Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education

Physics

Unit 1

Higher Tier

[GPY12]

Assessment

GPY12

Assessment Level of Control:
Tick the relevant box (✓)

Controlled Conditions	
Other	

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** 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 **4(c)** and **5(b)**.

12408

1 (a) (i) What is the difference between a vector and a scalar quantity?

_____

_____ [1]

(ii) Indicate which of the following quantities are vectors and which are scalars by placing a tick (✓) in the appropriate column.

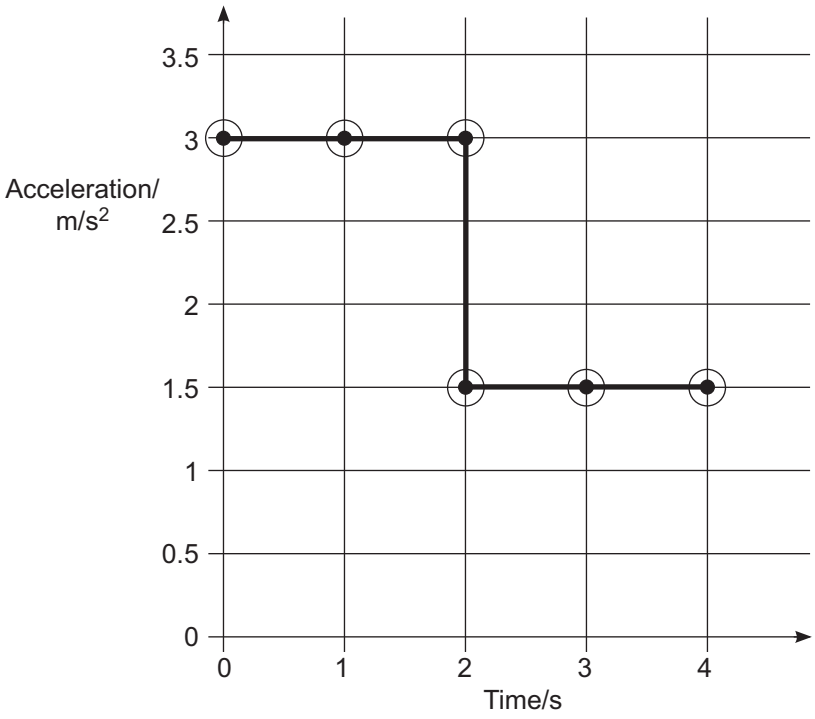
Quantity	vector	scalar
Acceleration		
Displacement		
Rate of change of speed		
Speed		
Velocity		

[3]

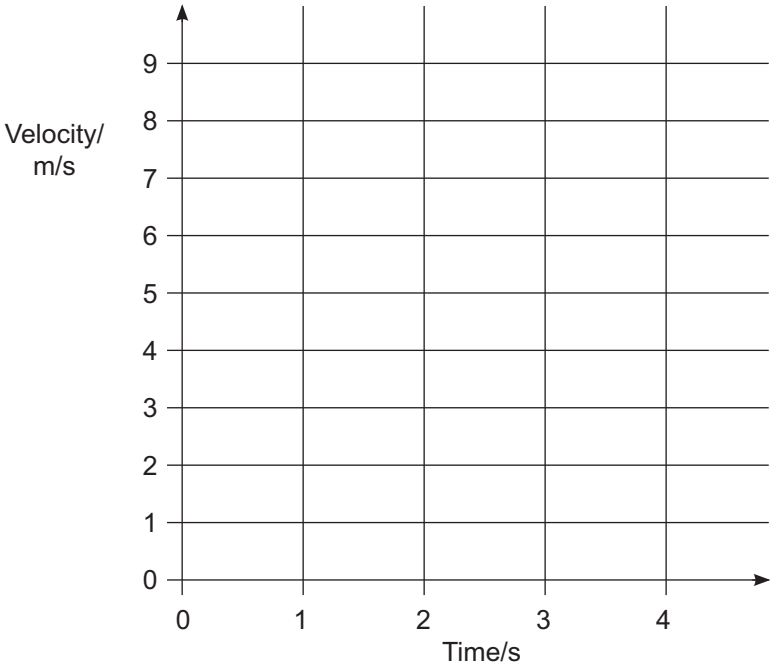
(iii) In what unit would you measure **the rate** at which the speed of an object is changing?

_____ [1]

(b) The graph below shows how the acceleration of a certain object changes with time.



