

GCSE (9–1) Chemistry A (Gateway Science)**J248/04** Paper 4, C4–C6 and C7 (Higher Tier)**Wednesday 13 June 2018 – Morning****Time allowed: 1 hour 45 minutes****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
numberCandidate
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.
- Additional paper may be used if required but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the barcodes.

INFORMATION

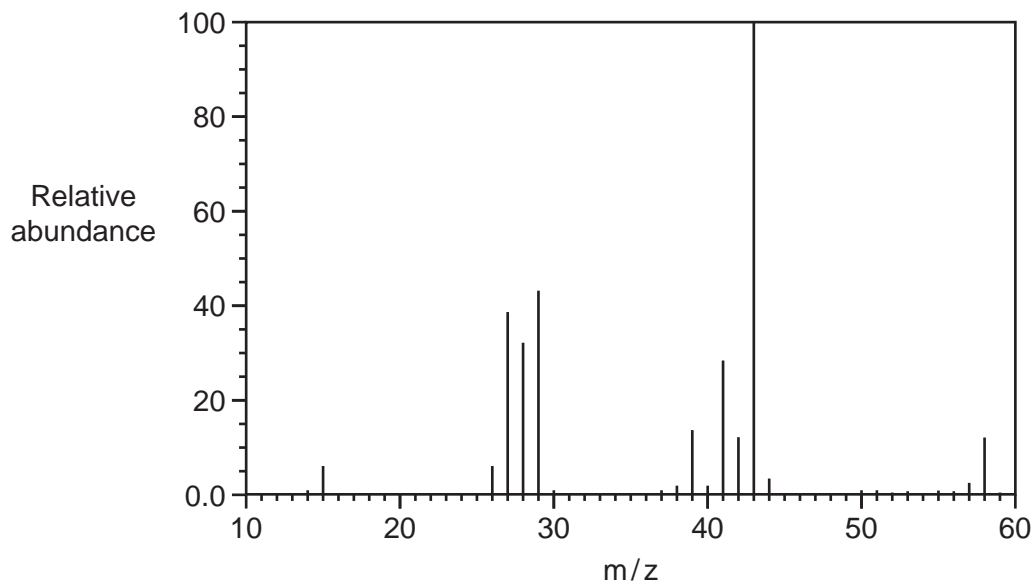
- The total mark for this paper is **90**.
- The marks for each question are shown in brackets [].
- Quality of extended responses will be assessed in questions marked with an asterisk (*).
- This document consists of **28** pages.

2
SECTION A

Answer **all** the questions.

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

- 1** 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]

2 Look at the data about four elements.

Element	Melting point (°C)	Density (g/cm ³)	Ions formed
A	98	0.97	A ⁺
B	-101	0.0032	B ⁻
C	1535	7.9	C ²⁺ , C ³⁺
D	660	2.7	D ³⁺

Which element is a transition element?

Your answer

[1]

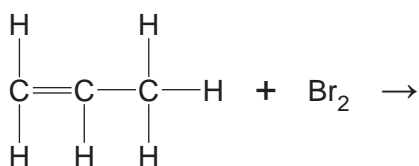
3 Which statement is true for a reversible reaction when it is at dynamic equilibrium?

- 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]

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



- A C₂H₃Br
- B C₃H₅Br₂
- C C₂H₃Br
- D C₃H₆Br₂

Your answer

[1]

5 The following statements describe one possible theory for how the Earth's atmosphere evolved.

The statements are not in the correct order.

1	Formation of water
2	Carbon cycle now keeps the composition of the atmosphere almost constant
3	Atmosphere of ammonia and carbon dioxide
4	Increase in oxygen and nitrogen levels
5	Photosynthetic organisms began to make oxygen
6	Degassing from the Earth's crust

What is the correct order for the sentences?

- A 3, 5, 4, 6, 1, 2
- B 3, 6, 5, 4, 1, 2
- C 6, 1, 3, 5, 4, 2
- D 6, 3, 1, 5, 4, 2

Your answer

[1]

6 Look at the information about four different polymers.

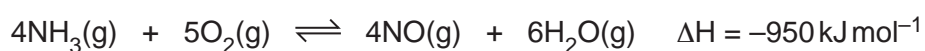
Polymer	Cost (£ per kg)	Tensile strength (MPa)	Melting point (°C)	Maximum useable temperature (°C)
A	0.74	15	120	85
B	1.20	78	254	70
C	0.92	35	176	160
D	1.42	42	156	160

Which polymer would be best for making a plastic washing up bowl?

