Surname

Other Names

Candidate Signature

AQA

General Certificate of Secondary Education
Higher Tier
June 2014

Additional Science
Unit Physics P2

Physics
Unit Physics P2

PH2HP

H

Monday 19 May 2014   1.30 pm to 2.30 pm

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

A

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 3(a)(iii) 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 **Figure 1** shows a slide in a children's playground.

Figure 1

Metal ladder

Metal support
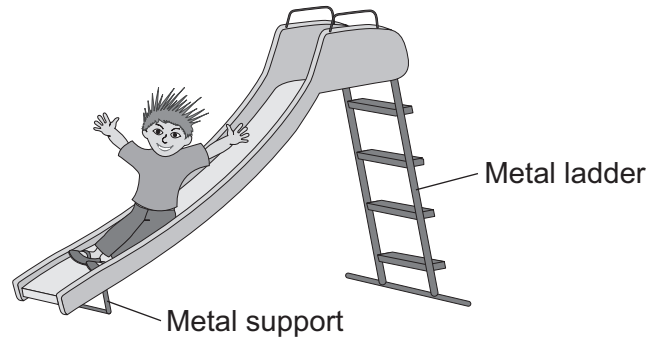
1 (a) A child of mass 18 kilograms goes down the slide.

The vertical distance from the top to the bottom of the slide is 2.5 metres.

Calculate the decrease in gravitational potential energy of the child sliding from the top to the bottom of the slide.

Gravitational field strength = 10 N/kg

Use the correct equation from the Physics Equations Sheet.

[2 marks]

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Decrease in gravitational potential energy = ... J

1 (b)   The slide is made of plastic.

1 (b) (i)   The child becomes electrically charged when he goes down the slide.

Explain why.

[2 marks]

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1 (b) (ii)   Going down the slide causes the child's hair to stand on end.

What conclusion about the electrical charge on the child's hair can be made from this observation?

[2 marks]

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Give a reason for your answer.

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1 (b) (iii) Why would the child **not** become electrically charged if the slide was made from metal?

[1 mark]

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7

Turn over for the next question

Turn over ▶

2 Stars go through a life cycle.

Some stars will finish their life cycle as a black dwarf and other stars as a black hole.

2 (a) **Table 1** gives the mass, relative to the Sun, of three stars, **J**, **K** and **L**.

Table 1

Star	Mass of the star relative to the Sun
J	0.5
K	14.5
L	20.0

Which **one** of the stars, **J**, **K** or **L**, will become a black dwarf? ....

[2 marks]

Give a reason for your answer.

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2 (b) Scientists can take the measurements needed to calculate the mass of many stars.

Scientists cannot calculate the mass of the star Betelgeuse.

They estimate that the star has a mass between 8 and 20 times the mass of the Sun.

2 (b) (i) Betelgeuse is in the red super giant stage of its life cycle.

What will happen to Betelgeuse at the end of the red super giant stage?

[1 mark]

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2 (b) (ii) Suggest **one** reason why scientists can only estimate and **not** calculate the mass of Betelgeuse.

[1 mark]

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2 (b) (iii) In the future, it may become possible for scientists to calculate the mass of Betelgeuse.

Suggest **one** reason why.

[1 mark]

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2 (c) Describe what happens to a star, after the main sequence period, for the star to eventually become a **black dwarf**.
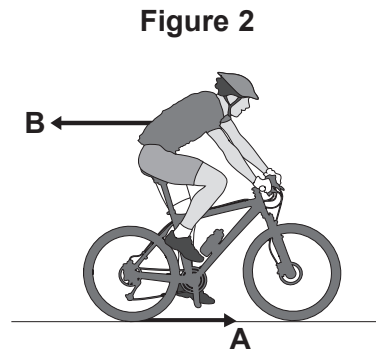
[5 marks]

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10

Turn over ▶

3 (a) **Figure 2** shows the horizontal forces acting on a moving bicycle and cyclist.

