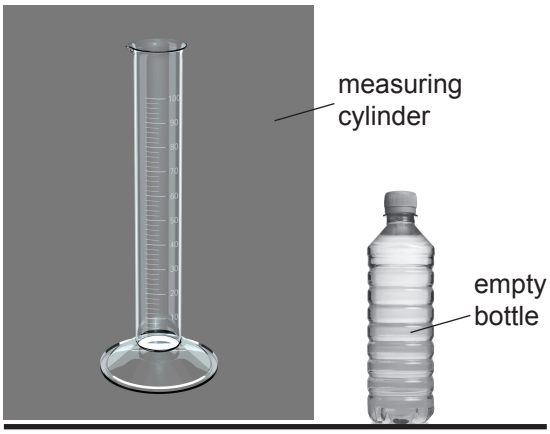
3 **(a)** **(i)** Write down, **in words**, the formula used to calculate the density of a substance.

[1]

(ii) Give the unit for density.

_____ [1]

(b) Maureen is asked to measure the volume of plastic used in a small bottle as shown below. She is given a large measuring cylinder and a supply of water.

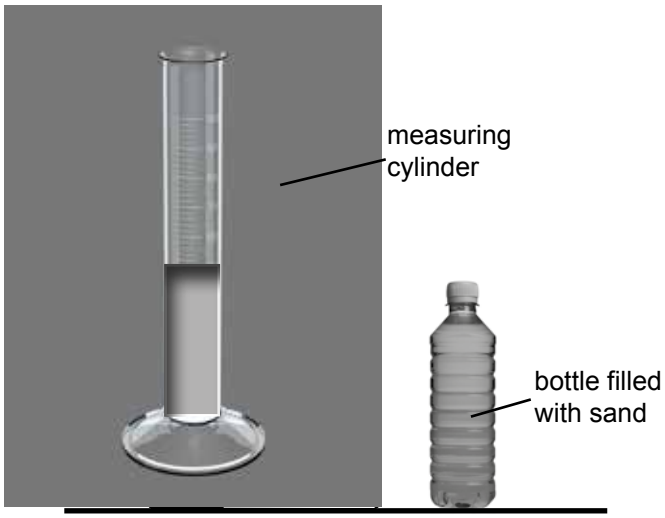


(i) Describe how she could find the volume of the inside of the bottle.

[3]

[Turn over

The bottle is now filled with sand and the top replaced.
The bottle will now sink in water.
The large measuring cylinder is now half-filled with water.



(ii) Describe how she could find the total volume of the bottle.

[3]

(iii) What calculation does she need to make to find the volume of the plastic used to make the bottle?

_____

_____

_____

_____ [1]

(c) (i) Is the density of steam greater than, smaller than or equal to the density of water at room temperature?
Answer by placing a tick (✓) in the box below.

Density of steam is	
greater than the density of water	
less than the density of water	
equal to the density of water	

[1]

(ii) Use the Kinetic Theory to explain briefly your answer to part **(i)**.

