OCR
Oxford Cambridge and RSA

Tuesday 11 June 2024 – Morning

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

J250/04 Chemistry (Foundation Tier)

Time allowed: 1 hour 10 minutes

F

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

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

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 an effect of increased levels of carbon dioxide in the Earth's atmosphere?

A Acid rain

B Global warming

C Light pollution

D Smog

Your answer ☐ **[1]**

2 What are catalysts found in biological systems called?

A Bacteria

B Enzymes

C Isotopes

D Vitamins

Your answer ☐ **[1]**

3 Burning fossil fuels can produce **solids** called particulates.

Which product of burning fossil fuels is an example of a particulate?

A Carbon

B Carbon monoxide

C Nitrogen dioxide

D Sulfur dioxide

Your answer ☐ **[1]**

4 The word equation shows how iron is extracted from iron oxide.

iron oxide + carbon → iron + carbon dioxide

The table shows the masses of the reactants and products.

	Iron oxide	**Carbon**	**Iron**	**Carbon dioxide**
Mass (tonnes)	3200	360		1320

What is the mass of iron produced?

A 1880 tonnes

B 2240 tonnes

C 2840 tonnes

D 4880 tonnes

Your answer ☐ **[1]**

5 Scientists think the Earth's oxygen-rich atmosphere developed due to photosynthesis by plants.

Which gas in the Earth's early atmosphere did plants absorb during photosynthesis?

A Ammonia

B Carbon dioxide

C Methane

D Sulfur dioxide

Your answer ☐ **[1]**

6 It is thought that the gases in Earth's early atmosphere were released by volcanoes.

The table shows the amounts of different gases released by a volcano.

Which of the gases are carbon dioxide and water vapour?

Gas	Percentage of gas (%)
W	64
X	8
Y	2
Z	26

A **W** and **Z**

B **W** and **Y**

C **X** and **Y**

D **X** and **Z**

Your answer ☐ **[1]**

7 A student adds some metals to different solutions.

The table shows their results.

Metal	Solution	Reaction
Copper	nickel sulfate	✗
Nickel	tin sulfate	✓
Tin	copper sulfate	✓

Key:
✓ = reaction
✗ = no reaction

What do the results tell the student about the reactivity of the three metals?

A All three metals have the same reactivity.

B Copper is the most reactive metal.

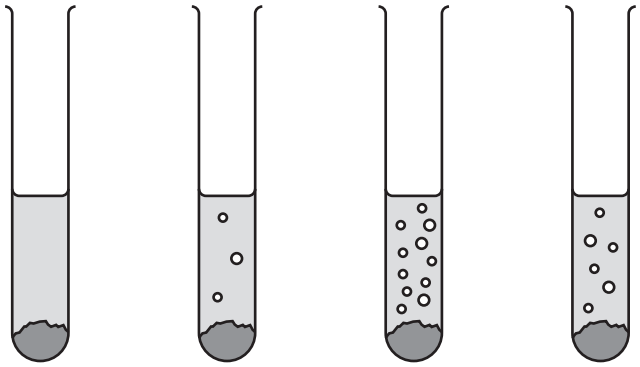
C Nickel is the most reactive metal.

D Tin is the most reactive metal.

Your answer ☐ **[1]**

8 Four different metals are placed into dilute hydrochloric acid.

Which metal forms positive ions **most** easily?



Metal **A** Metal **B** Metal **C** Metal **D**

Your answer ☐ **[1]**

9 Carbon reacts with copper oxide to produce copper.

copper oxide + carbon → copper + carbon dioxide

What is the role of the carbon?

A It is a catalyst.

B It neutralises the copper oxide.

C It oxidises the copper oxide.

D It reduces the copper oxide.

Your answer ☐ **[1]**

10 A teacher investigates some reactions of chlorine.

Why is it important that the teacher does **not** breathe in chlorine?

A Chlorine is highly flammable.

B Chlorine is inert.

C Chlorine is strongly alkaline.

D Chlorine is toxic.

