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F

Friday 13 November 2020 – Morning

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

J260/03 Physics (Foundation Tier)

Time allowed: 1 hour 45 minutes

8271358059

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

J260003

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 **28** pages.

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

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Answer **all** the questions.

1 Nina studies radiation and waves.

(a) Which **one** statement about electromagnetic radiation is **true**?

Tick (✓) one box.

Infrared radiation has enough energy to cause ionisation. ☐

Microwaves have a longer wavelength than visible light. ☐

Radio waves have a higher frequency than microwaves. ☐

[1]

(b) A sound wave travelling through a copper wire has a wavelength of 15 m and a frequency of 248 Hz.

Calculate the wave speed of the sound wave through the copper wire.

Use the equation: wave speed = wavelength × frequency

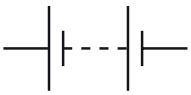
Wave speed = ... m/s **[2]**

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2 Ben is investigating electric circuits.

(a) Complete the table by filling in the blank spaces.

One has been done for you.

Circuit component	Name of circuit component
	
	
	battery
	
	

[2]

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(b) Ben wants to investigate the brightness of bulbs in series and parallel.

(i) Draw a series circuit diagram with **one** bulb that Ben can use to start his investigation.

Use **all** of the circuit components from the table.

[2]

(ii) Describe how Ben can investigate if the brightness of the first bulb changes when a second bulb is added in **parallel**.

.....

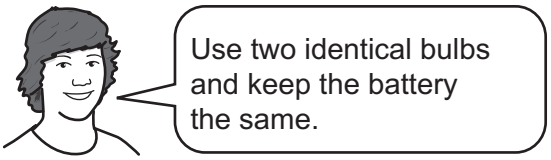
.....

.....

..... **[2]**

(iii) Ben compares the brightness of two bulbs in series, and two bulbs in parallel.

Alex says:



Why is it important for Ben to follow Alex's advice?

..... **[1]**

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(iv) Complete the sentences to describe the changes to the bulb brightness when more of the same bulbs are added to the circuit.

Use words from the list.

You can use each choice once, more than once, or not at all.

increase **decrease** **stay the same**

1. When more of the same bulbs are added in **parallel**, the brightness of all of the bulbs will .....

2. When more of the same bulbs are added in **series**, the brightness of all of the bulbs will .....

[2]

(c) (i) Suggest **one** hazard associated with adding more bulbs in series to the circuit.

.....

..... **[1]**

(ii) Suggest **one** way of making the experiment safer when more bulbs are added in series to the circuit.

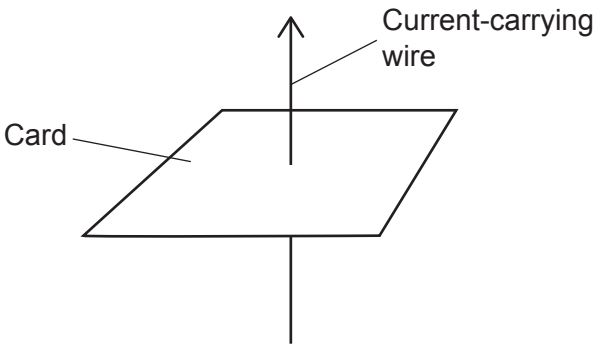
.....

..... **[1]**

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3 The diagram shows a vertical wire passing through a horizontal piece of card.

There is a current flowing through the wire in the direction of the arrow.



(a) Sundip plots the magnetic field around the current-carrying wire, on the card.

Describe the pattern and direction of the magnetic field.

Your description can be shown on the diagram.

.....

.....

..... **[3]**

(b) Sundip places an iron pin on the card.

The iron pin experiences a magnetic force, which is caused by the magnetic field around the current-carrying wire.

How can Sundip increase the effect of the magnetic field on the pin?

Tick (✓) **two** boxes.

Heat the wire. ☐

Increase the current in the wire. ☐

Increase the resistance of the wire. ☐

Move the card higher up the wire. ☐

Move the pin closer to the wire. ☐

[2]

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4 There are 2 types of waves.

