OCR
Oxford Cambridge and RSA

Friday 14 June 2024 – Afternoon

GCSE (9–1) Combined Science A (Gateway Science)

J250/06 Physics (Foundation Tier)

Time allowed: 1 hour 10 minutes

F

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

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

* J 2 5 0 6 0 6 *

* 9 9 8 1 9 6 7 5 5 7 3 *

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 **60**.
- 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.

Section A

You should spend a **maximum** of **20 minutes** on this section.

Write your answer to each question in the box provided.

1 What is a typical speed of a vehicle on a road with a 30 mph speed limit?

A 0.01 m/s

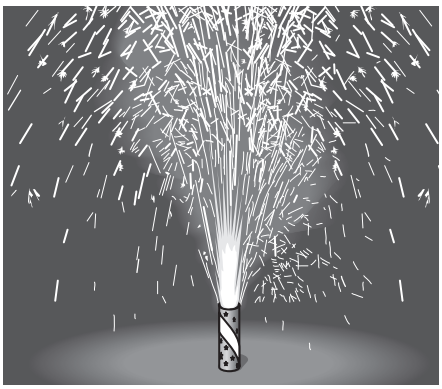
B 0.10 m/s

C 10 m/s

D 100 m/s

Your answer ☐ **[1]**

2 When some fireworks are lit, an explosive called gunpowder acts as a fuel and is ignited.



The gravitational potential store of the firework increases.

Which other energy changes take place when the firework is lit?

A A chemical store decreases and a kinetic store increases.

B A chemical store decreases and an elastic potential store increases.

C A nuclear store decreases and a kinetic store increases.

D A thermal store decreases and a chemical store increases.

Your answer ☐ **[1]**

3 A motorcycle has a mass of 200 kg and travels at 5 m / s.

What is the kinetic energy of the motorcycle?

Use the equation: kinetic energy = $\frac{1}{2}$ × mass × (speed)^2

A 2500 J

B 5000 J

C 100 000 J

D 200 000 J

Your answer ☐ **[1]**

4 A 4 kg mass is lifted 3 m vertically onto a shelf.

How much gravitational potential energy is gained?

Use the equation: gravitational potential energy = mass × gravitational field strength × height

Gravitational field strength = 10 N / kg

A 1.2 J

B 7.5 J

C 17 J

D 120 J

Your answer ☐ **[1]**

5 Material **X** has a **high** thermal conductivity. Material **Y** has a **low** thermal conductivity.

Each material is wrapped around a different identical beaker containing water at 60 °C.

Which beaker of water would have the **smallest** temperature decrease if all other variables are kept the same?

A 1 layer of material **X** wrapped around the beaker

B 1 layer of material **Y** wrapped around the beaker

C 2 layers of material **X** wrapped around the beaker

D 2 layers of material **Y** wrapped around the beaker

Your answer ☐ **[1]**

6 What does **thinking distance** mean?

A The distance travelled after pressing the brakes.

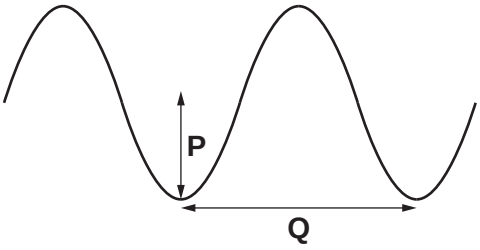
B The distance travelled while reacting.

C The time taken to react.

D The time taken to stop after pressing the brakes.

Your answer ☐ **[1]**

7 The diagram shows a picture of a water wave in a ripple tank.



Which row shows the correct labels for the diagram?

	P	Q
A	amplitude	frequency
B	amplitude	wavelength
C	wavelength	amplitude
D	wavelength	frequency

Your answer ☐ **[1]**

8 An atom absorbs electromagnetic radiation.

What happens to some electrons in this atom?

A They form a neutron.

