Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____
I declare this is my own work.

GCSE PHYSICS

F

Foundation Tier Paper 1

Thursday 22 May 2025 Morning Time allowed: 1 hour 45 minutes

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

Instructions
- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** 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.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- In all calculations, show clearly how you work out your answer.

Information
- The maximum mark for this paper is 100.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
TOTAL	

Do not write outside the box

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

0 1 Manufacturing a petrol car causes carbon dioxide to be emitted into the atmosphere.

Driving a petrol car also causes carbon dioxide to be emitted.

0 1 . 1 Which of the following is an environmental problem caused by the emission of carbon dioxide?

[1 mark]

Tick (✓) **one** box.

Acid rain ☐

Damage to the ozone layer ☐

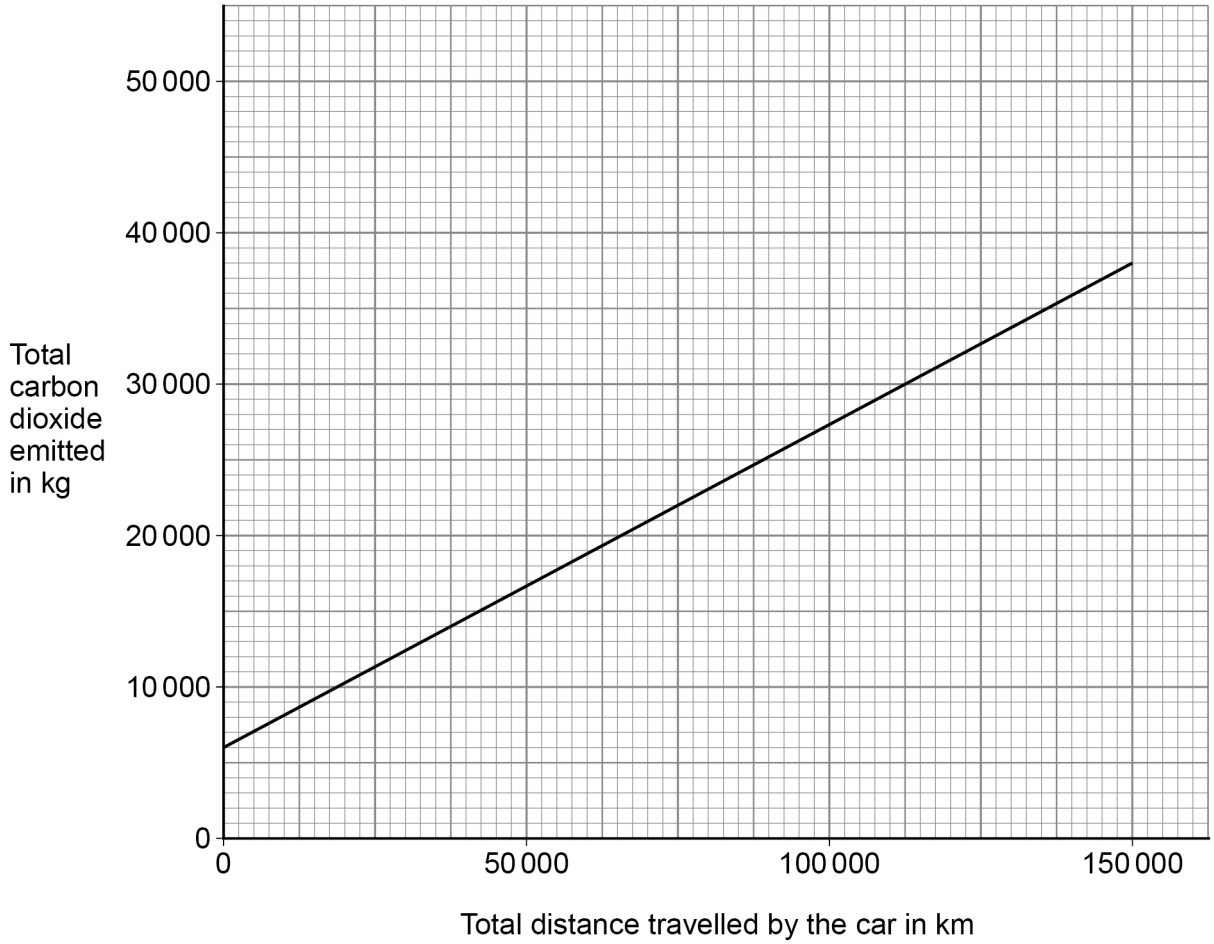
Global warming ☐

Do not write outside the box

Carbon dioxide is emitted during the manufacture of the car before the car has been driven.

Figure 1 shows the relationship between the total distance travelled by a petrol car and the total carbon dioxide emitted.

Figure 1



0 1 . 2 How much carbon dioxide is emitted during the manufacture of the car?

Use **Figure 1**.

[1 mark]

Carbon dioxide emitted = _____ kg

Question 1 continues on the next page

Do not write outside the box

0 1 . 3 How does the total carbon dioxide emitted change as the total distance travelled by the car increases?

Use **Figure 1**.

[1 mark]

_____

_____

0 1 . 4 An electric car does **not** emit carbon dioxide as it is driven.

Choose **one** reason why.

[1 mark]

Tick (✓) **one** box.

Electric cars are powered by a battery. ☐

Electric cars are powered by nuclear energy. ☐

Electric cars use diesel fuel. ☐

Do not write outside the box

0 1 . 5 Some energy resources used to generate electricity cause environmental issues.

Draw **one** line from each method of generating electricity to the environmental issue it causes.

[3 marks]

Method of generating electricity	Environmental issue
	Affects habitats of sea creatures
Hydroelectric dam	
	Emits carbon dioxide
Nuclear power station	
	Produces radioactive waste
Wave power	
	Valley needs flooding

