OCR
Oxford Cambridge and RSA

Friday 14 June 2024 – Afternoon

GCSE (9–1) Physics B (Twenty First Century Science)

J259/02 Depth in physics (Foundation Tier)

Time allowed: 1 hour 45 minutes

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

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

F

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

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

First name(s) _____

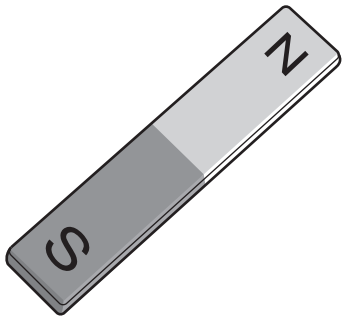
Last name _____

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 **90**.
- 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.

1 A bar magnet is a permanent magnet. It has a north-pole N and a south-pole S.



(a) Which metal can be used to make a permanent magnet?

Tick (✓) **one** box.

Aluminium ☐

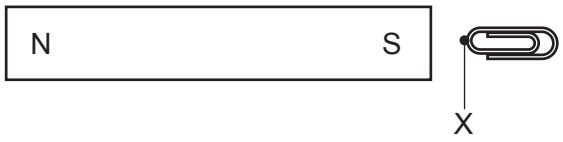
Copper ☐

Steel ☐

[1]

(b) A paperclip is an induced magnet.

(i) The diagram shows a paperclip being brought close to the S-pole of a magnet.



What happens?

Tick (✓) **one** box.

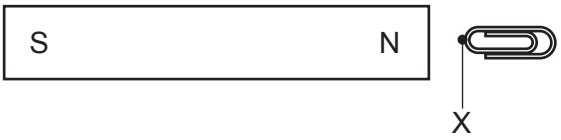
Point X is attracted to the S-pole. ☐

Point X is repelled by the S-pole. ☐

Nothing. ☐

[1]

(ii) The magnet is turned so the paperclip is now brought close to the N-pole of the magnet.



What happens?

Tick (✓) **one** box.

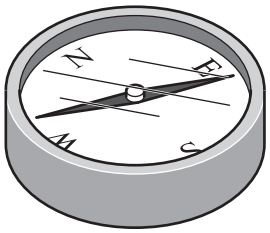
Point X is attracted to the N-pole. ☐

Point X is repelled by the N-pole. ☐

Nothing. ☐

[1]

(c) A magnetic compass consists of a magnetic pointer that can rotate freely.



Describe how a compass can be used to show that the core of the Earth is magnetic.

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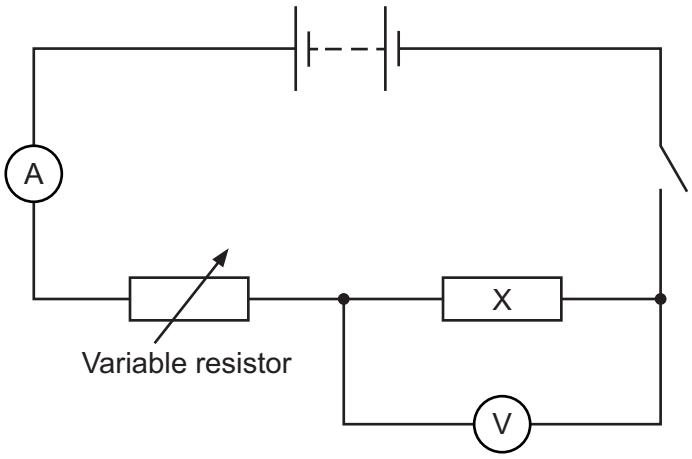
..... **[2]**

2 A student investigates the I-V characteristics of an unknown component X.

The diagram shows the circuit they build.



(a)

(i) The student needs to measure the current and the potential difference in the circuit.

Name the **two** pieces of measuring equipment shown in the circuit.

……..... and ……..... **[2]**

(ii) Why is there a variable resistor in the circuit?

Tick (✓) **one** box.

