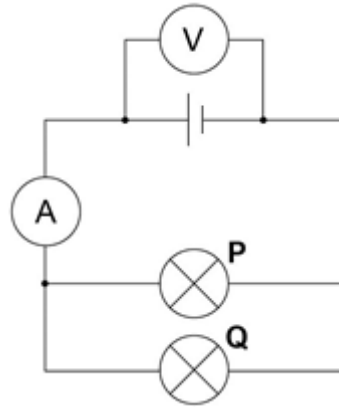


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0 1

Figure 1 shows a circuit diagram containing two identical lamps arranged in parallel. The reading on the ammeter is 186 mA.

Figure 1



0 1 . 1

Which statement about the current through the lamps is true?

[1 mark]

Tick **one** box.

The current through both lamp **P** and lamp **Q** is **0.093 A**

The current through both lamp **P** and lamp **Q** is **0.186 A**

The current through both lamp **P** and lamp **Q** is **0.93 A**

The current through both lamp **P** and lamp **Q** is **1.86 A**

0 1 . 2

One of the lamps breaks and is not replaced.

Which statement about the current in the other lamp is true?

Tick **one** box.

[1 mark]

The current through the lamp is **0.093 A**

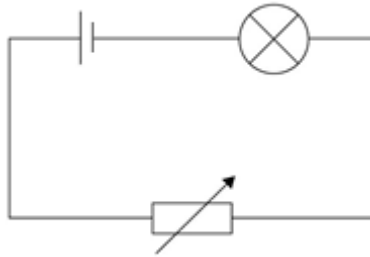
The current through the lamp is **0.186 A**

The current through the lamp is **0.93 A**

The current through the lamp is **1.86 A**

Figure 2 shows a circuit that can be used to alter the brightness of a lamp.

Figure 2



0 1 . 3 The resistance of the variable resistor is increased.

What effect will this have on the brightness of the lamp?

Explain your answer.

[2 marks]

When the potential difference across the lamp is 3.3 V, the current is 0.15 A.

0 1 . 4 Write down the equation that links current, potential difference and resistance.

[1 mark]

Equation _____

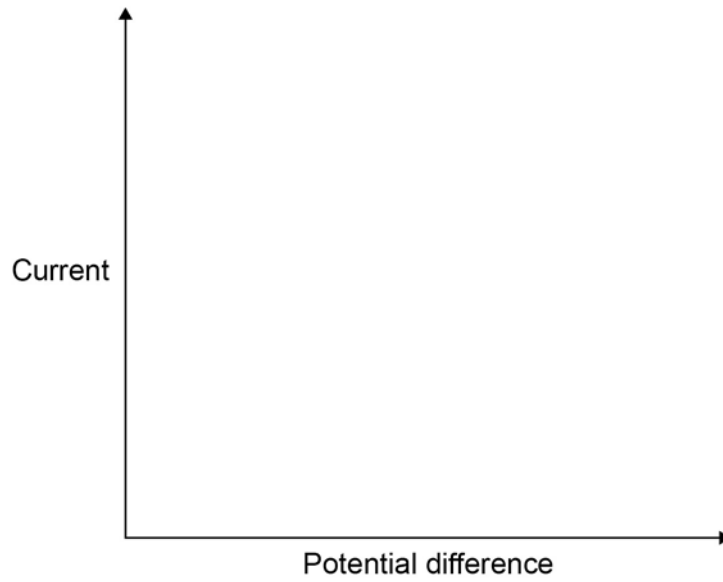
0 1 . 5 Calculate the resistance of the lamp.

[3 marks]

Resistance = _____ Ω

0 1 . **6** Sketch a current–potential difference graph for a filament lamp.

[1 mark]



Turn over for the next question

0 2**Figure 3** shows a battery operated remote control car.**Figure 3**

Image of a battery operated remote control car not reproduced here due to third party copyright restrictions.

0 2**1**

The car's battery contains a store of energy.

As the car moves, energy from one store is transferred to another store.

Describe how different stores of energy change as the car moves.

[2 marks]

The car has a top speed of 12 m/s and a mass of 800 g.

0 2**2**

Write down the equation that links kinetic energy, mass and speed.

[1 mark]

Equation _____

0 2**3**

Calculate the maximum kinetic energy of the car.

