Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
TOTAL	

General Certificate of Secondary Education
Foundation Tier
January 2014

Additional Science M (modular) MPH2FP
Unit Physics P2

Physics M (modular)
Unit Physics P2

F

Tuesday 21 January 2014 9.00 am to 10.00 am

For this paper you must have:
- a ruler
- a calculator
- the Physics Equations Sheet (enclosed).

B

Time allowed
- 1 hour

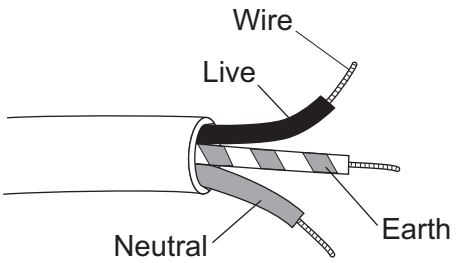
Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 60.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.
- Question 9(b) should be answered in continuous prose.
  In this question you will be marked on your ability to:
  – use good English
  – organise information clearly
  – use specialist vocabulary where appropriate.

Advice
- In all calculations, show clearly how you work out your answer.

Answer **all** questions in the spaces provided.

1 (a) The diagram shows a piece of three-core cable.



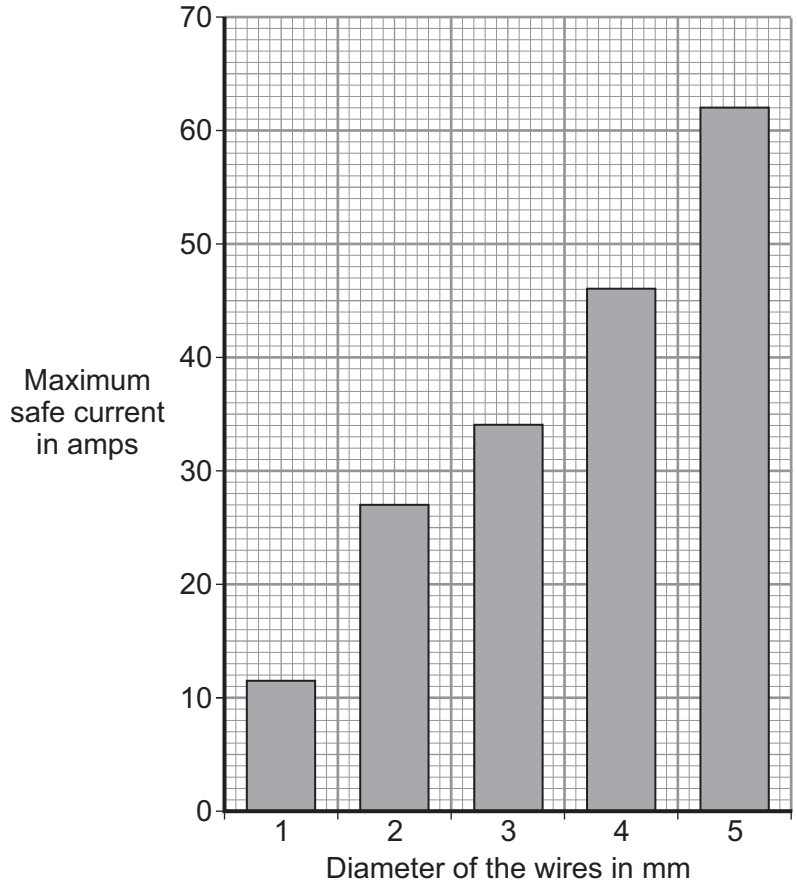
What is the colour of the insulation covering the neutral wire?

Draw a ring around the correct answer.

Blue **Brown** **Green and yellow**

(1 mark)

1 (b) The maximum electric current that can go safely through a cable depends on the diameter of the wires inside the cable.



1 (b) (i) Describe the pattern linking the maximum safe current through a cable and the diameter of the wires inside the cable.

.....

.....

.....

(1 mark)

1 (b) (ii) An electric shower needs a current of 43 amps from the mains electricity supply.

Complete the sentence.

The thinnest cable, shown in the bar chart, which could be used to safely connect the shower to the mains electricity supply has wires with a diameter

of ..... millimetres.

(1 mark)

3

Turn over for the next question

2 There are billions of stars in the Universe.

2 (a) Draw a ring around the correct answer to complete each sentence.

