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

J248/02 Paper 2, C4–C6 and C7 (Foundation Tier)

Wednesday 13 June 2018 – Morning
Time allowed: 1 hour 45 minutes

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1
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4
*

You must have:

- a ruler (cm/mm)
- the Data Sheet (for GCSE Chemistry A (inserted))

You may use:

- a scientific or graphical calculator
- an HB pencil



First name

Last name

Centre number

Candidate number

INSTRUCTIONS

- The data sheet will be found inside this document.
- Use black ink. You may use an HB pencil for graphs and diagrams.
- Complete the boxes above with your name, centre number and candidate number.
- Answer **all** the questions.
- Write your answer to each question in the space provided. If additional space is required, use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.
- Do **not** write in the barcodes.

INFORMATION

- The total mark for this paper is **90**.
- The marks for each question are shown in brackets [].
- Quality of extended responses will be assessed in questions marked with an asterisk (*).
- This document consists of **32** pages.

SECTION A

Answer **all** the questions.

You should spend a maximum of 30 minutes on this section.

1 Lithium, sodium and potassium are Group 1 elements.

What happens when these elements are added to water?

- A Some float and carbon dioxide gas and an alkaline solution are made.
- B Some float and hydrogen gas and an alkaline solution are made.
- C They all float and hydrogen gas and an acidic solution are made.
- D They all float and hydrogen gas and an alkaline solution are made.

Your answer

[1]

2 Damp litmus paper is used to test for chlorine gas.

Which statement describes the correct result of the test for chlorine gas?

- A Damp blue litmus paper turns red then white.
- B Damp blue litmus paper turns white then red.
- C Damp red litmus paper turns blue then white.
- D Damp red litmus paper turns white then blue.

Your answer

[1]

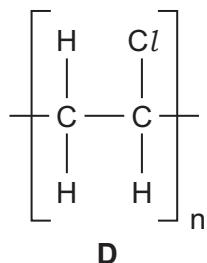
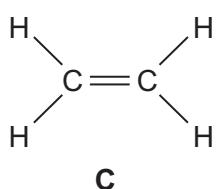
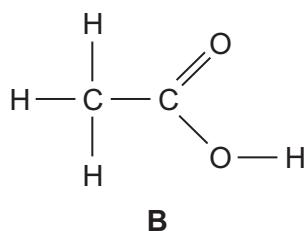
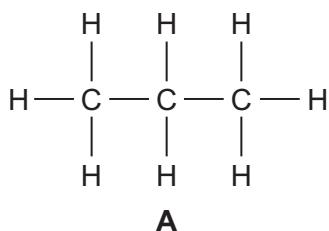
3 What is the name of the process that converts large alkane molecules into smaller alkane molecules?

- A Cracking
- B Fractional distillation
- C Hydrogenation
- D Polymerisation

Your answer

[1]

4 Which displayed formula shows an alkene?



Your answer

[1]

5 The list shows part of the reactivity series of metals including carbon.

Sodium
Lithium
Calcium
Magnesium
Aluminium
Carbon
Zinc
Iron
Tin
Lead

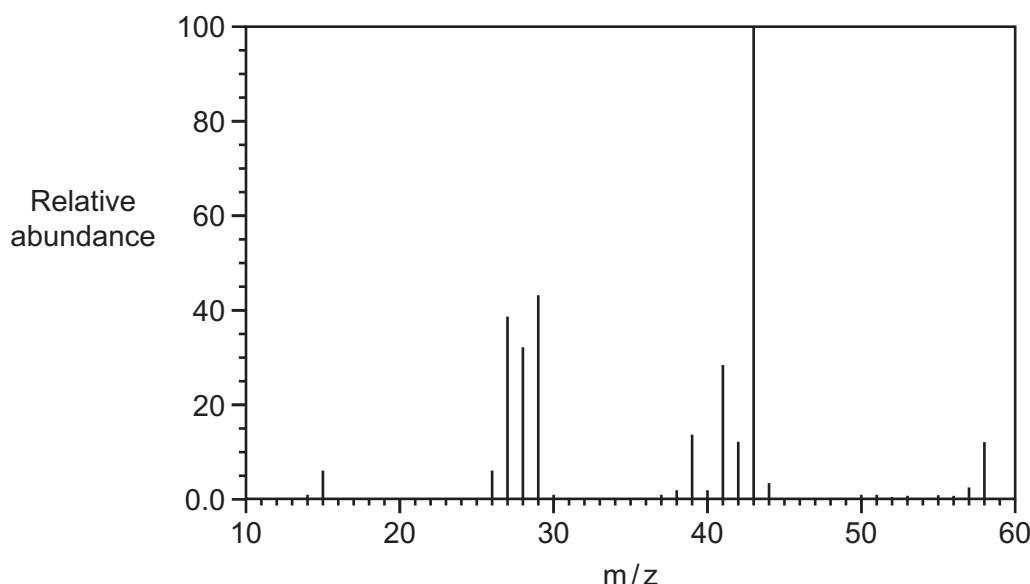
Which row of the table correctly describes how the metals are extracted from their ores?

| | Metals extracted by electrolysis | Metals extracted by heating with carbon |
|----------|----------------------------------|---|
| A | Sodium, Magnesium, Zinc | Aluminium, Iron, Tin |
| B | Aluminium, Zinc, Iron | Lead, Tin |
| C | Calcium, Magnesium, Aluminium | Sodium, Iron, Tin |
| D | Sodium, Calcium, Magnesium | Lead, Tin, Zinc |

Your answer

[1]

6 Look at the mass spectrum of a carbon compound.



Which carbon compound is the mass spectrum from?