Your answer ☐ **[1]**

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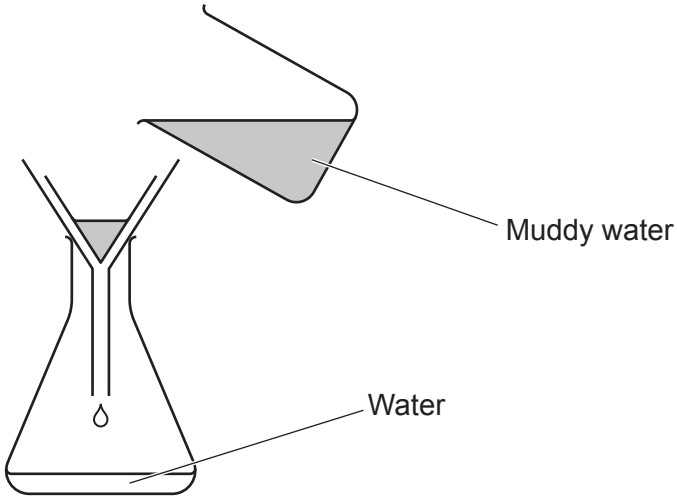
Section B

11 A student does some experiments to separate water from muddy water.

(a) **Fig. 11.1** shows the equipment the student uses in their first experiment.

Fig. 11.1



(i) What is the name of this separation technique?

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

(ii) The water produced in the experiment is a very light brown colour.

Why is the student **not** sure that the water produced is **potable**?

Tick (✓) **two** boxes.

Only small amounts of water are produced. ☐

The experiment takes too long. ☐

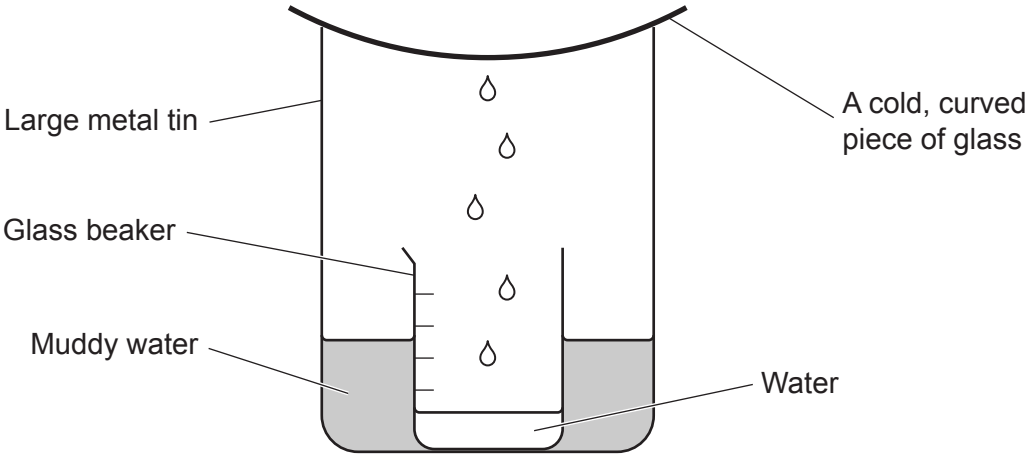
The water may contain bacteria. ☐

The water may contain tiny particles of mud. ☐

[2]

(b) **Fig. 11.2** shows the equipment the student uses in their second experiment.

Fig. 11.2



The student leaves the equipment in a sunny place.

The statements describe how the experiment produces water.

The statements are **not** in the correct order.

A The water drips into the beaker.

B The sun heats up the muddy water.

C The water evaporates.

D The water vapour cools and condenses.

E The water vapour rises upwards.

F The water vapour touches the cold piece of glass.

Write the remaining letters in the boxes to show the correct order of the statements.

B	→		→	E	→		→		→	A

[2]

12 This question is about Groups 1, 7 and 0 in the Periodic Table.

(a) What are the properties of the elements in Group 1, Group 7 and Group 0?

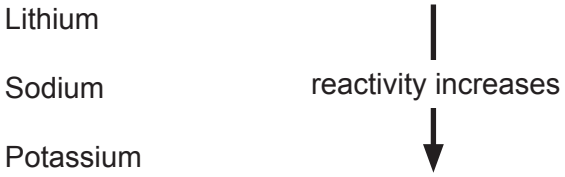
Tick (✓) **one**, **two** or **three** boxes in each row in **Table 12.1**.

Table 12.1

Properties	Group 1	Group 7	Group 0
They are non-metals.			
They are soft solids.			
They form coloured gases.			

[3]

(b) A teacher does an experiment to show that the order of reactivity going down Group 1 is:



- The teacher has pieces of the Group 1 elements of the same size.
- They react these with water.
- They then time how long it takes for the pieces to disappear.

Table 12.2 shows their results.

Complete **Table 12.2** by writing lithium, sodium and potassium in the correct spaces.