Your answer

[1]

7 Look at the equation for a reversible reaction.



The reversible reaction forms a dynamic equilibrium in a sealed container.

Which of the following would move the position of equilibrium to the **right**?

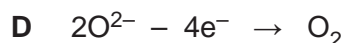
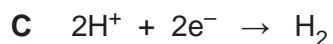
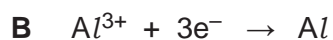
- A Decreasing the pressure and decreasing the temperature.
- B Increasing the pressure and decreasing the temperature.
- C Increasing the pressure and increasing the temperature.
- D Increasing the pressure and using a catalyst.

Your answer

[1]

8 Aluminium is extracted by the electrolysis of molten aluminium oxide, Al_2O_3 .

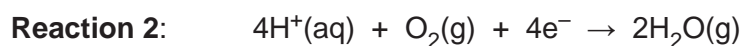
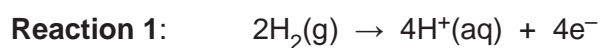
Which equation shows the reaction at the **anode** in this electrolysis?



Your answer

[1]

9 Look at the equations for the reactions that happen at each side of a hydrogen-oxygen fuel cell.



	Reaction 1	Reaction 2
A	Oxidation because electrons are gained	Reduction because electrons are lost
B	Reduction because electrons are gained	Reduction because electrons are gained
C	Oxidation because electrons are lost	Reduction because electrons are gained
D	Oxidation because electrons are lost	Oxidation because electrons are lost

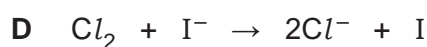
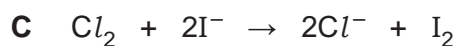
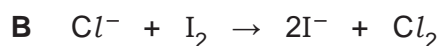
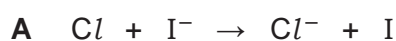
Which row of the table, **A**, **B**, **C** or **D**, is correct about reactions **1** and **2**?

Your answer

[1]

10 Chlorine can displace iodine from iodide ions.

Which equation represents this reaction?



Your answer

[1]

11 How much 0.2 mol/dm^3 hydrochloric acid solution could you make from 100 cm^3 of 1.0 mol/dm^3 hydrochloric acid?

- A 20 cm^3
- B 200 cm^3
- C 500 cm^3
- D 600 cm^3

Your answer

[1]

12 Which one of the following is an **advantage** of phytoextraction?

- A A high concentration of a metal can be obtained from a low grade ore.
- B Bacteria are used to dissolve metals instead of chemical solutions.
- C Better crops of plants are harvested.
- D Phytoextraction is a quick process and is not affected by poor weather.

Your answer

[1]

13 Group 1 elements get more reactive down the group.

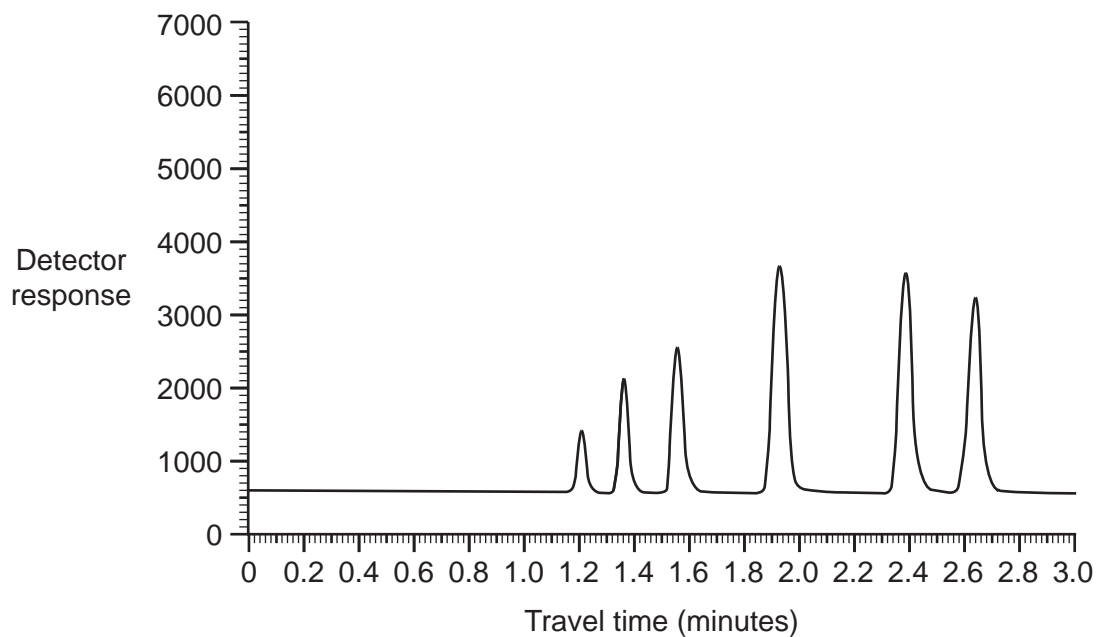
Which statement explains why?