- A C_2H_2
- B C_2H_5^+
- C C_3H_7^+
- D C_4H_{10}

Your answer

[1]

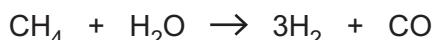
7 Which statement about catalysts is correct?

- A A catalyst decreases the activation energy of a reaction.
- B A catalyst increases the activation energy of a reaction.
- C A catalyst increases the time for a reaction to go to completion.
- D A catalyst slows down a reaction.

Your answer

[1]

8 Hydrogen gas can be made by reacting methane and steam (H_2O).



6g of hydrogen gas can be made from 18g of steam, H_2O .

How much hydrogen gas can be made from 3.6g of steam, H_2O ?

- A 0.4g
- B 0.6g
- C 1.2g
- D 6.8g

Your answer

[1]

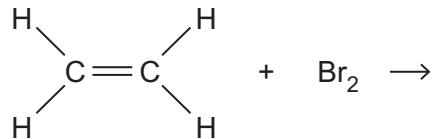
9 Which statement is true for a reversible reaction when it is at dynamic equilibrium?

- A The concentration of the products is increasing.
- B The rate of the backward reaction is greater than the rate of the forward reaction.
- C The rate of the forward reaction is equal to the rate of the backward reaction.
- D The rate of the forward reaction is greater than the rate of the backward reaction.

Your answer

[1]

10 What is the formula of the product in this equation?

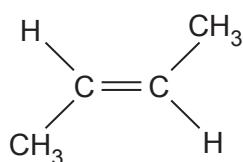


- A $\text{C}_2\text{H}_2\text{Br}$
- B C_3Br_4
- C $\text{C}_2\text{H}_3\text{Br}$
- D $\text{C}_3\text{H}_4\text{Br}_2$

Your answer

[1]

11 Look at the displayed formula of the monomer butene.



What is the formula of the **polymer** formed from butene?

| | | | |
|---|---|--|---|
| $ \left(\begin{array}{c} \text{H} & \text{H} \\ & \\ \text{C} & - & \text{C} \\ & \\ \text{H} & \text{H} \end{array} \right)_n $ | $ \left[\begin{array}{c} \text{H} & \text{CH}_3 \\ & \\ \text{C} & - & \text{C} \\ & \\ \text{CH}_3 & \text{H} \end{array} \right]_n $ | $ \left(\begin{array}{c} \text{CH}_3 & \text{H} \\ & \\ \text{C} & - & \text{C} \\ & \\ \text{H} & \text{H} \end{array} \right)_n $ | $ \left[\begin{array}{c} \text{H} & \text{CH}_3 \\ & \\ \text{C} & = & \text{C} \\ & \\ \text{CH}_3 & \text{H} \end{array} \right]_n $ |
| A | B | C | D |

Your answer

[1]

12 DNA molecules are polymers.

What are the monomers that make up DNA called?

- A Carbohydrates
- B Nucleotides
- C Phosphates
- D Proteins

Your answer

[1]

13 What is the major source of carbon monoxide in the Earth's atmosphere?

- A Incomplete combustion of fossil fuels and wood.
- B Production in a nuclear power station.
- C The combustion of impurities in coal.
- D The combustion of impurities in natural gas.

Your answer

[1]

14 Look at the following sentences.

They describe one possible theory for how the Earth's atmosphere evolved.

The sentences are not in the correct order.

1

Carbon cycle now keeps the composition of the atmosphere almost constant

2

Initial atmosphere of ammonia and carbon dioxide

3

Increase in oxygen and nitrogen levels

4

Photosynthetic organisms began to make oxygen

5

Degassing from the Earth's crust and formation of water

What is the correct order for the sentences?

- A** 2, 4, 3, 5, 1
- B** 2, 5, 4, 3, 1
- C** 5, 2, 3, 4, 1
- D** 5, 2, 4, 3, 1

Your answer

[1]

15 Look at the information about four different polymers.

| Polymer | Cost (£ per kg) | Tensile strength (MPa) | Melting point (°C) | Maximum useable temperature (°C) |
|---------|-----------------|------------------------|--------------------|----------------------------------|
| A | 0.74 | 15 | 120 | 85 |
| B | 1.20 | 78 | 254 | 70 |
| C | 0.92 | 35 | 176 | 160 |
| D | 1.42 | 42 | 156 | 160 |

Which polymer would be best for making a plastic cup to hold hot drinks?

