OCR
Oxford Cambridge and RSA

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Friday 13 November 2020 – Morning

GCSE (9–1) in Combined Science B
(Twenty First Century Science)

J260/07 Physics (Higher Tier)

Time allowed: 1 hour 45 minutes

You must have:
- a ruler (cm/mm)
- the Data Sheet for GCSE (9–1) Combined Science (Physics) B (inside this document)

You can use:
- an HB pencil
- a scientific or graphical calculator

Please write clearly in black ink. **Do not write in the barcodes.**

Centre number						Candidate number				

First name(s) _____

Last name _____

INSTRUCTIONS
- Use black ink. You can use an HB pencil, but only for graphs and diagrams.
- Write your answer to each question in the space provided. If you need extra space use the lined pages at the end of this booklet. The question numbers must be clearly shown.
- Answer **all** the questions.
- Where appropriate, your answer should be supported with working. Marks might be given for using a correct method, even if your answer is wrong.

INFORMATION
- The total mark for this paper is **95**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended response will be assessed in questions marked with an asterisk (*).
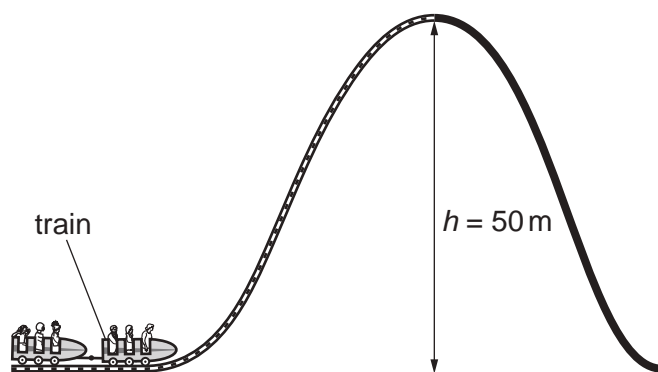- This document has **24** pages.

ADVICE
- Read each question carefully before you start your answer.

Turn over

2

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PLEASE DO NOT WRITE ON THIS PAGE

Answer **all** the questions.

1 The diagram shows a rollercoaster ride.

(a) (i) A motor pulls the train to the top of the track, 50 m above the ground. The weight of the train is 9000 N.

Calculate the potential energy gained by the train as it moves from the ground to the top of the track.

Give your answer in **standard form**.

Potential energy = ... J **[4]**

(ii) It takes 15 s for the train to travel to the top of the track.

Calculate the useful power output of the motor.

Useful power output = ... W **[3]**

(b) What is meant by the term power output when discussing the train motor used in the rollercoaster?

Put a ⟨ring⟩ around the correct words to complete the sentence.

The power output of the motor is equivalent to the **rate / time / voltage** at which energy is

transferred **electrically / mechanically / by heating** from the **elastic / chemical / kinetic**

energy store of the motor to the potential energy store of the train and to the

atmospheric / chemical / thermal energy store of the surroundings.

[2]

Turn over

2   Sarah is investigating two circuit components.

She changes the potential difference across each component and measures the current through each component.

The table shows her results for **component A**.

