OCR
Oxford Cambridge and RSA

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Thursday 9 June 2022 – Afternoon

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 **28** pages.

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

Answer **all** the questions.

1 **(a)** Which of these statements about the domestic electricity supply in the UK is true?

Tick (✓) **one** box.

The domestic electricity supply in the UK is d.c. ☐

The energy transferred = current × potential difference. ☐

The frequency of the supply is 230 Hz. ☐

Transmitting power at higher voltages is more efficient. ☐

[1]

(b) Sundip installs panels made of material with low thermal conductivity to the walls of a house.

Describe how this will help to keep the house warm when it is cold outside.

.....

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

(c) Sundip buys electricity from a company that uses energy from renewable energy resources.

What is the difference between a renewable and non-renewable energy resource?

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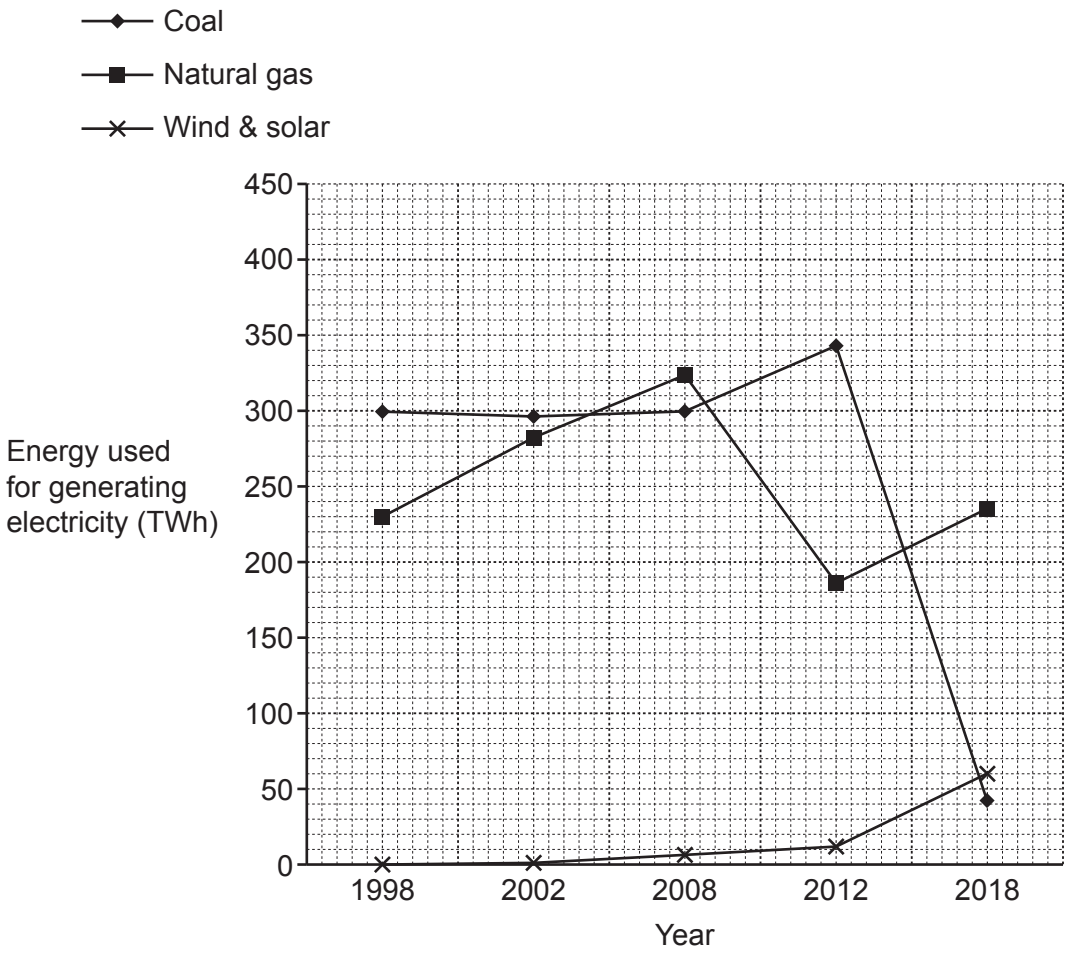
..... **[1]**

(d)* The graph shows how some energy resources were used to generate electricity in the UK over 20 years.



Explain how the use of these **three** energy resources changed between 1998 and 2018.

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

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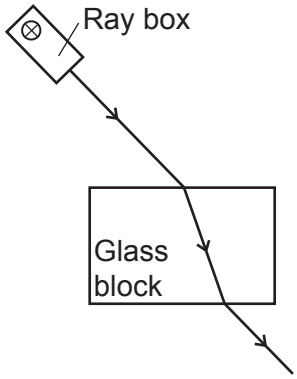
2 Alex is investigating the refraction of light in a rectangular glass block, using the equipment shown in the diagram.