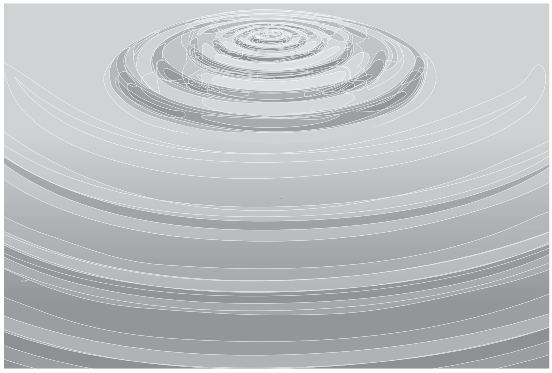
(a) Complete the sentences to describe each type of wave.

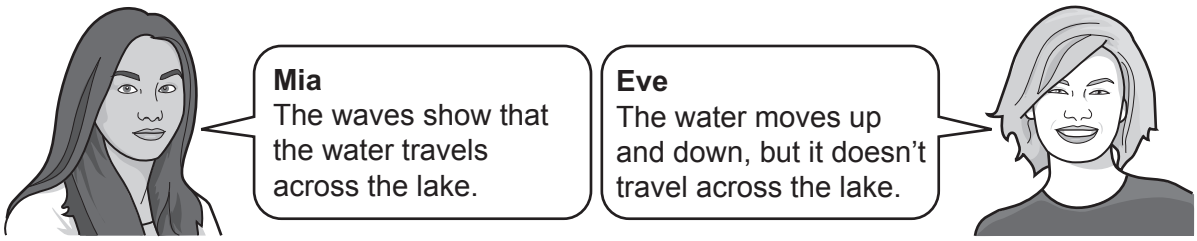
Waves on a rope are an example of ..... waves.

Sound waves in air are an example of ..... waves.

[2]

(b) Mia and Eve are discussing waves on the surface of a lake.





Eve places a plastic duck on the surface of the lake to show that she is correct.

Describe the motion of the plastic duck.

.....

.....

.....

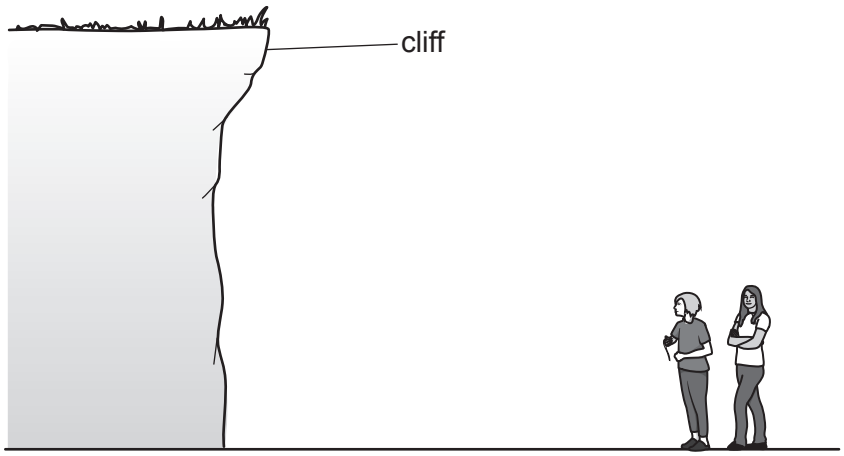
..... **[2]**

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(c) Sound waves in air travel at a speed of approximately 340 m/s.

Mia and Eve do an experiment to measure the speed of sound waves in air.

They use the echo from a cliff to measure the distance travelled by the sound waves, and the time taken for the sound waves to travel that distance.



(i) Describe how to take **accurate** measurements of the time taken and distance travelled, for the sound waves.

Include in your answer how the sound is produced, and any equipment needed.

.....

.....

.....

.....

.....

..... **[3]**

(ii) How can they calculate the speed of sound waves in air from their measurements?

.....

..... **[1]**

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5 Kareem reads some information about isotopes. They are listed as symbols.

(a) **(i)** Carbon has 6 protons.

What is the symbol for the isotope carbon-14?

Put a (ring) around the correct answer.