Component A	
Potential difference (V)	**Current (mA)**
−2.0	−12
−1.5	−9
−0.8	−5
0	0
0.5	3
0.9	5
1.4	8
1.8	11
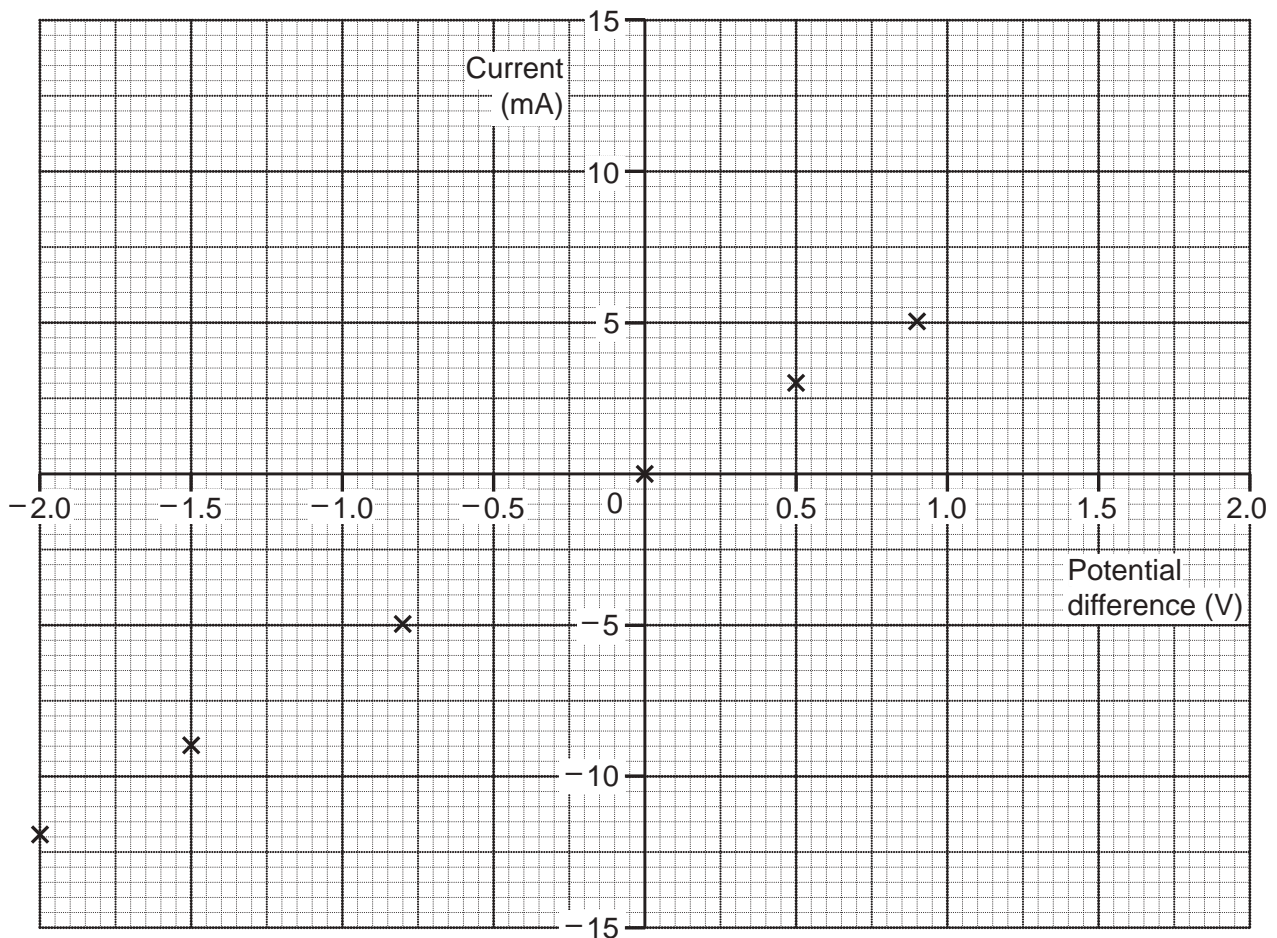
Fig. 2.1

(a) (i) Complete the graph in **Fig. 2.1** by plotting the remaining **two** points from the table. **[1]**

(ii) Draw a line of best fit on the graph in **Fig. 2.1**. **[1]**

(iii) Describe the relationship between current and potential difference for **component A**.

....

.... **[1]**

(iv) Suggest what **component A** could be.

.... **[1]**

(v) Calculate the resistance of **component A** when the potential difference across it is 2.0 V.

Use data from the graph in **Fig. 2.1**.

Use the equation: potential difference = current × resistance

Resistance = ... Ω **[4]**

Turn over

(b) **Fig. 2.2** shows the graph of Sarah's results for **component B**.
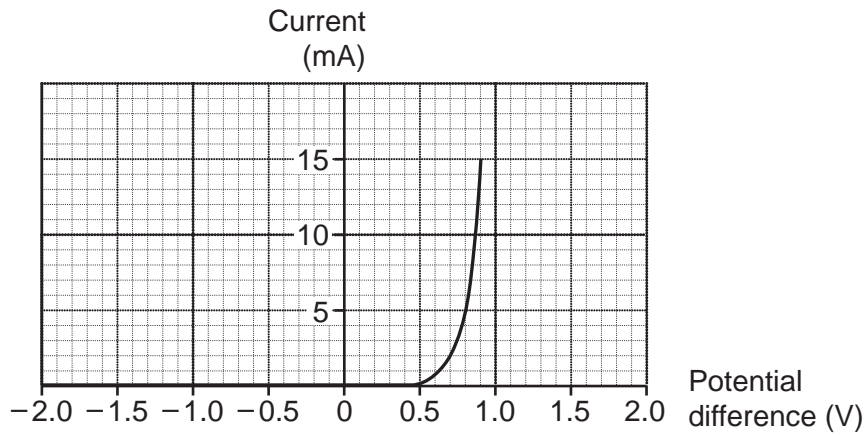
Current
(mA)