Figure 2

3 (a) (i) What causes force **A**?

Draw a ring around the correct answer.

[1 mark]

friction   gravity   weight

3 (a) (ii) What causes force **B**?

[1 mark]

....

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

Figure 3 shows how the velocity of the cyclist changes during the first part of a journey along a straight and level road. During this part of the journey the force applied by the cyclist to the bicycle pedals is constant.
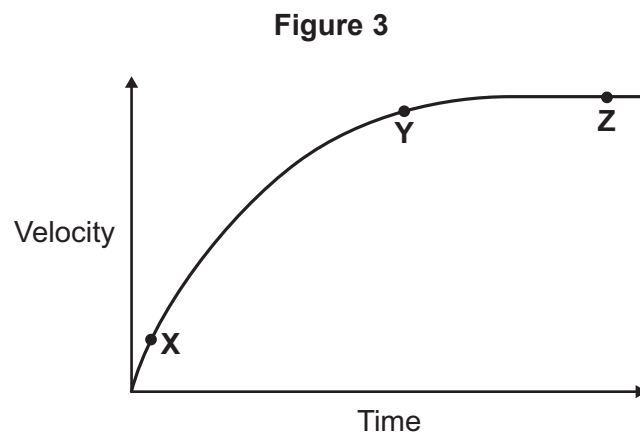
Figure 3

Describe how **and** explain, in terms of the forces **A** and **B**, why the velocity of the cyclist changes:

- between the points **X** and **Y**

- and between the points **Y** and **Z**, marked on the graph in **Figure 3**.

[6 marks]

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Extra space ....

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Turn over ▶

3 (b) (i) The cyclist used the brakes to slow down and stop the bicycle.

A constant braking force of 140 N stopped the bicycle in a distance of 24 m.

Calculate the work done by the braking force to stop the bicycle. Give the unit.

Use the correct equation from the Physics Equations Sheet.

[3 marks]

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Work done = ...

3 (b) (ii) Complete the following sentences.

[2 marks]

When the brakes are used, the bicycle slows down. The kinetic energy of the

bicycle ....

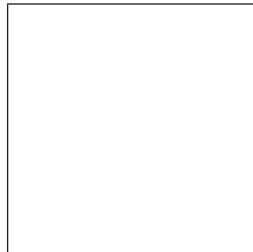At the same time, the .... of the brakes increases.

13

4 (a) **Figure 4** shows the apparatus used to obtain the data needed to calculate the resistance of a thermistor at different temperatures.
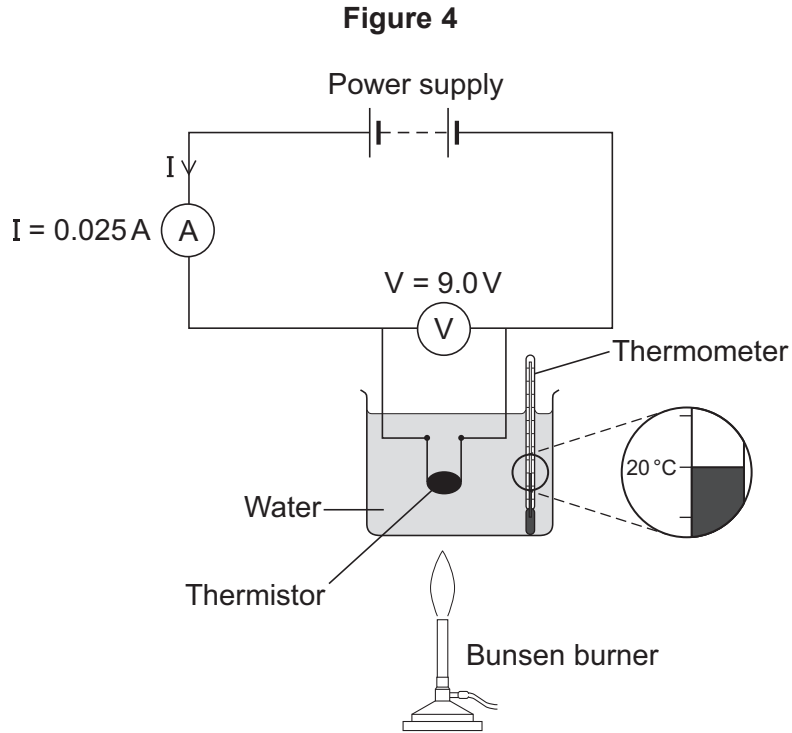
Figure 4