Table 12.2

Group 1 element	Time to disappear (s)
.....	4
.....	21
.....	12

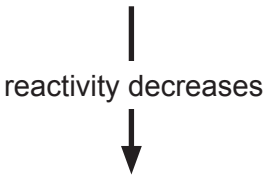
[2]

(c) The teacher also does an experiment to show that the order of reactivity going down Group 7 is:

Chlorine

Bromine

Iodine



They react gases of each Group 7 element with small pieces of hot iron and write down their observations.

Table 12.3 shows their results.

Complete **Table 12.3** by writing chlorine, bromine and iodine in the correct spaces.

Table 12.3

Group 7 element	Observation
.....	The iron glows brightly.
.....	The iron glows very brightly.
.....	The iron glows only slightly.

[2]

(d) **Table 12.4** shows the boiling points of some Group 0 elements.

Table 12.4

Element	Boiling point (°C)
Helium	–269
Neon	–246
Argon	
Krypton	–152
Xenon	–108

(i) Describe what happens to the boiling points going from helium to xenon.

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

(ii) Estimate the boiling point of argon. Use the information in **Table 12.4**.

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

13 Nitrogen is a gas found in the Earth's atmosphere.

(a) The table shows the percentages of different gases found in the Earth's atmosphere.

Gas	Percentage in the Earth's atmosphere (%)
Nitrogen	
Oxygen	20.95
Carbon dioxide	0.38
Other gases	0.92

Calculate the percentage of nitrogen in the Earth's atmosphere.

Percentage of nitrogen = ... % **[2]**

(b) Nitrogen reacts with hydrogen to form ammonia.

The word equation for the reaction is:

nitrogen + hydrogen $\rightleftharpoons$ ammonia

(i) Describe how the word equation shows that the reaction is reversible.

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

(ii) The word equation for the **forward** reaction is:

nitrogen + hydrogen $\rightarrow$ ammonia

Write the **word** equation for the **backward** reaction.

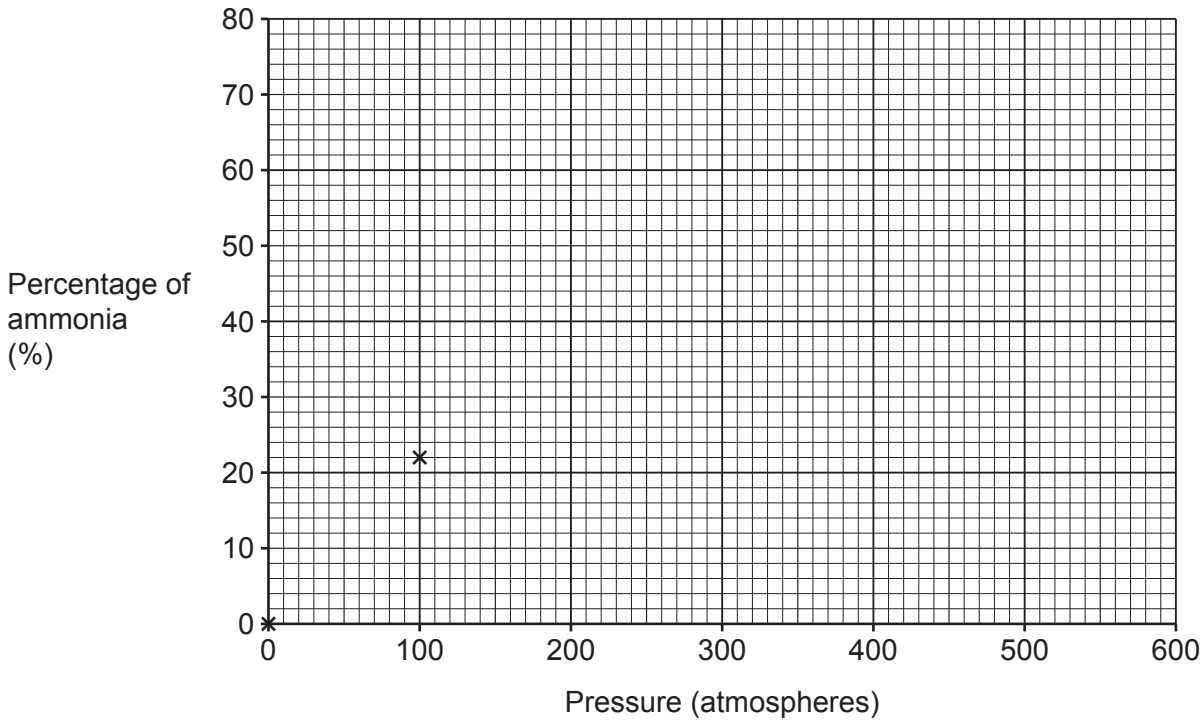
..... **[1]**

(c) This table shows the percentage of ammonia produced in the reaction at different pressures.