Your answer

[1]

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10

SECTION B

Answer **all** the questions.

16 The Group 7 elements are called the halogens.

The table shows information about some of the halogens.

| Name | Atomic number | Boiling point (°C) | State at room temperature | Molecular formula |
|----------|---------------|--------------------|---------------------------|-------------------|
| Fluorine | 9 | -188 | Gas | F_2 |
| Chlorine | 17 | -34 | Gas | Cl_2 |
| Bromine | 35 | 59 | Liquid | Br_2 |
| Iodine | 53 | 184 | Solid | I_2 |

(a) Which is the **most reactive** halogen in the table?

..... [1]

(b) Astatine is also a halogen. It has the atomic symbol At and an atomic number of 85.

Look at the table.

(i) Predict the **state** of astatine at room temperature.

..... [1]

(ii) Predict the **boiling point** of astatine.

..... [1]

(c) Sodium, Na, reacts with chlorine. A white solid is made.

(i) What is the **name** of this white solid?

..... [1]

(ii) Write down the **balanced symbol** equation for this reaction.

..... [2]

17 A student added 2.4 g of magnesium to hydrochloric acid. She observed that no magnesium was left when the reaction was complete.

The student transferred the solution to an evaporating basin. She heated the solution using a Bunsen burner and evaporated all the water.

(a) Explain how you can tell from the student's observation that the hydrochloric acid was in excess.

.....
.....

[1]

(b) Look at the equation for the reaction.



The student knows the reaction is complete when there is no magnesium left.

Use the equation to explain one **other** way the student could tell that the reaction was complete.

.....
.....

[1]

(c) The student predicts she should make 9.5 g of magnesium chloride, MgCl_2 .

She actually makes 7.9 g.

Calculate the **percentage yield**.

Give your answer to **3** significant figures.

Answer = [3]

(d) Write down one reason, other than a mistake, why the student may have obtained a percentage yield of less than 100%.

.....
.....

[1]

18 Antacid tablets are used to treat indigestion.

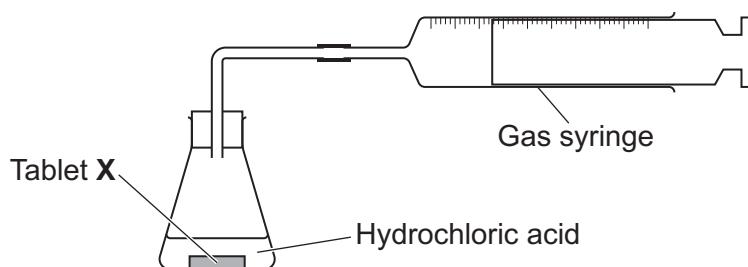
A student investigates two different antacid tablets, **X** and **Y**. Both tablets, **X** and **Y**, contain calcium carbonate, CaCO_3 .

Calcium carbonate reacts with hydrochloric acid. Calcium chloride, CaCl_2 , water and carbon dioxide are made.

(a) Write a **balanced symbol** equation for this reaction.

..... [2]

(b) The diagram shows the apparatus the student uses.



The student reacts tablet **X** with 100 cm^3 of hydrochloric acid. The hydrochloric acid is in excess.

He measures the volume of gas made every minute during the first five minutes.

He does a second experiment using tablet **Y** and a fresh 100 cm^3 sample of the same hydrochloric acid.

The table shows his results.