4 (a) (i) In the box below, draw the circuit symbol for a thermistor.

[1 mark]

4 (a) (ii) Use the data given in **Figure 4** to calculate the resistance of the thermistor at 20 °C.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

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Resistance = ... ohms

Question 4 continues on the next page
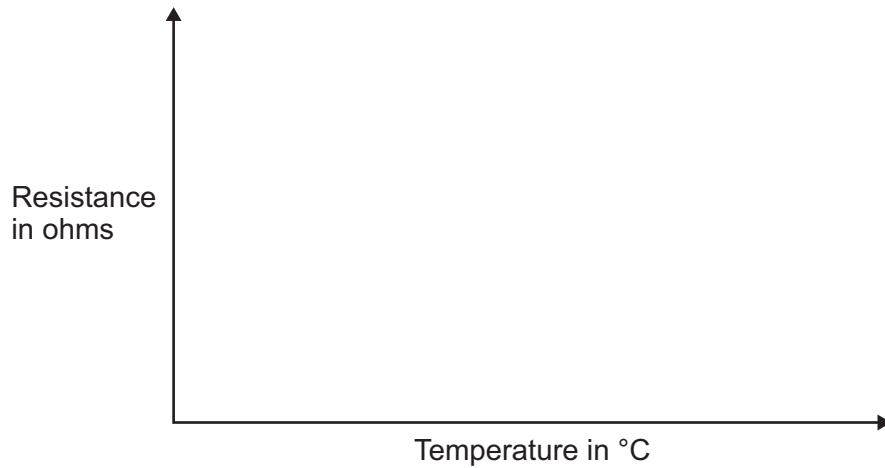
Turn over ▶

4 (a) (iii) **Figure 5** shows the axes for a sketch graph.

Complete **Figure 5** to show how the resistance of the thermistor will change as the temperature of the thermistor increases from 20 °C to 100 °C.

[1 mark]

Figure 5

4 (a) (iv) Which **one** of the following is most likely to include a thermistor?

Tick (✓) **one** box.

[1 mark]

An automatic circuit to switch a plant watering system on and off. ☐

An automatic circuit to switch an outside light on when it gets dark. ☐

An automatic circuit to switch a heating system on and off. ☐

4 (b) The ammeter used in the circuit has a very low resistance.

Why is it important that ammeters have a very low resistance?

[1 mark]

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4 (c) **Table 2** gives the temperature of boiling water using three different temperature scales.

Table 2

Temperature	Scale
100	Celsius (°C)
212	Fahrenheit (°F)
80	Réaumur (°Re)

Scientists in different countries use the same temperature scale to measure temperature.

Suggest **one** advantage of doing this.

[1 mark]

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4 (d) A student plans to investigate how the resistance of a light-dependent resistor (LDR) changes with light intensity.

The student starts with the apparatus shown in **Figure 4** but makes three changes to the apparatus.

One of the changes the student makes is to replace the thermistor with an LDR.

Describe what other changes the student should make to the apparatus.

[2 marks]

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9

5 **Figure 6** shows a skateboarder jumping forwards off his skateboard.

The skateboard is stationary at the moment the skateboarder jumps.

Figure 6

5 (a) The skateboard moves backwards as the skateboarder jumps forwards.

Explain, using the idea of momentum, why the skateboard moves backwards.