[2 marks]

Maximum kinetic energy = _____ J

0 2 . **4** Explain why having a more efficient motor increases the top speed of the car.

[2 marks]

Question 2 continues on the next page

Figure 4 shows an electric car being charged.

Figure 4

Image of an electric car being charged not reproduced here due to third party copyright restrictions.

0 2 . 5 A driver wishes to buy a new car.

Table 1 gives some data about an electric car and one with a petrol engine.

Table 1

	Electric car	Petrol engine car
Cost (£)	27 000	15 000
Running cost per year (£)	250	2 000
Average lifetime (years)	12	12

Which car would be the most economic over its 12 year lifetime?

Use data from **Table 1** to support your answer.

You should include the difference in cost in your answer.

[4 marks]

Turn over for the next question

0 3

Some small fractures do not show up on an X-ray image.

To see the fracture doctors inject the patient with a radioactive isotope.

The image is formed by detecting radiation as it leaves the body.

Figure 5 shows an image of a foot after the patient was injected with the radioactive isotope technetium-99.

Figure 5

Image of a foot after being injected not reproduced here due to third party copyright restrictions.

Technetium-99 emits gamma radiation.

0 3**. 1**

What is gamma radiation?

[1 mark]

0 3**. 2**

Explain why a gamma emitter is used.

[2 marks]

Technetium-99 has a **half-life** of 6 hours.

0 3 . **3** Give the meaning of the term **half-life**.

[1 mark]

0 3 . **4** After treatment, hospital equipment may become contaminated.

Describe the level of the hazard associated with contamination with technetium-99.

You should include in your answer a description of how the level of hazard changes over time.

[3 marks]

Question 3 continues on the next page

0 3 . **5** Some of the hospital equipment may also be irradiated during treatment.

Describe how equipment becomes irradiated.

[1 mark]

0 3 . **6** Why is irradiated equipment not hazardous?

[1 mark]

Turn over for the next question

0 4

Atoms are very small and most of their mass is concentrated in the nucleus.

Electrons orbit at different distances from the nucleus.

0 4 . **1**

A nucleus is much smaller than an atom.

Approximately how many times smaller is a nucleus than an atom?

[1 mark]

Tick **one** box.

100 1000 10 000 100 000 **0 4** . **2**

The electrons in an atom can only orbit at specific distances from the nucleus.

State what causes an electron's distance from the nucleus to increase or decrease.

[2 marks]

Increase

Decrease

0 4 . **3**

Atoms have different atomic numbers and mass numbers.

In terms of sub-atomic particles, describe the difference between an atom's atomic number and its mass number.

[2 marks]

0 4 . **4** Transmutation is the name given to a process where one element changes into another.

Explain and compare how two different types of radioactive decay can cause transmutation.

[4 marks]

Turn over for the next question

0 5

Figure 6 shows a kettle a student used to determine the specific heat capacity of water.

Figure 6

Image of a kettle not reproduced here due to third party copyright restrictions.

The student placed different masses of water into the kettle and timed how long it took for the water to reach boiling point.

The student carried out the experiment three times.

The student's results are shown in **Table 2**.

Table 2

Mass of water in kg	Time for water to boil in seconds				Mass × change in temperature in kg°C	Energy supplied in kJ
	1	2	3	Mean		
0.25	55	60	63	59	20	131
0.50	105	110	116	110	40	243
0.75	140	148	141	143	60	314
1.00	184	190	183	182	80	401
1.25	216	215	211	214	100	471
1.50	272	263	266	267	120	587
1.75	298	300	302		140	

0 5**. 1**

Suggest how the student was able to ensure that the change in temperature was the same for each mass of water.

[2 marks]

-
- 0 5** . **2** Calculate the uncertainty in the student's measurements of time to boil when the mass of water was 1.75 kg.

[2 marks]

Uncertainty = _____ s

- 0 5** . **3** The power rating of the kettle is 2.20 kW.

Calculate the average electrical energy used by the kettle, in kJ, for 1.75 kg of water to reach boiling point.

[2 marks]

Average energy = _____ kJ

- 0 5** . **4** Use information from **Table 2** to calculate the change in temperature of the water during the investigation.