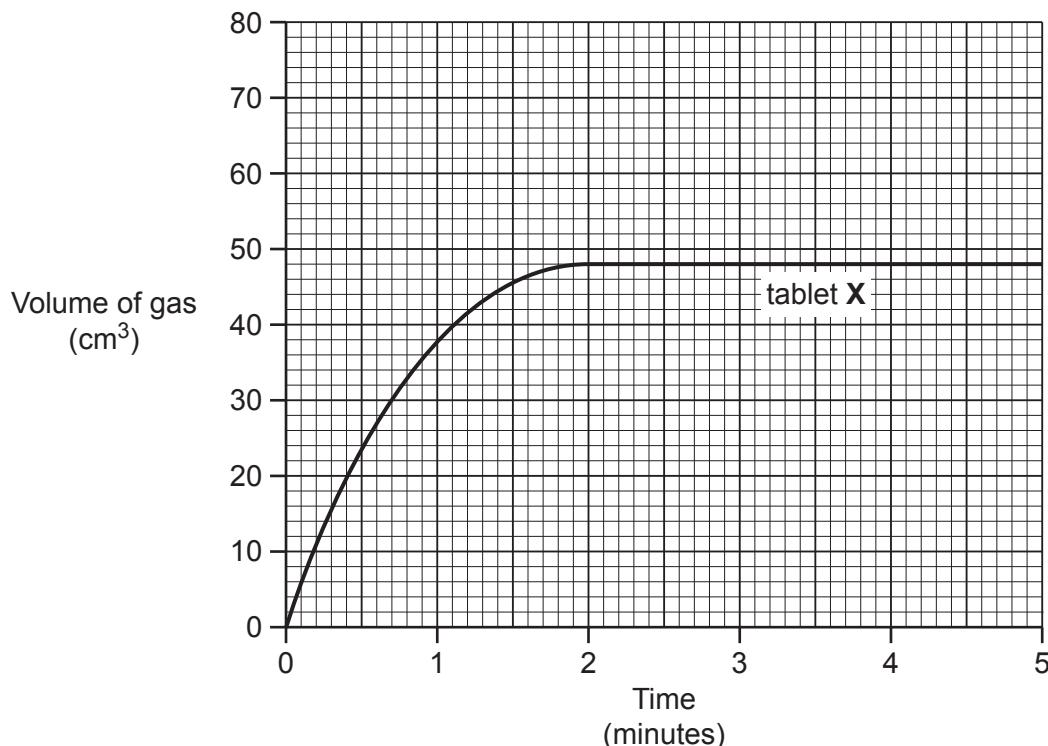
| Time (minutes) | Volume of gas (cm^3) | |
|-------------------|---------------------------------|----------|
| | Tablet X | Tablet Y |
| 0 | 0 | 0 |
| 1 | 38 | 32 |
| 2 | 48 | 54 |
| 3 | 48 | 67 |
| 4 | 48 | 72 |
| 5 | 48 | 72 |

13

(i) The graph shows the results for tablet X.

What is the volume of gas made by the end of the experiment?

Answer = cm³ [1]



(ii) Plot the results for tablet Y on the grid. Draw a line of best fit. [2]

(iii) Tablet X contains less calcium carbonate than tablet Y.

How do the results show this?

..... [1]

14

(c) The rate of reaction between calcium carbonate and hydrochloric acid can be increased by:

- Using a more concentrated solution of hydrochloric acid
- Increasing the temperature of the acid.

Explain how each of these methods increase the rate of the reaction.

Use ideas about collisions between particles.

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[4]

15

19 Ammonia is made from nitrogen and hydrogen.

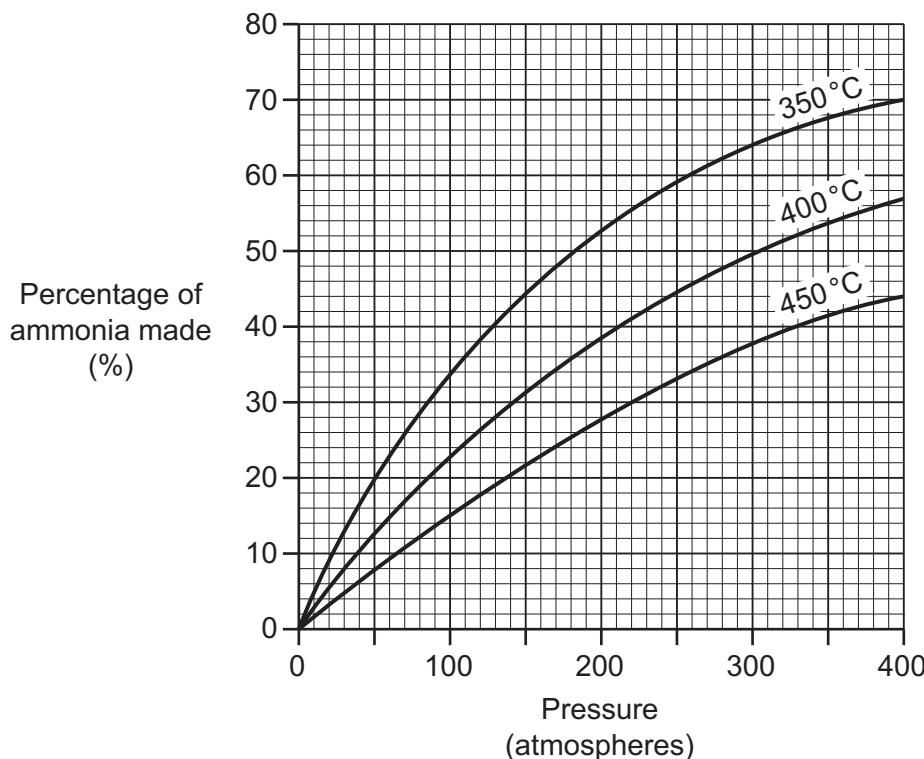
(a) The reaction between nitrogen and hydrogen is **reversible**.

Explain what this means.

.....
.....

[1]

(b) The graph shows the percentage of ammonia made at different temperatures and pressures.



(i) Describe how the percentage of ammonia changes as the **pressure** increases at 450 °C.

.....

[1]

(ii) Write down a temperature and pressure which make 20% of ammonia.

