

Chemical changes – GCSE Chemistry

1. No.2

0 2

This question is about acids and alkalis.

0 2

. 1

Acids and alkalis are substances that produce ions in aqueous solution.

Draw **one** line from each substance to the ion always produced by that substance in aqueous solution.

[2 marks]

Substance	Ion always produced in aqueous solution
	Cl ⁻
Acid	H ⁺
	Na ⁺
Alkali	OH ⁻
	SO ₄ ²⁻

0 2

. 2

What type of aqueous solution has a pH of 11?

[1 mark]Tick (✓) **one** box.

Acidic

☐

Alkaline

☐

Neutral

☐

A student determined the reacting volumes of hydrochloric acid and sodium hydroxide solution by titration.

This is the method used.

1. Measure 25.0 cm^3 of the sodium hydroxide solution.
2. Add the sodium hydroxide solution to a conical flask.
3. Add 3 drops of indicator to the sodium hydroxide solution.
4. Add the hydrochloric acid drop by drop until the indicator changes colour.
5. Record the volume of the hydrochloric acid added.
6. Repeat steps 1 to 5 three more times.

0 2 . 3

Which piece of equipment should be used to measure 25.0 cm^3 of the sodium hydroxide solution in step 1?

[1 mark]

Tick (✓) **one** box.

Beaker

☐

Pipette

☐

Ruler

☐

0 2 . 4

Which piece of equipment should be used to add the hydrochloric acid drop by drop in step 4?

[1 mark]

Tick (✓) **one** box.

Balance

☐

Burette

☐

Measuring cylinder

☐

Table 1 shows the results.

Table 1

Trial	1	2	3	4
Volume of hydrochloric acid added in cm ³	24.3	24.5	28.1	24.4

0 2 . 5 Which is the anomalous result in Table 1?

[1 mark]

Trial 1 ☐ Trial 2 ☐ Trial 3 ☐ Trial 4 ☐

0 2 . 6 Suggest one reason for the anomalous result in Table 1.

[1 mark]

0 2 . 7 The student used a solution of sodium hydroxide of concentration 4.00 g/dm³.

Calculate the mass of sodium hydroxide in 25.0 cm³ of this solution.

$$1 \text{ dm}^3 = 1000 \text{ cm}^3$$

[3 marks]

Mass = _____ g

2. No.7

0 7

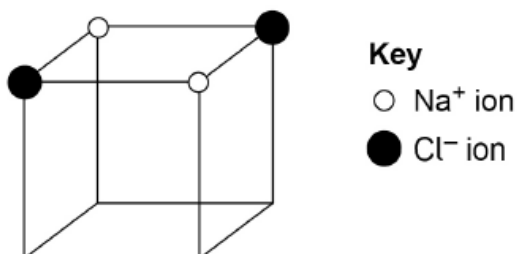
This question is about ionic compounds and electrolysis.

Sodium chloride is an ionic compound.

0 7 . 1

Figure 8 represents part of the structure of solid sodium chloride.

Figure 8



Complete Figure 8.

[2 marks]

0 7 . 2

Give **one** reason why molten sodium chloride conducts electricity.

Refer to ions in your answer.

[1 mark]

0 7 . 3

Table 3 shows products of the electrolysis of two molten ionic compounds.

Complete Table 3.

[2 marks]

Table 3

Molten compound	Product at the negative electrode	Product at the positive electrode
Magnesium bromide	Magnesium	_____
Potassium chloride	_____	Chlorine

07.4

Aluminium is extracted by electrolysis.

The electrolyte is a molten mixture of aluminium oxide and cryolite.

Why is a mixture used instead of pure aluminium oxide as the electrolyte?

[1 mark]

Tick (✓) **one** box.

The mixture has a lower melting point than pure aluminium oxide.

☐

The mixture has the same melting point as pure aluminium oxide.

☐

The mixture has a higher melting point than pure aluminium oxide.

☐

07.5

Electrolysis of an aqueous solution of sodium sulfate produces hydrogen and oxygen.

What is the source of the hydrogen and the oxygen produced during the electrolysis of aqueous sodium sulfate solution?

[1 mark]

Tick (✓) **one** box.

Air

☐

Sulfate ions

☐

Water

☐

Electrolysis of an aqueous solution of sodium sulfate produces hydrogen and oxygen.