[3 marks]

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5 (b) The mass of the skateboard is 1.8 kg and the mass of the skateboarder is 42 kg.

Calculate the velocity at which the skateboard moves backwards if the skateboarder jumps forwards at a velocity of 0.3 m/s.

Use the correct equation from the Physics Equations Sheet.

[3 marks]

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Velocity of skateboard = ... m/s

6

Turn over for the next question

Turn over ▶

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ANSWER IN THE SPACES PROVIDED

6 (a) There are many isotopes of the element molybdenum (Mo).

What do the nuclei of different molybdenum isotopes have in common?

[1 mark]

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6 (b) The isotope molybdenum-99 is produced inside some nuclear power stations from the nuclear fission of uranium-235.

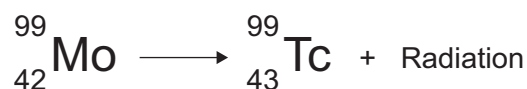**6 (b) (i)** What happens during the process of nuclear fission?

[1 mark]

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6 (b) (ii) Inside which part of a nuclear power station would molybdenum be produced?

[1 mark]

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6 (c) When the nucleus of a molybdenum-99 atom decays, it emits radiation and changes into a nucleus of technetium-99.

$$^{99}_{42}\text{Mo} \longrightarrow {}^{99}_{43}\text{Tc} + \text{Radiation}$$

What type of radiation is emitted by molybdenum-99?

[2 marks]

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Give a reason for your answer.

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Question 6 continues on the next page

Turn over ▶

6 (d) Technetium-99 has a short half-life and emits gamma radiation.

What is meant by the term 'half-life'?

[1 mark]

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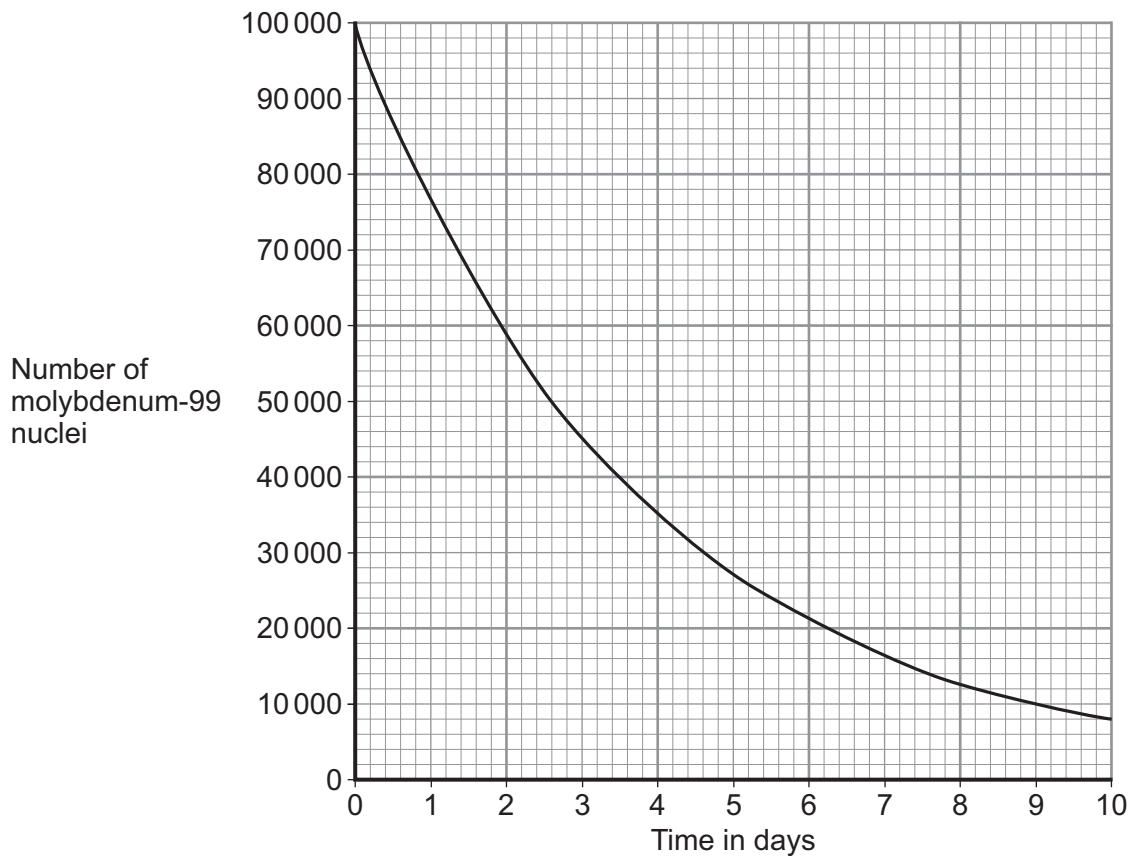
6 (e) Technetium-99 is used by doctors as a medical tracer. In hospitals it is produced inside a technetium generator by the decay of molybdenum-99 nuclei.