7

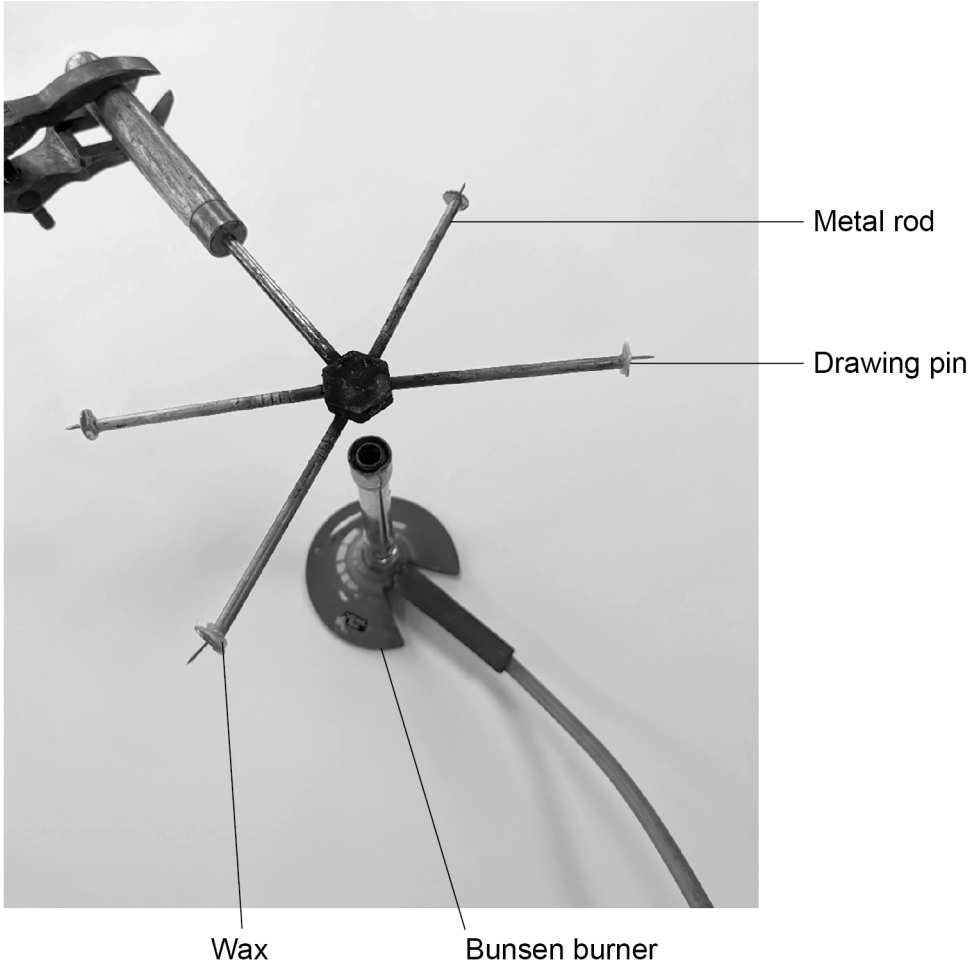
Turn over for the next question

Do not write outside the box

0 2 A student investigated the thermal conductivity of different metals.

Figure 2 shows some of the apparatus used.

Figure 2



Each rod was made from a different metal.

The metal rods are joined at the centre.

The size of each metal rod was the same.

This is the method used.

1. Attach a drawing pin to the end of each metal rod using wax.
2. Light the Bunsen burner.
3. Start a stopclock.
4. Record the time taken for the wax to melt and for the drawing pin to fall off each metal rod.

Do not write outside the box

Table 1 shows the results.

Table 1

Type of metal	**Time taken for drawing pin to fall off in seconds**
Copper	10
Iron	22
Nickel	18
Steel	24

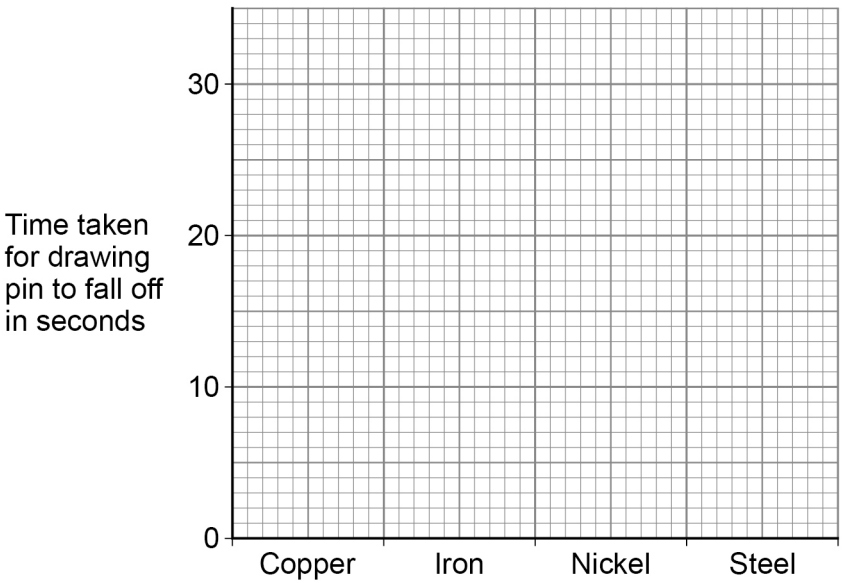
0 2 . 1 Complete **Figure 3**.

You should:

- label the *x*-axis
- plot the data from **Table 1** as a bar chart.

[3 marks]

Figure 3



Do not write outside the box

0 2 . 2 Which type of metal in **Table 1** had the greatest thermal conductivity?

Give a reason for your answer.

[2 marks]

Tick (✓) **one** box.

Copper ☐ Iron ☐ Nickel ☐ Steel ☐

Reason _____

_____

_____

0 2 . 3 The thermal energy transferred to the nickel rod was 132 J.

The temperature change of the rod was 20 °C.

mass of the nickel rod = 0.015 kg

Calculate the specific heat capacity of nickel.

Use the equation:

$$\text{specific heat capacity} = \frac{\text{thermal energy}}{(\text{mass} \times \text{temperature change})}$$

[2 marks]

_____

_____

_____

_____

Specific heat capacity = _____ J/kg °C

Do not write outside the box

Use the Physics Equations Sheet to answer questions **02.4** and **02.5**.

0 2 . 4 Write down the equation which links energy transferred (E), power (P) and time (t).

[1 mark]

_____

0 2 . 5 At the end of the investigation, the Bunsen burner was turned off.

As the nickel rod cooled to room temperature, the rod transferred 132 J of energy to the room.

The mean power transfer was 0.33 W.

Calculate the time taken for the energy transfer.

[3 marks]

_____

_____

_____

Time taken = _____ s

11

Turn over for the next question

Do not write outside the box

0 3 Different radioactive isotopes emit different types of radiation.

0 3 . 1 One isotope of uranium (U) decays into thorium (Th) by emitting an alpha particle (He).

Which nuclear equation shows the decay of this isotope of uranium?

[1 mark]

Tick (✓) **one** box.