2 (a) (i) Stars form when enough dust and gas from space is pulled together

by | electrostatic / friction / gravitational | forces.

(1 mark)

2 (a) (ii) A mass that is too small to form a star may become a | black hole. / planet. / white dwarf.

(1 mark)

2 (a) (iii) Stars give out energy by | burning gases. / nuclear fusion. / splitting atoms.

(1 mark)

2 (b) Elements are formed in stars.

Which **one** of the following elements can only be formed in a supernova?

Draw a ring around the correct answer.

helium **iron** **gold**

(1 mark)

2 (c) The table gives information about five stars.

Star	Mass compared to the Sun	Will produce a supernova
Proxima Centauri	0.1	No
Sirius A	2	No
Antares	16	Yes
Deneb		Yes
Rigel	18	Yes

What conclusion can be made from the information in the table about the mass of the star Deneb compared to the Sun?

.....

.....

(1 mark)

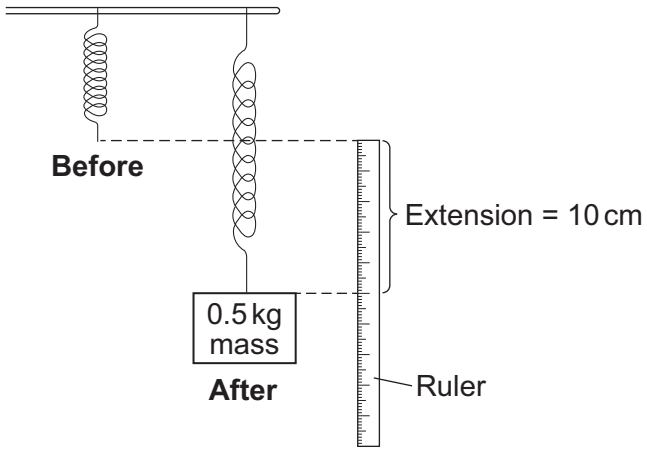
5

Turn over for the next question

3 A student uses a spring as a simple balance.

The diagram shows how the student calibrates the spring.

She hangs a 0.5 kg mass from the spring and measures the extension of the spring.



3 (a) (i) Draw a ring around the correct answer to complete the sentence.

Energy is stored in the stretched spring as [chemical / elastic potential / kinetic] energy.

(1 mark)

3 (a) (ii) The 0.5 kg mass does **not** cause the spring to go past its limit of proportionality.

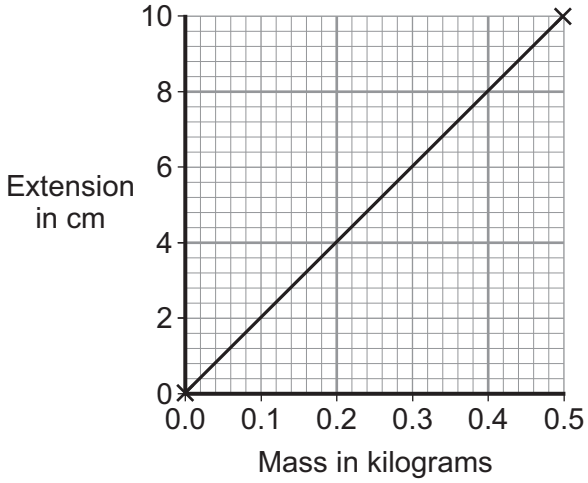
The student takes the 0.5 kg mass off the spring.

What is the extension of the spring with the 0.5 kg mass removed?

.....

(1 mark)

3 (b) The student used the extension of the spring to draw a calibration graph.



3 (b) (i) The student now hangs a bag of marbles from the spring. The spring extends 6 cm.

Use the graph to determine the mass of the bag of marbles.

Mass = ... kg
(1 mark)

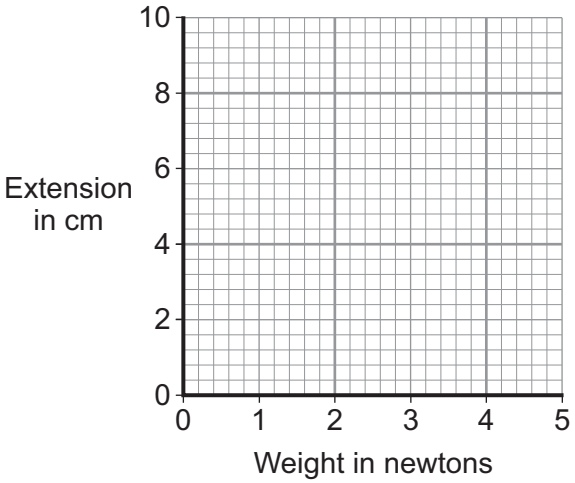
3 (b) (ii) Calculate the weight of the bag of marbles.