Temperature = °C Pressure = atmospheres

[1]

20 A student wants to identify the ions contained in a solid, X.

She dissolves the solid in some water and then does some tests on the solution.

Look at the table of her results.

| Test | Method | Observations |
|--------|---|--|
| Test 1 | Flame test | Red flame seen |
| Test 2 | Add dilute sodium hydroxide solution | White precipitate forms which re-dissolves in excess sodium hydroxide solution |
| Test 3 | Add dilute nitric acid, then silver nitrate solution | White precipitate forms |
| Test 4 | Add dilute hydrochloric acid, then barium chloride solution | No change – mixture stays clear and colourless |

(a) Describe how the student does the flame test in **Test 1**.

You may draw a **labelled** diagram to help your answer.

.....

.....

.....

.....

[3]

(b)* The student thinks that solid X contains only lithium ions, Li^+ , and sulfate ions, SO_4^{2-} .

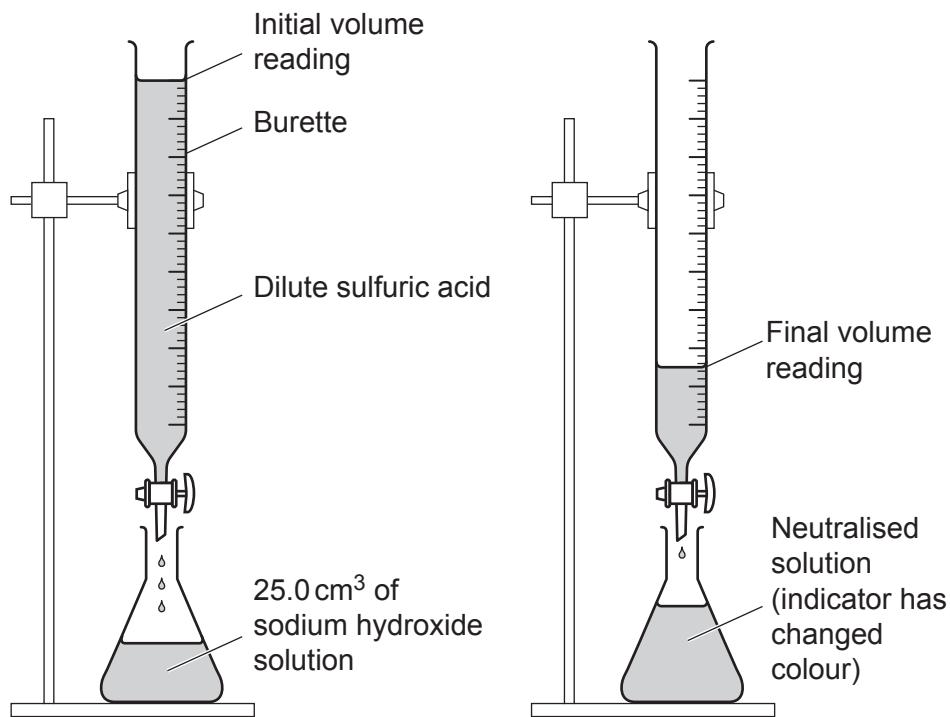
Use her results to explain if she is correct.

[6]

- [6]

21 A student does a titration with an acid and an alkali.

He uses dilute sulfuric acid, sodium hydroxide solution and an indicator solution.



The student's method is:

- Use a measuring cylinder to pour 25.0 cm^3 of sodium hydroxide solution into a conical flask
- Add a few drops of an indicator to the sodium hydroxide solution
- Use a burette to add dilute sulfuric acid to the sodium hydroxide solution until the indicator changes colour.

(a) The student wants to get a more accurate value for how much acid reacts with 25.0 cm^3 of sodium hydroxide solution.

Describe and explain how the student could improve his experiment to get a more accurate value.

.....
.....
.....
.....

[4]

19

(b) Another student does a titration. She also uses dilute sulfuric acid, sodium hydroxide solution and an indicator solution.

The table shows her results.

| Titration number | 1 | 2 | 3 | 4 |
|-----------------------------------|------|------|------|------|
| Volume of acid (cm ³) | 26.4 | 25.2 | 25.6 | 25.4 |

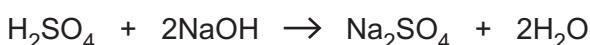
The student decides that the best value for the mean (average) volume of acid is 25.4 cm³.

Show how she calculated this value.

.....
.....

[2]

(c) The equation for this reaction is



| | Relative formula mass, M_r |
|--------------------------|------------------------------|
| H_2SO_4 | 98 |
| NaOH | 40 |
| Na_2SO_4 | 142 |
| H_2O | 18 |

Water is a waste product in this reaction.

Calculate the **atom economy** for the reaction.

Give your answer to 1 decimal place.

Answer = [3]

22 Scientists are worried about the greenhouse effect.

(a) Complete the following paragraph about the greenhouse effect.