- A The outer electron is closer to the nucleus and lost more easily.
- B The outer electron is further from the nucleus and lost more easily.
- C There is less shielding from the inner electrons.
- D There is more attraction between the nucleus and the outer electron down the group.

Your answer

[1]

14 A gas chromatogram is a chart that represents different substances in a mixture.



Which of the following statements about a gas chromatogram is **not** correct?

- A A gas chromatogram can detect very small amounts of substances.
- B One compound produces several peaks.
- C The area of each peak shows the relative amount of each substance.
- D The retention time is different for different substances.

Your answer

[1]

15 A student wants to test the purity of a liquid by testing its boiling point.

The actual boiling point of the pure liquid is 85 °C.

Which equation represents the percentage (%) difference between the student's value and the actual value?

A % difference = $100 \times \frac{(\text{student's value in } ^\circ\text{C}) - 85^\circ\text{C}}{85^\circ\text{C}}$.

B % difference = $100 \times \frac{85^\circ\text{C} - (\text{student's value in } ^\circ\text{C})}{85^\circ\text{C}}$.

C % difference = $\frac{(\text{student's value in } ^\circ\text{C}) - 85^\circ\text{C}}{85^\circ\text{C}}$.

D % difference = $\frac{85^\circ\text{C} - (\text{student's value in } ^\circ\text{C})}{85^\circ\text{C}}$.

Your answer

[1]

SECTION B

Answer **all** the questions.