Use the correct equation from the Physics Equations Sheet.
Gravitational field strength = 10 N/kg

.....

Weight = ... N
(2 marks)

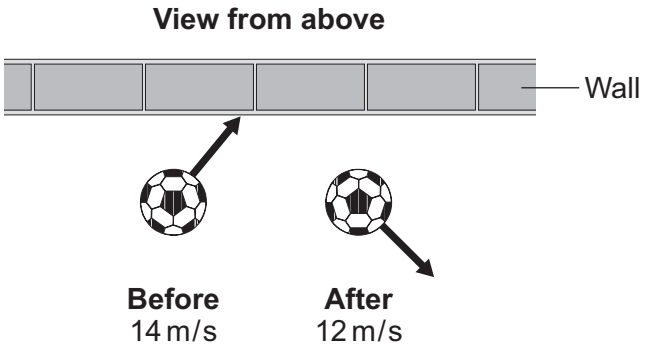
3 (b) (iii) On the axes below, draw a graph to show how the extension of the spring varies with the **weight** hanging from the spring.



(2 marks)

7

4 The drawing shows the direction and speed of a football just before and just after it hits a wall.



4 (a) Draw a ring around the correct answer to complete the sentence.

The kinetic energy of the football before it hits the wall is

less than
the same as
greater than

the kinetic energy of the football after it has hit the wall.

(1 mark)

4 (b) (i) The football has a mass of 0.45 kg.

Calculate the momentum of the football just before it hits the wall and give the unit.

Use the correct equation from the Physics Equations Sheet.

Choose the unit from the list below.

kg m/s **Nm** **W**

.....

.....

.....

Momentum = ...

(3 marks)

4 (b) (ii) The drawing shows that the momentum of the football after it hits the wall is **not** the same as the momentum of the football before it hits the wall.

State **two** changes to the way the football moves, each of which causes the momentum of the football to change.

1 .....

2 .....

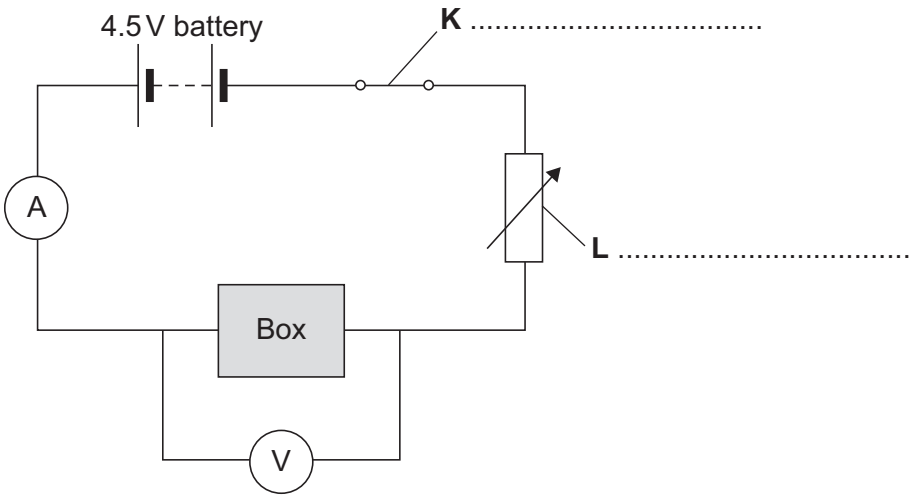
(2 marks)

6

Turn over for the next question

5 The diagram shows the circuit used by two students, **M** and **N**. The students used the circuit to obtain the data needed to plot a current–potential difference graph for an unknown component.

The unknown component was inside a box so it could not be seen.



5 (a) Use words from the list to label components **K** and **L**.

bulb **fuse** **switch** **variable resistor**

(2 marks)

5 (b) The 4.5 V battery is made by correctly connecting several 1.5 V cells in series.