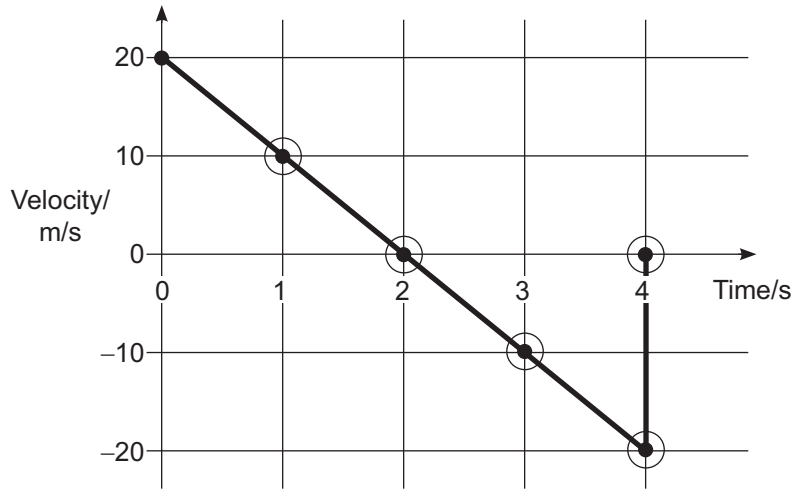
The velocity of the body is zero at time = 0.
Using the grid below, draw the velocity–time graph for the motion of the object during the 4 seconds shown on the graph above.



[4]

[Turn over

(c) A boy throws a stone vertically upwards.
The stone hits the ground 4.0 s after it was released.
The velocity–time graph for the motion of the stone is shown below.



(i) At what time is the stone at its maximum height?

Time = _____ s [1]

(ii) Calculate the average velocity of the stone during the period when it is rising towards its maximum height.
Show clearly how you get your answer, starting with the equation you plan to use.

Average velocity = _____ m/s [2]

(iii) Using the graph, calculate the maximum height the stone reaches.
Show clearly how you get your answer, starting with the equation you plan to use.

Maximum height = _____ m [3]

(iv) At what velocity does the stone hit the ground?

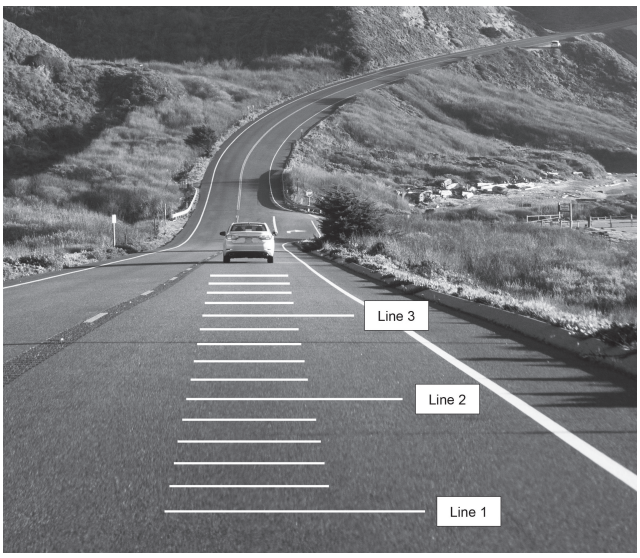
Velocity = _____ m/s [2]

(d) The acceleration due to gravity on the planet Mars is 3.8 m/s^2.
If an astronaut on Mars were to throw a stone vertically upwards with an initial velocity of 30 m/s, calculate how long it would take the stone to reach its maximum height.
Show clearly how you get your answer, starting with the equation you plan to use.

Time to reach maximum height = _____ s [3]

[Turn over

(e) Horizontal lines on the road are often used by the police to detect speeding drivers. The photograph below shows a number of such lines.
Lines 1 and 2 are **2 m apart** and lines 2 and 3 are also **2 m apart**.



Adapted © Getty Images

A timer is started when a car reaches line 1.
The time is recorded when the car reaches line 2 and again when it reaches line 3.

The timings for one car are shown below.

	Time/s
Time when line 1 is reached	0.000
Time when line 2 is reached	0.055
Time when line 3 is reached	0.155

(i) Describe the motion of the car as indicated by the time measurements shown opposite. Give a reason for your answer.

Type of motion _____

Reason _____

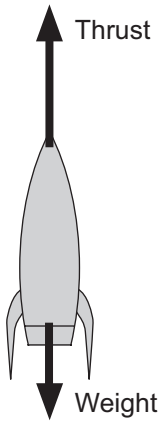
_____ [2]

(ii) Calculate the average speed of the car as it travelled from line 1 to line 3. Remember lines 1 and 2 are 2 m apart and lines 2 and 3 are also 2 m apart.
Show clearly how you get your answer, starting with the equation you plan to use.