To change the power of the battery. ☐

To change the potential difference across X. ☐

To measure the charge flowing in the circuit. ☐

[1]

(iii) The student states that component X is getting hot whilst they are doing the experiment.

Describe **one** precaution the student can take to prevent the component from over heating.

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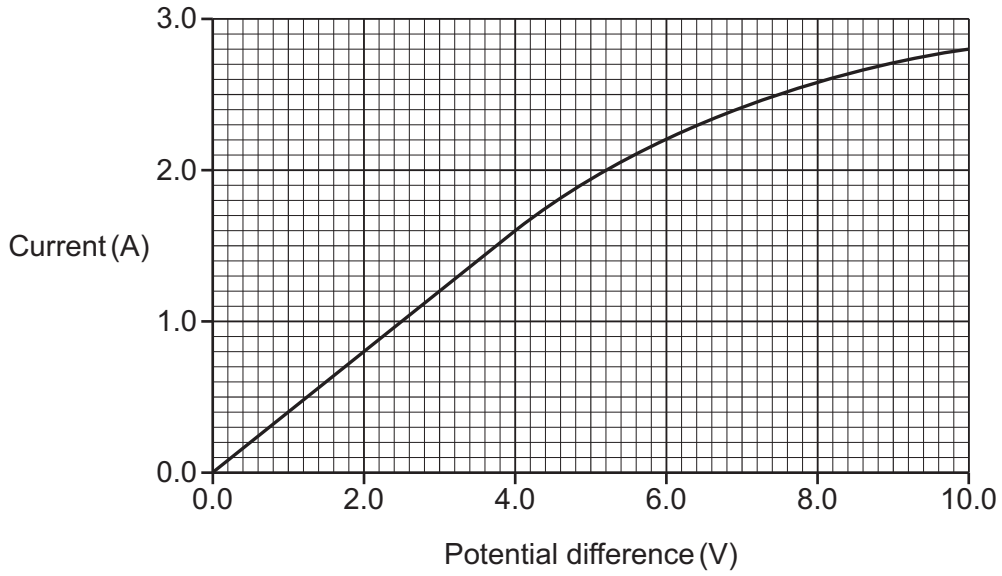
..... **[1]**

(b) The student plots a graph of her results.



(i) Calculate the resistance of X when the potential difference is 4.0 V.

Use the equation: potential difference = current × resistance

Resistance = ... Ω **[3]**

(ii) The student concludes that the resistance of component X changes as the potential difference increases.

Describe how the graph shows that the student is correct.

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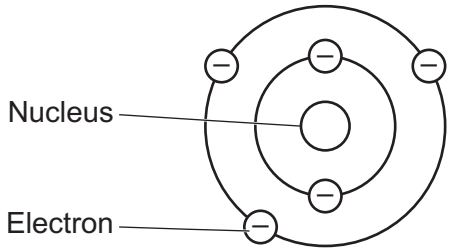
..... **[1]**

(iii) Suggest what component X is.

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

3 **Fig. 3.1** shows the Bohr model of an atom.

Fig. 3.1



(a) Complete the sentences about the Bohr model of an atom.

Put a (ring) around each correct option.

The nucleus has an overall **negative / neutral / positive** charge.

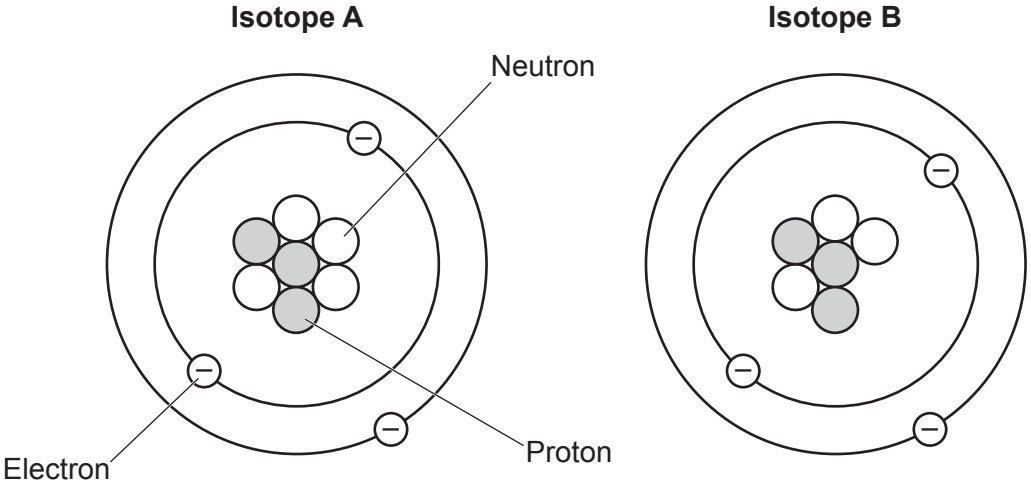
Most of the mass of the atom is found in the **electrons / nucleus / shells**.