Calculate the number of cells needed to make the battery.

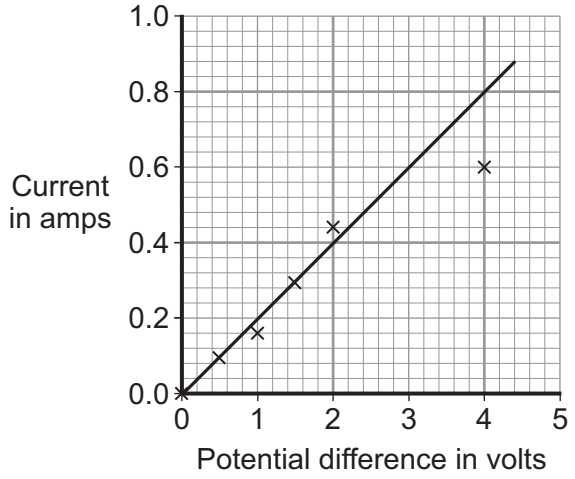
.....

Number of cells = ...

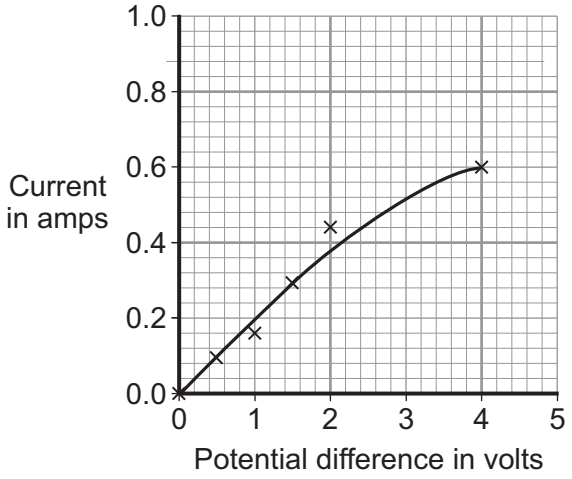
(1 mark)

5 (c) Each student used the data from the investigation to draw a graph.

Graph drawn by Student M



Graph drawn by Student N



5 (c) (i) Student **M** has drawn a graph with a straight line of best fit. The student thinks one of the points is anomalous.

Draw a circle around the point that student **M** thinks is anomalous.

(1 mark)

5 (c) (ii) Which **two** of the following would help to confirm if the line of best fit should be straight or curved?

Tick (✓) **two** boxes.

Taking fewer readings between 0 and 2 volts ☐

Taking more readings between 2 and 4 volts ☐

Re-doing any readings that may be anomalous ☐

Decreasing the range of the readings ☐

(2 marks)

5 (c) (iii) If the line of best fit drawn by student **M** is correct, state the name of the component in the box.

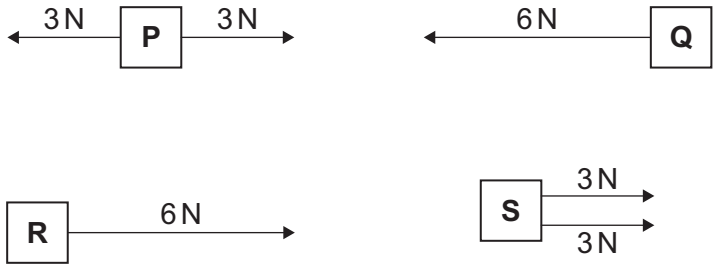
.....

(1 mark)

7

6 Forces can cause changes to the motion of an object.

6 (a) The diagrams show the force or forces acting on four identical boxes, **P**, **Q**, **R** and **S**.



6 (a) (i) Which **two** of the boxes would have the same motion?

Box ..... and Box .....

Give the reason for your answer.

.....

.....

(2 marks)

6 (a) (ii) All four boxes were stationary before any forces were applied.

Which **one** of the boxes remains stationary after the forces were applied?

Box .....

Give the reason for your answer.

.....

.....

(2 marks)

6 (b) At the start of a race, a sprinter pushed off from the starting blocks with a force of 175 N.

The sprinter has a mass of 70 kg.

Calculate the initial acceleration of the sprinter and give the unit.

Use the correct equation from the Physics Equations Sheet.

Choose the unit from the list below.

m/s **m/s^2** **Nm**

.....

.....

.....

Acceleration = ...