(a) This is Alex's method.
The sentences are **not** in the correct order.

A. Repeat the experiment for different angles of incidence.
B. Shine a ray of light into the block.
C. Place the glass block on some paper.
D. Measure the angle of incidence and angle of refraction.
E. Mark the path of the rays on the paper with a pencil.
F. Draw a line to show the path of the ray inside the glass block.
G. Remove the glass block and ray box.

Write the letters in the boxes to show the correct order of the method.

The first one has been done for you.

C						

[3]

(b) Suggest **two** ways in which Alex could improve his method to get more accurate measurements of the angles.

1 .....

.....

2 .....

.....

[2]

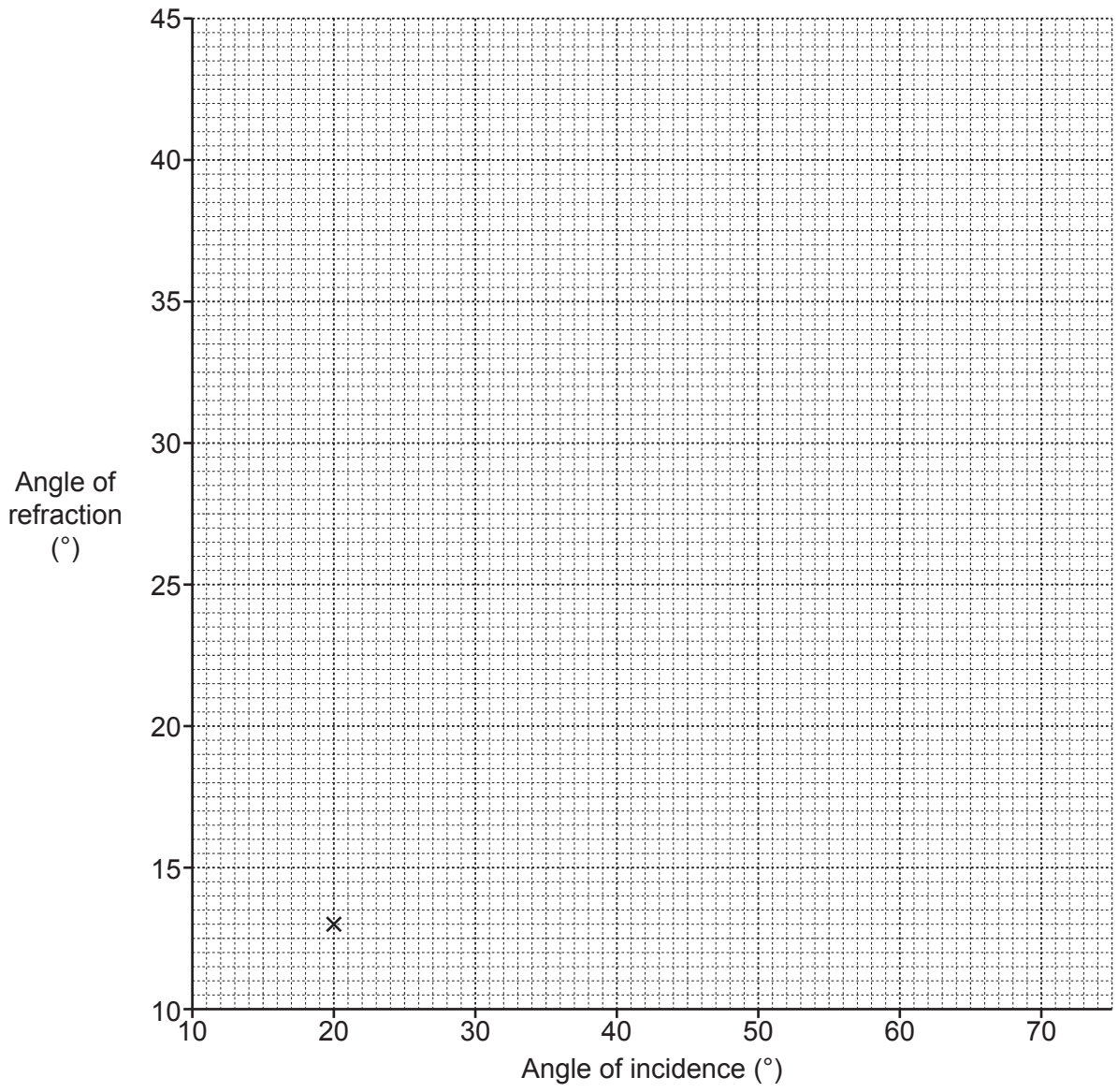
(c) Alex records his results in the table.

Angle of incidence (°)	Angle of refraction (°)
20	13
30	19
40	25
50	41
60	35
70	39

(i) Plot the results from the table on the graph. One point has already been plotted. **[2]**

(ii) Put a (ring) around the outlier on the graph. **[1]**

(iii) Draw a line of best fit. **[1]**



(iv) Describe the relationship between the angle of incidence and the angle of refraction for the rectangular glass block in Alex's investigation.