Speed = _____ m/s [2]

[Turn over

2 **(a)** The diagram below shows the two forces acting on a rocket at lift-off.



Source: Principal Examiner

(i) The rocket has a mass of 50 kg.
Calculate the weight of the rocket.
Show clearly your calculation, starting with the equation you plan to use to get your answer.

Weight of rocket = _____ N [1]

(ii) The rocket motor provides a **constant thrust of 750 N**.
Using this information and your answer to part **(i)**, calculate the acceleration of the rocket at lift-off.
Show clearly your calculation, starting with the equation you plan to use to get your answer.

Acceleration at lift-off = _____ m/s^2 [4]

(iii) Shortly after lift-off, the acceleration of the rocket is observed to show an increase.
Explain carefully why this happens.

_____

_____

_____ [2]

(iv) Several seconds after lift-off, when the velocity of the rocket has increased substantially, another force causes the acceleration of the rocket to gradually decrease until the rocket is travelling at a **constant velocity**.

Name this other force that causes the acceleration of the rocket to gradually decrease and state its direction.

Name _____

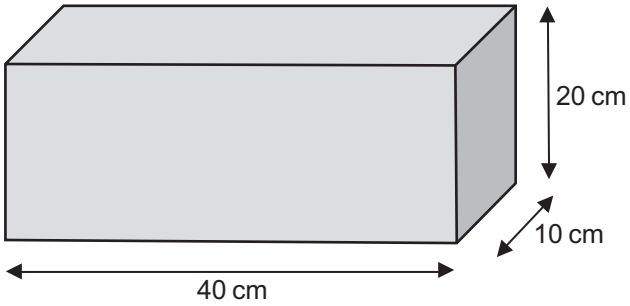
Direction _____ [2]

(v) Write down how this other force, the weight of the rocket and the thrust are related during this period of **constant velocity**.

_____ [1]

[Turn over

(b) The diagram below shows a block sitting on the ground.



Source: Principal Examiner

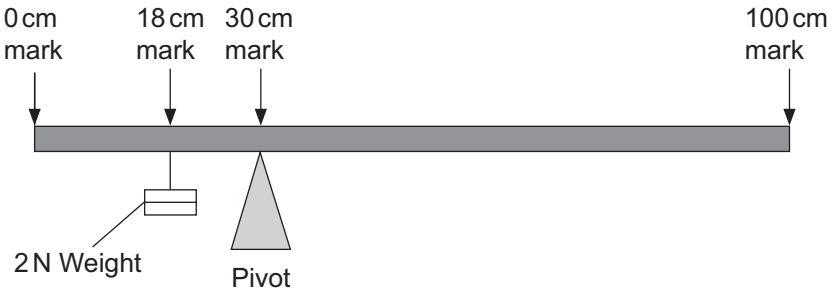
The block has a weight of 100 N.
Calculate the pressure exerted by the block when set in the position to exert **least** pressure on the ground.

Show clearly how you get your answer, starting with the equation you plan to use.
Include the unit for pressure with your answer.

Pressure = _____

Unit = _____ [5]

(c) The diagram below shows a uniform metre rule balanced on a pivot. The pivot is placed at the 30 cm mark.



Source: Principal Examiner

(i) Using the Principle of Moments and information from the diagram, calculate the weight of the metre rule.
Show clearly how you get your answer, starting with the equation you plan to use.

Weight of rule = _____ N [4]

(ii) Calculate the supporting force provided by the pivot for the balanced rule.
Show clearly how you get your answer.

Supporting force = _____ N [2]

(iii) If the 2 N weight is moved to the left, in what direction would the pivot be moved so that the metre rule remains balanced?

_____ [1]

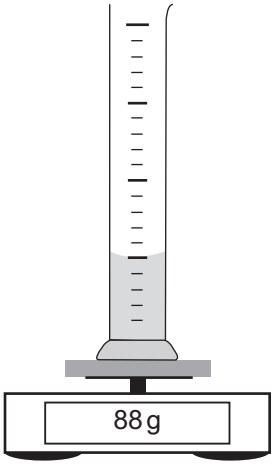
[Turn over

3 **(a)** The density of gold is 19.3 g/cm^3.
Explain carefully, **without giving an equation**, what this means.