_____

_____

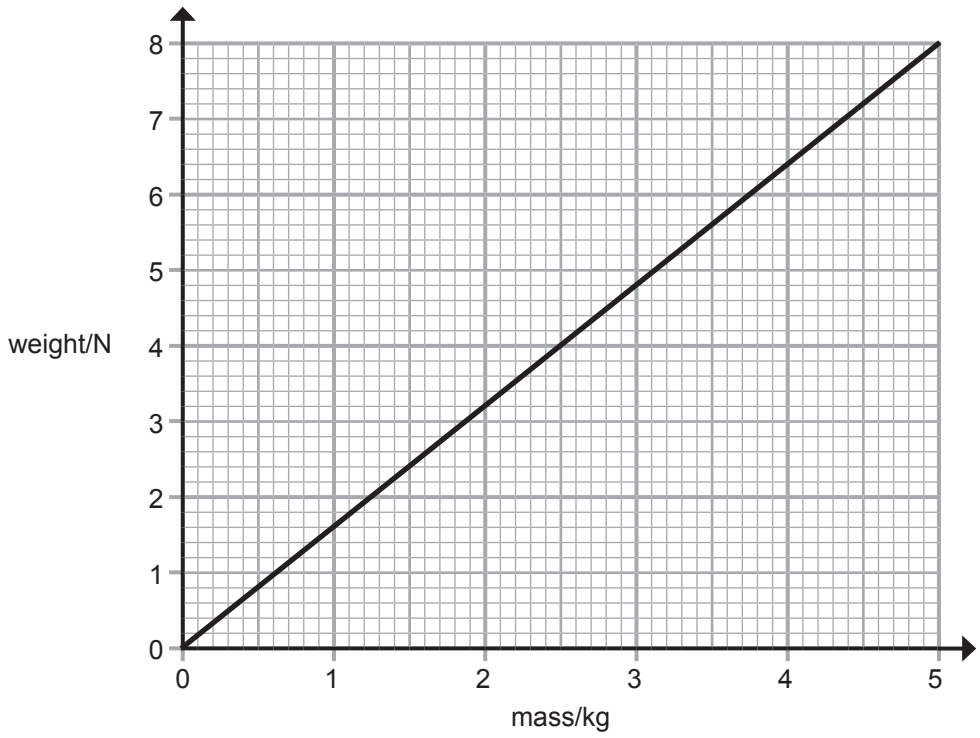
_____

_____

_____ [1]

[Turn over

(d) The graph below shows how the weight of an object varies with its mass on the surface of the Moon.



(i) Using the graph and your knowledge, find the **difference** between the weight of an object of mass 5 kg on the Earth and on the Moon.

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

Difference in weight = _____ N [3]

(ii) On the planet Mars the weight of an object of mass 1 kg is 3.7 N. On the grid above draw the graph which shows how weight varies with mass on Mars. [1]

4 **(a)** Mary is the front-seat passenger in a car involved in a road traffic accident.

(i) How might wearing a car seat belt reduce the injuries to Mary?

_____

_____

_____

_____

_____

_____ [1]

(ii) State one other safety feature of a modern car which might reduce the injuries to passengers involved in a road traffic accident.

_____

_____

_____

_____ [1]

Mary has a mass of 48 kg and, at the time of the collision, the car was travelling at 15 m/s.

(iii) Calculate Mary's momentum at the time of the collision.

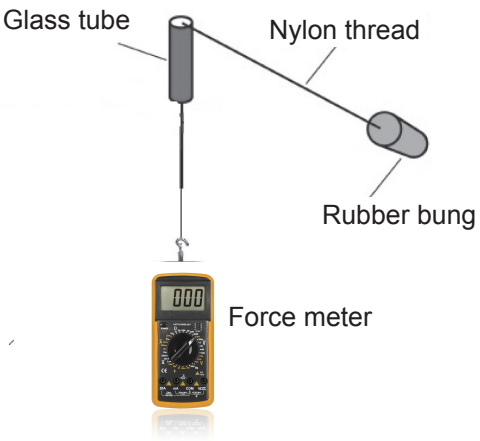
You are advised to show clearly how you get your answer.

Remember to include the unit for momentum.

Momentum = _____ [4]

[Turn over

(b) Jane carries out an investigation on the factors which control the size of the centripetal force. She uses the apparatus below.



© gilotyna / iStock / Thinkstock

Jane holds the glass tube in her hand and whirls the rubber bung above her head. When the bung is moving at a constant speed she records the reading on the force meter.

For different values of F, Jane's friend measures the speed of the bung, v, as it is whirled above her head in a circle.

The radius of the circle and the mass of the bung remain constant throughout. The results of Jane's experiment are shown below.