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

3 Waves can form on the surface of water.

Fig. 3.1 is a diagram of a water wave on the surface of water.

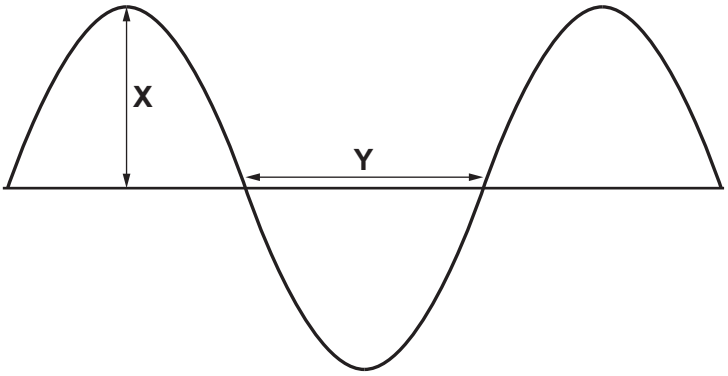

Fig. 3.1

(a) Which **two** statements about the water wave are correct?

Tick (✓) **two** boxes.

The amplitude of the wave is **X**. ☐

The wavelength of the wave is **Y**. ☐

The wave travels but the water does not. ☐

The water wave is a longitudinal wave. ☐

Water waves always travel at the same speed. ☐

[2]

(b) Mia is looking at a fish in a pond. The light waves from the fish are refracted as shown in **Fig. 3.2**.

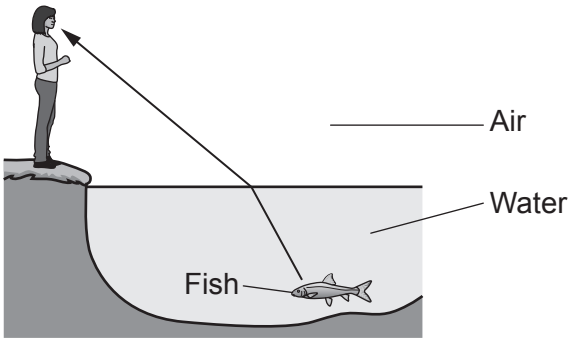

Fig. 3.2

Explain why the light waves from the fish are refracted as they pass from water to air.

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

4 A resistor **X** is connected to the terminals of a 12 V battery. The energy transferred from the battery to the resistor is 1.2 J per second.

(a) What is the power transferred to the resistor?

Use the Data Sheet.

Explain your answer.

Power = ... W

Explanation .....

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

(b) Ali wants to determine the resistance of resistor **X**.

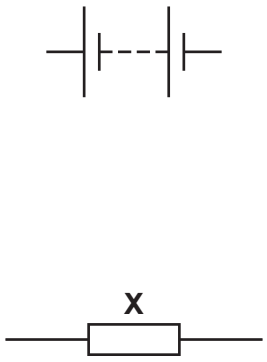

Fig. 4.1

Complete the circuit diagram in **Fig. 4.1** to allow Ali to determine the resistance of resistor **X**.
[2]

(c) **Fig. 4.2** shows a second resistor **Y** connected in parallel with resistor **X**.

The total current in this circuit is 1.0 A and the current through resistor **X** is 0.1 A.

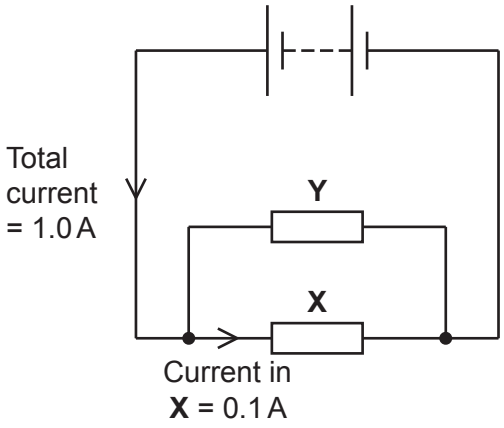

Fig. 4.2

(i) Explain why the resistance of **Y** is smaller than the resistance of **X**.

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.....

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.....

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

(ii) The potential difference across **Y** is 12 V.

Calculate the resistance of **Y**.

Use the equation: potential difference = current × resistance

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

State the unit.

Resistance = ... Unit = ... **[5]**

Ali wants to measure the total current in the circuit, but his ammeter can only measure up to 0.2A.

He connects the ammeter in the circuit as shown in **Fig. 4.3**.