The diameter of the nucleus is **much smaller / the same / much larger** compared to the diameter of the atom.

[3]

(b) **Fig. 3.2** shows the Bohr model of two isotopes of the same element.

Fig. 3.2



Describe the similarities and differences between the two isotopes shown in **Fig. 3.2**.

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

(c) Which **two** statements describe why the model of the atom has changed over time?

Tick (✓) **two** boxes.

Atoms have changed. ☐

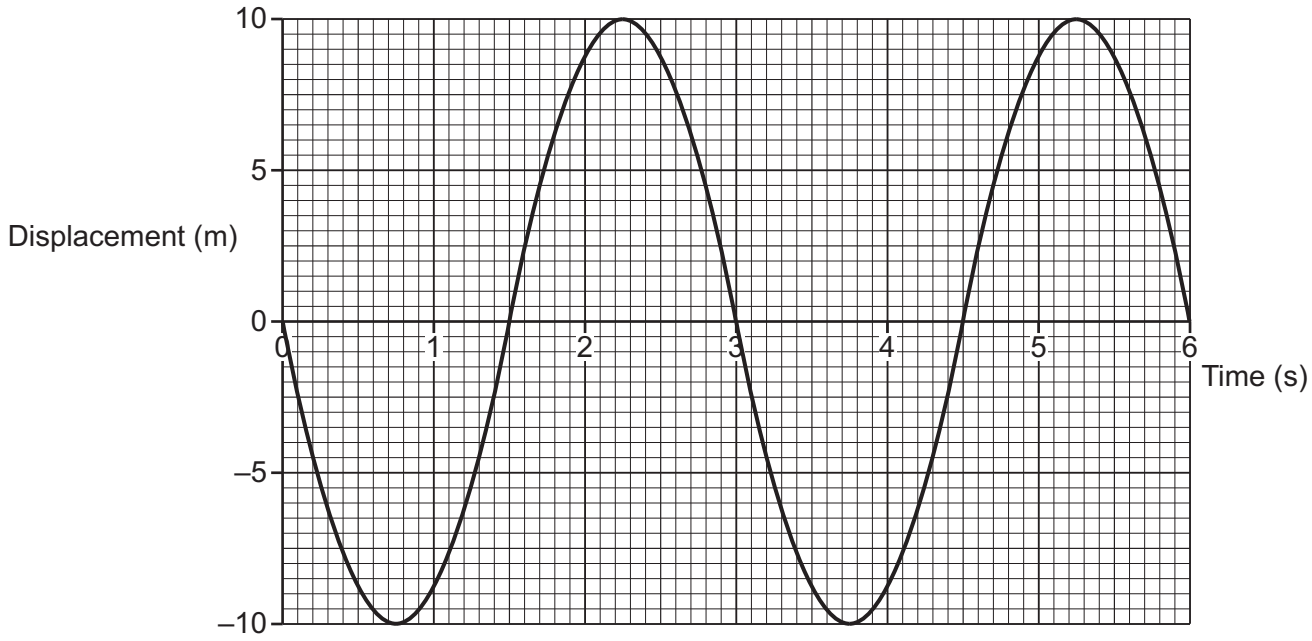
Experiments have provided new evidence. ☐

New particles have been discovered. ☐

People have become more intelligent. ☐

[2]

4 A graph of displacement against time for a particle on a wave is shown.



(a)

(i) State the amplitude of the wave. ..... m **[1]**

(ii) State the number of wavelengths shown. ..... **[1]**

(iii) State the period for the wave. ..... s **[1]**

(iv) Calculate the frequency of the wave.