$^{230}_{92}U \rightarrow ^{226}_{90}Th + ^{4}_{2}He$ ☐

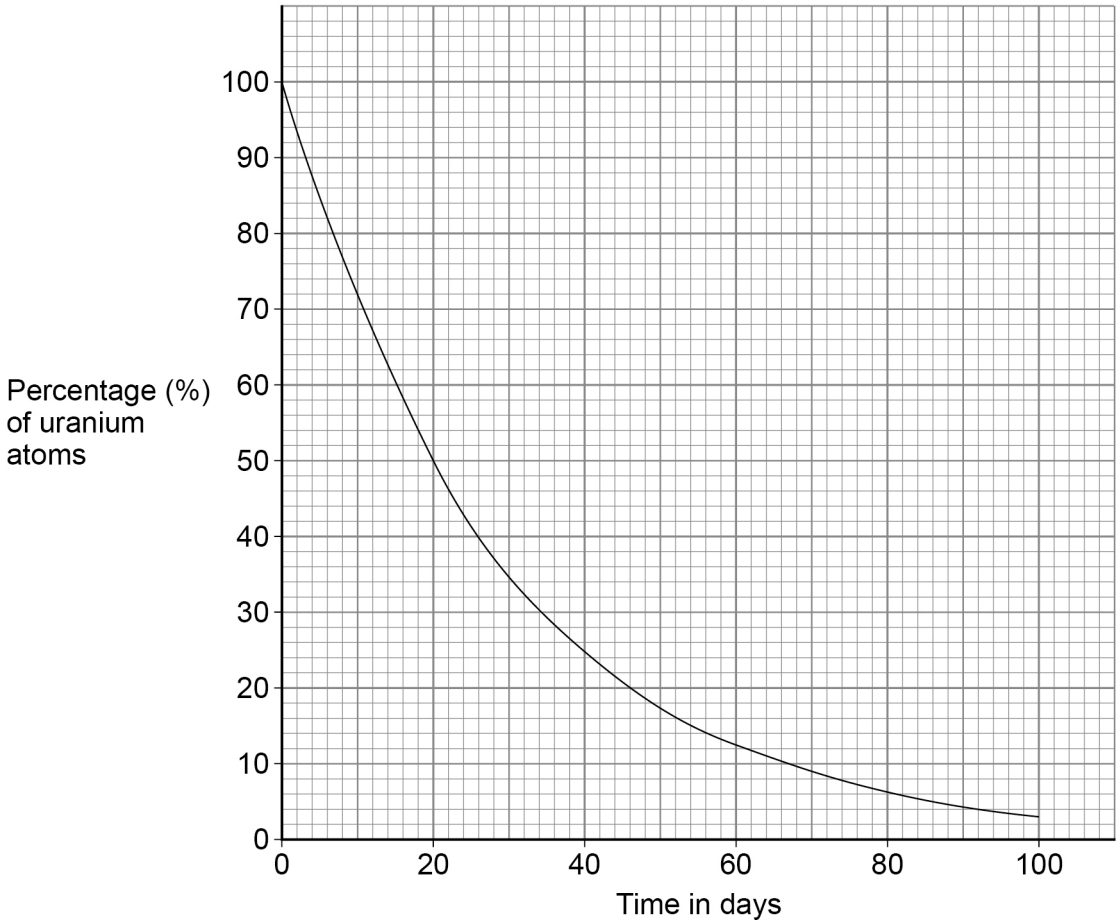
$^{226}_{90}Th \rightarrow ^{230}_{92}U + ^{4}_{2}He$ ☐

$^{230}_{92}U + ^{226}_{90}Th \rightarrow ^{4}_{2}He$ ☐

Do not write outside the box

Figure 4 shows how the percentage of uranium atoms in a sample of one uranium isotope varies with time.

Figure 4



0 3 . 2 What is the time taken for 50% of the atoms of this uranium isotope to decay?

Use **Figure 4**.

[1 mark]

Time taken = _____ days

0 3 . 3 What is the half-life of this uranium isotope?

[1 mark]

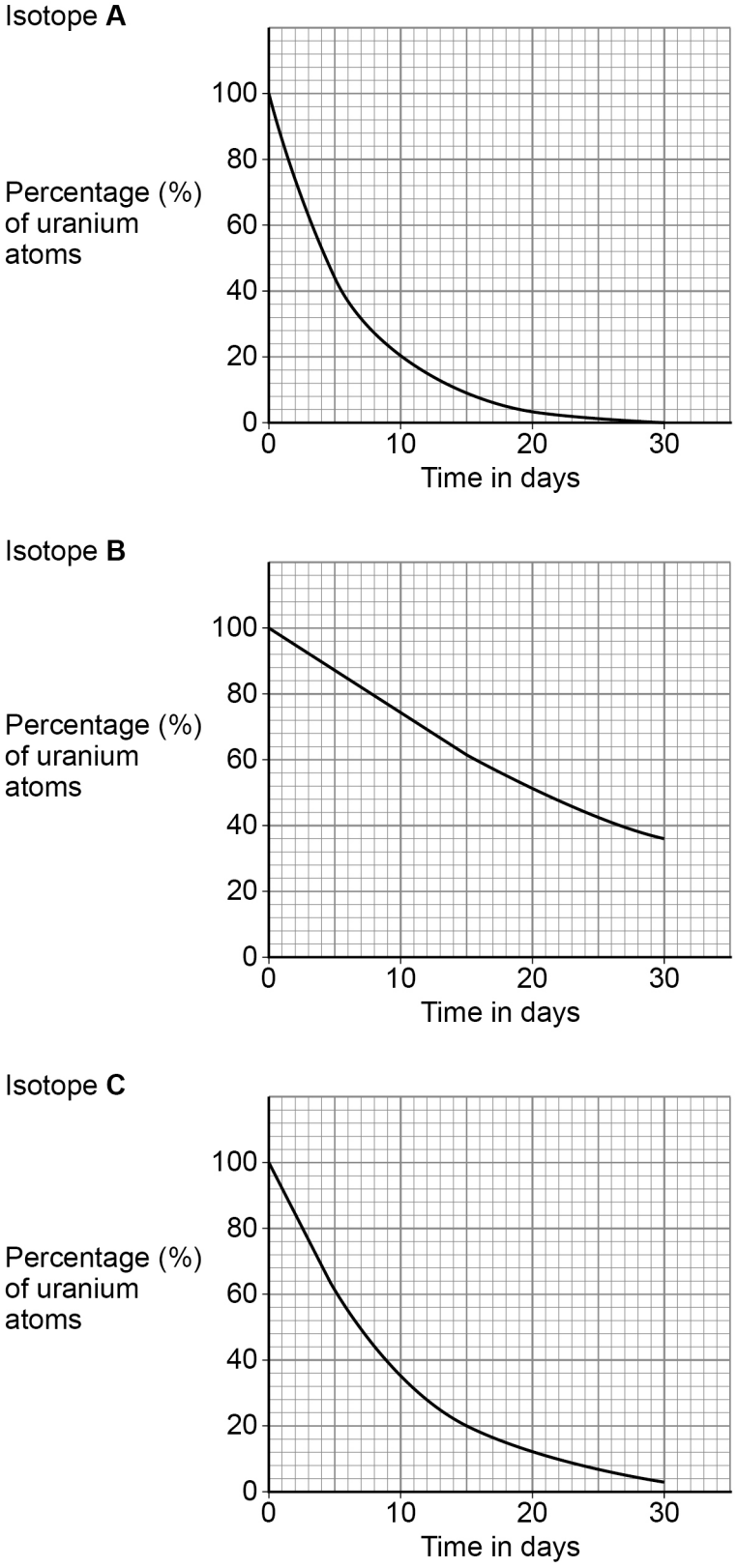
Half-life = _____ days

Turn over ►

Do not write outside the box

0 3 . 4 **Figure 5** shows how the percentage of uranium atoms varies with time for three different isotopes of uranium, **A**, **B** and **C**.