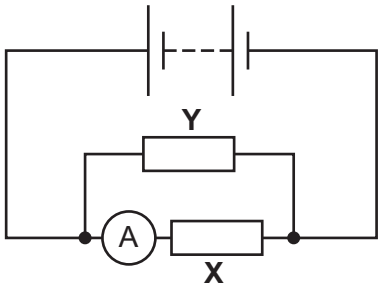

Fig. 4.3

(d) **Fig. 4.4** shows a graph of the current through resistor **X** for different values of the total current in the circuit.

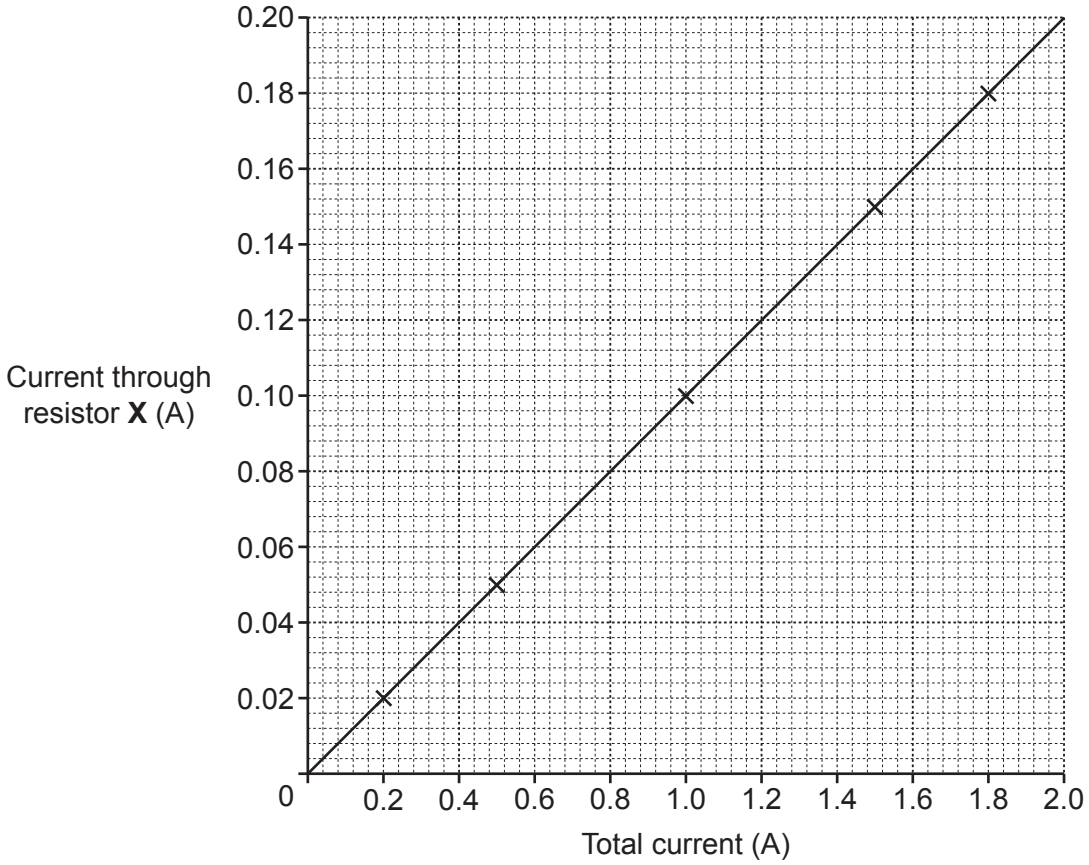

Fig. 4.4

How does the graph show that Ali can determine higher total currents up to 2.0A in the circuit in **Fig. 4.3**?

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

5 Kai watches as a metal bar is heated up.
After some heating it starts to glow red. After more heating it appears orange and finally yellow.

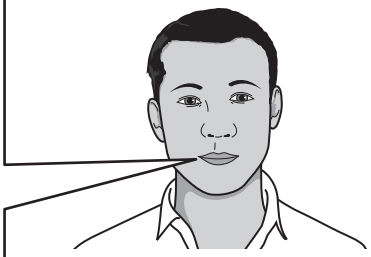
Kai tries to explain what happens.

Cold objects do not emit radiation.

When the bar has been heated for a long enough time it starts to emit red light.

The longer it is heated the more colour changes happen. It stops emitting red wavelengths and gives out orange wavelengths.

Finally, it changes to emit yellow wavelengths.



Kai

Explain what is wrong with Kai's explanation.

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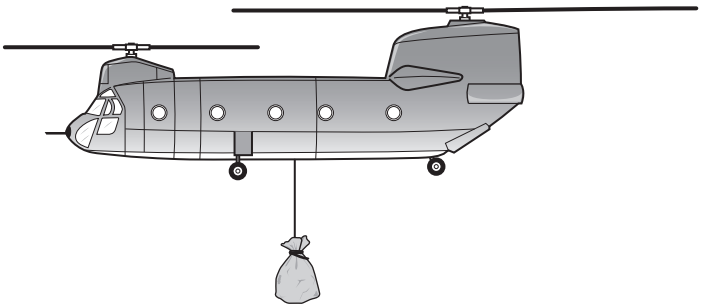
.....

