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	
TOTAL	

General Certificate of Secondary Education
Higher Tier
January 2014

Additional Science M (modular) MPH2HP
Unit Physics P2

Physics M (modular)
Unit Physics P2

H

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.

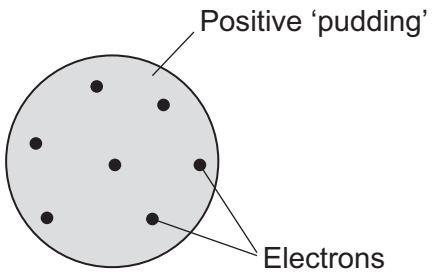
Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 60.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.
- Question 2(b) should be answered in continuous prose.
  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) 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.

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(2 marks)

1 (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.

1 (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)

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

Give **one** reason why.

.....

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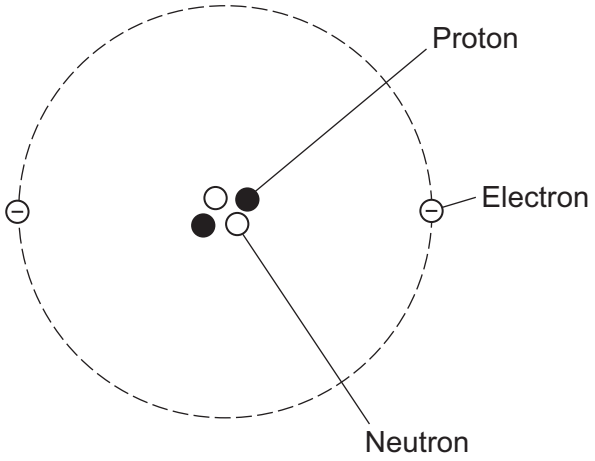
(1 mark)

Question 1 continues on the next page

1 (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)

1 (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. ☐

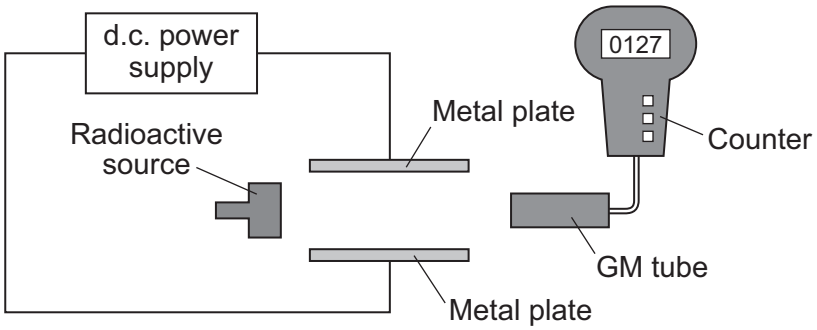
(1 mark)

7

Turn over for the next question

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

2 (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.



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

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(1 mark)

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

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

.....

(1 mark)

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

.....

(1 mark)

2 (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.

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(3 marks)

Question 2 continues on the next page

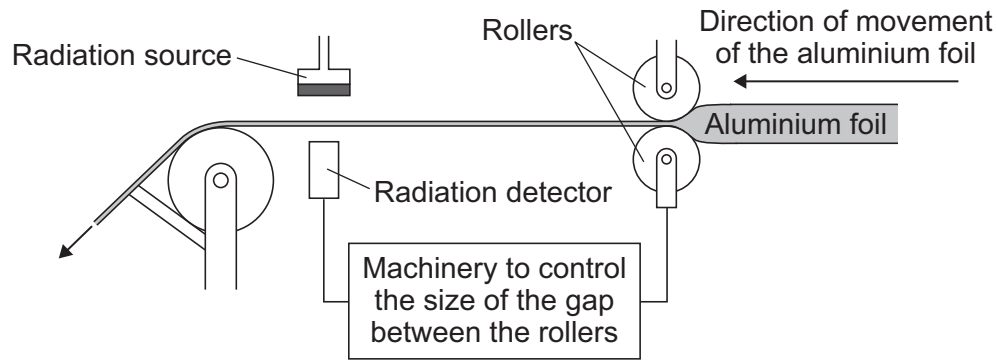
2 (b) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