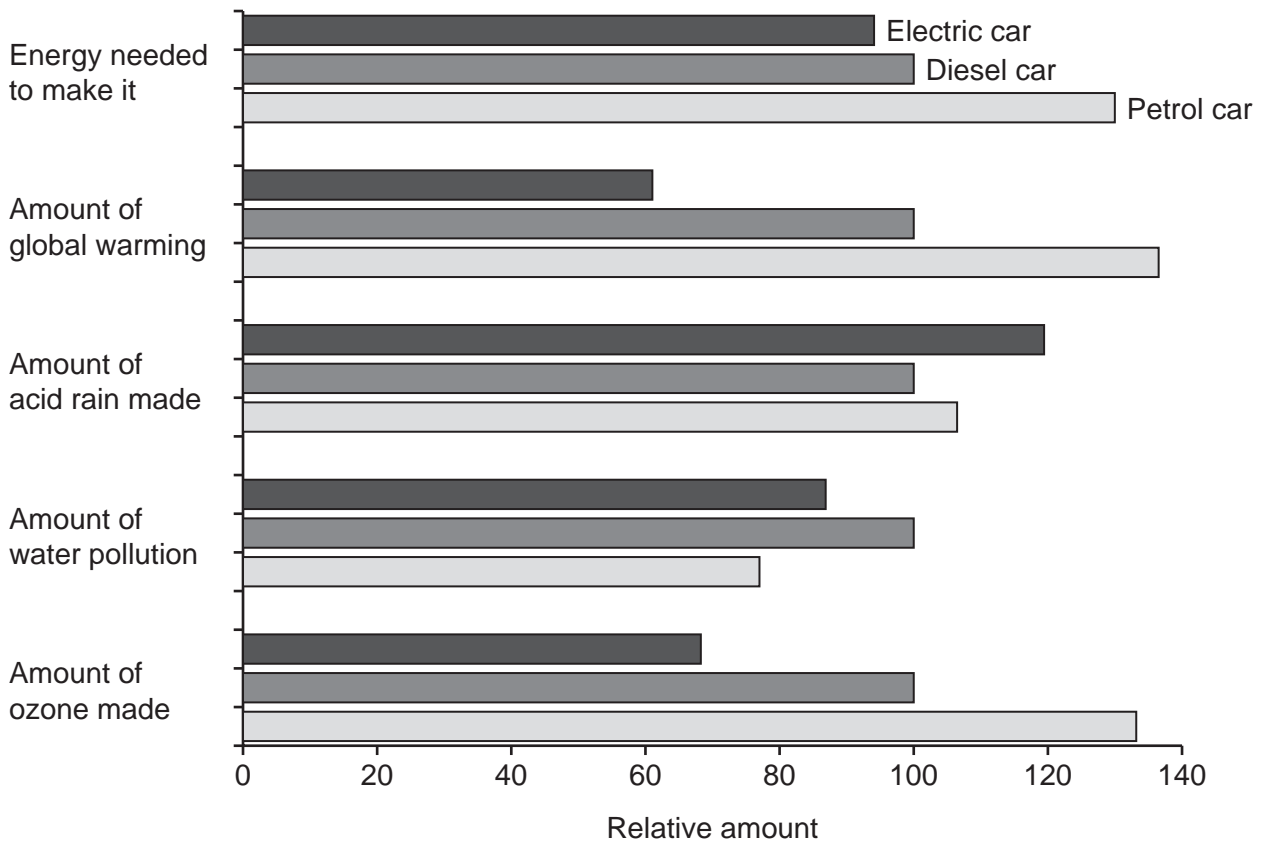
16 This question is about life-cycle assessment.

(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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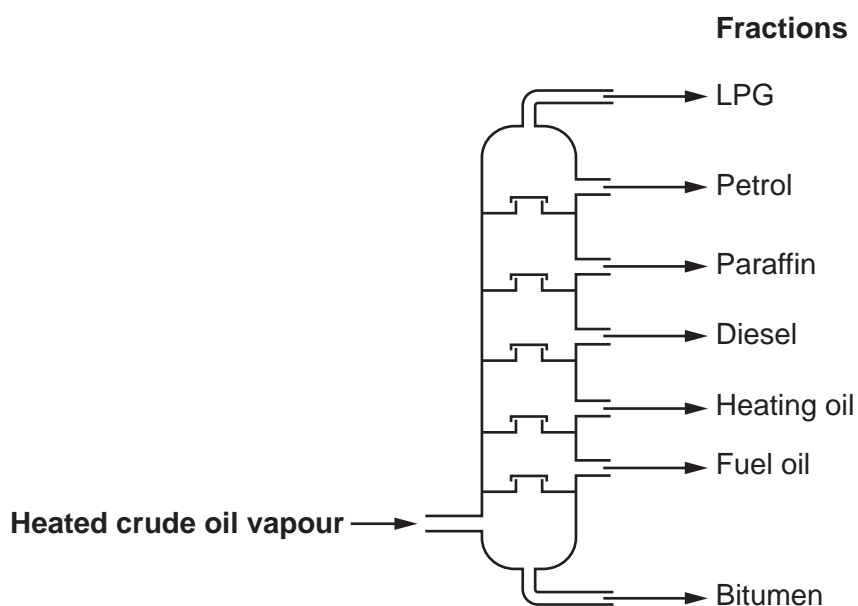
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[3]

(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.

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..... [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 200km 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.

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 [3]