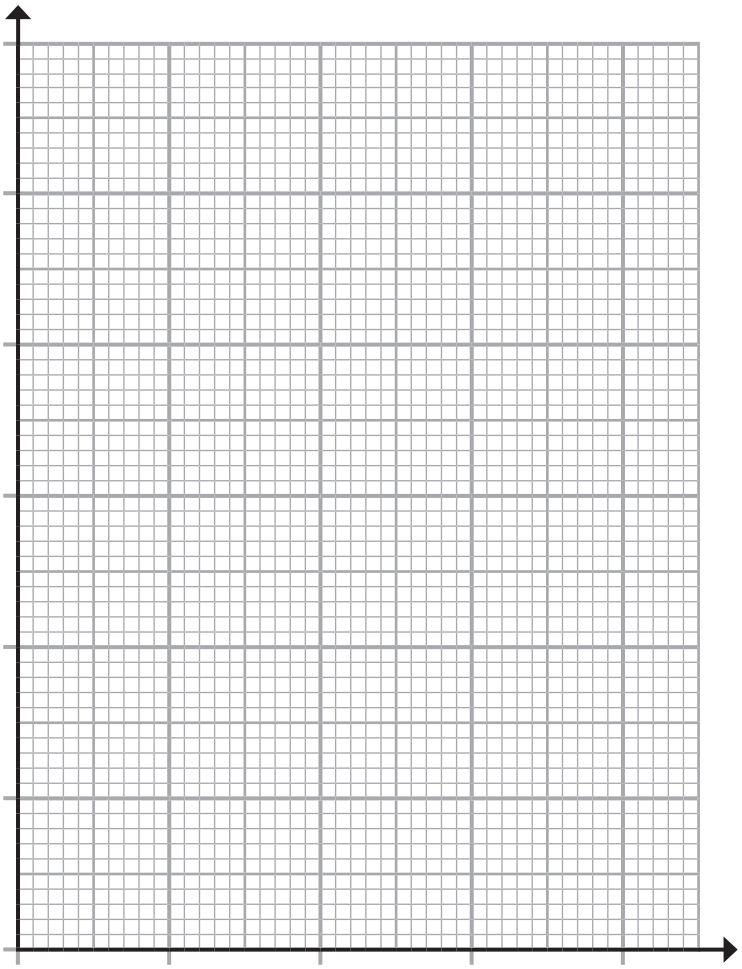
(i) Complete the table below by entering the values of v^2 **correct to 1 decimal place**. Two values have already been done for you.

Centripetal force, F in N	0.0	0.5	1.0	1.5	2.0
Speed of bung, v in m/s	0.0	0.9	1.3	1.6	1.8
v^2 in m^2/s^2	0.0			2.6	

[1]

(ii) On the grid below, plot the graph of F against v^2.
You will need to label the horizontal axis carefully and select a suitable scale.

centripetal force F/N



[4]

(iii) Draw the straight line of best fit through your points. [1]

[Turn over

Jane's teacher tells her that the mathematical equation linking F and v^2 is

$$F = kv^2$$

where k is a constant.

(iv) Calculate the gradient of the graph.

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

Gradient = _____ Ns^2/m^2 [2]

(v) How is the gradient related to the value of k?

_____

_____ [1]

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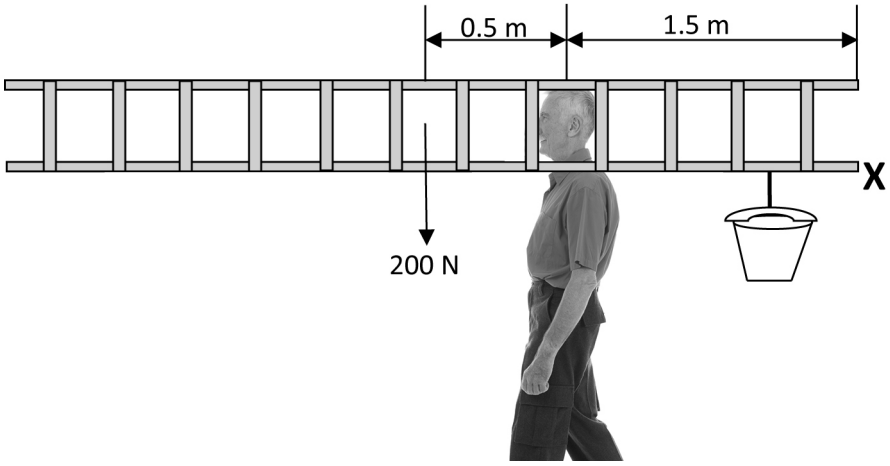
[Turn over

5 **(a)** The diagram below represents a window cleaner carrying a ladder and a bucket with water and cloths in it.

The ladder is uniform, 4 m long and weighs 200 N.



© IvonneW / iStock / Thinkstock

The bucket and its contents have a weight of 80 N.

(i) Clearly label, with the letter P, the position of the pivot. [1]

(ii) Mark clearly, with the letter G, the position of the centre of gravity of the ladder [1]

(iii) Calculate how far from the end **X** of the ladder the bucket should be hung for the ladder to remain balanced.

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

Distance = _____ m [4]

(iv) The window cleaner replaces the ladder with another type of the same length but of weight 220 N.
In what direction would the bucket have to be moved to maintain equilibrium of the ladder? Explain your answer.

Direction _____

Explanation _____

_____

_____

_____

_____

_____ [3]

[Turn over

(b) The picture below shows a Bunsen burner similar to those found in many school laboratories.
Describe, in detail, how its design contributes to its stability and why this is very necessary.