Fig. 2.2

(i) Describe what happens to the current as the potential difference changes for **component B**.

....

.... **[1]**

(ii) Suggest what **component B** can be used for in a circuit.

....

.... **[1]**

3 **(a)** This sign is used to mark sources of ionising radiation.

   (i) Name **two** types of ionising radiation.

   1. ....

   2. ....
   [2]

   (ii) Describe how ionising radiation is a hazard to humans.

   .... **[1]**

(b) Carbon dioxide in the atmosphere absorbs infrared radiation from the Earth.

Complete the following sentences to describe what happens when molecules of carbon dioxide absorb infrared radiation.

Use words from the list.

Each word can be used once, more than once or not at all.

decreases   density   faster   increases   mass

slower   temperature

When molecules of carbon dioxide absorb infrared radiation, their internal store of energy

....

They move .... and the .... of the carbon dioxide

increases. If the carbon dioxide is in a container with a constant volume the pressure

....

[3]

Turn over

4 Amaya looks up the relative atomic mass and the density of some metals.

(a) Complete the statement about density.

Tick (✓) one box.

The density of a material is equivalent to:

the mass per 1 kg of the material. ☐

the mass per 1 m^3 of the material. ☐

the volume per 1 m^3 of the material. ☐

the volume per 1 kg of the material. ☐

[1]

(b) Amaya makes a prediction.

> I predict that as the relative atomic mass of metals increases, the density will also increase.

She plots a graph of density against relative atomic mass for three metals.
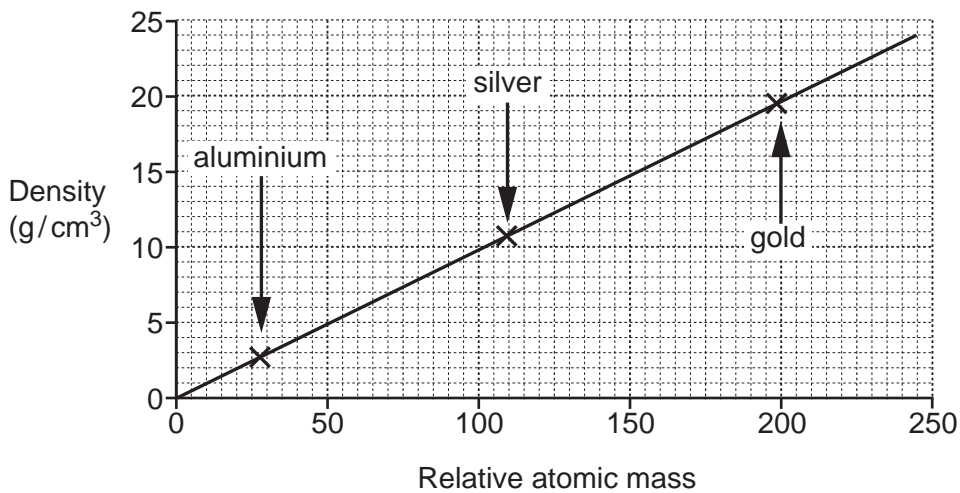
Predict the density of tin from Amaya's graph.

Show your working on Amaya's graph.

Relative atomic mass of tin = 119

Predicted density of tin = ... g/cm^3 **[1]**

(c) Amaya concludes from her graph that the density of metals increases as the relative atomic mass of the metals increases.

The table shows the relative atomic mass and the density for two other metals.

Metal	Relative atomic mass	Density (g/cm^3)
Zinc	65	7.14
Platinum	195	21.5

Does the data in the table increase or decrease your confidence in Amaya's conclusion?

Explain your answer.

....

....

....

....

....