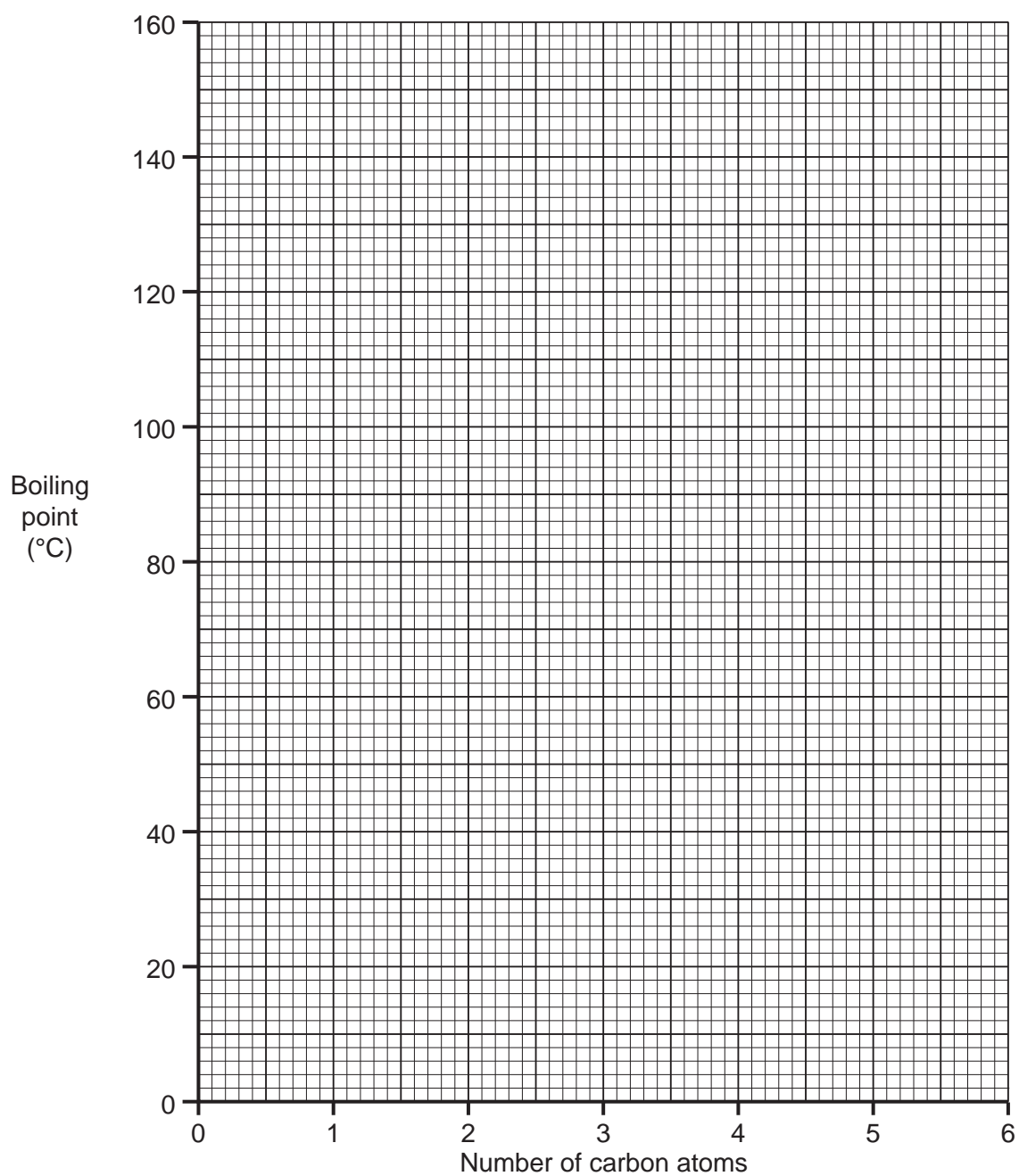
13
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17 A student is using the internet to find out about alcohols. The student finds the following information.

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]

- (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 = °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]

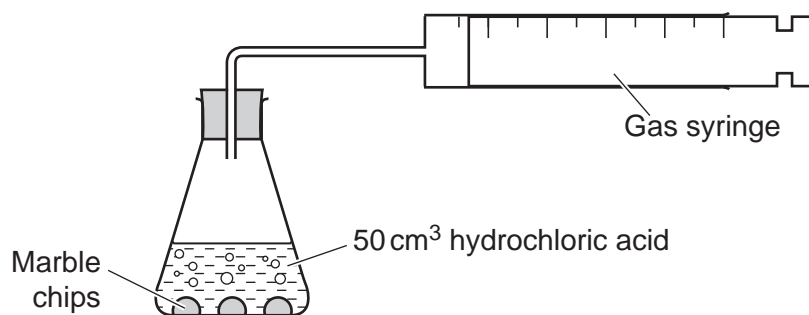
18 A student investigates the reaction between marble chips, CaCO_3 , and hydrochloric acid.