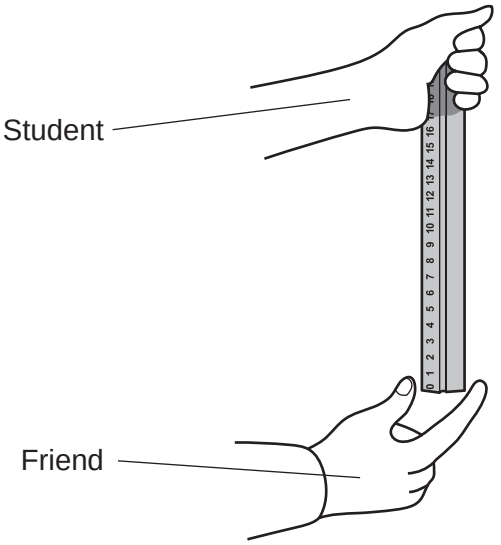
B They form a new element.

C They move from a high energy level to a lower energy level.

D They move from a low energy level to a higher energy level.

Your answer ☐ **[1]**

9 A student uses a ruler to measure a friend's reaction time.



How does the student determine the friend's reaction time?

A Divide the length of the ruler by the time taken to catch the ruler.

B Measure the length of the ruler where the friend catches it and convert to a time.

C Multiply the length of the ruler by the time taken to catch the ruler.

D Time how long it takes the ruler to hit the floor.

Your answer ☐ **[1]**

10 Some students design a practical to model radioactive decay.

Which model is correct?

A Throw a coin in the air 100 times and count the number of heads or tails.

B Throw 10 dice in a tray 10 times and add up the scores.

C Throw 100 dice in a tray and remove the ones with a 6 facing up.

D Throw 100 identical wooden blocks in a tray.

Your answer ☐ **[1]**

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Section B

11 This question is about radioactivity.

(a) Some atoms and isotopes of elements are shown.

$^{14}_{7}N$ $^{15}_{7}N$ $^{7}_{3}Li$ $^{3}_{1}H$

Which statements are correct for these atoms and isotopes?
Tick (✓) **three** boxes.

$^{7}_{3}Li$ and $^{3}_{1}H$ are isotopes. ☐

$^{7}_{3}Li$ contains 3 protons and 4 neutrons. ☐

$^{14}_{7}N$ and $^{15}_{7}N$ are isotopes. ☐

The atomic number of hydrogen is 3. ☐

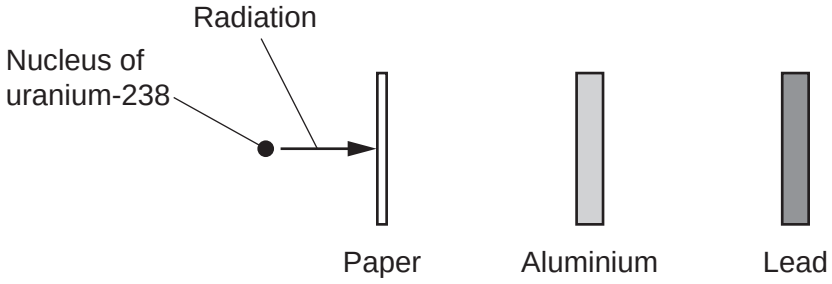
The atomic number of nitrogen is 7. ☐

The mass number of lithium is 4. ☐

[3]

(b) A nuclear scientist investigates the radiation emitted when a nucleus of uranium-238 decays.

The diagram shows the experiment.



Which type of radiation is emitted by uranium-238?

Put a (ring) around the correct answer.

alpha particles **beta particles** **gamma rays**

[1]

(c) Thorium-234 decays by emitting beta radiation.

What happens to the mass number and charge of a nucleus of thorium-234 when it decays?

Draw **one** line from **each** quantity to what happens.

Quantity	What happens
Mass number	decreases by 4
	decreases by 1
Charge	increases by 1
	stays the same

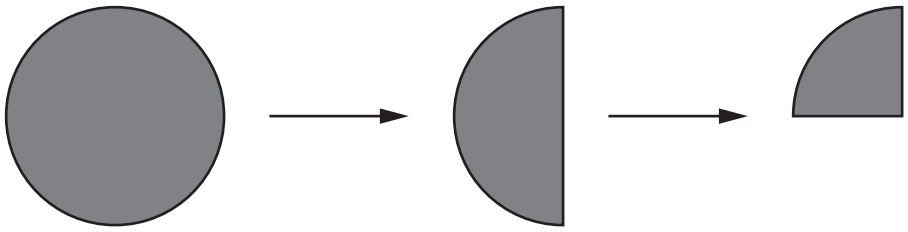
[2]

(d) Why do some atoms emit nuclear radiation?