.... **[3]**

5 This diagram shows a ripple tank.
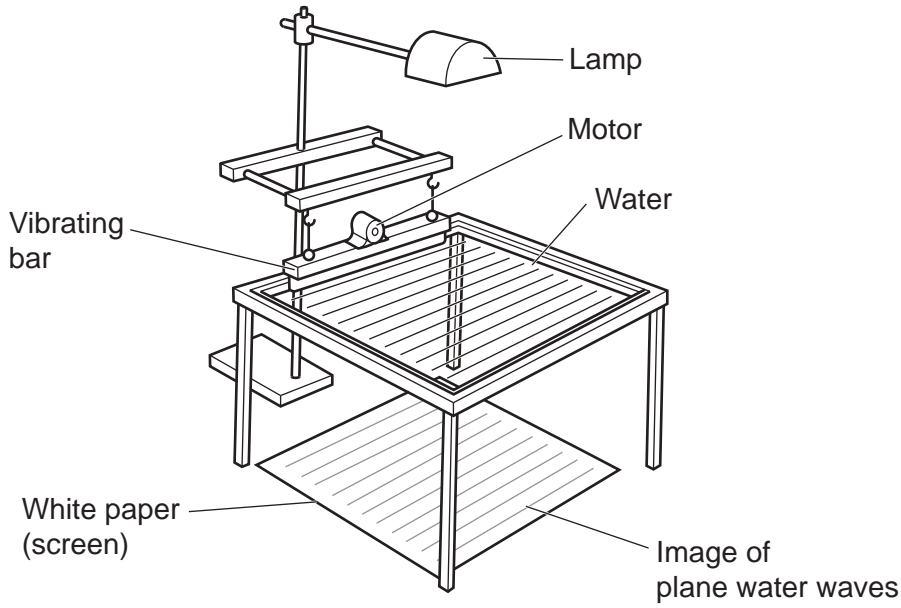
(a) (i) The image of the plane water waves does not show up very clearly on the paper.

Suggest how you could improve the quality of the image on the white paper (screen).

....

.... **[1]**

(ii) Describe how to use the ripple tank to **accurately** measure the wavelength of a plane water wave.

....

....

....

....

....

.... **[3]**

(iii) Alex wants to find out if the temperature of the water affects the wavelength of the plane water waves in the ripple tank.

Suggest how he could change the experiment in **(a)(ii)** to see if the temperature of the water affects the wavelength of the plane water waves.

....

....

....

.... **[2]**

(b) Alex counts 27 plane water waves passing a point on the white paper (screen) in 12 seconds.

(i) Calculate the frequency of the plane water waves.

Frequency = ... Hz **[2]**

(ii) Alex measures the wavelength of a plane water wave to be 2.4 cm.

Calculate the speed of the plane water waves.

Use your answer to **(b)(i)**.

Use the equation: wave speed = frequency **×** wavelength

Give your answer in **m/s**.

Speed = ... m/s **[3]**

Turn over

6 Kai investigates series and parallel circuits.

(a) Kai makes two different circuits, as shown in **Fig. 6.1**. He uses identical resistors, ammeters, voltmeters and batteries.

The resistance of all 4 resistors is the same: $R_A = R_B = R_C = R_D$
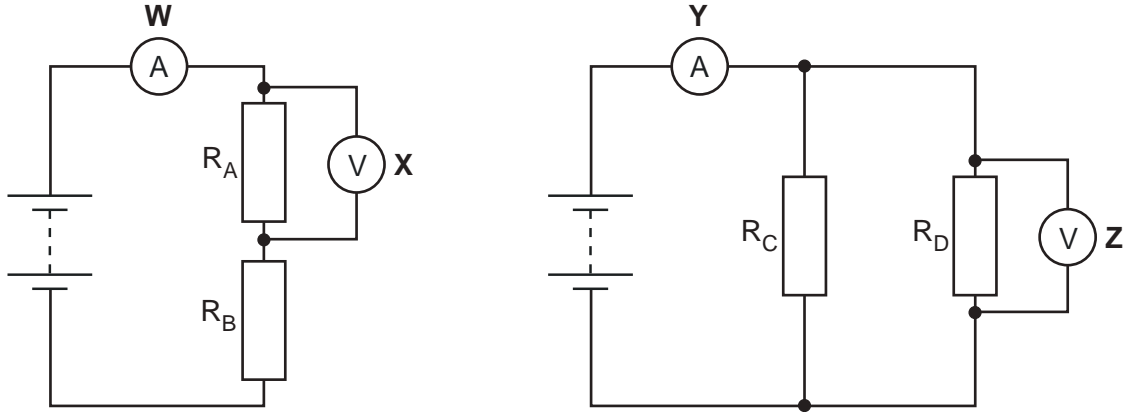
Fig. 6.1

(i) Complete the sentences below about the two circuits.