Use the equation: frequency = $\frac{1}{\text{period}}$

Frequency of the wave = ... Hz **[1]**

(b) A wave travels at a constant speed.

Complete the sentence to describe the relationship between the frequency and wavelength of the wave.

Put a (ring) around the correct option.

When the frequency is doubled the wavelength **doubles / halves / stays the same**. **[1]**

(c) Another wave has a wavelength of 2 cm and a frequency of 7.5 Hz.

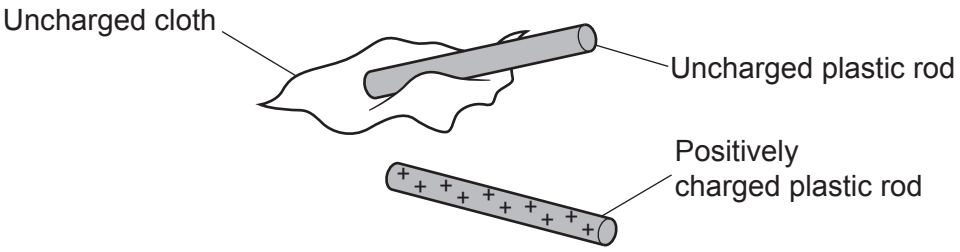
Calculate the speed of this wave, in **cm / s**.

Use the Equation Sheet.

Wave speed = ... cm / s **[3]**

5 A teacher demonstrates static electricity.

(a) The teacher rubs an uncharged plastic rod with an uncharged cloth. The rod becomes positively charged.



(i) Which particle has been removed from the rod and transferred to the cloth?

Tick (✓) **one** box.

Electron ☐

Proton ☐

Neutron ☐

[1]

(ii) What charge is now on the **cloth**?

Tick (✓) **one** box.

Positive ☐

Negative ☐

Neutral ☐

[1]

(b) The teacher hangs the positively charged rod from a string.

They hold a negatively charged rod close to it.

Describe what happens to the positively charged rod.

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

(c) The teacher touches the positively charged plastic rod with a piece of metal foil.

The rod becomes uncharged.

Explain how the rod becomes uncharged.

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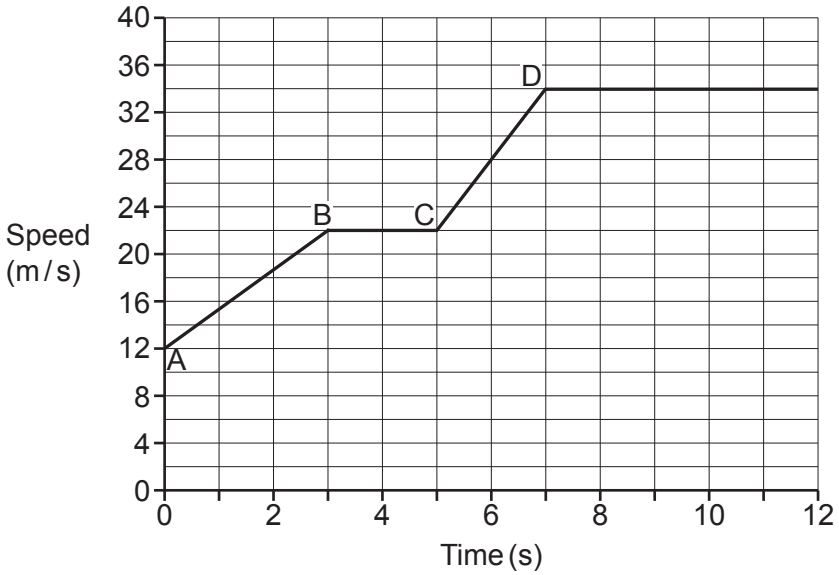
..... **[2]**

6

(a) The speed–time graph shows part of the journey of a car.