.....

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

(e) The diagram shows how the amount of a radioactive element changes over a total of 30 days.



Calculate the half-life of this radioactive element.

Half-life = ... days **[2]**

12 This question is about how electricity is generated.

(a) A student writes down advantages and disadvantages of wind turbines.

	Advantage		Disadvantage
A	do not need fuel	**C**	do not produce carbon dioxide
B	produce renewable energy	**D**	take up lots of land

The student has made **one** mistake.

State the **letter** of the statement that is in the wrong place.

Letter = ... **[1]**

(b) The student writes down a list of renewable and non-renewable energy sources.

Renewable	Non-renewable
hydroelectric	coal
solar	wave

The student has made **one** mistake.

State the **name** of the energy source that is in the wrong place.

Name = ... **[1]**

(c) It might not be possible to replace all non-renewable energy sources with renewable energy sources to generate **enough** electricity in the future.

Suggest **two** reasons why this might not be possible.

1 .....

.....

2 .....

.....

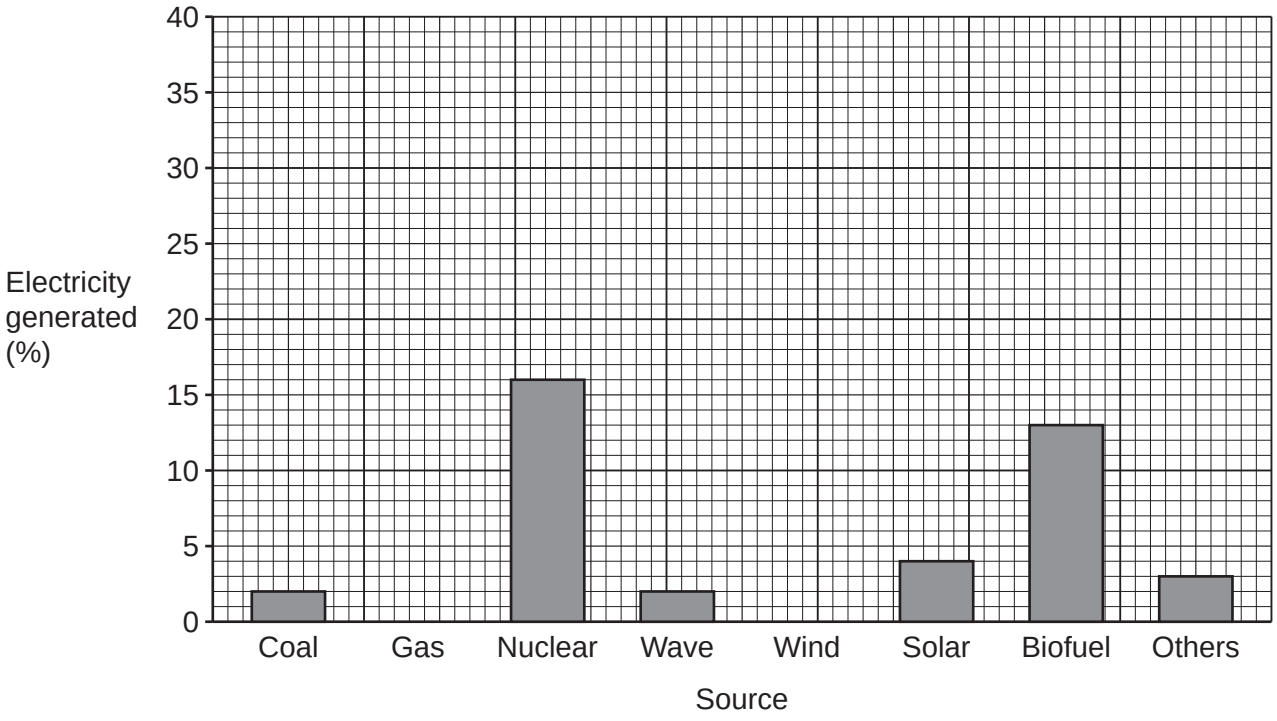
[2]

(d) The table shows the percentages of electricity generated by different energy sources in the UK in 2020.