Pressure (atmospheres)	Percentage of ammonia (%)
0	0
100	22
200	40
300	54
400	62
500	66

(i) Plot the data from the table on the graph. **[2]**
The first two points are already plotted.

(ii) Draw the curve of best fit. **[1]**



(d) Oxides of nitrogen released from cars cause acid rain.

(i) Oxides of nitrogen responsible for acid rain are given the formula NO_x.

What is the value of ***x*** in nitrogen dioxide?

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

(ii) Normal rain water is slightly acidic.

Describe a test and its result to show that acid rain is **more** acidic than normal rain water.

Test .....

.....

Result .....

.....

.....

[2]

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14 Crude oil is a source of useful chemicals called hydrocarbons.

(a) Complete the sentence about crude oil.

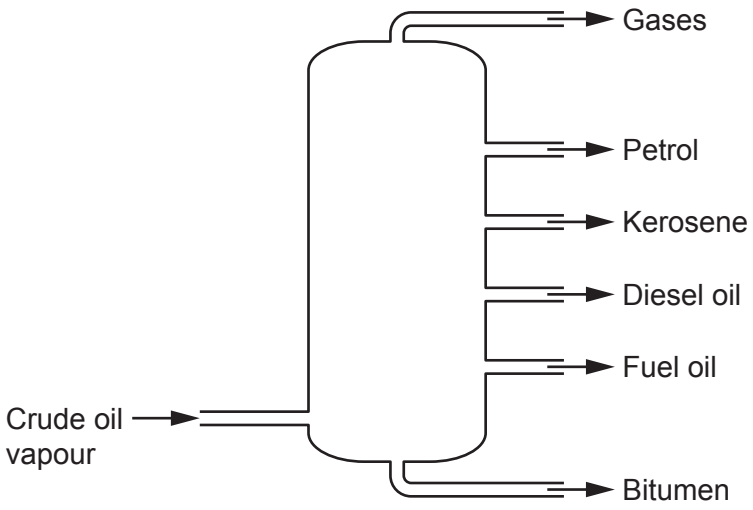
Put a ring around the correct option.

Crude oil is a **compound / feedstock / renewable resource** used by the petrochemical industry.

[1]

(b) The diagram shows the fractionating column used in the fractional distillation of crude oil.

Fractionating Column



(i) Which state symbol describes the crude oil as it enters the fractionating column?

Tick (✓) **one** box.

(g) ☐

(l) ☐

(s) ☐

[1]

(ii) Write an **X** on the fractionating column where it is **coolest**. **[1]**

(c) The table shows the boiling point of four hydrocarbons.

Hydrocarbon	Boiling point (°C)
P	69
Q	126
R	36
S	98

(i) Which of the hydrocarbons **P**, **Q**, **R** or **S** is produced nearest to the **top** of the fractionating column?

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

(ii) Which of the hydrocarbons **P**, **Q**, **R** or **S** has the **largest** molecules?

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

(d) Large hydrocarbons can be made more useful by cracking.

The equation shows the cracking of hydrocarbon **X**.

X $\longrightarrow$ C_6H_{14} + $2C_2H_4$

(i) What is the formula of hydrocarbon **X**?

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

(ii) Which homologous series of hydrocarbons does C_6H_{14} belong to?

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

(iii) The hydrocarbon C_2H_4 belongs to a different homologous series.

Suggest the **general formula** of the homologous series that contains C_2H_4.

Tick **one** (✓) box.

C_nH_n ☐

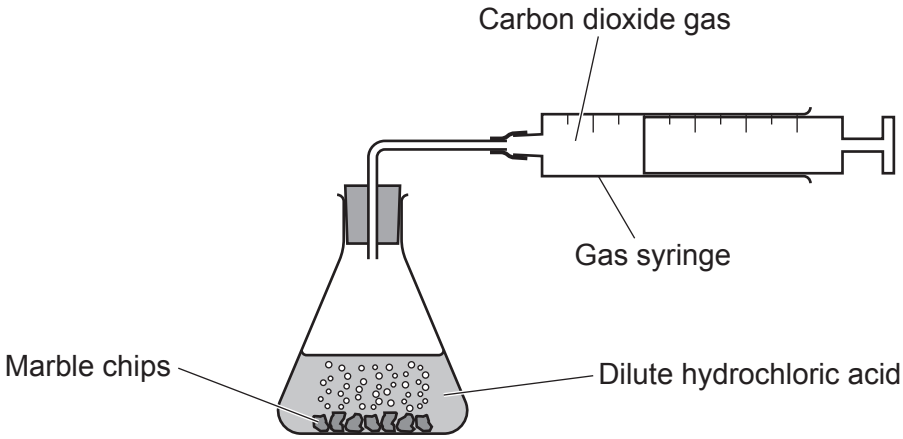
C_nH_{2n} ☐

$C_{2n}H_n$ ☐

[1]