Figure 5



Do not write outside the box

Which isotope is the most unstable?

Give a reason for your answer.

[2 marks]

Tick (✓) **one** box.

Isotope **A** ☐

Isotope **B** ☐

Isotope **C** ☐

Reason _____

_____

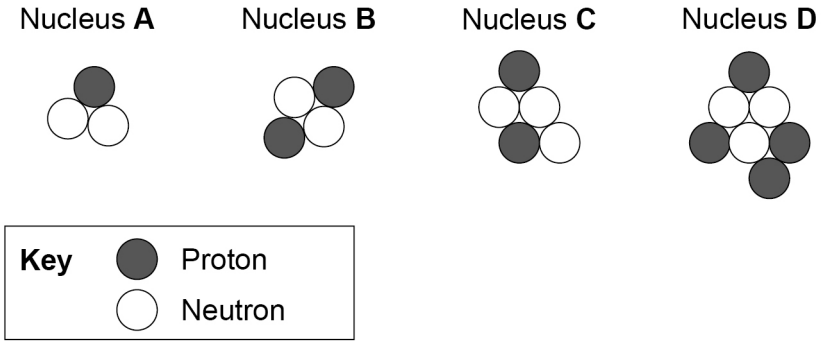
_____

Question 3 continues on the next page

Do not write outside the box

Figure 6 shows the nuclei of four different atoms.

Figure 6



0 3 . 5 Which nucleus in **Figure 6** has the smallest **mass** number?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

0 3 . 6 Which nucleus in **Figure 6** has an **atomic** number of 4?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

Do not write outside the box

0 3 . 7 Which **two** nuclei in **Figure 6** are isotopes of the same element?

Give a reason for your answer.

[2 marks]

Nucleus ☐ and nucleus ☐

Reason _____

_____

Scientists have replaced old models of the atom with newer models.

The nuclear model of the atom has a nucleus at the centre.

0 3 . 8 Which model of the atom was replaced by the nuclear model?

[1 mark]

Tick (✓) **one** box.

Bohr model ☐

Plum pudding model ☐

Tiny spheres that cannot be divided ☐

0 3 . 9 What does the nuclear model state about the mass of an atom?

[1 mark]

Tick (✓) **one** box.

The mass of the atom is concentrated in the electrons. ☐

The mass of the atom is concentrated in the nucleus. ☐

The mass of the atom is spread throughout the atom. ☐

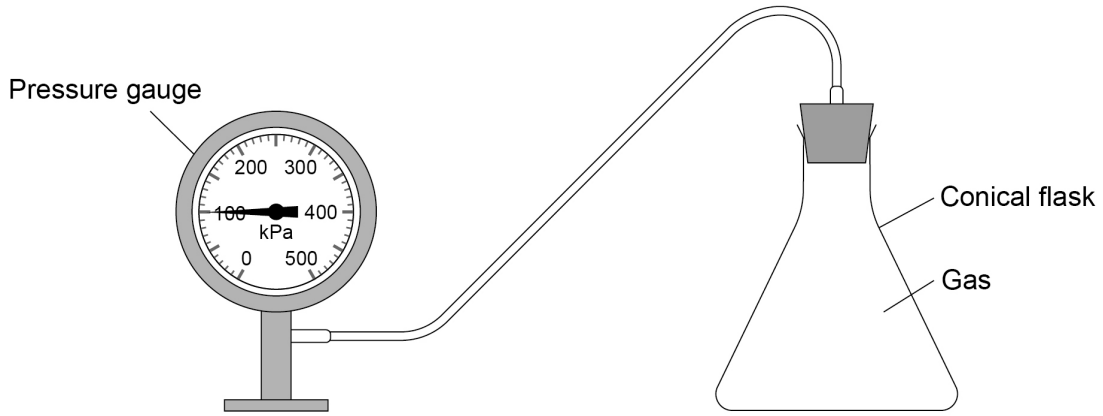
11

Do not write outside the box

0 4 A teacher demonstrated how the pressure in a gas varies with temperature.

Figure 7 shows some of the apparatus used.

Figure 7



The teacher heated the conical flask.

The temperature of the gas in the flask increased.

0 4 . 1 How did heating the gas affect the average speed of the gas particles?

[1 mark]

Tick (✓) **one** box.

The speed decreased. ☐

The speed stayed the same. ☐

The speed increased. ☐

Do not write outside the box

0 4 . 2 How did heating the gas affect the average kinetic energy of the gas particles?

[1 mark]

Tick (✓) **one** box.

The kinetic energy decreased. ☐

The kinetic energy stayed the same. ☐

The kinetic energy increased. ☐

As the temperature of the gas increased, the pressure of the gas inside the flask increased.

0 4 . 3 How did increasing the pressure affect the number of collisions each second between gas particles and the walls of the flask?

[1 mark]

Tick (✓) **one** box.

The number of collisions each second decreased. ☐

The number of collisions each second stayed the same. ☐

The number of collisions each second increased. ☐

Question 4 continues on the next page

Do not write outside the box

0 4 . 4 What happened to the force exerted on the walls of the flask by the gas particles when the pressure increased?

[1 mark]

Tick (✓) **one** box.

The force exerted decreased. ☐

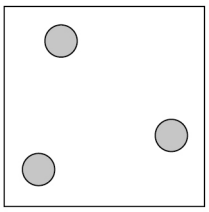
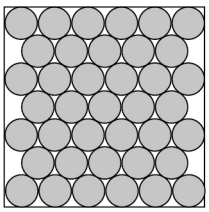
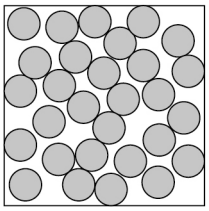
The force exerted stayed the same. ☐

The force exerted increased. ☐

0 4 . 5 At different temperatures, nitrogen can be a gas, a liquid or a solid.

Draw **one** line from the state of matter to the arrangement of particles in each state.

[2 marks]

State of matter	**Arrangement of particles**
Liquid	
Solid	
Gas	

Do not write outside the box

0 4 . 6 The boiling point of nitrogen is –196 °C and the melting point of nitrogen is –210 °C.

What is the state of matter of nitrogen at a temperature of –200 °C?

[1 mark]

Tick (✓) **one** box.

Solid ☐ Liquid ☐ Gas ☐

0 4 . 7 What is the state of matter of nitrogen when the temperature is lower than the melting point of nitrogen?

[1 mark]

Tick (✓) **one** box.

Solid ☐ Liquid ☐ Gas ☐

0 4 . 8 As a substance melts, the temperature of the substance is constant.

What happens to the kinetic energy **and** the potential energy of the particles as the substance melts?

[2 marks]

Tick (✓) **one** box in each row.

	Decreases	**Stays the same**	**Increases**
Kinetic energy of particles			
Potential energy of particles			

10

Do not write outside the box

0 5 **Figure 8** shows an electric kettle used to boil water.