Source	Electricity generated (%)
Coal	2
Gas	36
Nuclear	16
Wave	2
Wind	24
Solar	4
Biofuels	13
Others	3

(i) The student plots a bar chart using the data in the table.

Draw a bar for gas and a bar for wind on the bar chart.



[2]

(ii) The total electricity generated in the UK in 2020 was 315 TWh.

Solar produced 4% of the total electricity generated.

Calculate the amount of electricity generated in TWh from solar.

Amount of electricity = ... TWh **[2]**

(iii) The total electricity generated in the UK in 2020 was 315 TWh.

1 TWh = 1 000 000 000 kWh

What is the total amount of electricity generated in kWh?

Tick (✓) **one** box.

315 000 kWh ☐

315 000 000 kWh ☐

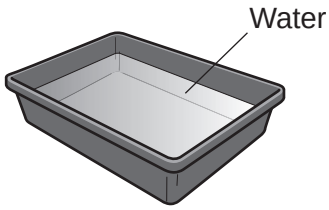
315 000 000 000 kWh ☐

315 000 000 000 000 kWh ☐

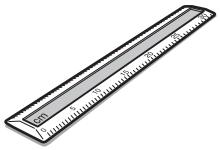
[1]

13

13* A student investigates the speed of a water wave using this equipment.



Plastic tray



Ruler

Stopwatch

The student lifts one side of the plastic tray and drops it to make a wave.

Describe how the student can use this equipment to measure the speed of a water wave.

In your answer you should include:

- the measurements they should take
- the variables they need to keep constant
- any precautions they should take to obtain accurate and precise results.

.....

.....

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.....

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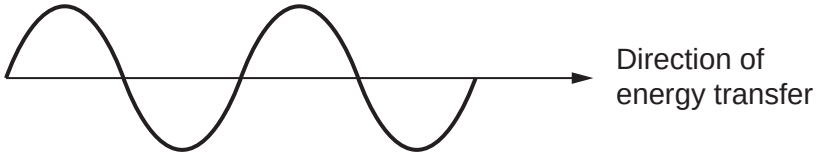
..... **[6]**

14 This question is about electromagnetic waves.

(a) Electromagnetic waves are transverse waves.

Describe what a transverse wave is.

You can label the diagram of a transverse wave to help explain your answer.



.....

.....

[1]

(b) A radio wave has a frequency of 7 500 kHz and a wavelength of 40 m.

Calculate the speed of this radio wave.

Use the equation: wave speed = frequency × wavelength

Give your answer in metres per second.

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

(c) The table shows some different radio waves.

Type of radio wave	Frequency range (Hz)	Wavelength range (m)
HF	3 000 000–30 000 000	10–100
VHF	30 000 000–300 000 000	1–10
UHF	300 000 000–3 000 000 000	0.1–1
SHF	3 000 000 000–30 000 000 000	0.01–0.1

(i) What is the relationship between frequency range and wavelength?

Use the table.

.....

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

(ii) Which type of radio wave has a frequency of 15 MHz **and** a wavelength of 20 m?

Tick (✓) **one** box.

HF ☐

VHF ☐

UHF ☐

SHF ☐

[1]

(iii) High frequency radio waves are similar to microwaves.

Suggest how high frequency radio waves can harm the human body.

.....

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

(iv) Complete the sentence about high frequency radio waves.

Put a (ring) around the correct option.

