Centre Number

Candidate Number

**General Certificate of Secondary Education
2015–2016**

Double Award Science: Physics

Unit P1

Higher Tier

ML

[GSD32]

WEDNESDAY 25 MAY 2016, AFTERNOON

TIME

1 hour, plus your additional time allowance.

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.
Answer **all nine** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 70.
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** and **6**.

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1 **(a)** The symbol for Thorium-234 is

$$^{234}_{90}\text{Th}$$

    (i) State the total number of protons and neutrons in a nucleus of Thorium-234.

_____ [1]

    (ii) How many protons does a nucleus of Thorium-234 contain?

_____ [1]

    (iii) What name is given to the total number of protons and neutrons in the nucleus of Thorium-234?

_____ [1]

    (iv) How many neutrons does a nucleus of Thorium-234 contain?

_____ [1]

(b) A radioactive isotope has a half-life of 30 days. Initially there are 64 000 undecayed nuclei. How many undecayed nuclei will remain after 90 days?

Show your working out.

Number of undecayed nuclei = _____ [3]

2 The modern theory for the structure of the atom is quite different from the earlier theory which it replaced.

Write a brief account of both theories.

Your account should include:

- the name of each theory;
- a description of the structure of the atom in each theory.

You will be assessed on your written communication skills including the use of specialist scientific terms.

_____

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_____

_____ [6]

[Turn over

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3 Theory shows that the gravitational potential energy (G.P.E.) of a body depends on its height (h) above the Earth's surface, according to the formula:

$$G.P.E. = k\,h \qquad \textbf{Equation 3.1}$$

where k is a constant.

The following table shows the results for the gravitational potential energy (G.P.E.) of an object at different heights above the Earth's surface.

Height/m	0	10	20	30	40	50
G.P.E./J	0	50	100	150	200	250

You are asked to plot a graph of gravitational potential energy against height.

(a) Choose a suitable vertical scale and label its axis. [2]

(b) Plot the points on the grid of G.P.E. against height above the Earth's surface. [2]

(c) Draw a line of best fit. [1]
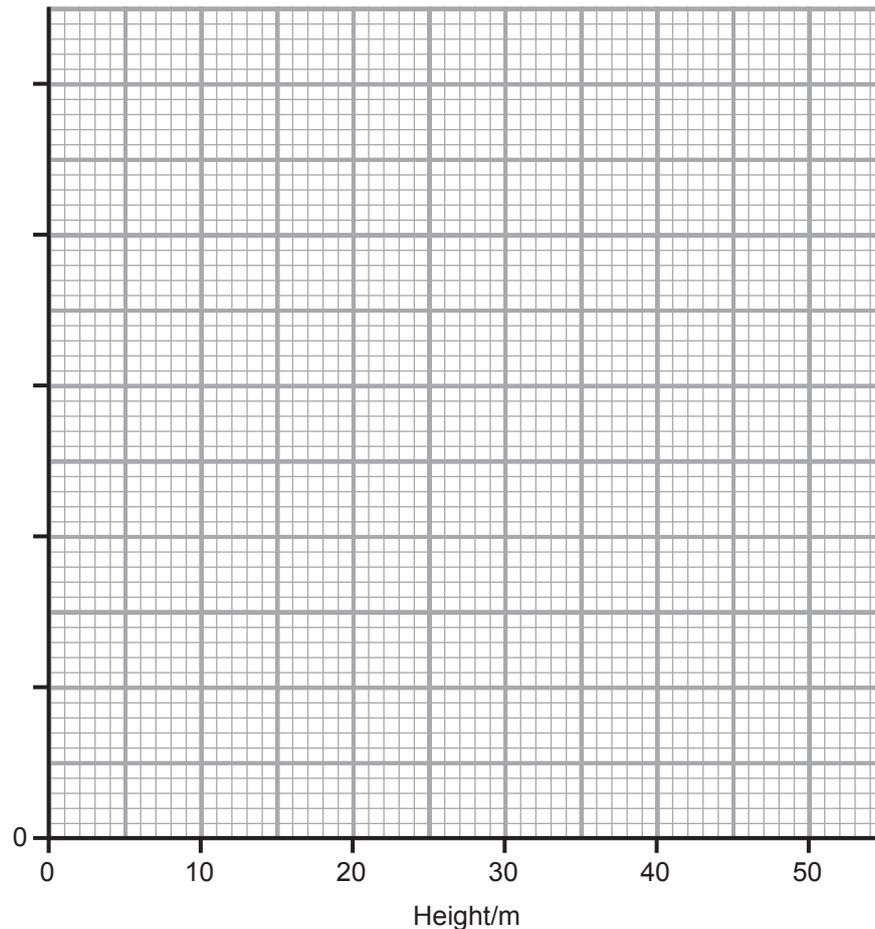
(d) (i) From your graph state the relationship between G.P.E. and height above the Earth's surface.