(i) Describe the motion of the car between B and C.

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

(ii) Calculate the acceleration of the car between C and D.

Use the equation: acceleration = $\frac{\text{change in speed}}{\text{time taken}}$

Acceleration between C and D = ... m/s^2 **[3]**

(iii) The car also accelerates between A and B.

Compare the acceleration of the car between A and B with the acceleration of the car between C and D.

Use the graph.

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

(b) Zayn owns an electric car.

He completes a journey of 410 km. It takes 4 hours 30 minutes.

Calculate the average speed of the journey.

Use the Equation Sheet.

Average speed = ... km/h **[3]**

(c)

(i) It takes 8 hours to fully charge the battery in the electric car using a 7 kW power source.

Calculate the energy transferred to the battery.

Use the equation: energy transferred = power × time

Energy transferred = ... kWh **[2]**

(ii) The cost of the energy supplied by electricity is 34p per kWh.

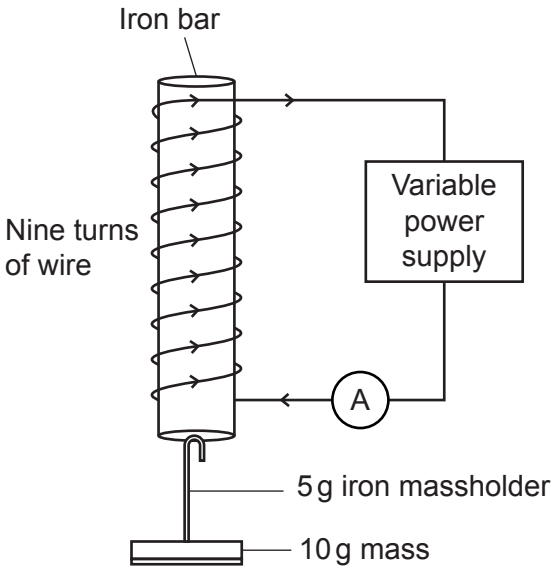
Calculate the cost to fully charge the battery.

Give your answer in pounds.

Use your answer from **(c)(i)**.

Cost = £ ..... **[2]**

7* A student builds an electromagnet by wrapping a wire around an iron bar.



The student uses the variable power supply to increase the current in the wire in steps of 1 A.

They measure the maximum number of 10 g masses that the bar can hold at each value of current.

They predict that as the current increases, the electromagnet will hold more mass.

The table shows their results.

Current (A)	Number of 10 g masses
0	0
1	0
2	0
3	1
4	1

Explain improvements that the student can make to their experiment to show that their prediction is correct.

Use ideas about:
- the validity of the measurements
- improvements to the apparatus.

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

8 The brakes of three different cars **A**, **B** and **C** are being tested on a test track.

The cars travel at 14 m / s along the track and the brakes are applied to bring them to a stop.

The braking distance and the time taken for each car to stop are measured.

(a) After the brakes are applied car **A** decelerates at 4.7 m / s^2.

(i) Calculate the braking force.

The mass of car **A** = 1500 kg

Use the equation: force = mass × acceleration

Braking force = ... N **[2]**

(ii) A very large mass is added to car **A** and the test is repeated.

The braking force is unchanged.

Complete the sentences about the deceleration and the time taken for the car to stop.

Put a (ring) around the correct options.

The deceleration **decreases / increases / stays the same**.

The time taken for the car to stop **decreases / increases / stays the same**.

[2]

(b) Cars **B** and **C** have the same mass.

The table shows the braking force and the time taken to stop for cars **B** and **C**.

Car	Braking force (N)	Time taken to stop (s)
B	5000	5
C	10000	

(i) Calculate the deceleration of car **B** as its speed reduces from 14 m/s to 0 m/s.