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

6 In 2019 the wall of the dam at the Toddbrook water reservoir was damaged.

The wall of the dam was strengthened using large bags of rock.
The image shows a helicopter carrying a large bag of rock.



(a) Draw a free body force diagram for the bag of rock when the helicopter is stationary in the air above the dam.

[3]

(b) The height of the water in the reservoir was reduced by removing 966 000 m^3 of water.

(i) Calculate the weight of this volume of water.

Use the equation: density = mass ÷ volume

Density of water = 1000 kg / m^3
Gravitational field strength = 10 N / kg

Weight = ... N **[4]**

(ii) The water was pumped out of the reservoir by 23 pumps.

The 23 pumps worked together to raise the water a distance of 4.1 m.

Calculate the mean work done by **one** of the 23 pumps to raise the water a distance of 4.1 m.

Use the equation: Work done = force × distance

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

Work done = ... J **[3]**

7 A radioactive source emits ionising radiation.

(a) Complete the table to show which materials absorb **alpha** radiation.
Tick (✓) at least **one** box.

Radiation	Absorbing material		
	Paper	**Thin aluminium**	**Thick lead**
alpha			
beta		✓	✓
gamma			✓

[1]

(b) Kareem uses the equipment shown in **Fig. 7.1** to investigate how different absorbing materials affect the amount of radiation received by a radiation detector.

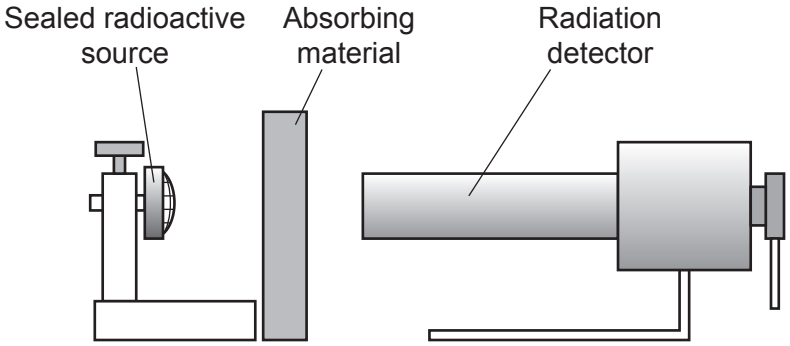


Fig. 7.1

This is Kareem's method:
- measure the count rate with no absorbing material
- measure the count rate with different absorbing materials placed between the source and the radiation detector.

Kareem plots his results on the bar chart in **Fig. 7.2**.