Use words from the list.

| | | |
|-----------|----------|-------------|
| CFCs | cool | Earth's |
| hydrogen | infrared | methane |
| microwave | Sun's | ultraviolet |
| | | warm |

Greenhouse gases such as carbon dioxide and absorb radiation radiated by the surface, then emit it in all directions. This greenhouse effect keeps the Earth and its atmosphere enough for living things to exist.

[2]

(b) Write about **two** possible ways that greenhouse gas emissions can be reduced.

.....
.....
.....
.....

[2]

21

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23 This question is about metals and alloys.

(a) The table gives information about some alloys.

| Alloy | Main metal or metals | Use |
|-----------|----------------------|-------------------------------|
| Brass | | Musical instruments and coins |
| Bronze | | Statues |
| Duralumin | | Aircraft parts |
| Solder | Lead and tin | Joining metals |
| Steel | Iron | Bridges, cars |

Complete the table.

Choose your answers from the list.

Aluminium and copper

Aluminium and iron

Copper and tin

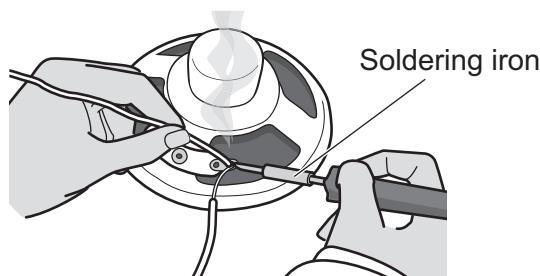
Copper and zinc

Copper and lead

Lead and zinc

[3]

(b) Solder can be used to join metals together. A hot soldering iron is used to melt the solder.



The table gives some information about solder, copper and tin.

| Metal | Melting point (°C) | Density (g/cm ³) | Relative hardness |
|--------|--------------------|------------------------------|-------------------|
| Copper | 1085 | 8.96 | Soft |
| Tin | 232 | 7.31 | Soft |
| Solder | 130 | 10.3 | Quite hard |

Solder is better than copper or tin for joining metals together.

Suggest why. Use the information in the table.

.....
.....
.....

[2]

(c) Steel is an alloy containing iron.

Complete the **word equation** for the corrosion of iron.

Iron + + →

[2]

(d) (i) Iron can be plated with a layer of **zinc** to prevent it corroding.

This is called **galvanising**.

Explain how galvanising prevents iron from corroding.

.....
.....
.....

[2]

(ii) Iron can also be plated with a layer of **tin** to prevent it corroding.

Describe a **disadvantage** of tin plating for preventing corrosion.

.....
.....

[1]

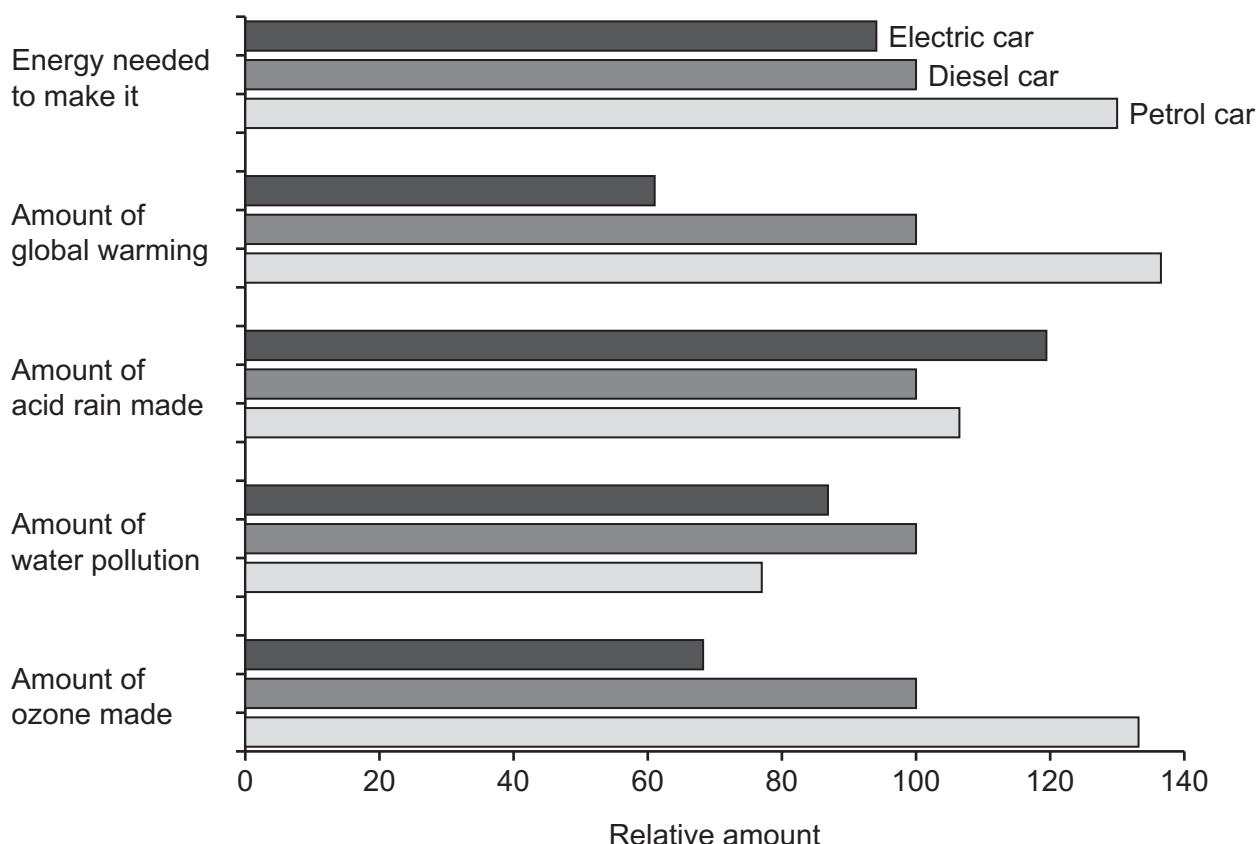
24 This question is about life-cycle assessment.