$^{6}_{8}C$ $^{6}_{14}C$ $^{8}_{6}C$ $^{14}_{6}C$

[1]

(ii) The most common isotope of carbon is carbon-12.

Define the term isotope.

.....

..... **[1]**

(b) Uranium-238 is an isotope and decays into thorium-234 by emitting an alpha particle. This process is called alpha decay.

$$^{238}_{92}U \rightarrow {}^{234}_{90}Th + {}^{4}_{2}He$$

How does the nucleus change when uranium-238 decays?

Tick (✓) **one** box in each row.

	Decreases	**Increases**	**Stays the same**
Charge of nucleus			
Mass of nucleus			

[2]

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(c)* Kareem is researching the effects of radiation.

In 1986, a nuclear reactor at the Chernobyl nuclear power plant exploded. A cloud of radioactive material spread over many countries. In the UK, radioactive rain fell on some hills, which caused the contamination of plants, which had the effect of contaminating the sheep who ate the plants. The sheep were then contaminated with caesium-137.

Currently in the UK, fish and shellfish may be irradiated with cobalt-60, to kill the bacteria that causes food poisoning. It also helps to make food last longer, and therefore reduce food waste.

	Cobalt-60	**Caesium-137**
Emits gamma radiation?	yes	yes
Half-life	5 years	30 years

Explain why **irradiated** fish are safe to eat, but **contaminated** sheep are not.

Use the information in the table to support your answer.

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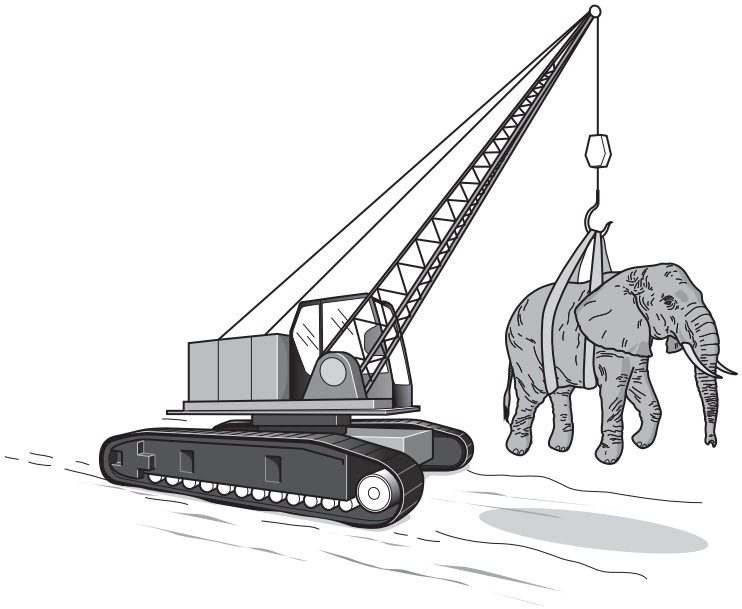
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..... **[6]**

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6 Cranes can be used to safely lift and move elephants.



(a) Complete the definition for the weight of an elephant.

Tick (✓) **one** box.

The weight of an elephant acts towards the centre of the Earth and is:

The acceleration of gravity on the elephant.	☐
The gravitational force on the elephant.	☐
The magnetic force on the elephant.	☐
The mass of the elephant.	☐

[1]

(b) A 60 000 N elephant was lifted a height of 5 m.

Calculate the gravitational potential energy gained by the elephant.

Use the equation: gravitational potential energy = weight × height

Gravitational potential energy = ... J **[2]**

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(c) The crane engine transferred 750 000 J lifting the elephant.

Calculate the efficiency of the crane engine.

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

Use the equation: efficiency = $\frac{\text{useful energy transferred}}{\text{total energy transferred}} \times 100\%$

Efficiency of the crane engine = ... % **[2]**

(d) The crane engine transferred more energy than the energy needed to lift the elephant.

Describe what has happened to the energy that was **not** used to lift the elephant.

.....

..... **[1]**

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7 The table shows examples of objects interacting.

Example of objects interacting	Type of force involved in the interaction
A balloon rubbed with a cloth sticks to a wall.	electrostatic
A compass needle points to the North pole.	.....
A ball falls to the ground.	.....