(3 marks)

7

Turn over for the next question

7 (a) A student rubs a Perspex ruler with a woollen cloth. The ruler becomes positively charged.

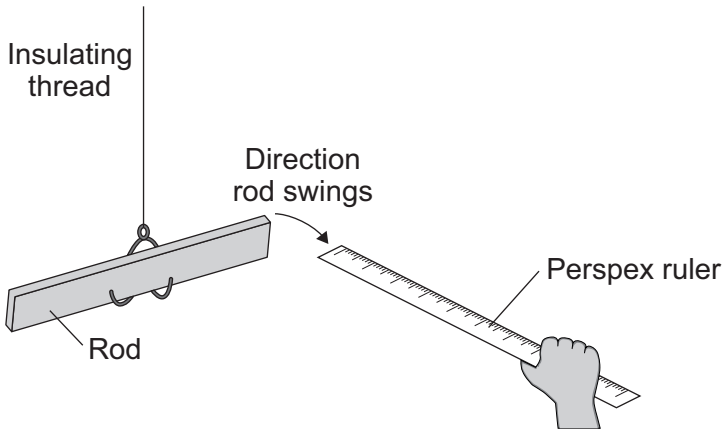
7 (a) (i) What happens to the woollen cloth?

.....

.....

(1 mark)

7 (a) (ii) The student holds the positively-charged ruler close to, but not touching, a suspended charged rod.



The rod swings towards the charged ruler.

What **two** conclusions should the student make about the rod?

1 .....

.....

2 .....

.....

(2 marks)

7 (b) A gardener uses a car battery to power a filament light bulb in a garden shed.

7 (b) (i) The fully charged battery stores 108 000 coulombs of charge and can run the light bulb for 27 000 seconds.

Calculate the current used by the light bulb.

Use the correct equation from the Physics Equations Sheet.

.....

.....

.....

Current = ... amps
(2 marks)

7 (b) (ii) The gardener could replace the filament light bulb with an equally bright LED bulb.

Give **one** advantage of using an LED bulb rather than a filament light bulb.

.....

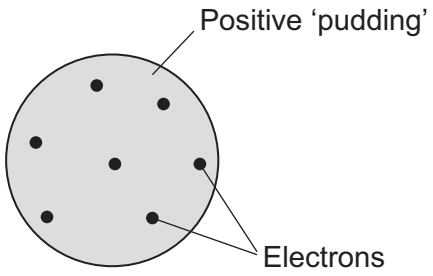
.....
(1 mark)

6

Turn over for the next question

8 (a) At the start of the 20th century, scientists used the 'plum pudding' model to explain the structure of the atom.

The scientists knew that the total charge on an atom is zero.



Use the 'plum pudding' model to explain why the total charge on an atom is zero.

.....

.....

.....

.....

.....

(2 marks)

8 (b) An experiment was designed to investigate the 'plum pudding' model. The experiment involved firing positively charged alpha particles at a thin sheet of gold. The paths taken by the alpha particles were then observed.

8 (b) (i) **List A** gives some of the observations made by the scientists doing the experiment.

List B gives possible explanations for these observations.

Draw **one** line from each observation in **List A** to the most likely explanation for that observation in **List B**.

List A Observation	**List B** Explanation
	because the negative electrons orbit the nucleus.
Most of the alpha particles pass in a straight line through the gold foil	
	because most of an atom is empty space.
Some alpha particles are deflected as they pass through the gold foil	
	because the atom has a charged nucleus.

(2 marks)

8 (b) (ii) The explanations given in **List B** could **not** be made using the 'plum pudding' model of the atom.

Give **one** reason why.

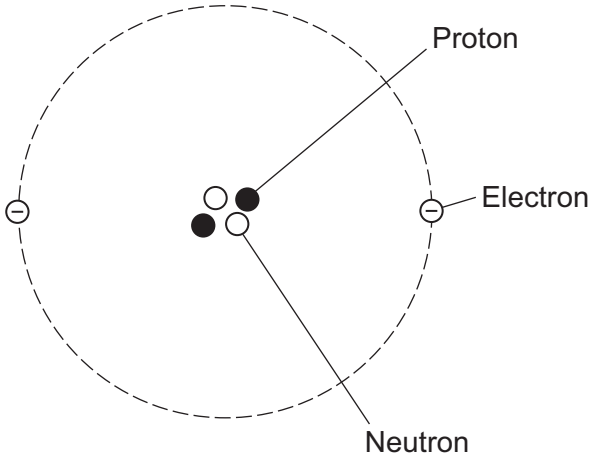
.....