_____

_____ [2]

(b) A student is asked to investigate how the mass of liquid varies with its volume.
He placed a measuring cylinder on electronic scales as shown below and added different volumes of the same liquid.
He recorded the **total mass of the measuring cylinder and the liquid**.

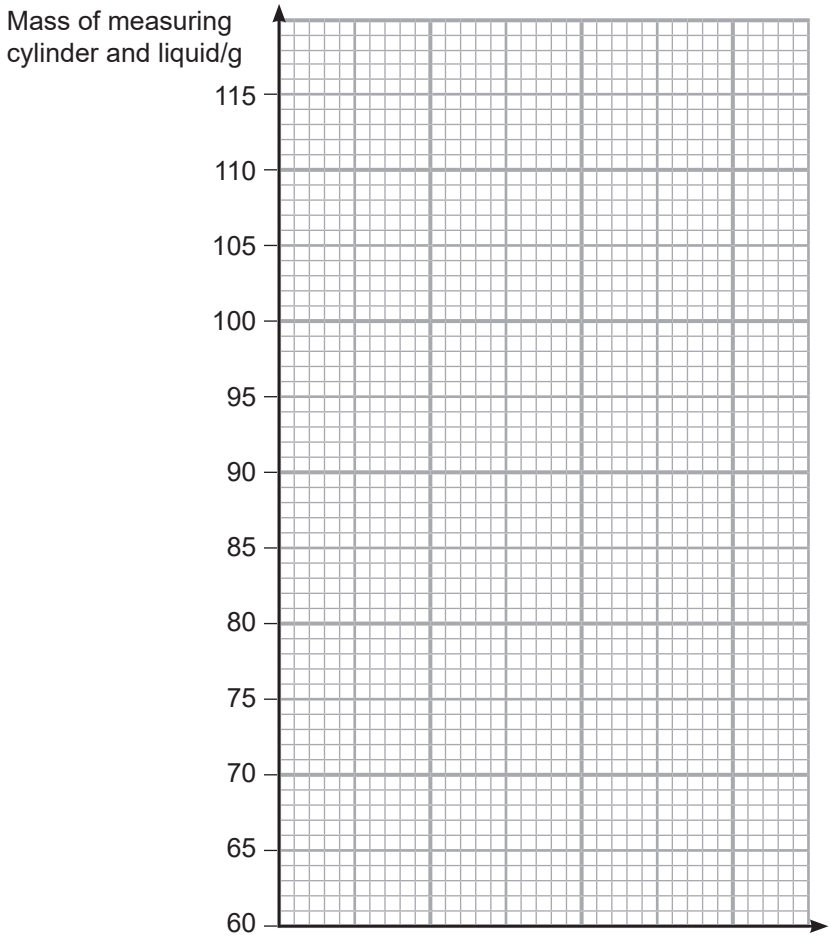


Source: Chief Examiner

The results are shown in the table below.

Volume of liquid/cm^3	Mass of measuring cylinder + liquid/g
10	79
20	88
30	97
40	106
50	115

(i) On the grid opposite, plot a graph of the mass of measuring cylinder plus liquid against the volume of the liquid.
Label the x-axis with the quantity and its unit. [3]



(ii) By drawing a line of best fit through the points, determine the mass of the measuring cylinder.

Mass of measuring cylinder = _____ g [2]

(iii) Calculate the density of the liquid.
Show clearly how you get your answer, starting with the equation you plan to use.

Density of the liquid = _____ g/cm^3 [3]

[Turn over

(c) The kinetic theory of matter describes matter as a large number of particles and uses this idea to explain the properties of solids.

(i) Why do solids have a fixed shape and volume?

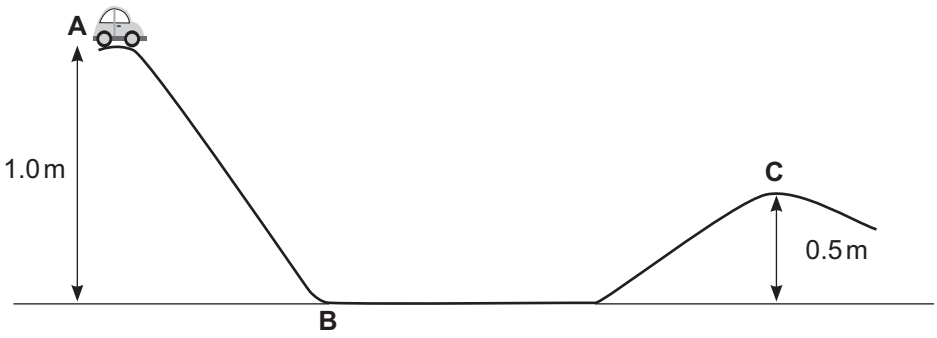
_____

_____ [1]

(ii) Using **one word**, describe the motion of the particles in a solid.