Calcium chloride, CaCl_2 , carbon dioxide and water are made.

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

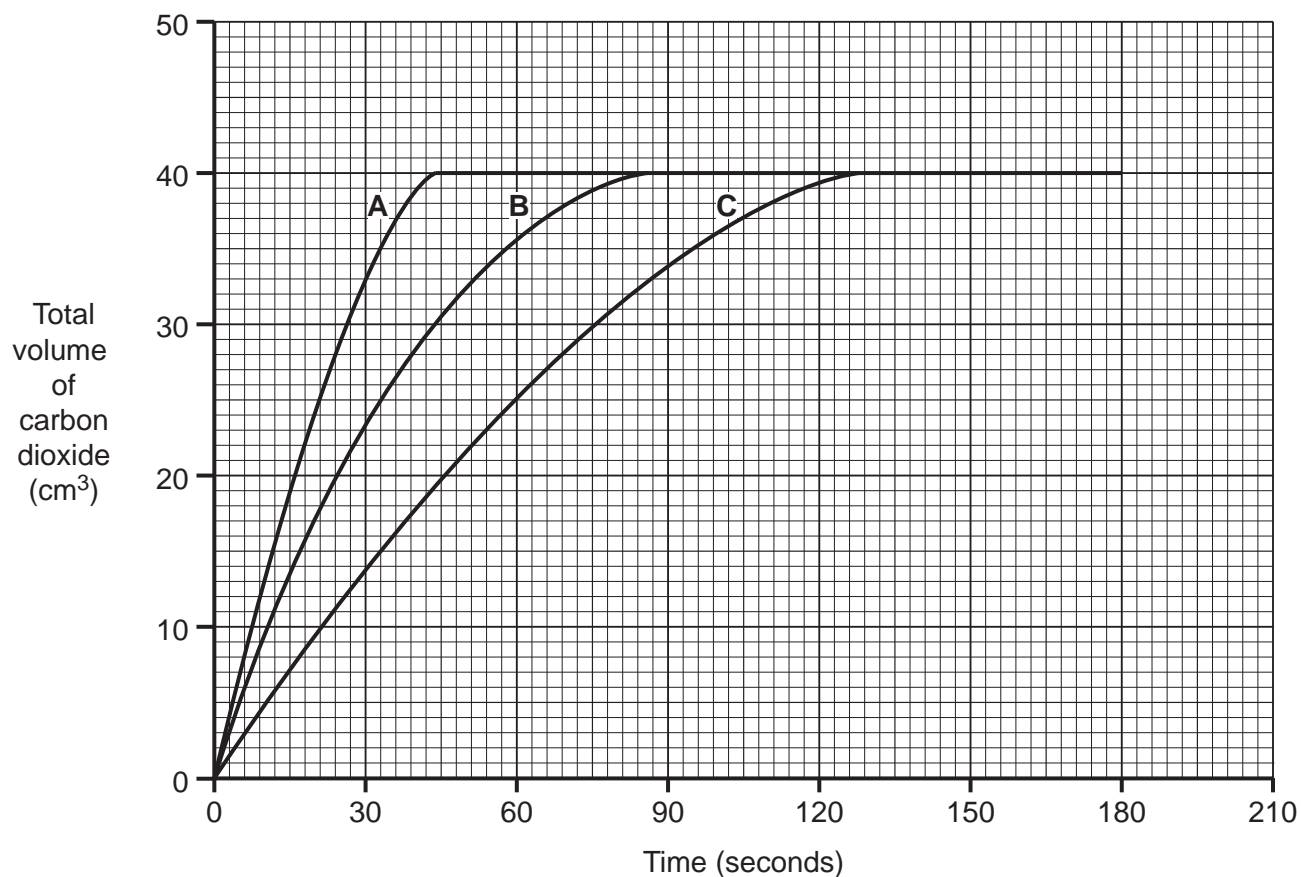
..... [2]

(b) The student does three experiments, **A**, **B** and **C**.



In each experiment she uses a different size of marble chip. She uses the same mass of marble in each experiment. She also uses the same concentration of acid.

Look at the graph of her results.



- (i) Look at the line for experiment **B** on the graph.