6 (e) (i) **Figure 7** shows how the number of nuclei in a sample of molybdenum-99 changes with time as the nuclei decay.

Figure 7

A technetium generator will continue to produce sufficient technetium-99 until 80% of the original molybdenum nuclei have decayed.

After how many days will a source of molybdenum-99 inside a technetium-99 generator need replacing?

Show clearly your calculation and how you use the graph to obtain your answer.

[2 marks]

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Number of days = ...

6 (e) (ii) Medical tracers are injected into a patient's body; this involves some risk to the patient's health.

Explain the risk to the patient of using a radioactive substance as a medical tracer.

[2 marks]

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6 (e) (iii) Even though there may be a risk, doctors frequently use radioactive substances for medical diagnosis and treatments.

Suggest why.

[1 mark]

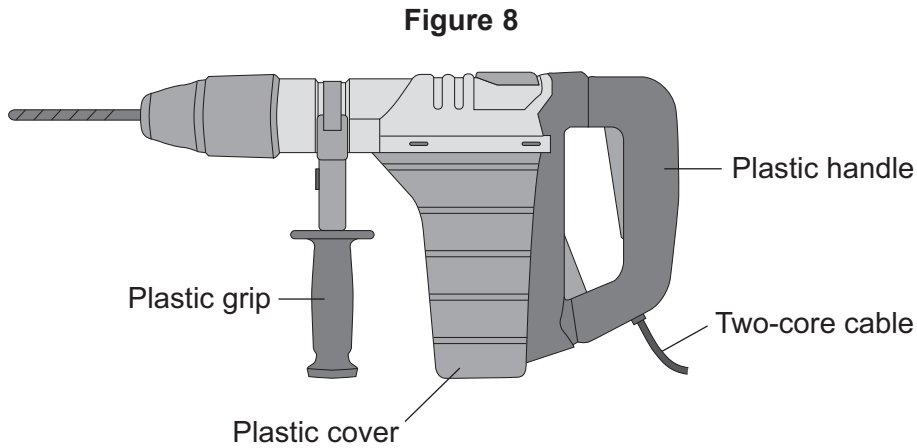..

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11

Turn over ▶

7 **Figure 8** shows an electric drill.

Figure 8

Plastic handle

Plastic grip

Two-core cable

Plastic cover

The information in the box is taken from the booklet supplied with the drill.

- This drill is fitted with a two-core cable
- Power supply: 230 V a.c. 50 Hz
- Power input: 1012 W
- Mass: 6 kg

7 (a) Why is it safe for this drill to be fitted with a two-core cable rather than a three-core cable?

[1 mark]

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7 (b) Calculate the current drawn from the mains electricity supply by the drill.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

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Current = ... A

7 (c) It is advisable to use all 230 V power tools with a residual current circuit breaker (RCCB).

How does an RCCB operate?

[1 mark]

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4

END OF QUESTIONS

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