(a) A car company is developing three new cars:

- A petrol car
- A diesel car
- An electric car.

They do a life-cycle assessment of each car.

Look at the information about the life-cycle assessment of each car.



The company decides to manufacture and sell the electric car.

Explain why they make this choice.

Use the information from the life-cycle assessment to help you.

.....

.....

.....

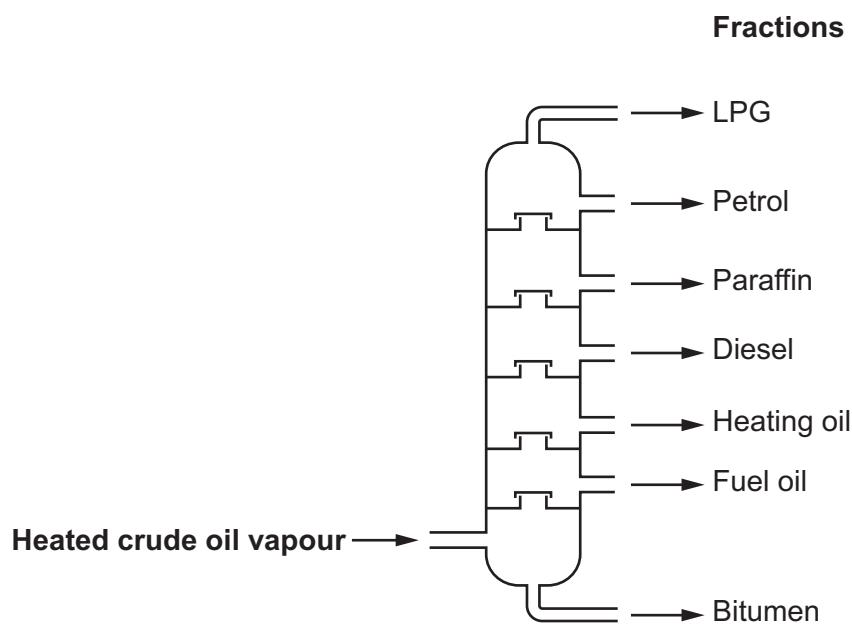
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[3]

(b) The fuels for the petrol and diesel cars are made from crude oil.

Crude oil is separated into different parts by **fractional distillation**.

The diagram shows a fractionating column.



Explain why crude oil **vapour** can be separated by fractional distillation.

[3]

. [3]

(c) The table shows the boiling points of molecules present in different crude oil fractions.

| Molecule | Boiling point (°C) |
|----------|--------------------|
| A | -2 |
| B | 125 |
| C | 216 |
| D | 502 |

Which molecule, **A**, **B**, **C** or **D**, is in the **LPG fraction**?

Explain your decision.

.....
.....

[2]

(d) Car manufacturers are developing cars that are powered by hydrogen/oxygen fuel cells.

The table shows some information about a 200 km journey using an electric car and a car using a fuel cell.

| Feature | Electric | Fuel cell |
|------------------------------|----------|-----------|
| Refuelling time (minutes) | 360 | 4 |
| Cost of refuelling (£) | 3.20 | 4.20 |
| CO ₂ emitted (kg) | 48 | 36 |
| Mass of car (kg) | 1550 | 1200 |

Evaluate the **advantages** and **disadvantages** of using a car powered by a fuel cell, rather than an electric car for the 200 km journey.

.....
.....
.....
.....
.....