(a) Complete the **table** by filling in the blank spaces. **[1]**

Use words from the list.

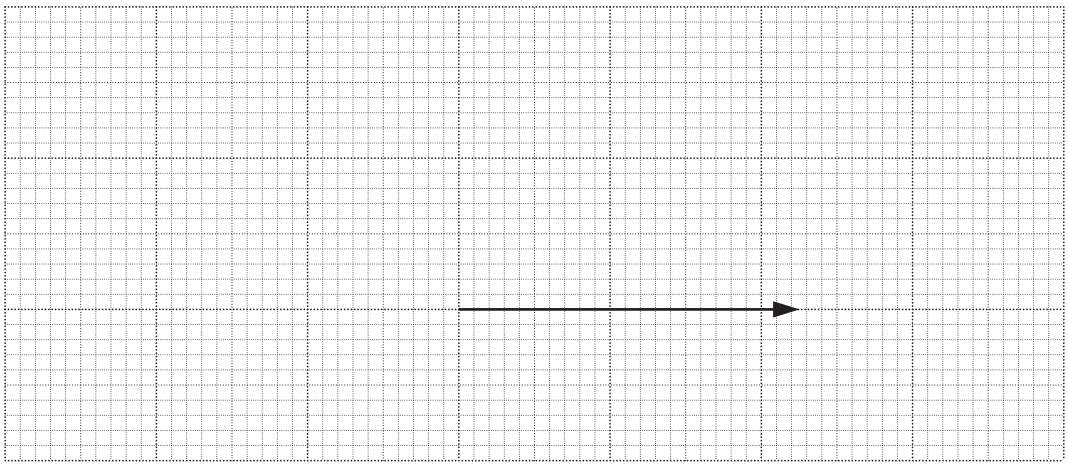
You can use each word once, more than once, or not at all.

electrostatic **frictional** **gravitational** **magnetic**

One has been done for you.

(b) A train is travelling on a level track.

Fig. 7.1 shows a vector diagram for the driving force on the train. It is drawn to scale.



Scale: 1cm = 100 kN.

Fig. 7.1

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(i) Use **Fig. 7.1** to calculate the size of the driving force on the train.

Driving force = ... kN **[1]**

(ii) The train is travelling at a constant speed.

Draw **one** vector on **Fig. 7.1** to represent the friction forces on the train. **[2]**

(c) James jumps upwards through the air from the ground, and then falls back down through the air.

He does not fall through the ground when he lands.



Describe the interaction that stops James from falling through the ground when he lands.

.....

.....

.....

.....

.....

..... **[3]**

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8 Scientists did an experiment to see how the acceleration of a car changed when the accelerating force was changed.

The table shows some of their data.

	Accelerating force (N)	**Mass (kg)**	**Acceleration (m/s^2)**
With driver only	2400	1200	2.0
With driver and passengers	2400	1500	1.6
With driver only	4800	1200	4.0
With driver and passengers	4800	1500	3.2

(a) Describe how the acceleration changed when the accelerating force changed.

.....

..... **[2]**

(b) In one situation, when there were no passengers, the driver changed the accelerating force again.

The new acceleration of the car was $2.5\,m/s^2$.

(i) Calculate the new accelerating force.

Accelerating force = ... N **[3]**

(ii) The car accelerated at $2.5\,m/s^2$ for 9 s from stationary. After 9 s, the car was travelling at a constant speed.

Calculate the speed of the car after 9 s.

Use the equation: acceleration = change in speed ÷ time taken

Give your answer in **km/h**.

Speed = ... km/h **[4]**

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9 Jamal has a new television.

Fig. 9.1 shows the Sankey diagram for the energy transferred by the new television in one second.

(a) Complete the Sankey diagram in **Fig. 9.1**.