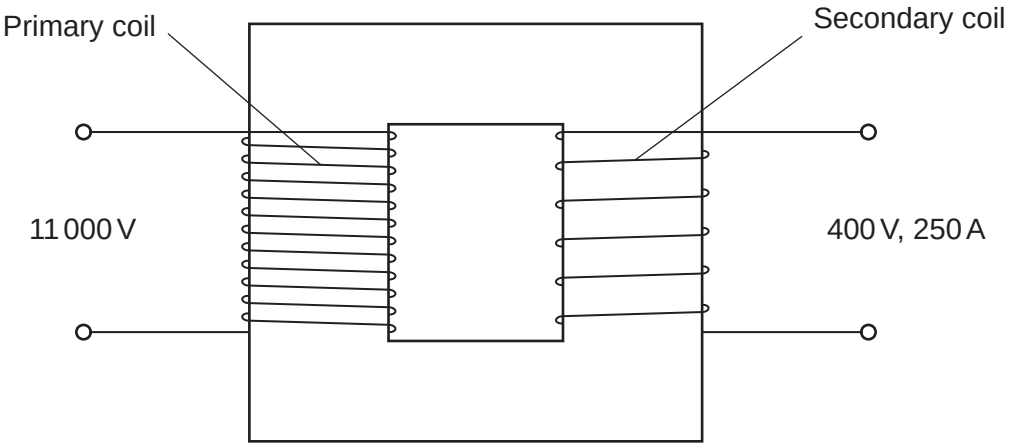
High frequency radio waves are **more** / **less** dangerous than microwaves.

Suggest a reason for your answer.

Reason .....

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

15 This is a diagram of a transformer.



(a) Calculate the power output from the secondary coil.

Use the equation: power = potential difference × current

Power output = ... W **[2]**

(b)

(i) Name the type of transformer shown in the diagram.

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

(ii) Where can this type of transformer be used in the national grid?

Tick (✓) **one** box.

Between the power lines and homes ☐

Between the power station and power lines ☐

In a phone charger ☐

In the power station ☐

[1]

(c) The energy input to the primary coil is 200 kJ.

The energy output from the secondary coil is 180 kJ.

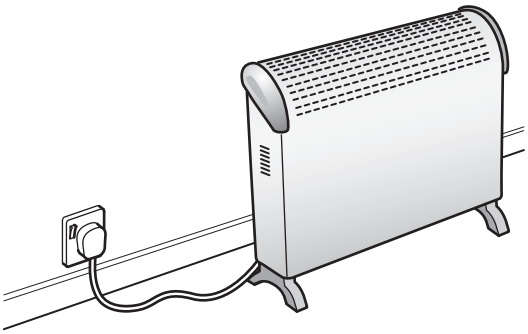
Calculate the efficiency of the transformer.

Use the equation: efficiency = $\frac{\text{useful output energy transfer}}{\text{input energy transfer}}$

Efficiency = ... **[2]**

16 **Fig. 16.1** shows a heater plugged into an electrical socket.

Fig. 16.1



(a) The heater is operating normally.

What are the names of the two wires in the plug that carry a current?

Tick (✓) **one** box.

Earth and fuse ☐

Earth and neutral ☐

Live and fuse ☐

Live and neutral ☐

[1]

(b) A live wire is accidentally connected to the earth wire in the house. This causes a large current to flow in the earth wire.

This can cause electrocution.

Suggest **another** reason why this is dangerous.

.....

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

(c) A 2.4 kW heater is used for 2.5 hours each day for 1 week.

Calculate the energy transferred in kW h by the heater in 1 week.