_____ [1]

4 **(a)** The diagram shows part of a toy roller coaster.



The toy car of mass 0.2 kg is released from the top at point A.
At point A the toy car has 2.0 J of potential energy.
When it reaches the bottom at point B its velocity is 2.0 m/s.

(i) Calculate the energy the toy car loses between A and B.
Show clearly how you get your answer, starting with the equation you plan to use.

Energy lost = _____ J [4]

(ii) Will the toy car reach C? Circle your answer.

YES NO

By comparing the heights of points A and C, explain, in terms of energy, your answer.

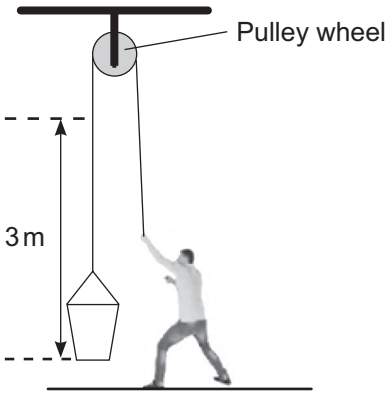
_____

_____

_____ [3]

[Turn over

(b) George raises a bucket of water of mass **5000 g** as shown in the diagram below.



Source: Principal Examiner / Getty Images

(i) Calculate the potential energy gained by the bucket when it is raised by 3 m.
Show clearly how you get your answer, starting with the equation you plan to use.

Potential energy = _____ J [4]

(ii) He does 195 J of work. Calculate the efficiency of lifting the bucket in the way shown.
Show clearly how you get your answer, starting with the equation you plan to use.

Efficiency = _____ [3]

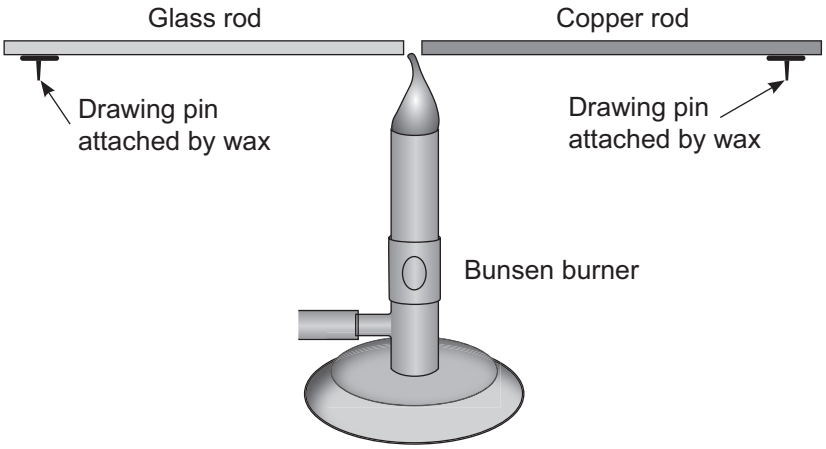
(iii) Considering that George does 195 J of work raising the bucket, use your answer to part **(i)** to calculate the work done against the frictional force. Use this answer to calculate the size of the frictional force when the bucket is raised 3 m.
Show clearly how you get your answer, starting with the equation you plan to use.

Work done against friction = _____ J

Frictional force = _____ N [4]

[Turn over

(c) To investigate the transfer of heat by two different solids, a student proposed setting up the apparatus shown below. A drawing pin is attached to the end of each rod by a small piece of wax.
When the wax melts, the drawing pin will drop off.



Source: Principal Examiner

Describe in detail how the student should carry out this investigation.

In your description you should state:

- the method of heat transfer being investigated;
- how a fair test is ensured;
- what the student will observe and conclude;
- why, in terms of particles, the heat is able to transfer more quickly through one of the rods.

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

Write your answers in the appropriate spaces on the opposite page.

Method of heat transfer _____

How a fair test is ensured _____

Observation and conclusion _____

Particle explanation _____

[6]

[Turn over

5 **(a)** During the historical development of the model of the atom, physicists knew that atoms contained both positive and negative charge.
However, they were unsure of how they were arranged in the atom.
Two models were proposed as stated below.
For each one, describe how the electric charges were arranged.