0 7 . 6

Why is hydrogen produced instead of sodium in the electrolysis of aqueous sodium sulfate solution?

[1 mark]

Tick (✓) **one** box.

Hydrogen is less reactive than sodium.

☐

Hydrogen has the same reactivity as sodium.

☐

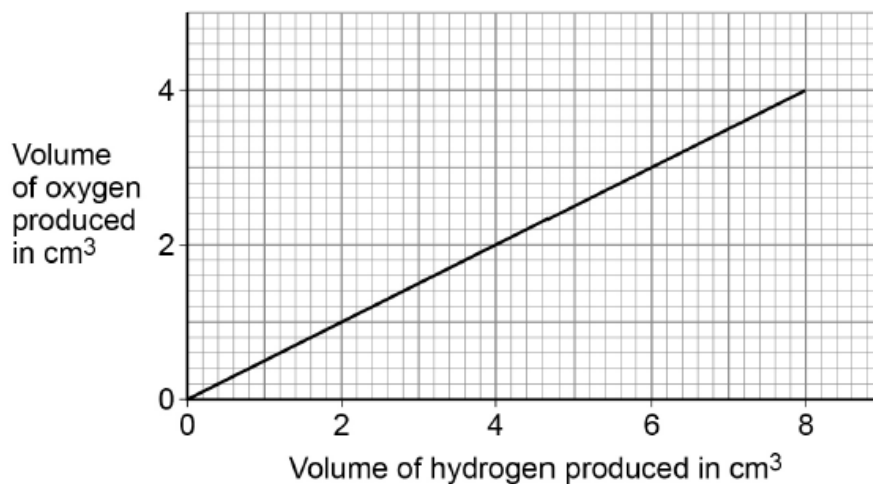
Hydrogen is more reactive than sodium.

☐

0 7 . 7

Figure 9 shows the relationship between the volume of hydrogen and the volume of oxygen produced during the electrolysis.

Figure 9



Give **one** conclusion that can be made about the volume of hydrogen produced compared to the volume of oxygen produced.

[1 mark]

3. No.8

0 8

This question is about displacement reactions.

Iron is extracted from iron oxide by a displacement reaction with carbon.

0 8

. 1

Balance the equation for the reaction.

[2 marks]



0 8

. 2

Iron oxide is reduced in this reaction.

How does the equation show that iron oxide is reduced?

[1 mark]

0 8

. 3

Calculate the relative formula mass (M_r) of Fe_2O_3 Relative atomic masses (A_r): O = 16 Fe = 56

[2 marks]

 $M_r =$ _____

08.4

Copper oxide reacts with hydrogen to produce copper.

The equation for the reaction is:



Calculate the percentage atom economy for obtaining copper from this reaction.

Use the equation:

$$\text{Percentage atom economy} = \frac{A_r \text{ of Cu}}{M_r \text{ of H}_2 + M_r \text{ of CuO}} \times 100$$

Relative atomic mass (A_r): Cu = 63.5

Relative formula masses (M_r): H₂ = 2 CuO = 79.5

[2 marks]

Percentage atom economy = _____ %

A student investigated the reactivity of four different metals, **A**, **B**, **C** and **D**.

The student:

- added each metal to aqueous solutions of each of the metal sulfates
- observed whether a reaction took place.

08.5

Give one observation that would show a reaction took place.

[1 mark]

0 8 . 6 Table 4 shows the results.

Table 4

	Metal sulfate solution			
Metal	A sulfate	B sulfate	C sulfate	D sulfate
A	×	×	✓	×
B	✓	×	✓	×
C	×	×	×	×
D	✓	✓	✓	×

✓ shows that a displacement reaction took place.

× shows that a displacement reaction did not take place.

Write metals **A**, **B**, **C** and **D** in order of reactivity.

Give a reason for your order of reactivity.

[2 marks]

Most reactive _____

Least reactive _____

Reason _____

[6 marks]

[illegible]

[2 marks]

- 1 _____
- 2 _____

5. No.5

0 5

This question is about acids and alkalis.

0 5 . 1

Ethanoic acid is a weak acid.

What is meant by 'weak acid'?

Answer in terms of ionisation.

[1 mark]

0 5 . 2

The concentration of an acid can be measured in mol/dm^3 .Which combination of changes **increases** the concentration of an acid?