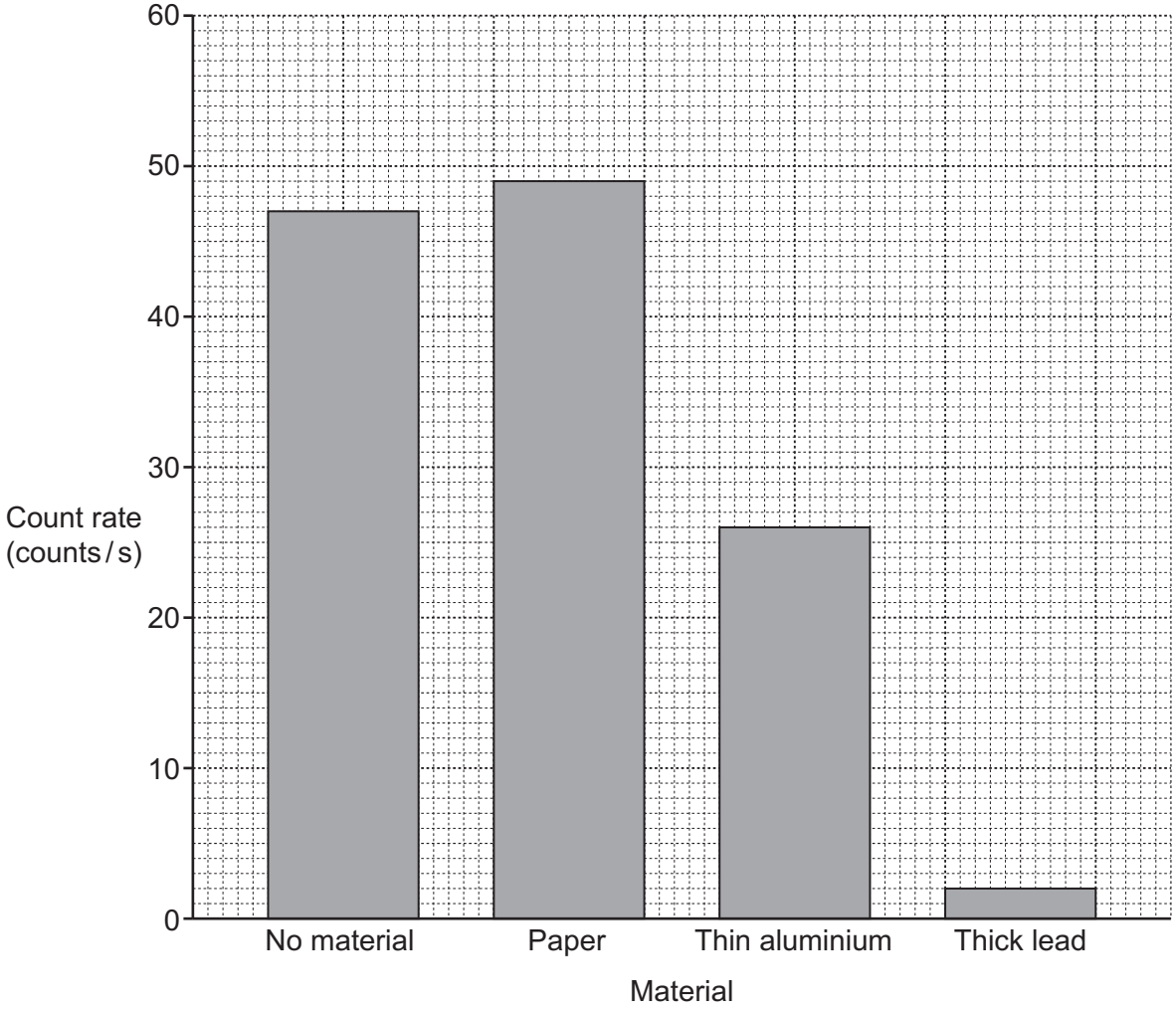


Fig. 7.2

(b) Suggest which type, or types of radiation the source emits.

Use the table and **Fig. 7.2** to explain your answer.

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..... **[4]**

8 Oxygen gas can be stored in large metal cylinders.
On a hot day the temperature of the oxygen gas in a metal cylinder increases, but the volume of the cylinder does not change.

(a) Describe how the behaviour of the oxygen molecules in the cylinder changes as the temperature increases.

.....

.....

.....

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

(b) State what happens to the pressure of the gas **and** use your answer to **(a)** to explain why this happens.

The pressure of the gas .....

Explanation .....

.....

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.....

..... **[4]**

(c) Oxygen is also stored and used as a liquid.
The table shows some properties of oxygen.

Properties of oxygen	
Boiling point	–183 °C
Specific latent heat of vapourisation	213 kJ / kg
Specific heat capacity of oxygen gas	920 J / kg °C

Before liquid oxygen is stored, a large amount of energy must be transferred from the mass of oxygen gas, to cool and liquify it.

(i) 1.7 MJ of energy is transferred from the mass of oxygen gas to reduce the temperature of the oxygen to its boiling point.

Calculate the mass of the oxygen gas.

Use the Data Sheet.

The initial temperature of the oxygen gas is 20 °C.

Mass = ... kg **[4]**

(ii) The mass of oxygen gas calculated in **(c)(i)** is at its boiling point.

Calculate the energy that must be transferred from the mass of oxygen gas to liquify it.

Use the Data Sheet.

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

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9 Uranium has a number of isotopes. The isotope uranium-234 is radioactive and decays to give an isotope of thorium.

(a) What are isotopes of an element?

.....