Use the equation: acceleration = $\frac{\text{change in speed}}{\text{time taken}}$

Deceleration = ... m/s^2 **[2]**

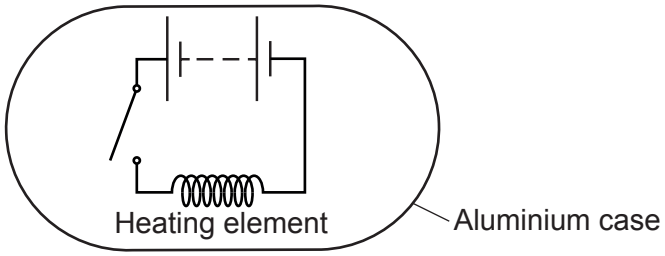
(ii) Find the time taken to stop for car **C**.

Time taken to stop = ... s **[1]**

9 Sasha has a battery operated electric hand warmer.

The hand warmer has these components:

- an aluminium case
- a heating element
- a battery
- a switch.



(a) Sasha closes the switch and holds the hand warmer.

Describe the transfer between energy stores when the switch is closed.

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

(b) The table shows some specifications of the aluminium case.

Description	Detail
Mass of the aluminium case	0.2 kg
Specific heat capacity of aluminium	920 J / kg °C

The temperature of the aluminium case increases from 20 °C to 50 °C.

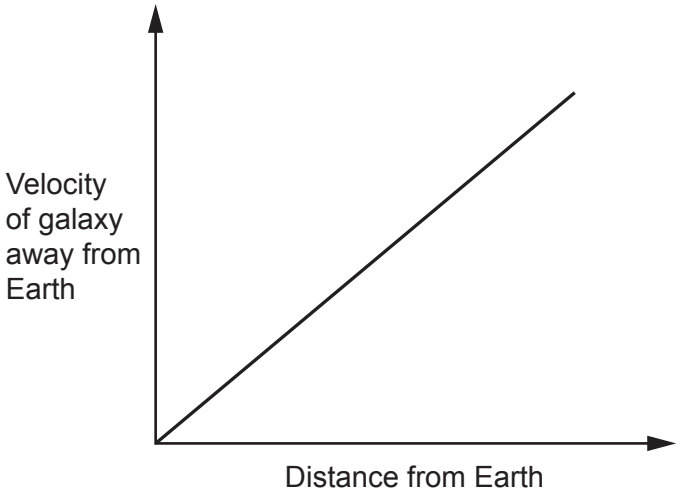
Calculate the change in internal energy of the aluminium case.

Use the Equation Sheet.

Change in internal energy = ... J **[4]**

10 The astronomer Edwin Hubble observed how the velocity of a galaxy away from Earth depends on the distance of the galaxy from Earth.

A graph of his results is shown.



(a) Describe the relationship shown by the graph.

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

(b) Explain how this relationship provides evidence for the Big Bang model of the universe.

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

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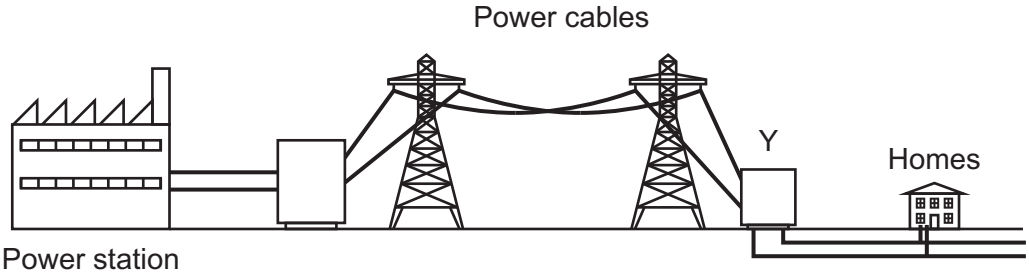
Turn over for the next question

11 The diagram below shows part of the National Grid.



(a)

(i) What is the domestic mains supply voltage to homes in the UK?

Tick (✓) **one** box.

60 V a.c. ☐

60 V d.c. ☐

230 V a.c. ☐

230 V d.c. ☐

[1]

(ii) The electricity is transmitted along the power cables at around 230 000 V.

Explain how this high voltage makes the energy transfer along the power cables more efficient.