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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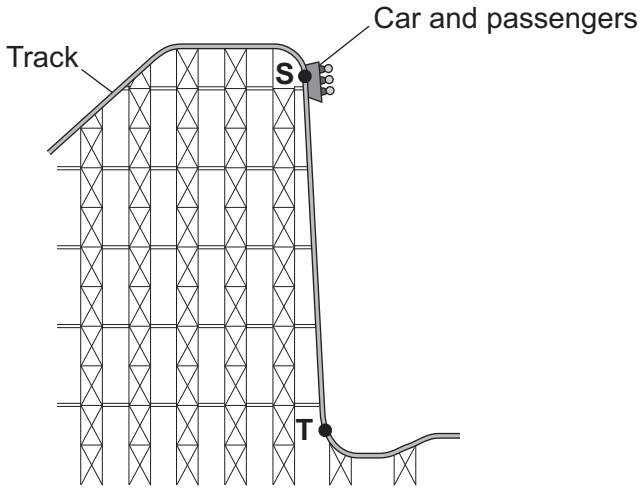
(6 marks)

12

Turn over for the next question

3 The diagram shows part of a theme park ride.



3 (a) The passenger car is held stationary at point **S** on the track before being released to fall vertically.

3 (a) (i) What is the resultant force acting on the stationary car and passengers at point **S**?

.....

(1 mark)

3 (a) (ii) Draw an arrow on the diagram to show the direction of the resultant force once the car is released.

(1 mark)

3 (b) For part of the ride, the maximum gravitational field strength acting on the passengers appears to be 4.5 times bigger than normal gravitational field strength.

Normal gravitational field strength = 10 N/kg

3 (b) (i) Calculate the maximum gravitational field strength that appears to act on the passengers during the ride.

.....

Maximum gravitational field strength = ... N/kg

(1 mark)

3 (b) (ii) One of the passengers has a mass of 60 kg.

Calculate the maximum weight this passenger seems to have during the ride.

Use the correct equation from the Physics Equations Sheet.

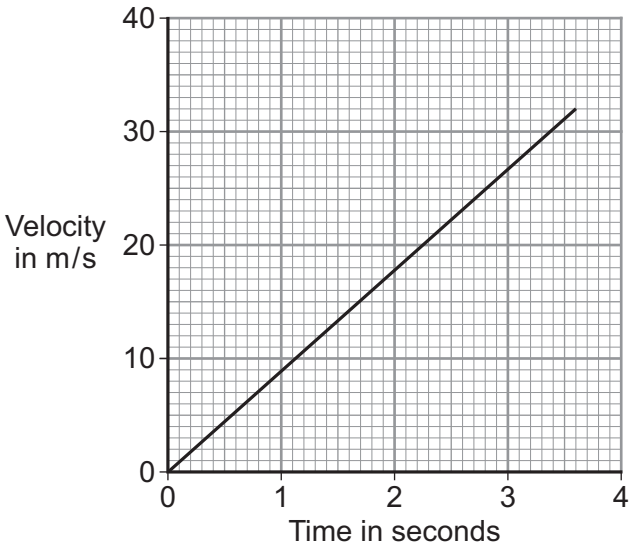
.....

.....

Maximum weight = ... N

(2 marks)

3 (c) The graph shows how the velocity of the car and passengers varies as the car falls from point **S** to point **T** on the track.



Use the graph to calculate the distance between points **S** and **T**.

.....

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Distance = ... m

(2 marks)

3 (d) The car continues for a short distance after point **T** at the same speed before braking. During this short distance the velocity of the car changes.

How is it possible for the speed of the car to stay the same but for the velocity of the car to change?

.....

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(1 mark)

8

4 All stars, including the Sun, go through a life cycle.

4 (a) (i) During which part of the life cycle is a star called a protostar?

.....

(1 mark)

4 (a) (ii) What happens inside a star to end the 'main sequence' period of the star's life cycle?

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(1 mark)

4 (a) (iii) What determines whether a star, at the end of the 'main sequence' period, becomes a red giant or a red supergiant?

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(1 mark)

4 (b) Scientists have analysed the composition of the Sun. They found that over 99.9% of the atoms are either hydrogen atoms or helium atoms. Another 65 elements have been identified including elements heavier than iron.

4 (b) (i) Scientists think the Sun is likely to contain more than 67 elements.

Suggest **one** reason why scientists have been unable to identify more elements in the Sun.

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(1 mark)

4 (b) (ii) The number of hydrogen atoms in the Sun is decreasing while the number of helium atoms is increasing.