[2 marks]

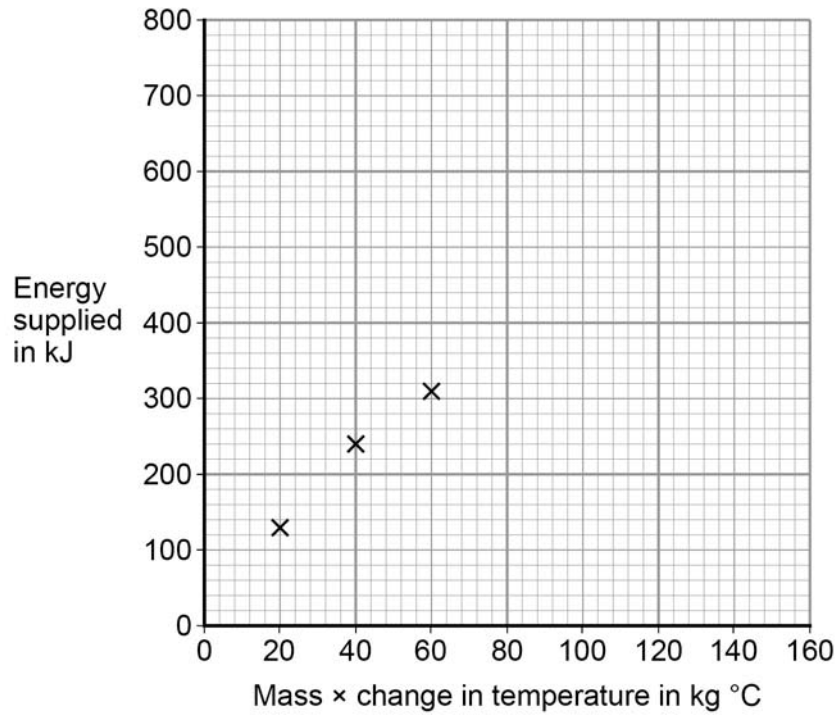
Change in temperature = _____ °C

Question 5 continues on the next page

The student plotted a graph of energy supplied in kJ against mass \times change in temperature in kg $^{\circ}$ C.

Figure 7 shows the graph the student plotted.

Figure 7



0 5 . **5** Use data from **Table 2** to plot the four missing points.

Draw a line of best fit on the graph.

[3 marks]

-
- 0 5** . **6** Use the graph to determine the mean value of the specific heat capacity of water, for the student's investigation.

[4 marks]

Specific heat capacity of water = _____ J/kg °C

- 0 5** . **7** The student's value for the specific heat capacity of water was greater than the accepted value.

Suggest why.

[1 mark]

- 0 5** . **8** The kettle used in the experiment had a label stating that the power rating of the kettle was 2.2 kW.

The student did not measure the power of the kettle.

Suggest why measuring the power of the kettle may improve the student's investigation.

[1 mark]

0	6
---	---

The particle model can be used to explain the properties of gases.

0	6	.	1
---	---	---	---

Describe the direction of motion of the particles in a gas.

[1 mark]

0	6	.	2
---	---	---	---

Explain why heating a gas increases the average speed of the gas particles.

[3 marks]

0 6 . **3** Water can exist as either a liquid or a gas at 100 °C.

Explain why a mass of gaseous water at 100 °C contains more energy than an equal mass of liquid water at 100 °C.

[2 marks]

Question 6 continues on the next page

Water vapour is a gas. Gases change state when they cool.

Figure 8 shows condensation on a cold bathroom mirror.

Figure 8

Image of condensation on a cold bathroom mirror not reproduced here due to third party copyright restrictions.

0 6 . **4** A volume of $2.5 \times 10^{-5} \text{ m}^3$ of condensation forms on the mirror.

Density of water = 1000 kg/m^3

Specific latent heat of vaporisation of water = $2.26 \times 10^6 \text{ J/kg}$.

Calculate the energy released when the condensation forms.

[5 marks]

Energy released = _____ J

0 6 . **5** Central heating boilers burn gas and use the energy released to heat water.

Modern condensing central heating boilers take advantage of the energy that is released when water condenses.

Waste water vapour produced when the water is heated in the boiler is used to preheat the cold water entering the boiler.

Give some of the arguments in favour of condensing boilers compared to older non-condensing boilers.

[4 marks]

END OF QUESTIONS

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