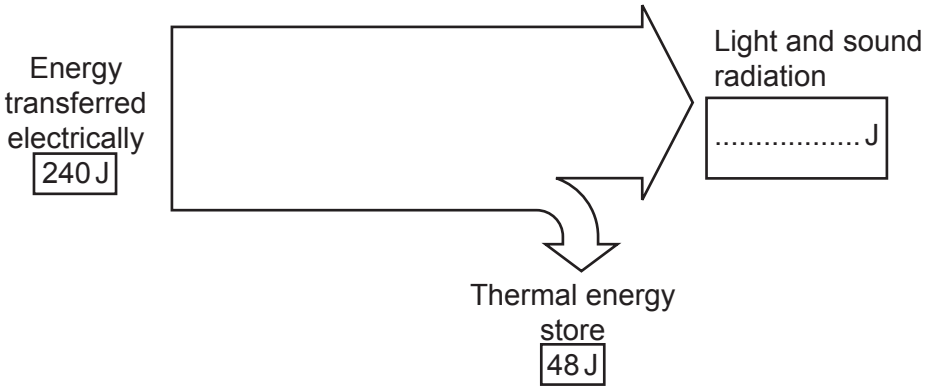


Fig. 9.1

[1]

(b) Jamal wants to work out how long he watches television in one week.

He makes some measurements of the energy transferred by the television.

Energy transferred by the television in one week	5.04 kWh
Power rating of television	240 W

Calculate the time, in **hours**, that the television was used during the week.

Use the equation: energy transferred = power × time

Time ..... hours **[3]**

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(c) The energy transferred electrically to the television is supplied by a **nuclear** power station.

Complete **Fig. 9.2** to show the order of electricity generation in a nuclear power station.

Use words from the list.

You can use each word once, more than once, or not at all

reactor **furnace** **generator** **grid** **turbine**

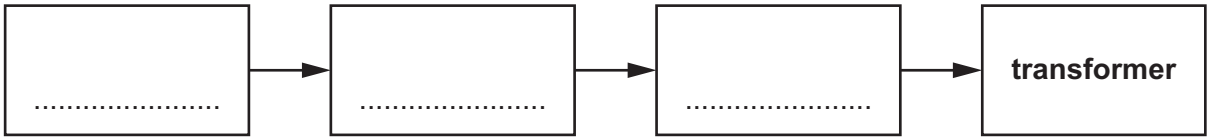
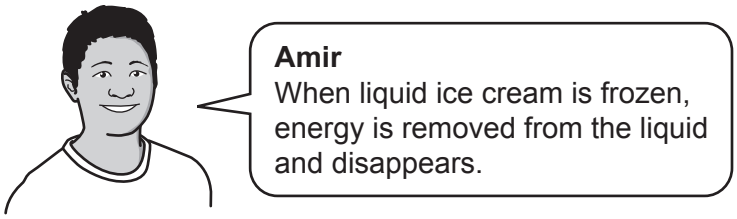


Fig. 9.2

[2]

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10 Amir thinks about what happens, in terms of energy, when ice cream freezes.



(a) Explain what is **incorrect** about Amir's statement.

1. .....

.....

2. .....

..... **[2]**

(b) **(i)** What is the correct equation to calculate density?

Put a (ring) around the correct answer.

density = mass × volume **density = $\frac{\text{mass}}{\text{volume}}$** **density = $\frac{\text{volume}}{\text{mass}}$** **[1]**

(ii) A 90 cm^3 scoop of ice cream has a mass of 66 g.

Calculate the density of the ice cream.

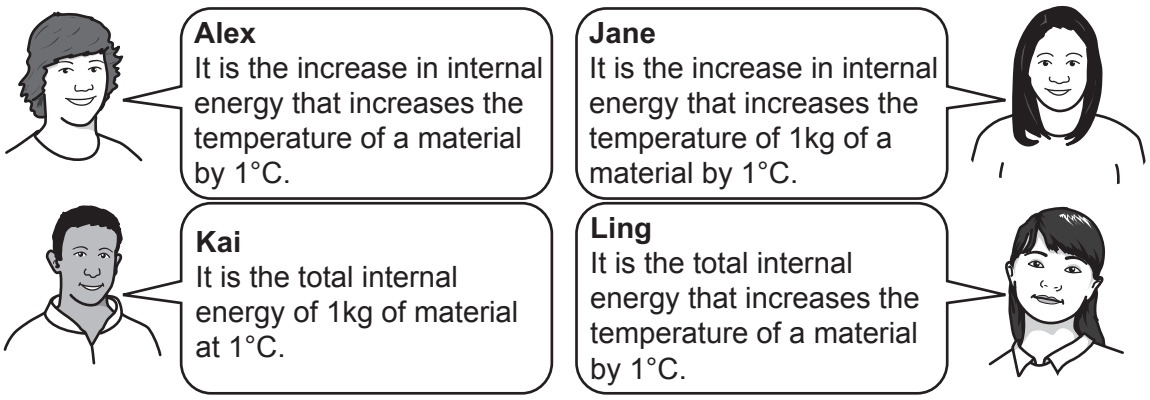
Give your answer to **2** significant figures.