[1 mark]

Tick (✓) **one** box.

The mass of acid dissolved is halved and the volume of the solution is halved.

☐

The mass of acid dissolved is halved and the volume of the solution is doubled.

☐

The mass of acid dissolved is doubled and the volume of the solution is halved.

☐

The mass of acid dissolved is doubled and the volume of the solution is doubled.

☐

0 5 . 3

The concentration of an acid can be determined by titration.

An indicator is added to an alkali in a flask.

Name an indicator that can be used in this titration.

Give the colour change of the indicator when acid from a burette is added to the alkali in the flask.

[2 marks]

Name of indicator _____

Colour change from _____ to _____

0 5 . 4

Sodium carbonate dissolves in water to produce an alkaline solution.

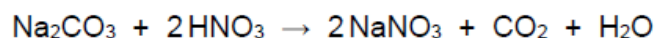
Give the formula of the ion that makes a solution alkaline.

[1 mark]

0 5 . 5

A student does a titration using sodium carbonate solution and nitric acid.

The equation for the reaction is:



25.0 cm³ of 0.124 mol/dm³ sodium carbonate solution is neutralised by 23.6 cm³ of nitric acid.

Calculate the concentration of the nitric acid.

Give your answer to 3 significant figures.

You should calculate:

- the number of moles of sodium carbonate in 25.0 cm³ of the solution
- the number of moles of nitric acid in 23.6 cm³ of the nitric acid
- the concentration of the nitric acid in mol/dm³.

[5 marks]

Concentration (3 significant figures) = _____ mol/dm³

When hydrochloric acid dissolves in water, hydrogen ions (H^+) and chloride ions (Cl^-) are produced.

0 5 . 6

A solution of hydrochloric acid with pH 4.5 has a concentration of H^+ ions of $3.16 \times 10^{-5} \text{ mol/dm}^3$.

What is the concentration of H^+ ions in a solution of hydrochloric acid with pH 2.5?

[1 mark]

Concentration of H^+ ions = _____ mol/dm^3

0 5 . 7

Which element has atoms that have the same electronic structure as the chloride ion?

Use the periodic table.

[1 mark]

6. No.7

0	7
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This question is about electrolysis.

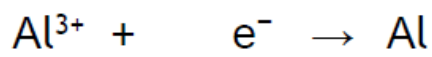
Aluminium is manufactured by electrolysing a molten mixture of aluminium oxide (Al_2O_3) and cryolite (Na_3AlF_6).

0	7
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.	1
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Complete the half equation for the reaction occurring at the negative electrode.

[1 mark]



0	7
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.	2
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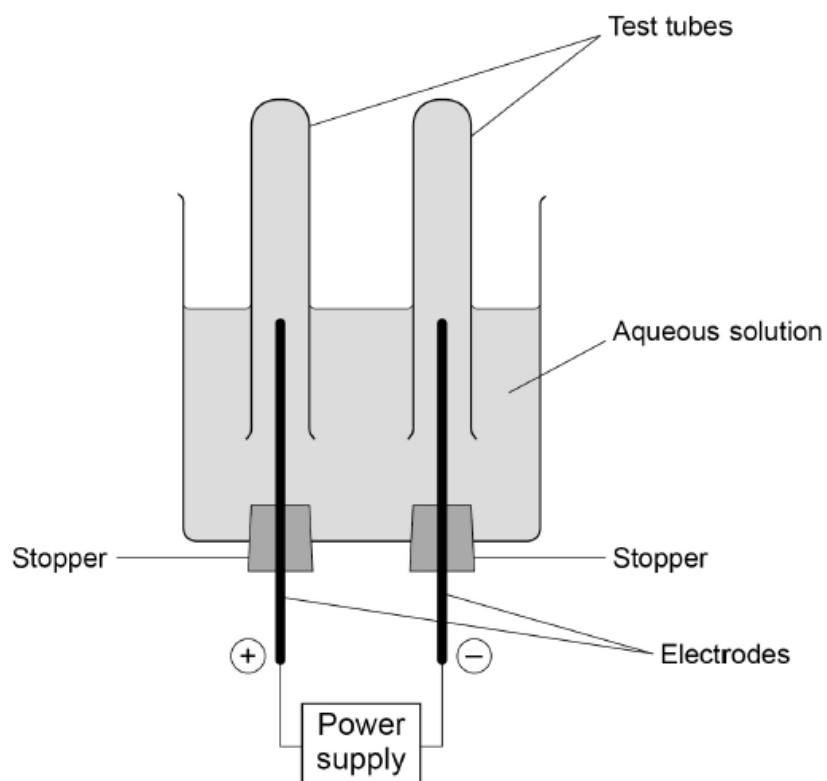
Cryolite contains Na^{+} ions as well as Al^{3+} ions.Suggest **one** reason why sodium is **not** a product of the electrolysis.