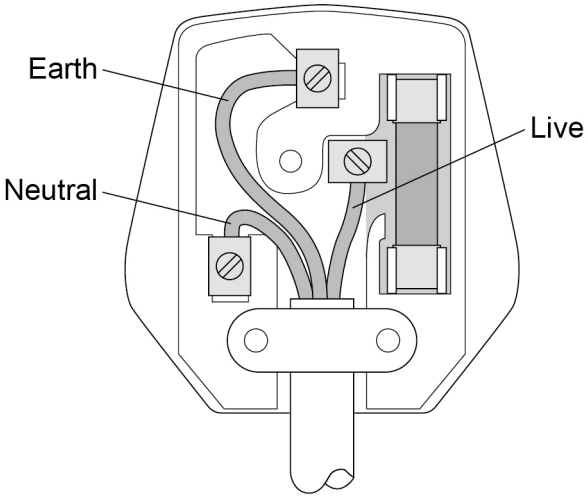
Figure 8

Do not write outside the box

0 5 . 1 The kettle is connected to the mains electricity supply by a three-core cable and plug.

Figure 9 shows the inside of the plug.

Figure 9



What are the colours of the insulation around the earth, live and neutral wires inside a plug?

[3 marks]

Choose answers from the box.

blue	**brown**	**green and yellow**	**red**	**yellow and brown**

Earth wire _____

Live wire _____

Neutral wire _____

Question 5 continues on the next page

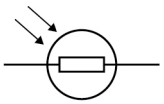
Do not write outside the box

0 5 . 2 The plug in **Figure 9** contains a fuse.

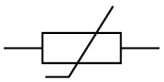
What is the circuit symbol for a fuse?

[1 mark]

Tick (✓) **one** box.



☐



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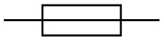


☐

0 5 . 3 The electric kettle contains a heating element.

The power of the heating element is 2420 W.

The current in the heating element is 11.0 A.

Calculate the potential difference across the heating element.

Use the equation:

$$\text{potential difference} = \frac{\text{power}}{\text{current}}$$

[2 marks]

_____

_____

_____

Potential difference = _____ V

Do not write outside the box

0 5 . 4 The power of the heating element is 2420 W.

The current in the heating element is 11.0 A.

Calculate the resistance of the heating element.

Use the equation:

$$\text{resistance} = \frac{\text{power}}{(\text{current})^2}$$

[2 marks]

Resistance = _____ Ω

0 5 . 5 Kettle **A** and kettle **B** have the same total power input.

Kettle **A** has a greater efficiency than kettle **B**.

Which **two** of the following describe heating water in kettle **A** compared with kettle **B**?

[2 marks]

Tick (✓) **two** boxes.

- A greater percentage of energy is usefully transferred by kettle **A**. ☐
- Kettle **A** has a lower useful power output. ☐
- Kettle **A** takes less time to boil the same volume of water. ☐
- More energy is wasted by kettle **A** each second. ☐
- The temperature of the same volume of water increases more slowly in kettle **A**. ☐

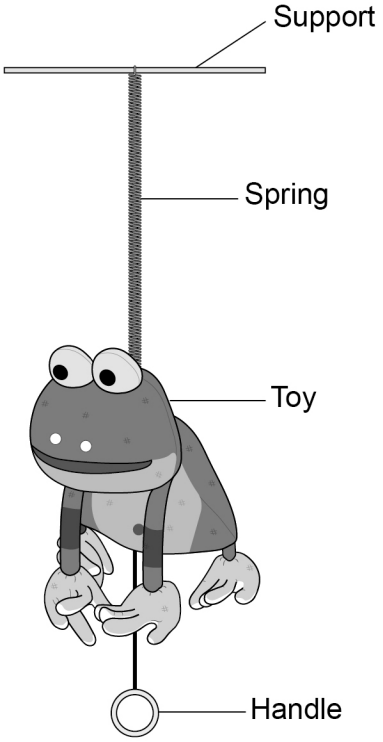
10

Do not write outside the box

0 6 **Figure 10** shows a toy which is hung from a support.

When the handle is pulled down and then released, the toy bounces up and down.

Figure 10



0 6 . 1 When the handle is pulled down, the spring extends.

The extension of the spring is 0.35 m.

The spring constant of the spring is 5.6 N/m.

Calculate the elastic potential energy stored by the stretched spring.

Use the equation:

elastic potential energy = 0.5 × spring constant × (extension)^2

[2 marks]

Elastic potential energy = _____ J

Do not write outside the box

Use the Physics Equations Sheet to answer questions **06.2** and **06.3**.

0 6 . 2 Which equation links gravitational field strength (g), gravitational potential energy (E_p), height (h) and mass (m)?

[1 mark]

Tick (✓) **one** box.

$E_p = \frac{mg}{h}$ ☐

$E_p = \frac{m}{gh}$ ☐

$E_p = mgh$ ☐

0 6 . 3 When the handle is released, the toy moves upwards through a height of 0.60 m.

The toy has 0.294 J of gravitational potential energy in its highest position.

gravitational field strength = 9.8 N/kg

Calculate the mass of the toy.

[3 marks]

_____

_____

_____

_____

_____

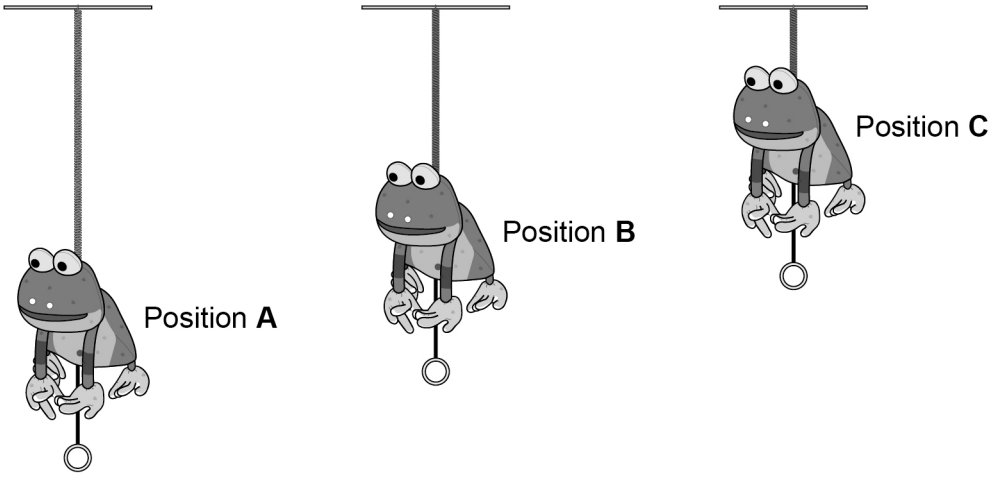
Mass of the toy = _____ kg

Question 6 continues on the next page

Do not write outside the box

Figure 11 shows the toy in three different positions.

Figure 11



The toy is released from position **A** and moves upwards.