.....

(1 mark)

Question 8 continues on the next page

8 (c) The diagram represents the model we now use for a helium atom.



The diagram of the helium atom is **not** to scale.

Give **one** way in which the scale is wrong.

.....

.....

(1 mark)

8 (d) The model of the atom used by scientists has changed several times.

Why has the model of the atom used by scientists changed?

Tick (✓) **one** box.

Scientists change all models regularly. ☐

Scientists found out new things about the atom. ☐

The atom has changed. ☐

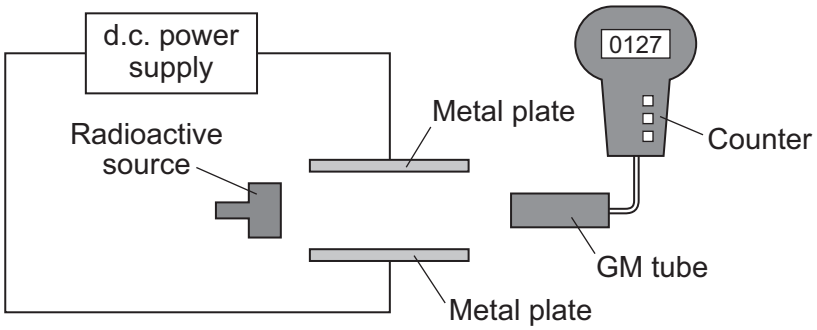
(1 mark)

7

Turn over for the next question

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

9 (a) The diagram shows a Geiger-Müller (GM) tube and counter. The GM tube is detecting the nuclear radiation emitted from both a radioactive source and background radiation. The radioactive source emits beta and gamma radiation.



9 (a) (i) What is *background* radiation?

.....

.....

(1 mark)

9 (a) (ii) Sources of background radiation can be natural or man-made.

Name **one** man-made source of background radiation.

.....

(1 mark)

9 (a) (iii) What is *gamma* radiation?

.....

(1 mark)

9 (a) (iv) Switching on the direct current (d.c.) power supply creates a strong electric field between the metal plates.

Draw a ring around the correct answer to complete the sentence.

The electric field will | decrease / decrease to background level / not affect | the amount of radiation

detected each minute by the GM tube.

Give the reason for your answer.

.....

.....

.....

.....

.....

(3 marks)

Question 9 continues on the next page

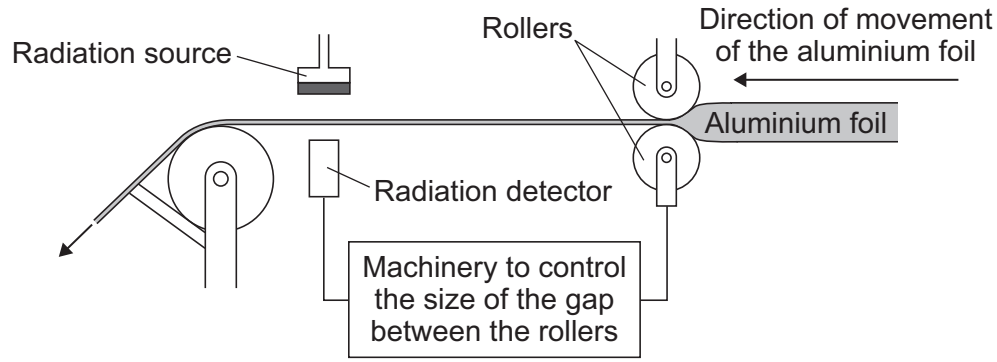
9 (b) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

The table gives information about four radioactive sources, **A**, **B**, **C** and **D**.

Source	Type of radiation emitted	Half-life
A	alpha	430 years
B	beta	14 days
C	beta	28 years
D	gamma	6 hours

One of the radioactive sources given in the table forms part of the control system used to determine the thickness of aluminium foil as it is being rolled.

The amount of radiation detected from the source controls the size of the gap between the rollers.



Evaluate how suitable the radioactive sources, **A**, **B**, **C** and **D**, given in the table are for this control system.

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(6 marks)

12

END OF QUESTIONS

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