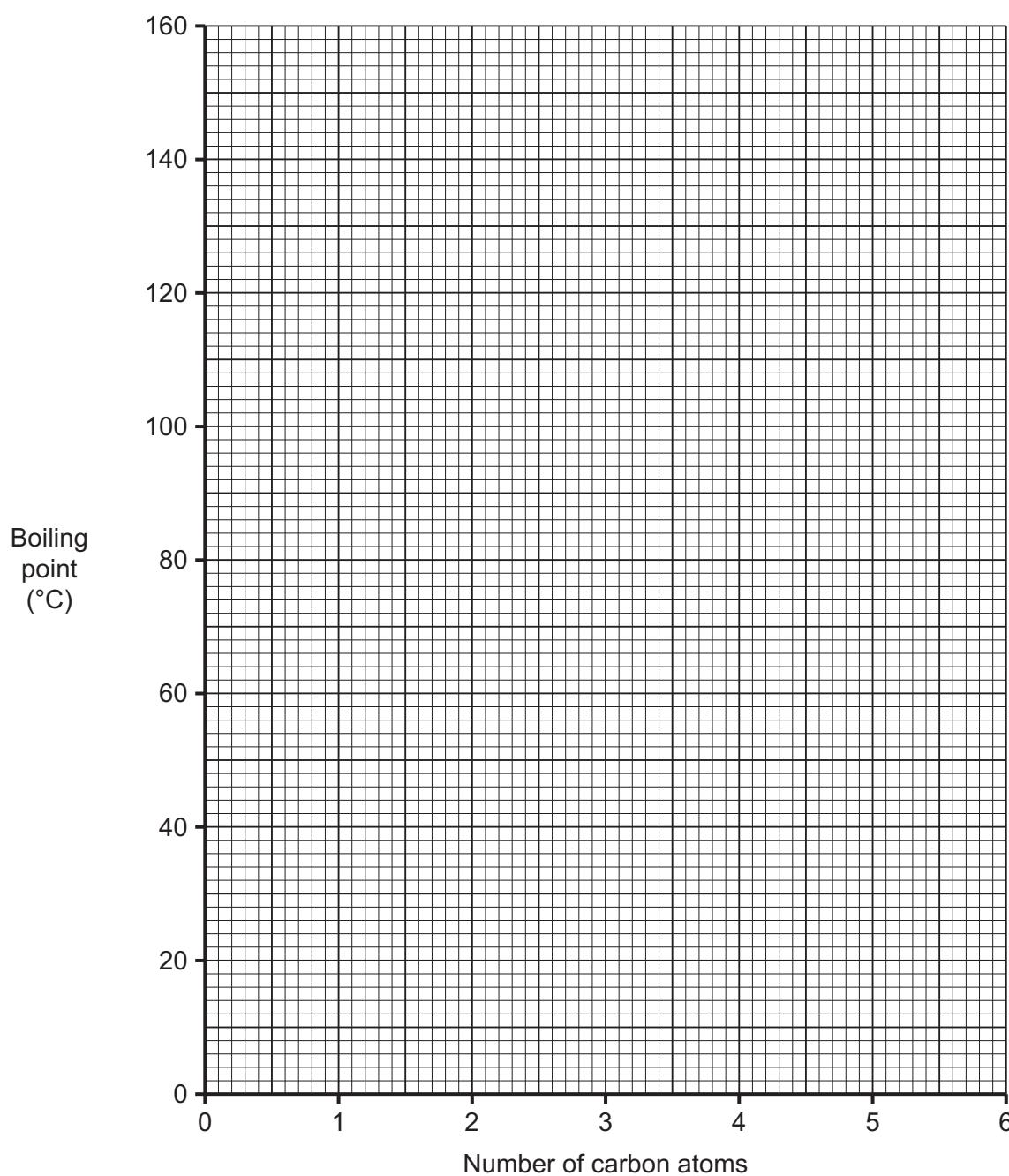
[3]

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25 A student is using the internet to find out about alcohols. The student finds the following information.

| Name | Number of carbon atoms | Boiling point (°C) |
|----------|------------------------|--------------------|
| Methanol | 1 | 65 |
| Ethanol | 2 | 79 |
| Propanol | 3 | 97 |
| Pentanol | 5 | 138 |
| Hexanol | 6 | 156 |

(a) Plot a graph of the boiling points of the alcohols on the grid. Draw a line of best fit.



[3]

29

(b) (i) The student could not find a value for the boiling point of butanol, C_4H_9OH .

Use the graph to estimate the boiling point of butanol.

Answer = $^{\circ}C$ [1]

(ii) Draw the **displayed formula** of butanol, C_4H_9OH .

[1]

(c) The alcohols all react in a similar way because they all contain the same **functional group**.

What is the functional group in an **alcohol** molecule?

..... [1]

(d) Ethanol, C_2H_5OH , can be oxidised to **ethanoic acid** using potassium manganate(VII).

What is the formula of ethanoic acid?

..... [1]

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).





This image shows a blank sheet of handwriting practice paper. It features a vertical red line on the left side, likely representing a margin. To the right of this margin, there are 22 horizontal grey lines spaced evenly down the page, intended for practicing letter formation and alignment.



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