The toy is moving upwards in position **B**.

The toy is at maximum height in position **C**.

0 6 . 4 Between position **A** and position **B**, the extension of the spring decreases.

How does the elastic potential energy stored by the spring change as the extension decreases?

[1 mark]

Tick (✓) **one** box.

Elastic potential energy decreases. ☐

Elastic potential energy stays the same. ☐

Elastic potential energy increases. ☐

Do not write outside the box

0 6 . 5 Between position **B** and position **C**, the toy slows down.

How does the kinetic energy of the toy change as the toy slows down?

[1 mark]

Tick (✓) **one** box.

Kinetic energy decreases. ☐

Kinetic energy stays the same. ☐

Kinetic energy increases. ☐

0 6 . 6 How does the gravitational potential energy of the toy change as the toy moves from position **B** to position **C**?

[1 mark]

Tick (✓) **one** box.

Gravitational potential energy decreases. ☐

Gravitational potential energy stays the same. ☐

Gravitational potential energy increases. ☐

Question 6 continues on the next page

Do not write outside the box

0 6 . 7 The toy moves up and down many times before eventually stopping.

Which **two** of the following are reasons why the toy eventually stops?

[2 marks]

Tick (✓) **two** boxes.

Air resistance opposes the motion of the toy. ☐

Energy is destroyed. ☐

Energy is transferred to the surroundings. ☐

The gravitational field strength decreases. ☐

The spring loses its elasticity. ☐

11

Do not write outside the box

Turn over for the next question

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

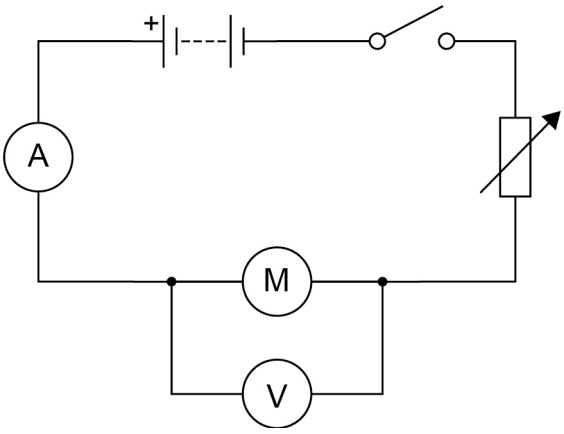
Do not write outside the box

0 7 A student built a circuit to investigate how the efficiency of a motor varies with the speed of the motor.

The symbol for a motor is

Figure 12 shows the circuit.

Figure 12



The student used the motor to lift a mass through a height of 1.0 m.

0 7 . 1 The motor took 12 seconds to lift the mass.

The charge flow through the circuit was 6.0 C.

Calculate the current in the circuit.

Use the equation:

$$\text{current} = \frac{\text{charge flow}}{\text{time}}$$

[2 marks]

Current = _____ A

Do not write outside the box

0 7 . 2 The potential difference across the motor was 8.0 V.

The charge flow through the motor was 6.0 C.

Calculate the energy transferred to the motor.

Use the equation:

energy transferred = charge flow × potential difference

[2 marks]

Energy transferred = _____ J

Question 7 continues on the next page

Do not write outside the box

Use the Physics Equations Sheet to answer questions **07.3** and **07.4**.

0 7 . 3 Which equation links efficiency, total input energy transfer and useful output energy transfer?

[1 mark]

Tick (✓) **one** box.

efficiency = useful output energy transfer × total input energy transfer ☐

efficiency = $\frac{\text{total input energy transfer}}{\text{useful output energy transfer}}$ ☐

efficiency = $\frac{\text{useful output energy transfer}}{\text{total input energy transfer}}$ ☐

0 7 . 4 The efficiency of the motor was 0.70

The useful output energy transfer of the motor was 1.96 J.

Calculate the total input energy transfer to the motor.

[3 marks]

_____

_____

_____

_____

_____

_____

Total input energy transfer = _____ J

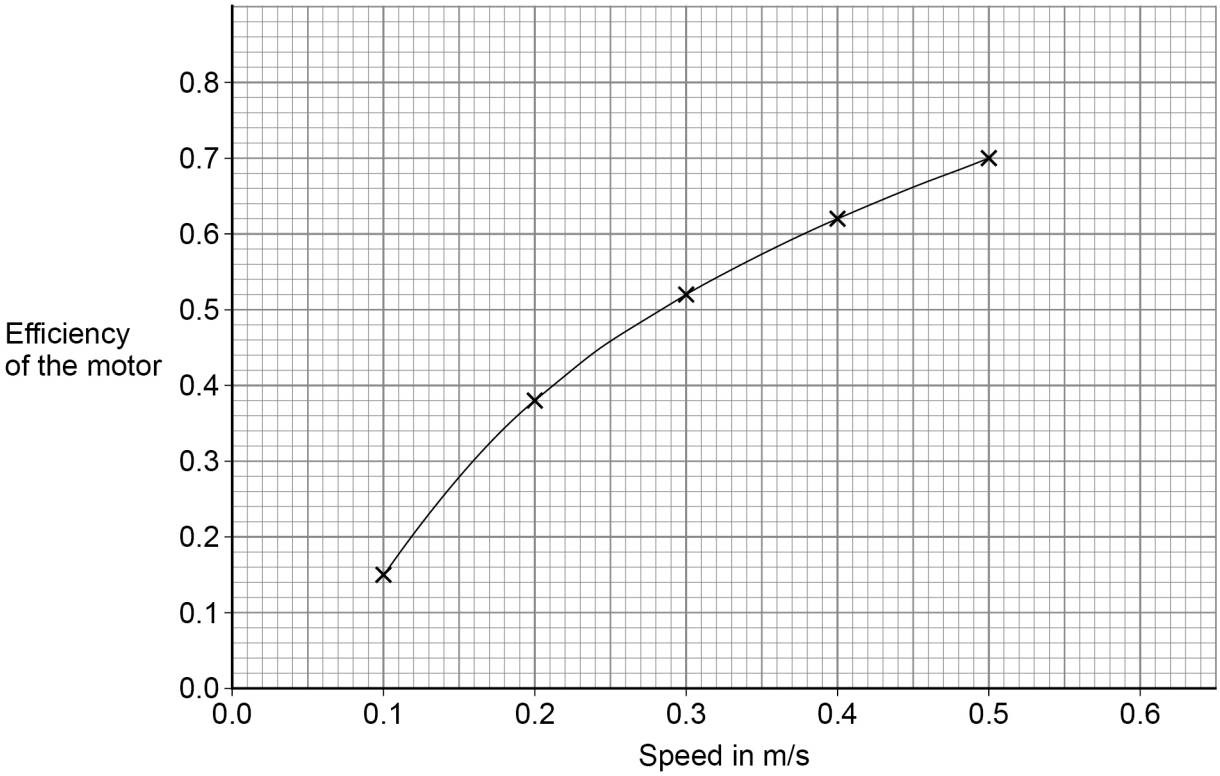
Do not write outside the box

The student adjusted the speed at which the mass was lifted.