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

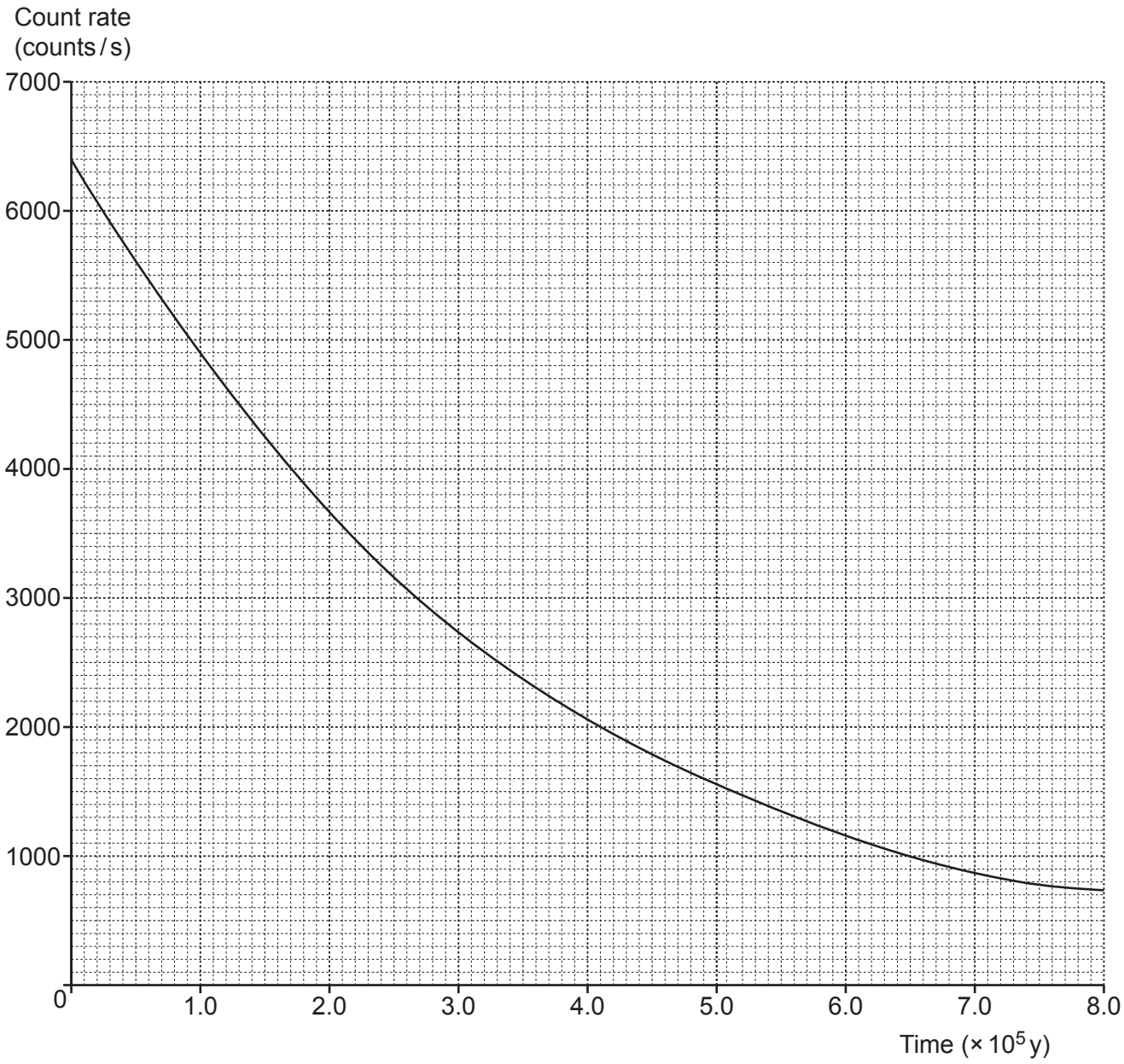
(b) Uranium-234 decays by emitting an alpha particle.

Complete the following equation for the decay of uranium-234 to thorium.

$$^{234}_{92}U \longrightarrow {}^{\cdots\cdots}_{\cdots\cdots}Th + {}^{\cdots\cdots}_{\cdots\cdots}\cdots\cdots$$

[2]

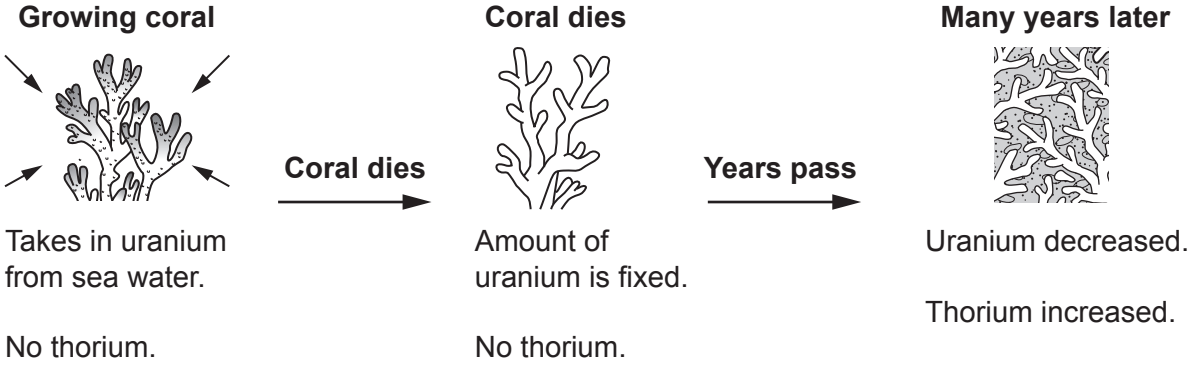
(c) The graph shows the decay of a sample of uranium-234.



Use the graph to determine the half-life of uranium-234.

Half-life = ... years **[3]**

(d) Ling is a geologist. She uses the decay of uranium-234 to thorium to find the age of rocks which are made of ancient coral. The method is shown in the diagram.



(i) After about ten uranium-234 half-lives have passed, this method of finding the age can no longer be used.

Suggest **one** reason why this method no longer works.