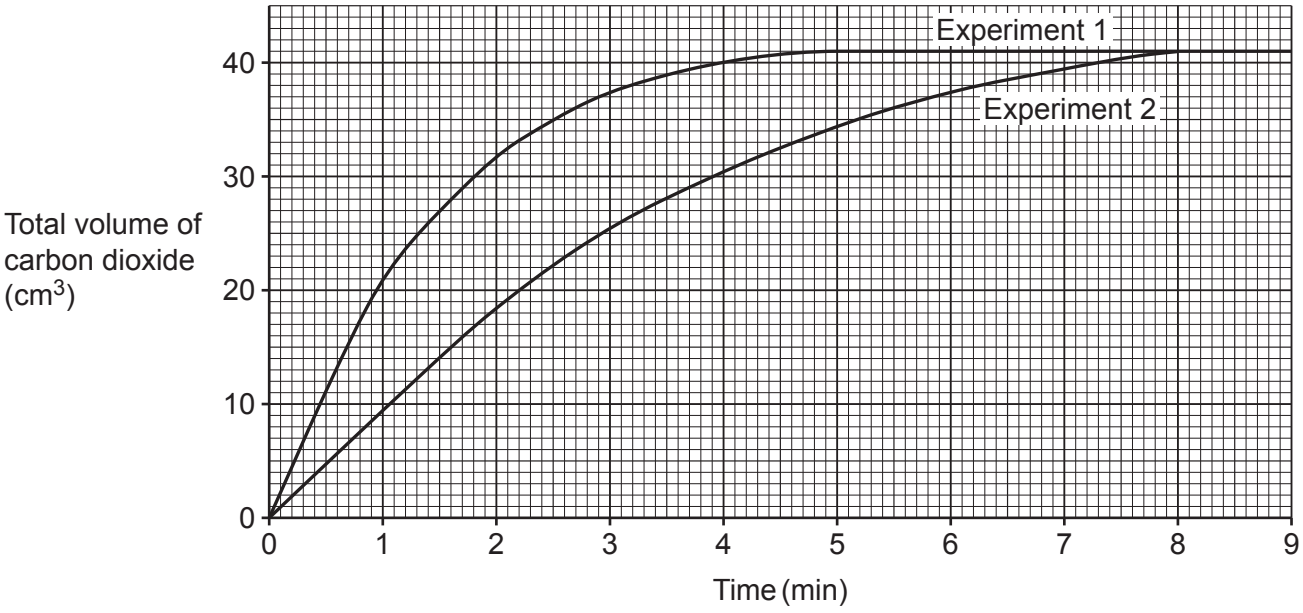
15* A student investigates the rate of reaction between pieces of marble chips and an excess of dilute hydrochloric acid.

The diagram shows the equipment they use.



The student measures the total volume of carbon dioxide gas produced every minute until the reaction finishes.

They do two different experiments and plot a graph of the results.



Which experiment has the greater rate of reaction?

Explain your answer by including:

- information from the graph
- a description of how the experiments might be different
- ideas about the reacting particle model including particles and their collisions.

.....

.....

.....

.....

.....