For each speed, the student determined the efficiency of the motor.

Figure 13 shows the results.

Figure 13



0 7 . 5 Use **Figure 13** to predict the efficiency of the motor when the speed is 0.6 m/s.

[1 mark]

Efficiency = _____

0 7 . 6 How does **Figure 13** show that the efficiency of the motor is **not** directly proportional to the speed?

[1 mark]

_____

_____

_____

10

Do not write outside the box

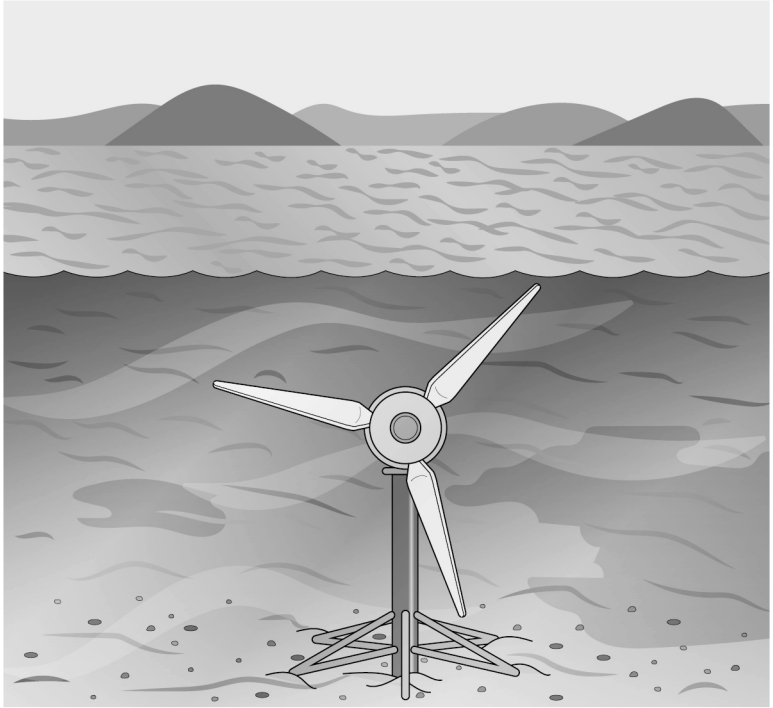
0 8 Tides and wind are two renewable energy resources.

0 8 . 1 Describe the difference between renewable energy resources and non-renewable energy resources.

[2 marks]

Figure 14 shows a new design of tidal turbine to generate electricity using the tides.

Figure 14



Do not write outside the box

Use the Physics Equations Sheet to answer questions **08.2** and **08.3**.

0 8 . 2 Write down the equation which links density (ρ), mass (m) and volume (V).

[1 mark]

_____

0 8 . 3 The mass of seawater passing through the tidal turbine each second is 824 000 kg.

The density of seawater is 1030 kg/m^3.

Calculate the volume of seawater passing through the tidal turbine each second.

[3 marks]

_____

_____

_____

_____

_____

Volume = _____ m^3

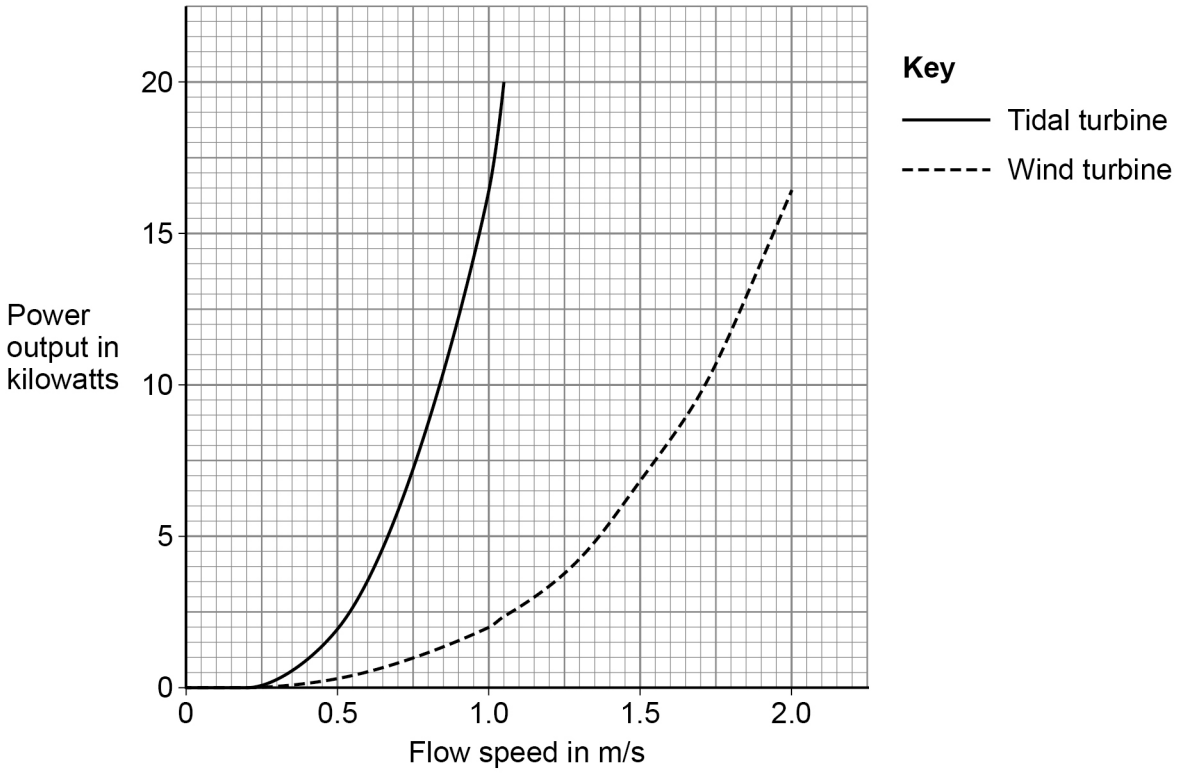
Question 8 continues on the next page

Do not write outside the box

The speed of the tide or the speed of the wind past a turbine is called the 'flow speed'.

Figure 15 shows how the power output of a tidal turbine compares with a wind turbine for different flow speeds.

Figure 15



0 8 . 4 As flow speed increases, power output increases.

Give **two** other conclusions that can be made using information from **Figure 15**.