Put a ring around the correct choice to complete each sentence.

The current at **W** is **equal to** / **higher** / **lower** than the current at **Y**.

The potential difference measured by voltmeter **X** is **equal to** / **higher** / **lower** than the potential difference measured by voltmeter **Z**. **[2]**

(ii) Kai replaces resistor R_A with another resistor that has much **smaller** resistance.

Describe what happens to the current measured by ammeter **W** and the potential difference measured by voltmeter **X**.

....

....

....

.... **[2]**

(b) **Fig. 6.2** shows the circuit diagram for an LED torch.
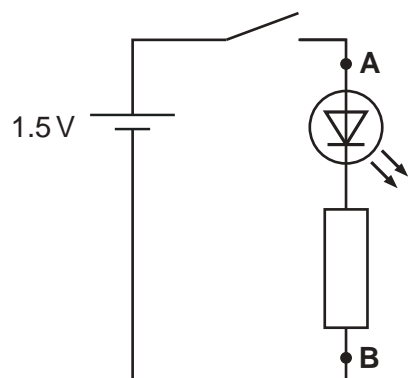
Fig. 6.2

The potential difference between points **A** and **B** is 1.5 V.

How much work is done moving 300 mC of charge from **A** to **B**?

Work done = ... J **[4]**

7 When an electrical appliance is used, energy is transferred from one energy store to another, so there is a change in stored energy.

The table shows the change in stored energy for different electrical appliances.

Electrical appliance	Power rating (W)	Time used (h)	Change in stored energy (Wh)
shower	7500	0.2	1500
kettle	3000	0.2	600
television	125	1.0	125
cordless vacuum cleaner	125	0.4	50
lamp	9	5.0	45

(a) Explain how the power rating of the appliance, and the time used, affects the change in stored energy.

Use data from the table to support your answer.

....

....

....

....

....

.... **[3]**

(b) (i) Calculate the useful energy transferred to the cordless vacuum cleaner motor when it is used for 0.4 hours.

The efficiency of the cordless vacuum cleaner motor is 90%.

Use data from the table.

Use the equation: $\text{efficiency} = \dfrac{\text{useful energy transferred}}{\text{total energy transferred}}$

Useful energy transferred = ... Wh **[3]**

(ii) Draw a labelled Sankey diagram to show the energy transfers that take place when the cordless vacuum cleaner is used for 0.4 hours.

Use information from the table and your answer to **(b)(i)**.