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

(iii) Name the device at Y.

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

(b) Many different energy resources are used to generate electricity.

(i) State **two** types of **renewable** energy resources used to generate electricity.

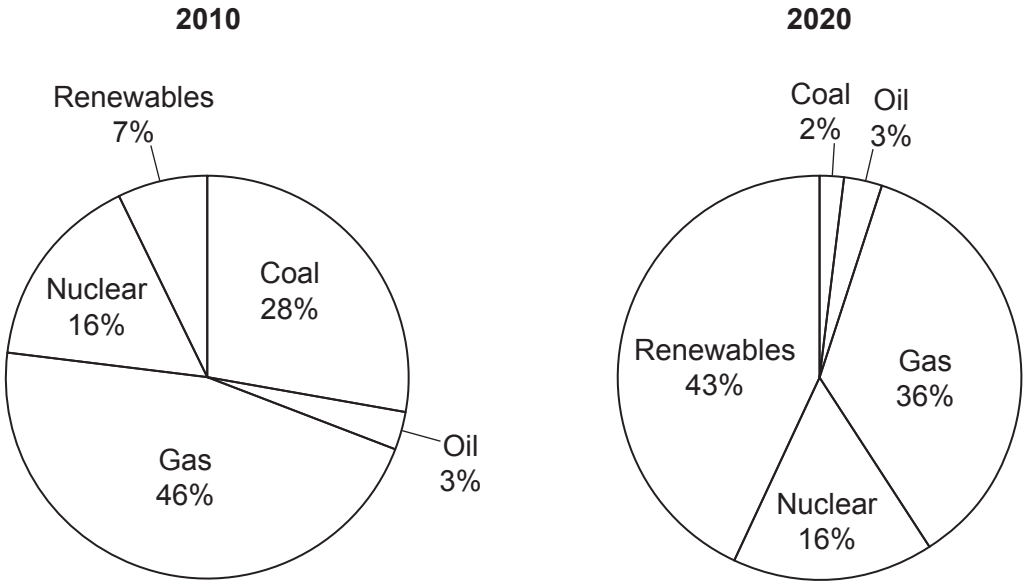
1 .....

2 .....

[2]

(ii)* **Fig. 11.1** shows the percentage of electricity generated by different energy resources in the UK in 2010 and 2020.

Fig. 11.1



Describe how the trends in the use of energy resources in the UK changed between 2010 and 2020.

Suggest reasons for these changes.

Use the data in **Fig. 11.1** in your answer.

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

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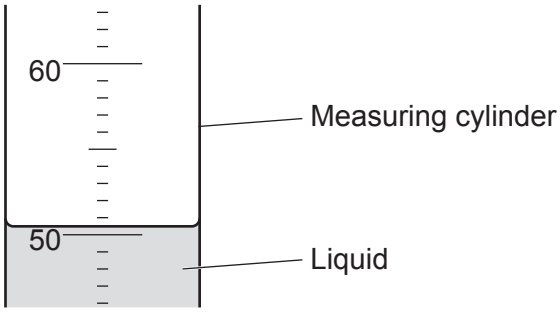
12 A student is doing an experiment to find the density of an unknown liquid.

They pour some of the liquid into a measuring cylinder and measure the volume in cm^3.

Fig. 12.1 shows a close-up of the liquid in the measuring cylinder.

Fig. 12.1

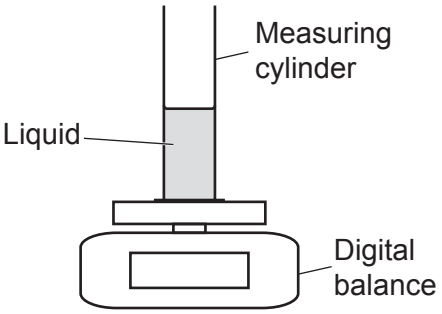


(a) What is the volume of the liquid?

Use **Fig. 12.1**.