Use the graph.

.....

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

(ii) By measuring the amount of thorium in a sample, Ling calculates that 75% of the uranium-234 in the sample has decayed.

Calculate the age of the sample.

Use the graph or your answer to **(c)** to help.

Age = ... years **[3]**

10 Jane investigates the motion of a model car.
She records some data for her model car in a table:

Initial velocity	0 m / s
Final velocity	1.9 m / s
Mass	0.82 kg
Time	3.8 s
Acceleration	0.5 m / s^2

(a) Calculate the rate of change of momentum of the car.

Use the equation: rate of change of momentum = $\frac{\text{change in momentum}}{\text{time}}$

Use the Data Sheet.

Rate of change of momentum = ... kgm / s^2 **[4]**

(b) Calculate the force used to accelerate the car.

Use the Data Sheet.

Force = ... N **[3]**

(c) Explain how your answers to **(a)** and **(b)** are related.

.....

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

11 An electrical conductor is placed in a magnetic field. There is a direct current passing through the conductor.

(a) **Fig. 11.1** shows a left hand.

Complete all the labels to show how you can use your left hand to determine the direction of the force on a conductor in a magnetic field.

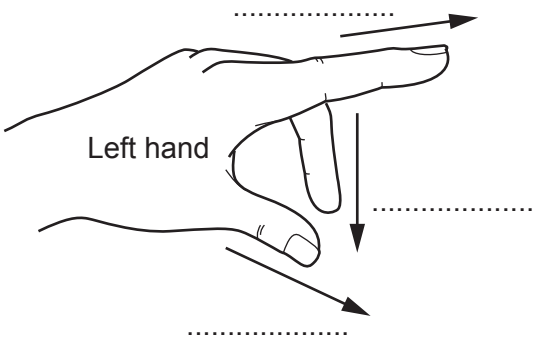


Fig. 11.1

[2]

(b) **Fig. 11.2** shows the conductor in the magnetic field between the north pole **N** and the south pole **S** of a bar magnet.

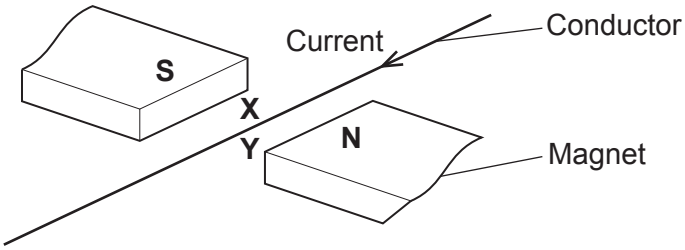


Fig. 11.2

X is a point directly above the conductor and **Y** is a point directly below the conductor.

(i) Complete the sentences to describe the behaviour of the conductor when the current is switched on.

Put a (ring) around each correct option.

The conductor moves towards **N / S / X / Y** when the current is switched on.

When both the current **and** the magnetic field directions are reversed, the conductor

moves in the opposite direction / moves in the same direction / does not move.

When both the current **and** the magnetic field strength are increased the movement of

the conductor is **decreased / increased / unchanged**.

[2]

(ii) The power supply to the conductor is changed from direct current (d.c.) to alternating current (a.c.).

What happens when the current is switched on?

Tick (✓) **one** box.

The conductor may vibrate about its rest position or appear not to move. ☐

The conductor does not vibrate. It moves further from its rest position. ☐

The conductor does not vibrate. It moves in the opposite direction. ☐

The movement of the conductor is the same as for d.c. ☐

[1]

(c) A rectangular coil is placed in a magnetic field, as shown in **Fig. 11.3**.

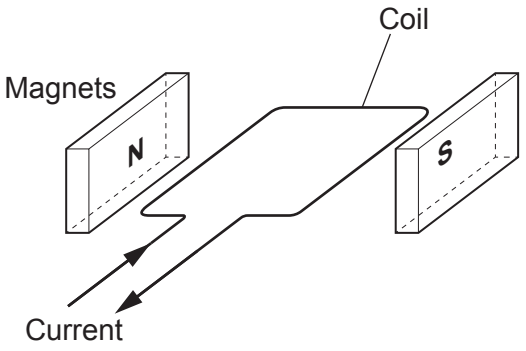


Fig. 11.3

- A d.c. current in the coil is switched on.
- The coil turns.

Explain why there is a turning effect on the coil.

.....

.....

.....

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

(d) In a motor the coil is connected so that it continues to turn.

Complete the sentences about the energy transferred in the motor.

Use words from the list.

chemical	**current**	**electric**	**kinetic**	**light**
magnetic	**potential difference**		**sound**	**thermal**

When the motor is switched on:

Energy is transferred from the battery's ..... store.

Energy is transferred to the motor's ..... store and to the

..... store of the motor and the surroundings.

The amount of energy transferred depends on the ..... through the coil of the motor.

[3]

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).