When is the rate of reaction **greatest**?

Choose your answer from the list.

0 – 30 seconds

30 – 60 seconds

60 – 90 seconds

90 – 120 seconds

Answer = seconds [1]

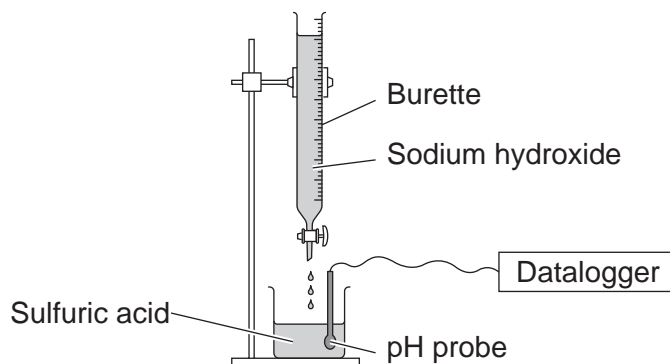
- (ii) Look at the line for experiment **C**.

Calculate the **rate of reaction** during the first 45 seconds.

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

Answer = cm³/s [3]

(b) Student **B** does a titration.



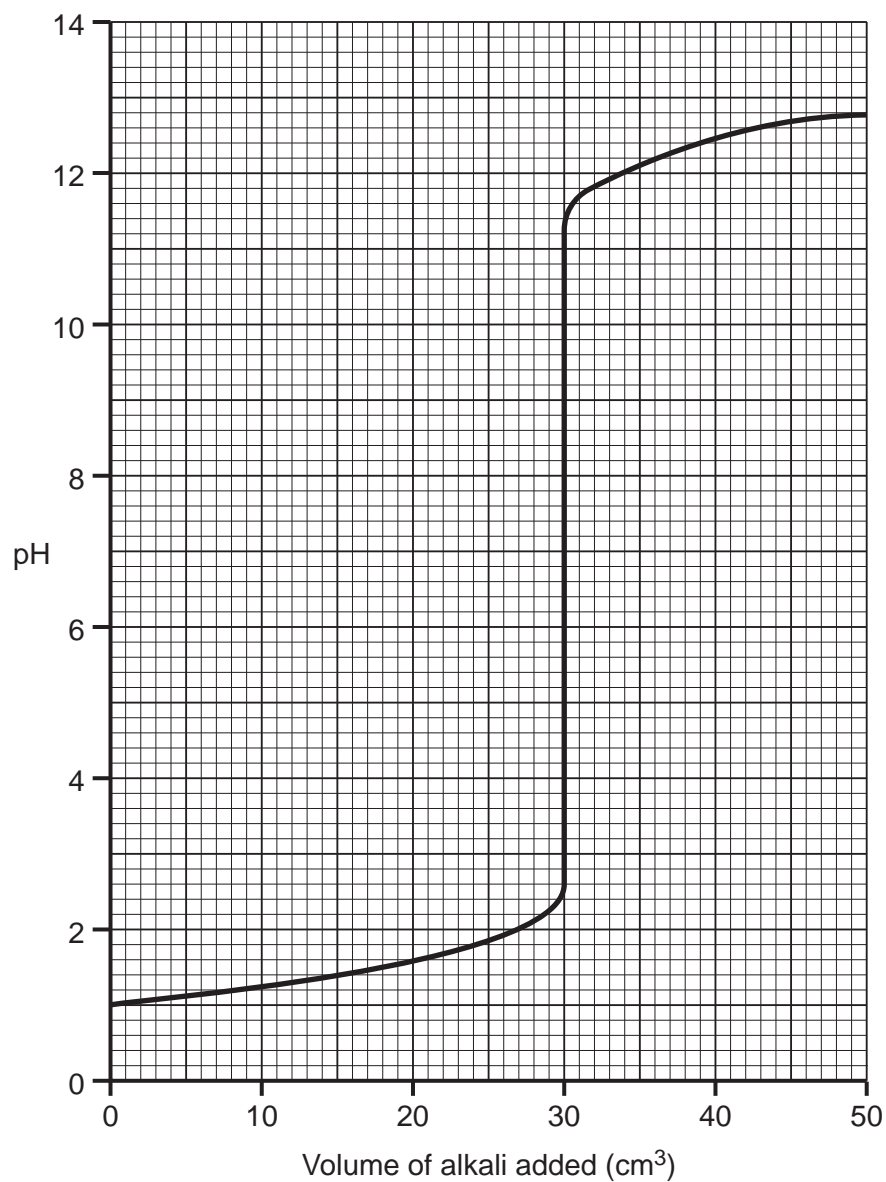
Sodium hydroxide solution is slowly added to the beaker of dilute sulfuric acid.