Density = ... g/cm^3 **[3]**

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(c) The specific heat capacity of ice cream is 2740 J / kg °C.

Four students are trying to define specific heat capacity.



Which student has given the correct definition of specific heat capacity?

..... **[1]**

(d) Amir wants to calculate the energy transferred to a 0.4 kg tub of melted ice cream as it warms up from 4 °C to room temperature, 20 °C.

He uses data from the table.

	Ice cream
Specific heat capacity	2740 J / kg °C
Specific latent heat of melting	204 kJ / kg
Melting point	–6 °C

What is the correct method to calculate the energy transferred?

Tick (✓) **one** box

0.4 × 204 × (20 – 4) ☐

0.4 × 204 × 20 ☐

0.4 × 2740 × (20 – 4) ☐

0.4 × 2740 × 20 ☐

[1]

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(e) Calculate the energy needed to change 0.4 kg of solid, frozen ice cream at –6 °C into 0.4 kg of liquid, melted ice cream at –6 °C.

Use data from the table.

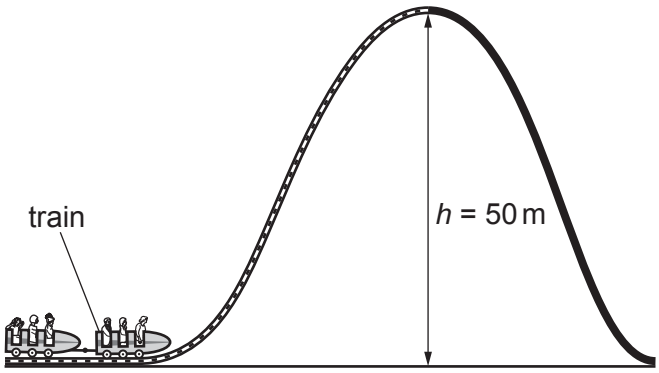
Use the Data Sheet.

Give your answer in **joules**.

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

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11 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]

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12 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