[1 mark]

A student investigated the electrolysis of an aqueous solution of a different compound.

Figure 7 shows the apparatus.

Figure 7



Hydrogen was produced at the negative electrode and oxygen was produced at the positive electrode.

0 7 . 3

Explain how oxygen was produced from water during the electrolysis of this aqueous solution.

[4 marks]

0 7 . 4

The student compared the volumes of the two gases collected.

How can the student change the apparatus in **Figure 7** to compare the volumes of the two gases produced more accurately?

Give **one** reason for your answer.

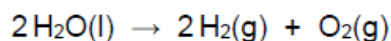
[2 marks]

Change _____

Reason _____

0 7 . 5

The overall equation for the reaction is:



What is the volume of oxygen produced when 20 cm³ of hydrogen has been produced?

[1 mark]

Tick (✓) **one** box.

10 cm³

☐

20 cm³

☐

30 cm³

☐

40 cm³

☐

7. No.9

0 9

This question is about displacement reactions.

Iron is extracted from iron oxide by a displacement reaction with carbon.

The equation for the reaction is:



0 9 . 1

Which substance in the equation is reduced?

Give **one** reason for your answer.

Answer in terms of oxygen.

[2 marks]

Substance reduced _____

Reason _____

0 9 . 2

Which expression shows how to calculate the mass of carbon needed to produce 1 mole of iron from iron oxide?

Relative atomic mass (A_r): C = 12

[1 mark]

Tick (✓) **one** box.

$$\frac{1}{3} \times 12 \text{ g}$$

☐

$$\frac{3}{2} \times 12 \text{ g}$$

☐

$$1 \times 12 \text{ g}$$

☐

$$3 \times 12 \text{ g}$$

☐

A student investigated displacement reactions of four different metals represented by **A**, **B**, **C** and **D**.

A, **B**, **C** and **D** are **not** the actual chemical symbols for the metals.

The student:

- added each metal to aqueous solutions of the metal nitrates
- observed whether a reaction took place.

Table 6 shows information about three of the reaction mixtures.

Table 6

Reaction	Metal	Metal nitrate solution	Equation
1	A	BNO₃	$\text{A} + 2\text{BNO}_3 \rightarrow 2\text{B} + \text{A(NO}_3)_2$
2	C	A(NO₃)₂	$2\text{C} + 3\text{A(NO}_3)_2 \rightarrow 3\text{A} + 2\text{C(NO}_3)_3$
3	C	D(NO₃)₂	no reaction

0 9 . 3 The ionic equation for **Reaction 1** is:



Why is this a redox reaction?

[1 mark]

Tick (✓) **one** box.

A gains electrons and **B⁺** loses electrons.

☐

A loses electrons and **B⁺** gains electrons.

☐

Both **A** and **B⁺** gain electrons.

☐

Both **A** and **B⁺** lose electrons.

☐

0 9 . 4 Which of the four metals has the greatest tendency to form positive ions?

Use Table 6.

[1 mark]

Tick (✓) **one** box.

A ☐

B ☐

C ☐

D ☐

0 9 . 5 The nitrate ion has the formula NO_3^-

Which of the four metals could be aluminium?

Explain your answer.

Use Table 6.

[3 marks]

Metal _____

Explanation _____

0 9 . 6 Metal **X** is extracted from an oxide of metal **X** by reaction with hydrogen.

The equation for the reaction is:



The percentage atom economy for obtaining metal **X** by this method is 77.3%.

Calculate the relative atomic mass (A_r) of metal **X**.

Relative atomic masses (A_r): H = 1 O = 16

[4 marks]

Relative atomic mass (A_r) = _____