[2 marks]

1 _____

_____

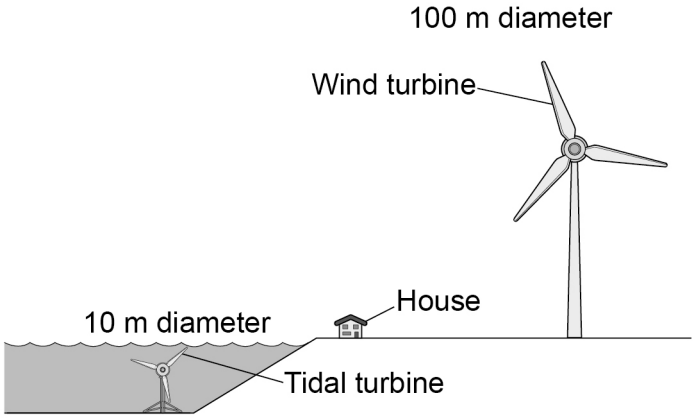
2 _____

_____

Do not write outside the box

0 8 . 5 **Figure 16** shows the turbines used to obtain the data for **Figure 15**.

Figure 16



Compare the environmental impacts of the wind turbine and the tidal turbine in **Figure 16**.

[4 marks]

12

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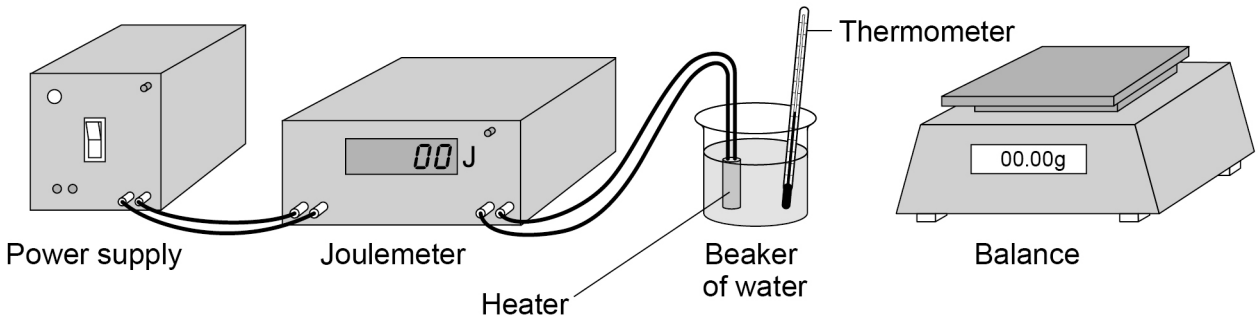
0 9 A student determined the specific heat capacity of water.

Figure 17 shows the apparatus used.

Figure 17



The joulemeter measures energy transfer.

0 9 . 1 Give **one** hazard in the investigation.

[1 mark]

_____

_____

0 9 . 2 Describe how the student could determine the specific heat capacity of water using the apparatus in **Figure 17**.

[6 marks]

_____

_____

_____

_____

_____

_____

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Extra space

0 9 . 3 One source of error in the experiment was energy loss to the surroundings.

Suggest **one** change to the apparatus to reduce energy loss to the surroundings.

[1 mark]

0 9 . 4 The student's value for the specific heat capacity of water was 4410 J/kg °C.

The actual value for the specific heat capacity of water is 4200 J/kg °C.

Calculate the percentage difference between the student's value and the actual value.

[2 marks]

Percentage difference = _____ %

10

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1 0 A student investigated how the current in an LED varies with the potential difference across the LED.

Figure 18 shows the circuit used.

Figure 18

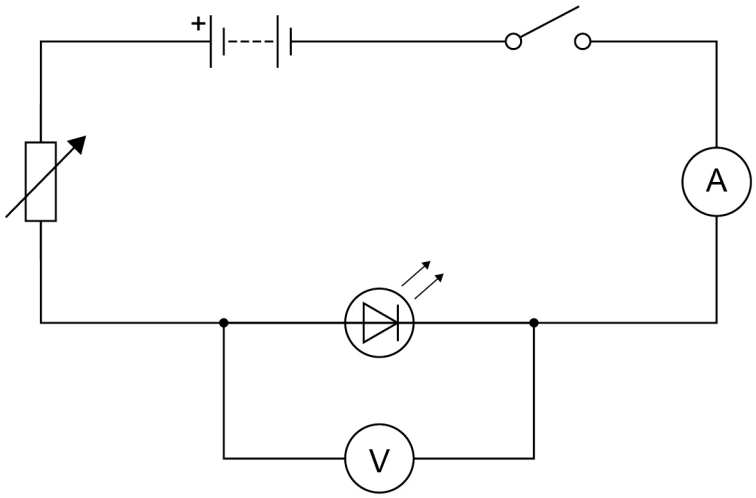
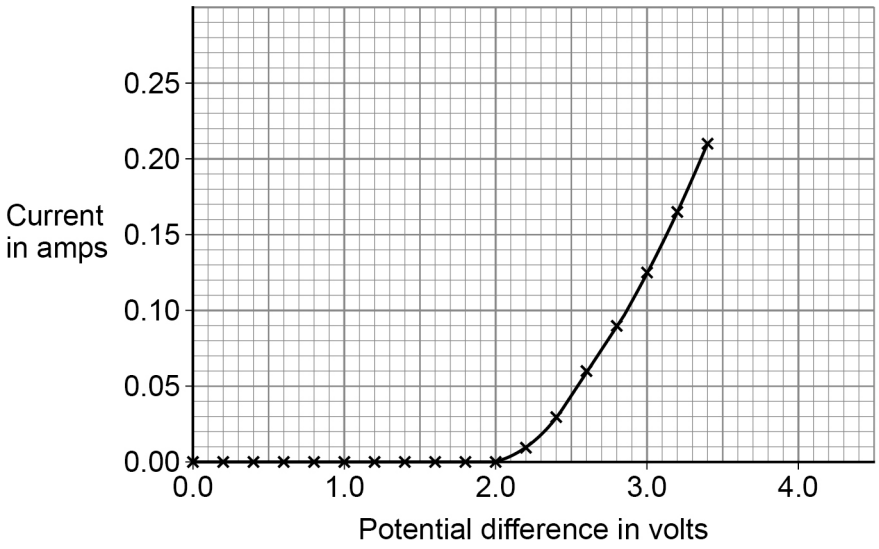


Figure 19 shows the results.

Figure 19



1 0 . 1 Give **one** way the student could have varied the potential difference across the LED.

[1 mark]

_____

_____

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Use the Physics Equations Sheet to answer questions **10.2** and **10.3**.

1 0 . 2 Which of the following equations links current (I), potential difference (V) and resistance (R)?

[1 mark]

Tick (✓) **one** box.

$V = I^2 \times R$ ☐

$V = I \times R$ ☐

$V = \frac{I}{R}$ ☐

$V = \frac{R}{I}$ ☐

1 0 . 3 Determine the resistance of the LED when the potential difference across the LED was 3.0 V.

Use **Figure 19**.

[4 marks]

Resistance = _____ Ω

Question 10 continues on the next page

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1 0 . 4 The student reversed the connections to the power supply and varied the potential difference across the LED.

Explain why the ammeter displayed a value of 0.0 A for all the values of potential difference the student used.

[2 marks]

_____

_____

_____

_____

8

END OF QUESTIONS

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