_____

_____ [1]

(ii) Explain fully how the graph shows this.

_____

_____

_____ [1]

(e) From your graph find the gravitational potential energy when the height is 45 m.

_____ [1]

(f) Use your graph to determine the constant k, in **Equation 3.1**.
Remember to include the units for k.

Show your working out.

k = _____   Units = _____ [4]

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4 A boat crew passes the finishing line at a speed of 7 m/s and immediately stops rowing.

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(i) Calculate how long it takes the boat to slow from 7 m/s to 1 m/s if its retardation (deceleration) is 0.75 m/s^2.

Show your working out.

Time = _____ s   [3]

The total mass of the boat, the crew and all the rowing kit is 540 kg.

(ii) Calculate the drag force acting on the boat during this time interval. Remember the retardation (deceleration) is 0.75 m/s^2.

Show your working out.

Drag force = _____ N   [3]

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(Questions continue overleaf)

5 A motorist is travelling at a constant speed when he spots danger ahead.
Six seconds later he applies the brakes. He comes to rest 10 seconds after he applies the brakes.
The graph below illustrates the motion of the motorist.
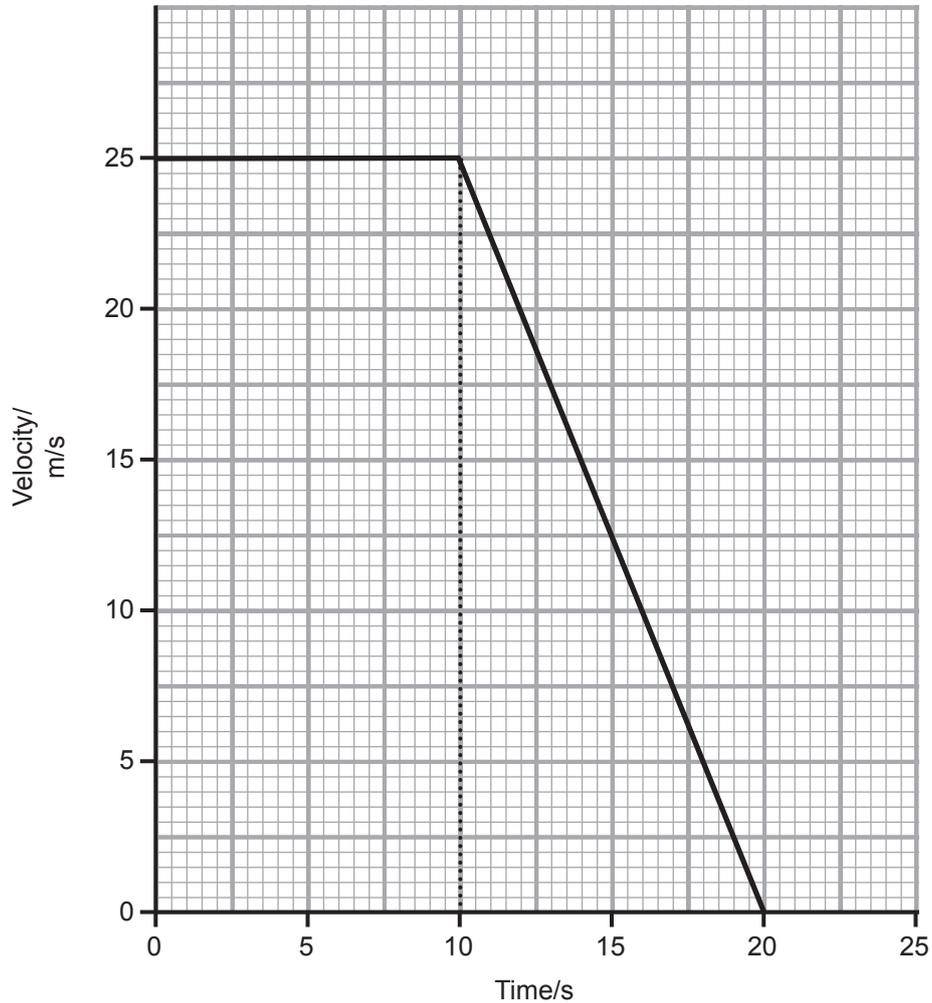
(i) 1. At what time did the motorist first spot the danger?