The energy store at the start is the 50 Wh chemical energy store of the battery in the cordless vacuum cleaner.
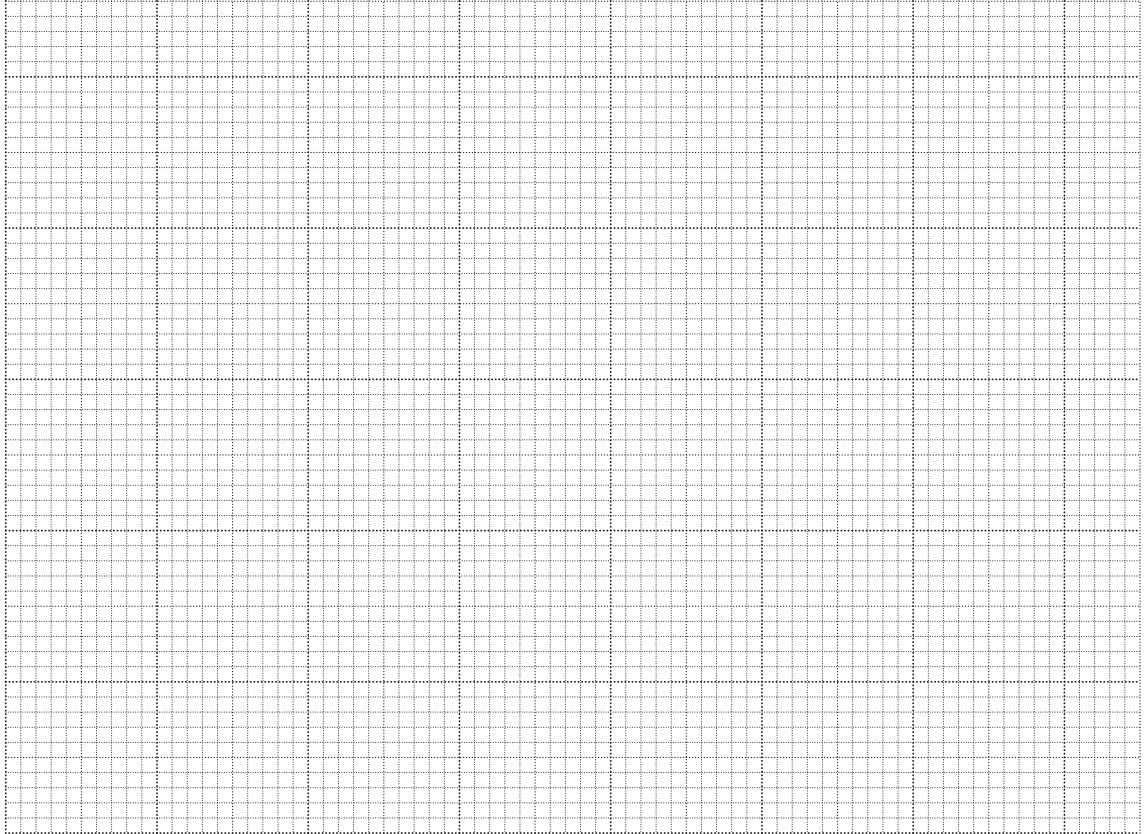
[4]

(c) The kettle uses the mains domestic electricity supply.

Complete **Fig. 7.1** to describe the energy transfers that take place when a kettle heats water, starting with the energy store at the power station.

....

energy store at the power station.

Transferred

....

to ....

energy store of the kettle and its surroundings.
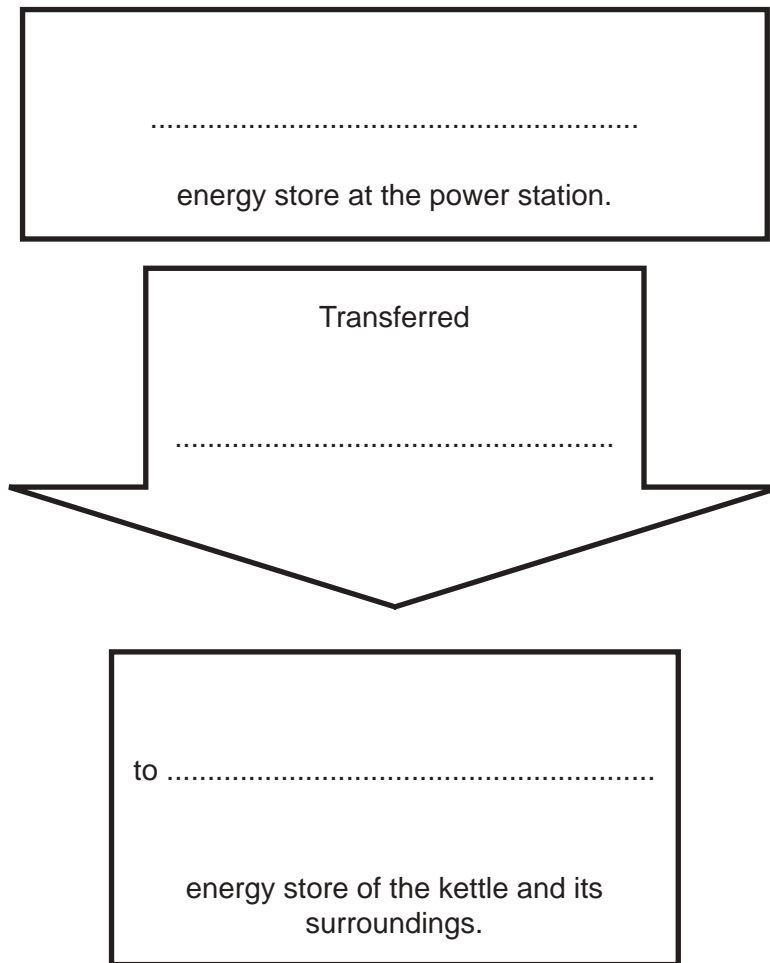
Fig. 7.1

[3]

8 In **1986** there was an explosion at the Chernobyl nuclear reactor.

Caesium-137 is one of the largest sources of radioactivity left over from the explosion.