Use the equation: energy transferred = power × time

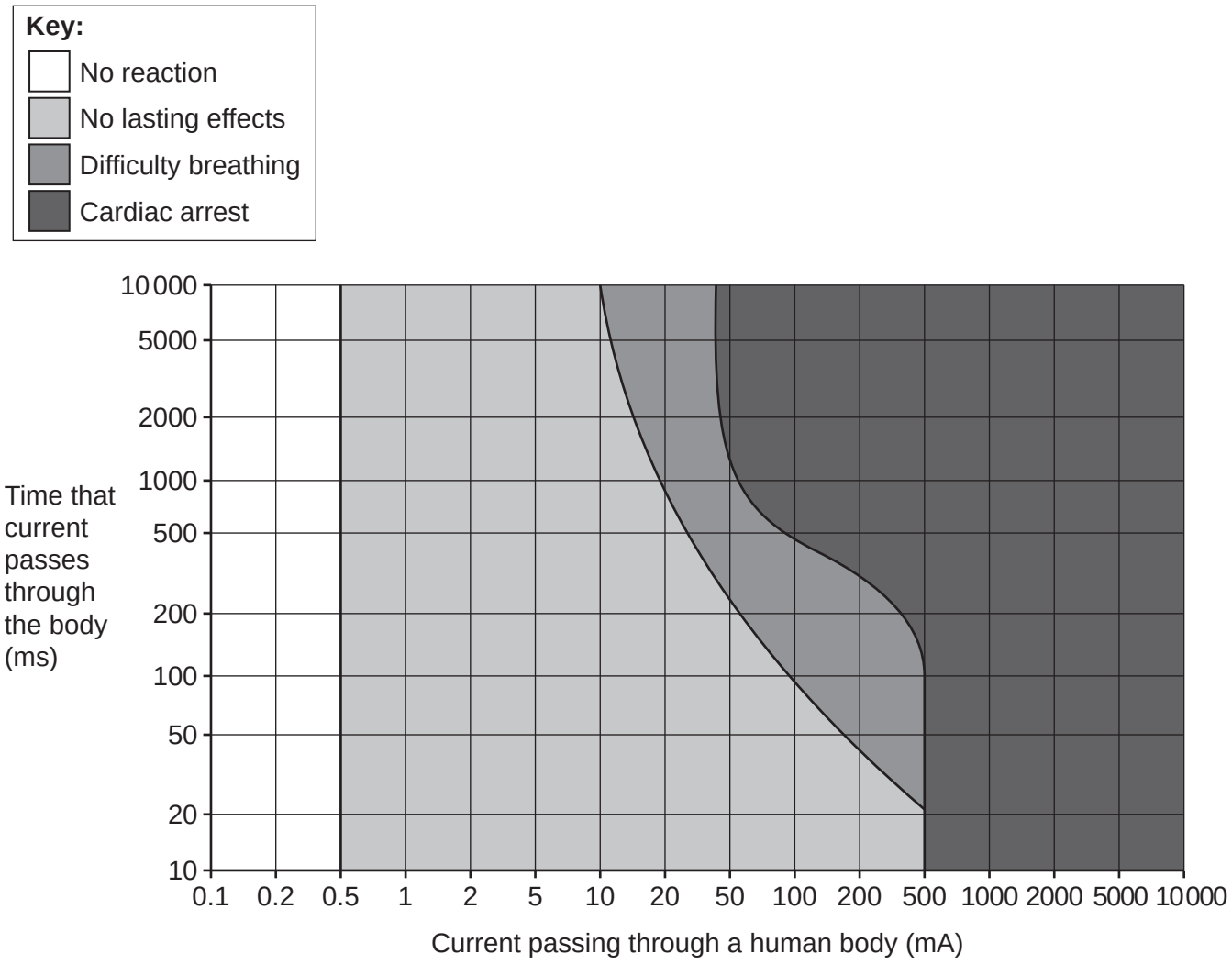
Energy transferred in 1 week = ... kW h **[2]**

(d) A residual current device (RCD) is a safety feature found in homes.

The RCD turns off the electricity quickly if it detects a fault due to a difference between the current in the live wire and the current in the neutral wire.

Fig. 16.2 shows the effects that mains current has on a human body.

Fig. 16.2



(i) Describe **one** trend shown by **Fig. 16.2**.

.....

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

(ii) A current of 10 mA is passing through a human body.

How long can the current pass through the body before the person has difficulty breathing?

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

(iii) Calculate the charge flowing when 150 mA is in the human body for 0.3 s.

Use the equation: charge flow = current × time

Charge flow = ... C **[3]**

(iv) Sensitive RCDs are designed to shut off the electricity supply within 40 ms.

Suggest why this is an important feature for currents below 200 mA. Use **Fig. 16.2**.

.....

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

(v) An electrician has a choice of two different RCDs, **A** and **B**, to use in a house.

	RCD A	**RCD B**
Minimum difference in current needed between the live wire and neutral wire before electricity turns off (mA)	10	30
Time taken to turn off electricity (ms)	100	40

Suggest which RCD the electrician should use in the house.

Give **two** reasons. Use **Fig. 16.2**.

1 .....

.....

2 .....

.....

[2]

END OF QUESTION PAPER

EXTRA ANSWER SPACE

If you need extra space use these lined pages. You must write the question numbers clearly in the margin.