Time = _____ s

2. What is the velocity when the motorist first spots the danger?

Velocity = _____ m/s [2]

(ii) Calculate how far the vehicle travels in the 20 seconds of its motion.

Show your working out.

Distance = _____ m   [4]

(iii) Use your graph to find the acceleration of the vehicle.

Show your working out.

Acceleration = _____ m/s^2 [3]

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6 Give a brief description of nuclear fusion.

In part **(i)** below you should describe the fusion process including what particles are involved.

In part **(ii)** you should state where fusion occurs naturally. Give two technical difficulties which must be overcome if we are to use fusion to supply our energy needs.

You will be assessed on your written communication skills including the use of specialist scientific terms.

(i) _____

_____

_____

_____

_____

(ii) _____

_____

_____

_____

_____ [6]

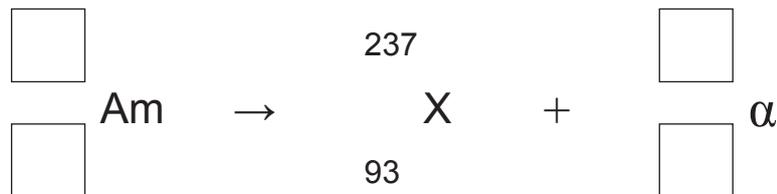**BLANK PAGE**

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(Questions continue overleaf)

7 Americium is a radioactive substance which decays by emitting an alpha (α) particle to produce a different nucleus X.
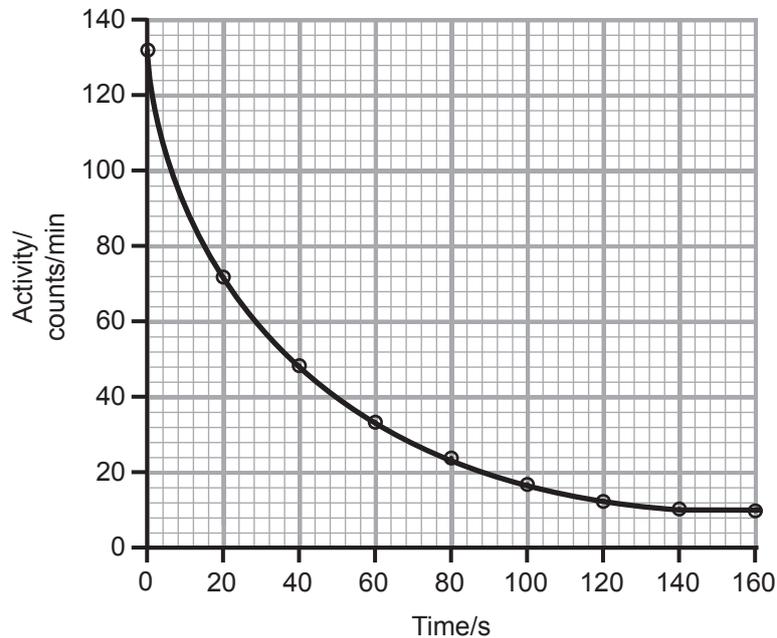
(a) (i) Why is americium radioactive?

_____ [1]

The equation for the reaction is shown.

$$\boxed{}_{\boxed{}}Am \rightarrow {}^{237}_{93}X + \boxed{}_{\boxed{}}\alpha$$

(ii) Complete the equation above by filling in the boxes. [4]

The half-life of a radioactive substance is being measured. Activity measurements are taken every 20 seconds and a graph plotted.

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(b) (i) What is the background radiation?

Background radiation = _____ counts/min   [1]

(ii) Give a **major** source of background radiation, excluding medical sources.

_____ [1]

(c) (i) What is an ion?

_____ [1]

(ii) Describe how an alpha particle can cause ionisation of air molecules.

_____

_____ [2]

(d) State one precaution that users can take to protect themselves from ionising radiations.

_____ [1]

[Turn over

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8 Barnaby kicks a ball and gives 100 J of energy to it. When the ball has reached the point X shown in the diagram, the ball has lost 19 J of energy to the atmosphere because of air resistance.