Explain why.

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(2 marks)

4 (b) (iii) The composition of the Sun provides evidence that the Sun was formed after the explosion of a massive star (a supernova).

Suggest why.

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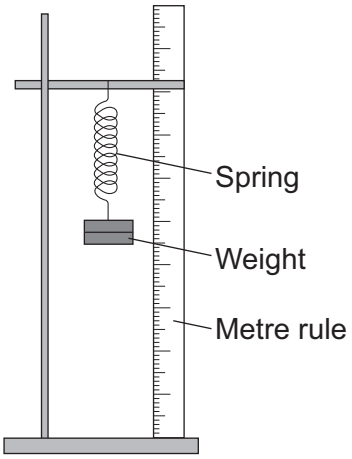
(2 marks)

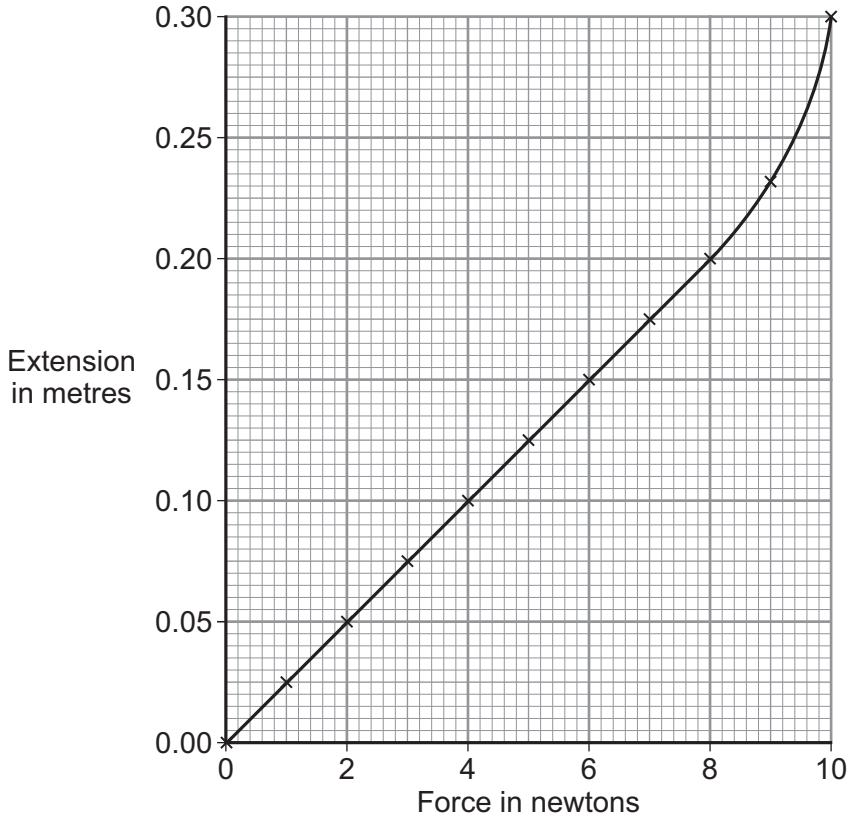
8

Turn over for the next question

5 (a) A student set up the equipment shown in the diagram.



The student added different weights to the spring. Each time a new weight was added the student calculated the extension of the spring. The student's results are plotted on the graph.



5 (a) (i) The student has read that a spring obeys 'Hooke's Law'.

Hooke's Law states that:
'the extension of a spring is directly proportional to the force applied to the spring.'

Over what range of force does the spring used by the student obey Hooke's Law?

From ..... to ..... newtons

Explain your answer.

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(3 marks)

5 (a) (ii) At the end of the investigation the student removed the weights from the spring.

How does the length of the spring after the investigation compare with the original length of the spring before the investigation?

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(1 mark)

5 (a) (iii) Use data from the graph to calculate the spring constant and give the unit.

Use the correct equation from the Physics Equations Sheet.

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.....

.....

Spring constant = ...

(3 marks)

Question 5 continues on the next page

5 (b) Ropes are tested to measure the maximum extension before the rope snaps.

The table gives the maximum extension for two ropes. One rope was made from material **X** and the other rope was made from material **Y**.

Material	Maximum extension before snapping as a percentage of the original length
X	4
Y	18

5 (b) (i) It is important that the ropes are tested in the same way.

Why?