Caesium-137 has a half-life of 30 years.

(a) (i) Calculate the fraction of the radioactive emission from Caesium-137 that will still be present in **2076**.

Fraction = ... **[3]**

(ii) What year will the fraction have fallen to $\frac{1}{64}$ of the original radioactive emission?

Year = ... **[3]**

(b) The first international reports of the explosion were made when measuring instruments in Sweden detected high radiation levels in the air.

Since the explosion at Chernobyl, scientists in many countries have shared their research on radiation levels and its effects.

Give **two** reasons why these scientists should communicate their work to the public, politicians and other scientists.

1. ....

....

2. ....

....
[2]

9 **(a)** Geostationary satellites are used for communications and television broadcasting.

They travel in a circular orbit around Earth with a constant speed of 3 km/s.

Explain how a geostationary satellite can have constant speed but changing velocity.

....

....

....

.... **[2]**

(b) A planet such as Earth has a large inertial mass.

Explain what is meant by **inertial mass**.

....

.... **[1]**

(c)* This is a statement of Newton's First Law:

| When there is no resultant force on a stationary object it does not move. |
| When there is no resultant force on a moving object it continues to move with constant velocity. |

This equation represents Newton's Second Law:

| Force = mass × acceleration |

A space probe is travelling through space to a distant star. It is travelling through a vacuum and is not affected by any other objects. The space probe is on course to crash into the star.

Explain the motion of the space probe as it travels towards the star, and why it then crashes into the star.

You should apply Newton's first law and Newton's second law in your answer.

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.... **[6]**

Turn over

10 (a) Jack puts 560 g of milk in a pan and heats it, taking care not to let it boil by using a thermometer. Energy is transferred from the pan to the milk.

(i) Describe the effect on the milk.

Use ideas about energy stores in your answer.

....

.... **[1]**

(ii) Nina heats 560 g of water, using the same method that Jack uses for heating the milk.

Why does the temperature of the milk increase more quickly than the temperature of the water?

....

.... **[1]**

(b) Nina heats the 560 g of water until it is boiling.

(i) Calculate the energy needed to turn all the water to steam once it is boiling.

Specific latent heat of water = $2.23 \times 10^6 \, J\,kg^{-1}$

Give your answer to **3** significant figures.

Energy needed = ... J **[3]**

(ii) The time taken for all the water to turn to steam is 7 minutes.

Calculate the power of the heater used.

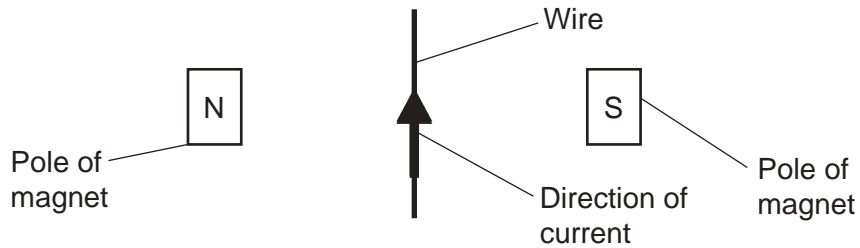Use the equation: energy transferred = power × time

Power = ... W **[3]**

11 Beth investigates forces and magnetic fields.

(a) State Newton's third law.

....

.... **[1]**

(b) Beth places a wire between the poles of a magnet.

The diagram shows a view of the poles of the magnet and the wire from above.

Explain what happens to the wire when a current flows through it.

Use ideas about magnetic fields and forces in your answer.

You may draw on the diagram to support your answer.

....

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....

.... **[3]**

(c) When Beth sets the current in the wire to 5.6 A there is a force of 0.072 N on the wire. The wire has a length of 0.45 m.

Calculate the magnetic flux density.

Use the Data Sheet.

Give your answer in **standard form** and to **2** significant figures.

Magnetic flux density = ... T **[4]**

END OF QUESTION PAPER

ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).