X

4.6 m

© Principal Examiner

(i) Give the total energy of the ball at X.

Total energy at X = _____ J   [1]

The ball which has a mass of 1.5 kg, reaches a maximum height of 4.6 m at point X.

(ii) Calculate its gravitational potential energy at X.

Show your working out.

Gravitational potential energy = _____ J   [3]

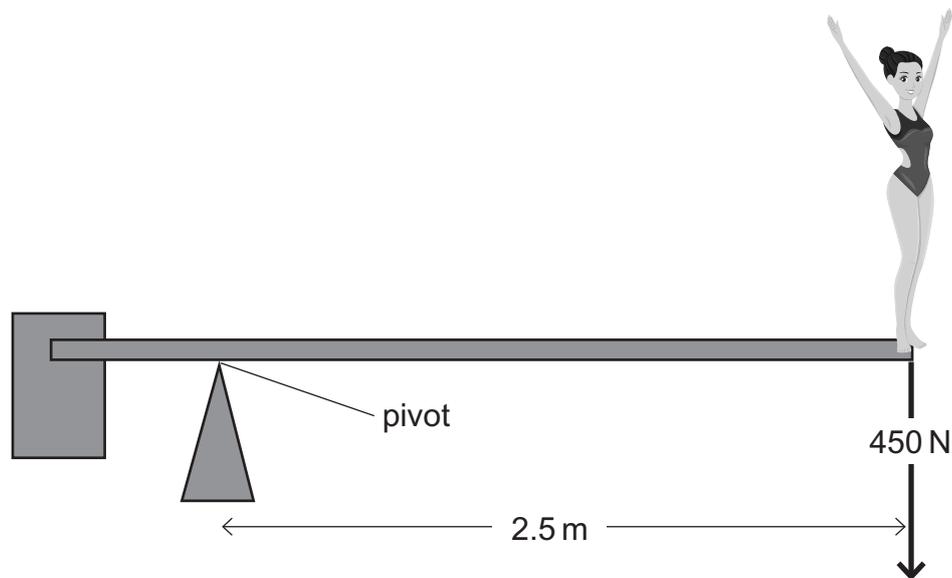At a certain point, the kinetic energy of the ball is 12 J.

(iii) Calculate the speed of the ball at that point.
Remember the mass of the ball is 1.5 kg.

Show your working out.

Speed = _____ m/s   [3]

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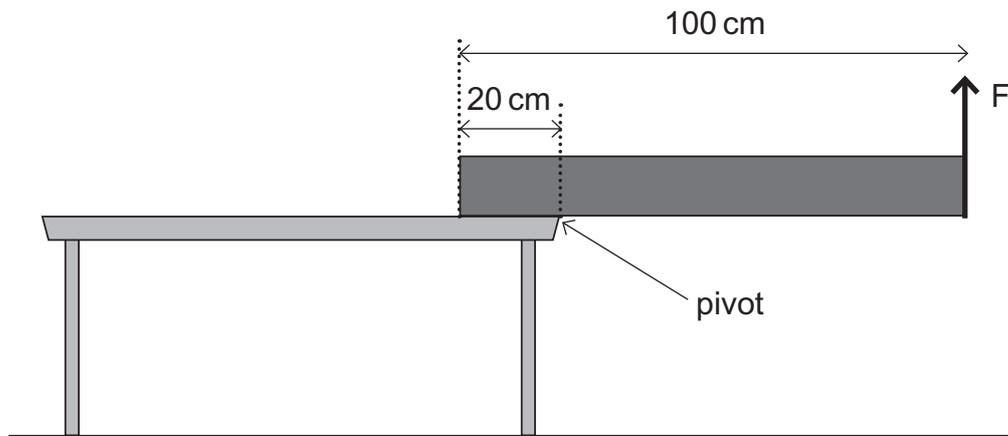**9** **(a)** Deirdre, who has a weight of 450 N, stands at the end of a diving board.

pivot

450 N

2.5 m

Source: Principal Examiner

Calculate the moment of Deirdre's weight about the pivot when she stands at the end of the diving board.

Show your working out.

Moment = _____ Nm   [3]

(b) A uniform piece of wood is held at the edge of a bench by exerting an upward force, F. The wood has a weight of 8 N.

Calculate the upward force, F.

Show your working out.

Force = _____ N   [3]

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