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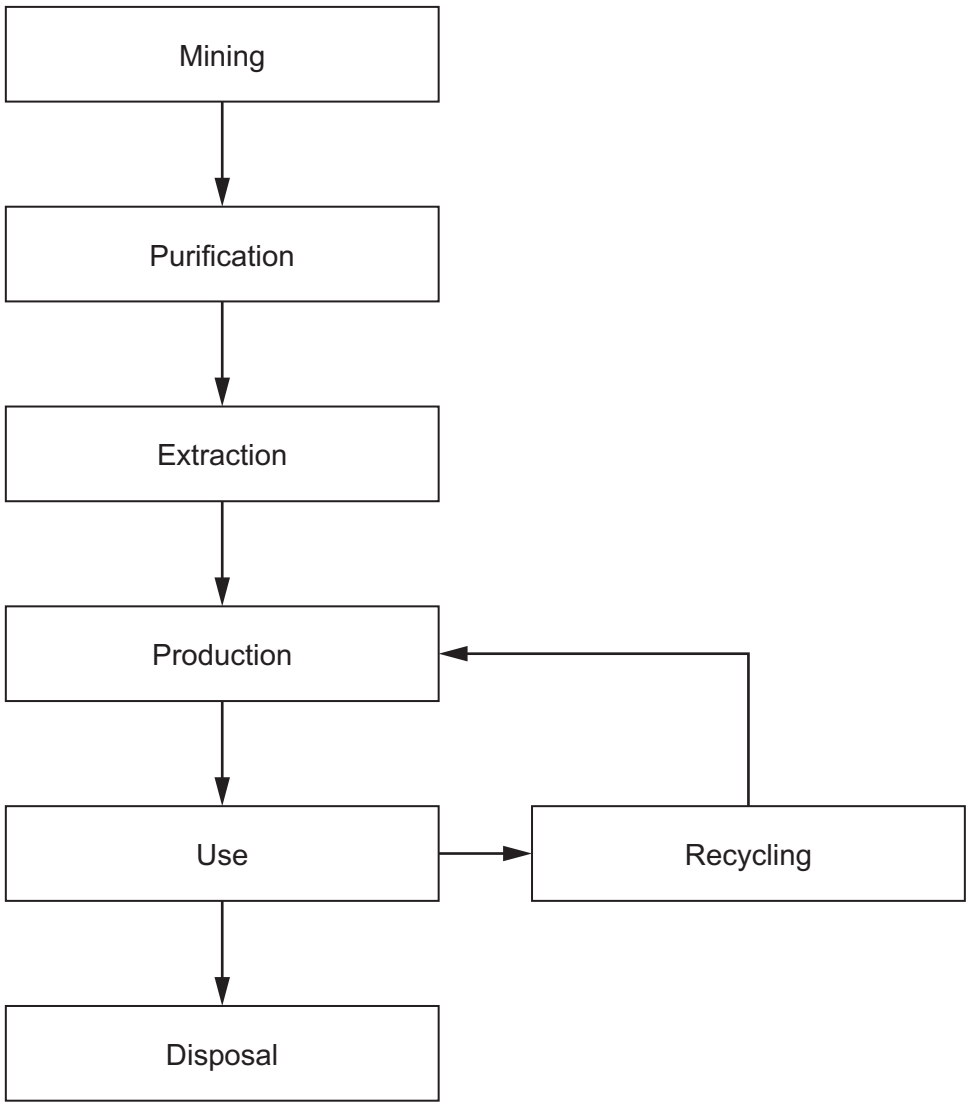
..... **[6]**

16 Aluminium is extracted from a rock called bauxite which contains aluminium oxide.

The diagram shows information from a life-cycle assessment for the manufacture and use of aluminium products.



(a) Give **one** reason why a life-cycle assessment is carried out.

.....

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

(b) Give **two** reasons why the products should be recycled at the end of their useful life.

1 .....

.....

2 .....

.....

[2]

(c) 18% of the bauxite rock is turned into aluminium.

Calculate the mass of aluminium that is extracted from 7500 kg of bauxite.

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

Mass of aluminium = ... kg **[3]**

(d) During the purification, aluminium oxide, Al_2O_3, is produced from aluminium hydroxide, $Al(OH)_3$.

Complete the **balanced symbol** equation for the reaction.

$$.....Al(OH)_3 \longrightarrow Al_2O_3 + ...H_2O$$

[2]

(e) Aluminium is extracted from aluminium oxide, Al_2O_3, by electrolysis.

(i) This is the equation for the electrolysis of aluminium oxide.

$$2Al_2O_3 \longrightarrow 4Al + 6O_2$$

A student thinks that this reaction is an example of reduction.

Explain why the student is **correct**.

.....

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

(ii) Extracting aluminium by electrolysis is expensive.

Which statements about why the electrolysis is expensive are **true**, and which are **false**?

Tick **one** (✓) box in each row.

	True	**False**
Aluminium oxide is melted at a high temperature.		
The electrolysis produces impure aluminium.		
The electrolysis uses large amounts of electricity.		

[2]

(iii) It would be cheaper if aluminium could be extracted by heating the aluminium oxide with carbon.

Explain why aluminium oxide does **not** react with carbon.

.....

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

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.