The pH probe is connected to a datalogger.

Suggest how student **B**'s method is better than student **A**'s.

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

(c) Look at the display from the datalogger.



(i) What is the pH value when 15 cm³ of alkali has been added?

Answer = [1]

(ii) What volume of alkali is needed to exactly neutralise the sulfuric acid?

Answer = cm³ [1]

(d) Student **B** does another experiment.

This time she uses:

- 20.0 cm³ of dilute hydrochloric acid in the beaker
- sodium hydroxide solution of concentration 0.200 mol/dm³ in the burette.

Look at student **B**'s results.

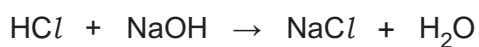
Titration number	1	2	3	4
Final burette reading (cm ³)	26.9	27.6	27.0	28.2
Initial burette reading (cm ³)	0.5	2.5	1.2	3.2
Titre (volume of alkali used) (cm ³)	26.4	25.1	25.8	25.0

(i) Student **B** decides to only use the results from titration numbers **2** and **4**.

Explain why.

.....
 [1]

(ii) Look at the equation for the reaction between hydrochloric acid, HCl, and sodium hydroxide, NaOH.



Calculate the concentration of hydrochloric acid in mol/dm³.

Use the average titre, in cm³, from titration numbers **2** and **4**.

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

Answer = mol/dm³ [4]

21 (a) A student dissolves 0.6 g of zinc sulfate in 250 cm³ of water.

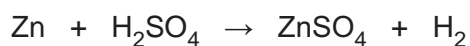
(i) Calculate the volume of the water in dm³.

Answer = dm³ [1]

(ii) Use your answer to part (a)(i) to help you calculate the concentration of the zinc sulfate in g/dm³.

Answer = g/dm³ [1]

(b) Zinc reacts with sulfuric acid. Zinc sulfate and hydrogen gas, H₂, are made.



(i) Calculate the amount of **hydrogen gas**, in mol, that could be made from 3.27 g of **zinc**.

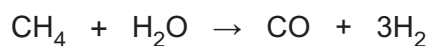
Answer = mol [2]

(ii) Use your answer to part (b)(i) to calculate the **volume** of hydrogen gas produced at room temperature and pressure.

One mole of any gas occupies 24 dm³ at room temperature and pressure.

Answer = dm³ [2]

- (c) Hydrogen can be made by reacting methane with steam.



The **atom economy** for this process is 17.6%.

Hydrogen can also be produced by the decomposition of ammonia.

This reaction requires a catalyst.



- (i) Calculate the atom economy for the production of hydrogen from ammonia.

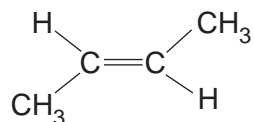
Give your answer to **3** significant figures.

Answer = % **[3]**

- (ii) Suggest other factors, apart from atom economy, that must be considered when deciding which reaction pathway to choose for the manufacture of hydrogen.

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

22 Look at the displayed formula of the monomer butene.



(a) What feature of butene molecules allows them to act as monomers?

..... [1]

(b) Butene is an alkene.

What is the **general formula** for an alkene?

..... [1]

(c) Butene undergoes **addition polymerisation** to form poly(butene).

Write the **displayed formulae**, for poly(butene).

[2]

(d) DNA molecules are polymers made from four different monomers.

What are the monomers in DNA called?

..... [1]

(f) Nylon is another polymer formed in a condensation polymerisation reaction.

Nylon can be made from hexanedioyl dichloride and hexane-1,6-diamine.

Both chemicals are highly corrosive.

A solvent is needed which is highly flammable.

(i) Describe how to make nylon in a laboratory.

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..... [3]

(ii) Describe and explain **three** precautions needed to control the hazards in this experiment.

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..... [3]

END OF QUESTION PAPER



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