Plum Pudding Model _____

_____

_____

_____

_____

Rutherford–Bohr Model _____

_____

_____

_____

_____ [4]

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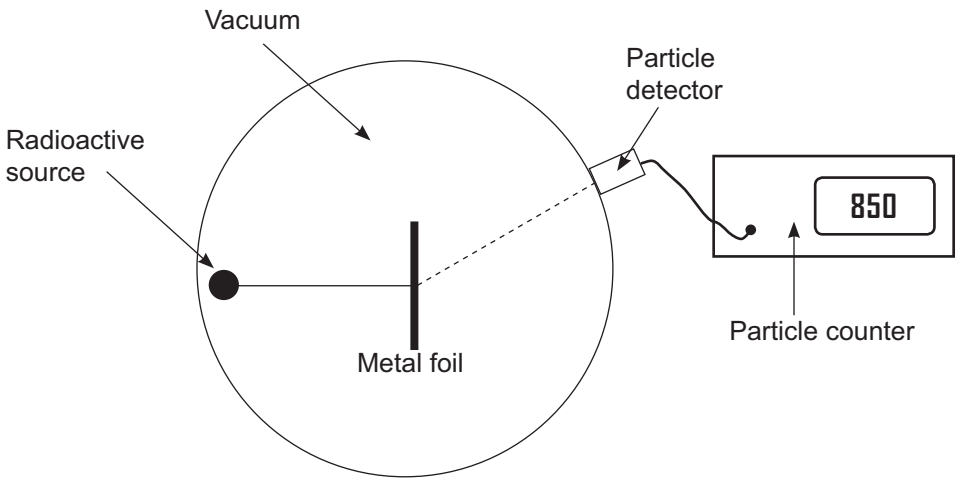
(Questions continue overleaf)

(b) The Plum Pudding model of the atom was replaced by the Rutherford–Bohr model of the atom based on the findings of an experiment performed when positively charged particles from a radioactive source were fired at a metal foil and the paths taken by the particles detected.
The diagram below shows the main features of the apparatus used.



Source: Chief Examiner

Describe in detail how this experiment was carried out and how the observations led to the Rutherford–Bohr model of the atom.
In your description you should state:

- why the radioactive source and metal foil were in a vacuum;
- how the measurements were taken;
- why some of the alpha particles were deflected as they passed through the metal foil;
- how the measurements show that this nucleus is small;
- how the measurements show that the nucleus has a much greater mass than the particles fired at the metal foil.

In this question you will be assessed on your written communication skills including the use of specialist science terms.
Write your answers in the appropriate spaces on the next page.

Why a vacuum was necessary _____

_____

_____

_____

How the measurements were taken _____

_____

_____

_____

Why alpha particles were deflected _____

_____

_____

Small nucleus _____

_____

_____

The nucleus more massive than the particles _____

_____

_____ [6]

[Turn over

(c) Radon is a radioactive gas, which we cannot see or smell.
Radon gas is produced during the radioactive decay of uranium.
Uranium decays over many thousands of years producing various elements.
Part of the radioactive decay of uranium is stated below.

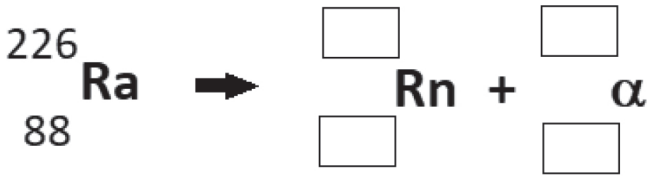
$$^{238}_{92}uranium \rightarrow {}^{226}_{88}radium$$

(i) Between uranium and radium, calculate the difference in the following;

Number of protons _____

Number of neutrons _____ [2]

(ii) Radium (Ra) decays to radon (Rn) by emitting an alpha (α) particle.
Complete the decay equation for this change.



[2]

(iii) A sample of radon gas has an activity of 1024 counts per second.
After 11.4 days the activity is 128 counts per second.
Calculate the half-life of radon.

Half-life =_____ days [2]

(iv) Radon gas decays by emitting an alpha particle.
Why is this gas dangerous if breathed in?

_____

_____ [1]

(v) In some areas the amount of radon emitted from underground rocks is high.
What precautions are taken in homes built over such rocks to reduce the dangers for owners associated with the build-up of radon gas in their homes?

_____

_____ [1]

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Question Number	**Marks**
1	
2	
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Total Marks	

Examiner Number