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

Source: Chief Examiner

[6]

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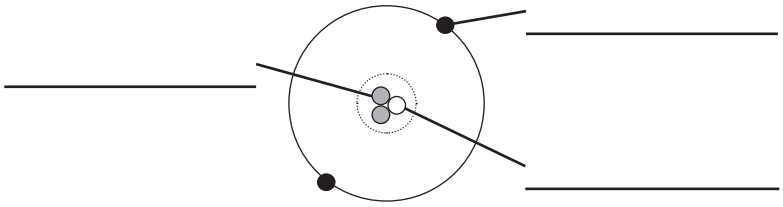
(Questions continue overleaf)

[Turn over

6 The diagram below represents a neutral atom of an isotope of the chemical element helium.

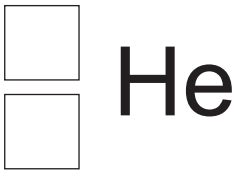
Carefully label the particles with their names in the spaces provided.

(a) (i)



[3]

(ii) Normal helium nuclei are represented by the symbol $^{4}_{2}He$.
Complete the diagram below to show the correct symbol for the nucleus shown above.



[1]

(b) If government is to meet its Carbon Emissions Target, to help in the reduction of global warming, it has been suggested that more nuclear power stations should be built.

(i) What is the name of the process used, in today's nuclear power stations, to produce energy?

_____ [1]

(ii) There is much debate as to whether more nuclear power stations should be built. Suppose the government was to suggest building one such station in Northern Ireland.

Would you be in favour of this? Circle your answer.

Yes No

Explain your choice with two reasons, **not including global warming**.

Reason 1:

Reason 2:

[2]

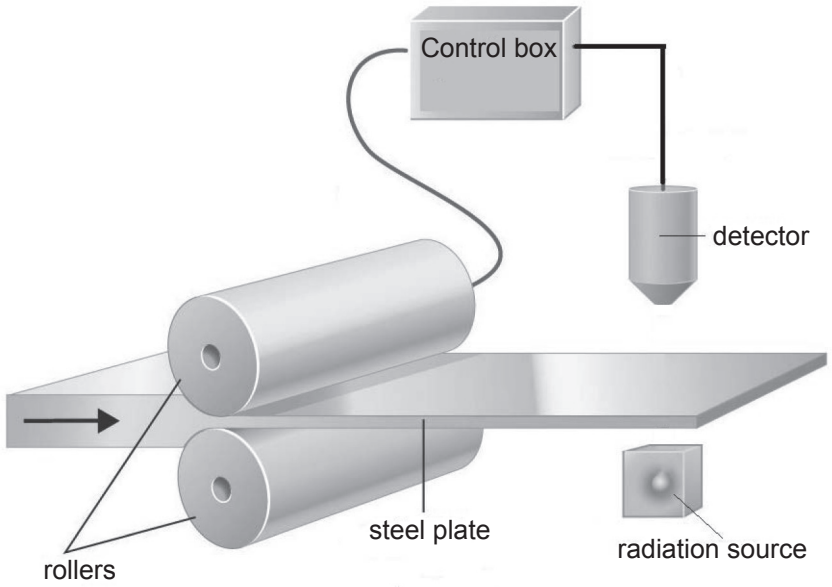
(c) Radioactivity is also known as ionising radiation.

What do you understand by this?

[1]

[Turn over

(d) There are many uses to which radioactivity can be put. The diagram below represents a thickness control unit for the production of steel plate.



(i) Which type of emitter, alpha, beta or gamma, should the radioactive source be? Explain your choice.

Type of source: _____

Explanation:

_____

_____

_____ [2]

(ii) Explain briefly how the pressure on the rollers can be controlled by the system to maintain a constant thickness for the sheet of steel.

_____

_____

_____

_____

_____

_____

_____

_____ [2]

(e) The chemical element carbon has an isotope C-14 which is radioactive by beta emission. It is used in the process of Radio Carbon Dating to estimate the age of material that was once part of a living organism.
C-14 has a half-life of 5600 years. A 1 mg sample of oak wood removed from a living tree has a count rate of 20 counts per second due to the presence of C-14. A 1 mg sample of oak wood from an ancient dugout canoe has a count rate of 5 counts per second due to the presence of C-14 that remains in it. Use the above information to calculate the age of the canoe.

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

Age of canoe = _____ years [3]

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

Examiner Number