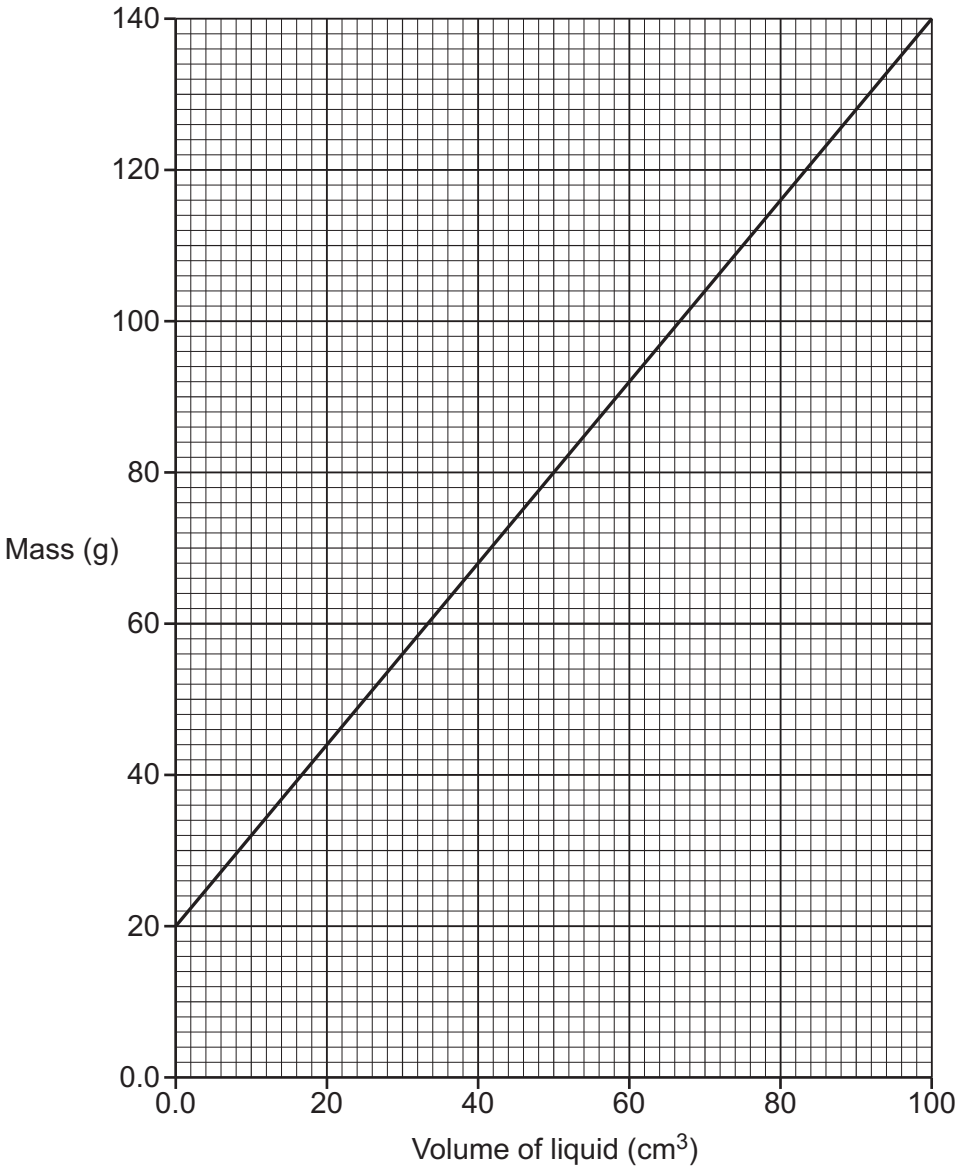
Volume = ... cm^3 **[1]**

(b) The student places the measuring cylinder on to a digital balance and measures the mass of the measuring cylinder and the liquid.



They increase the volume of the liquid and repeat the measurements.

The graph shows their results.



(i) What is the mass of the empty measuring cylinder?

Mass = ... g **[1]**

(ii) Calculate the density of the liquid.

Use:

- data from the graph
- the equation: density = $\frac{\text{mass}}{\text{volume}}$

Density = ... g / cm^3 **[4]**

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.