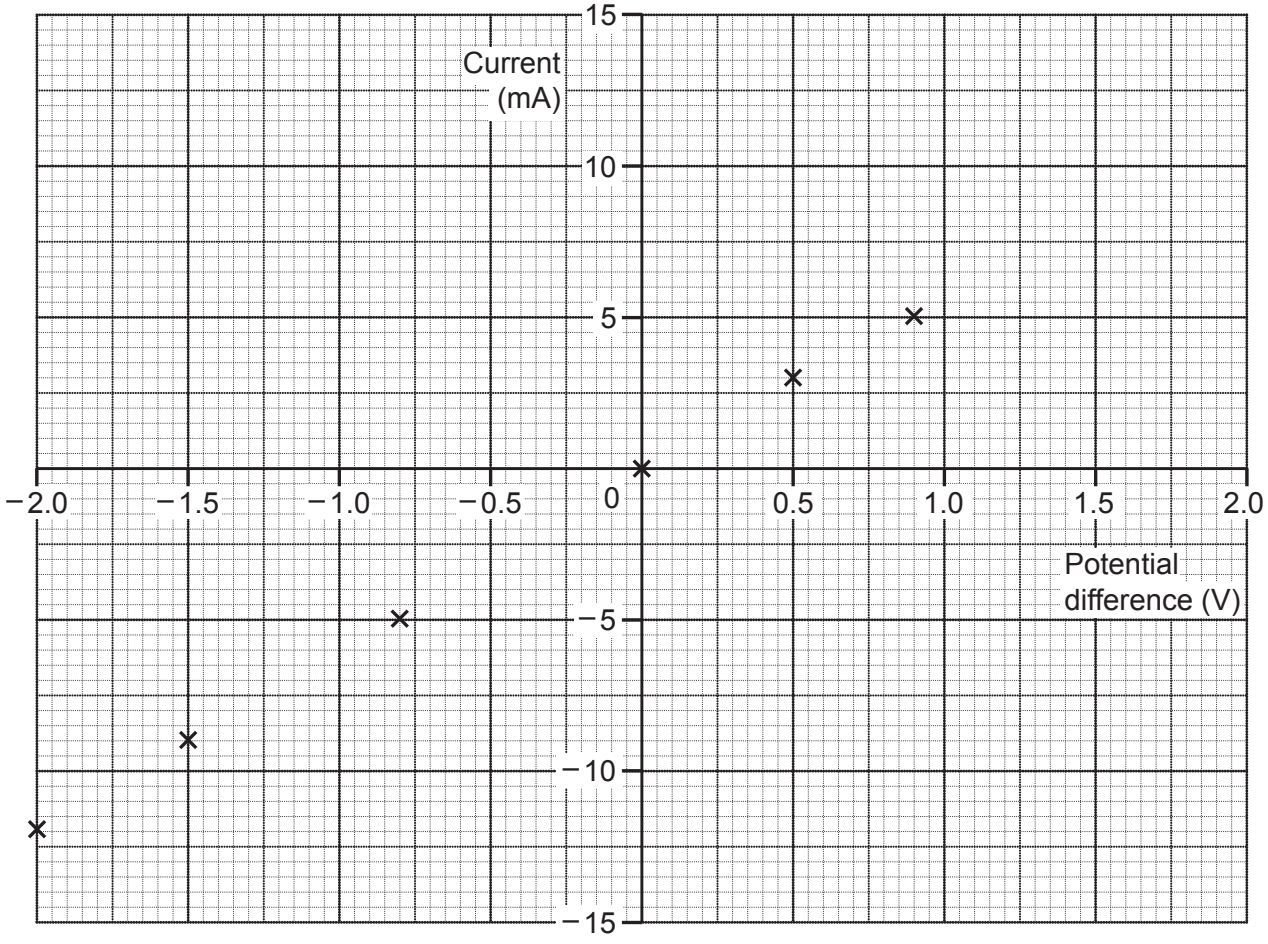


Fig. 12.1

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(a) (i) Complete the graph in **Fig. 12.1** by plotting the remaining **two** points from the table. **[1]**

(ii) Draw a line of best fit on the graph in **Fig. 12.1**. **[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. 12.1**.

Use the equation: potential difference = current × resistance

Resistance = ... Ω **[4]**

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(b) **Fig. 12.2** shows the graph of Sarah's results for **component B**.

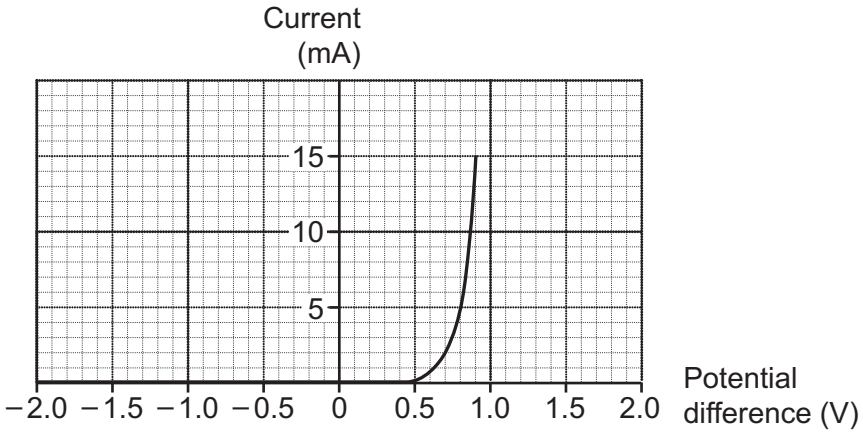


Fig. 12.2

(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]**

END OF QUESTION PAPER

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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).

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