.....

.....

(1 mark)

5 (b) (ii) Dynamic climbing ropes are used by mountain climbers to attach themselves to the mountain side while they are climbing. A dynamic climbing rope is designed to stretch when a large force is applied to it.

It would be better for a mountain climber who fell to be using a rope made from material **Y** rather than a rope made from material **X**.

Explain why.

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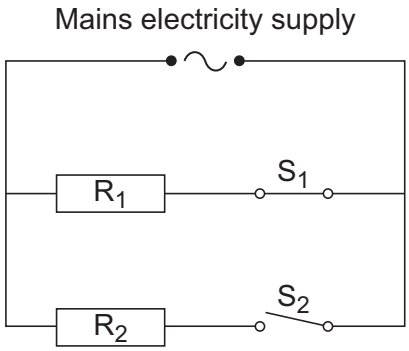
(4 marks)

12

6 The diagram shows the circuit for a mains electric fire.

The two identical heating elements are represented by the resistors R_1 and R_2.



6 (a) What is the potential difference of the mains electricity supply in the UK?

..... volts

(1 mark)

6 (b) What change, if any, would happen to the current through R_1 when the switch S_2 is closed?

.....

Give the reason for your answer.

.....

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(2 marks)

6 (c) The electric fire has a metal case. For this reason the electric fire is earthed.

What is meant by an electric appliance being *earthed*?

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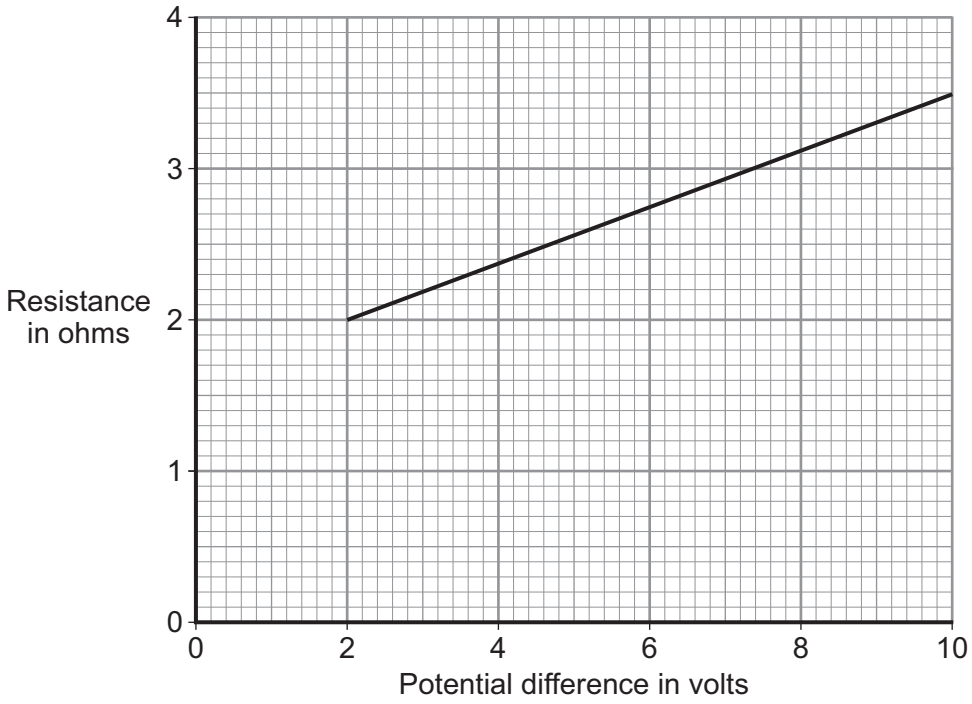
(1 mark)

4

7 The graph shows how the resistance of a filament bulb varies as the potential difference across the bulb increases from 2 volts to 10 volts.



7 (a) What is meant by the term *potential difference*?

.....

.....

(1 mark)

7 (b) The potential difference across the bulb is kept constant at 10 volts.

Use data from the graph to calculate the total charge passing through the bulb in 30 seconds and give the unit.

Give your answer to **two** significant figures.

Use the correct equations from the Physics Equations Sheet.

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Total charge = ...

(5 marks)

7 (c) The resistance of the metal filament inside the bulb is small when the potential difference across the bulb is low.

Explain why.

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(3 marks)

9

END OF QUESTIONS

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