

[1.1] An equation for the reaction is:



Calculate the percentage atom economy for the reaction to produce nickel.

Relative atomic masses (A_r): C = 12 Ni = 59

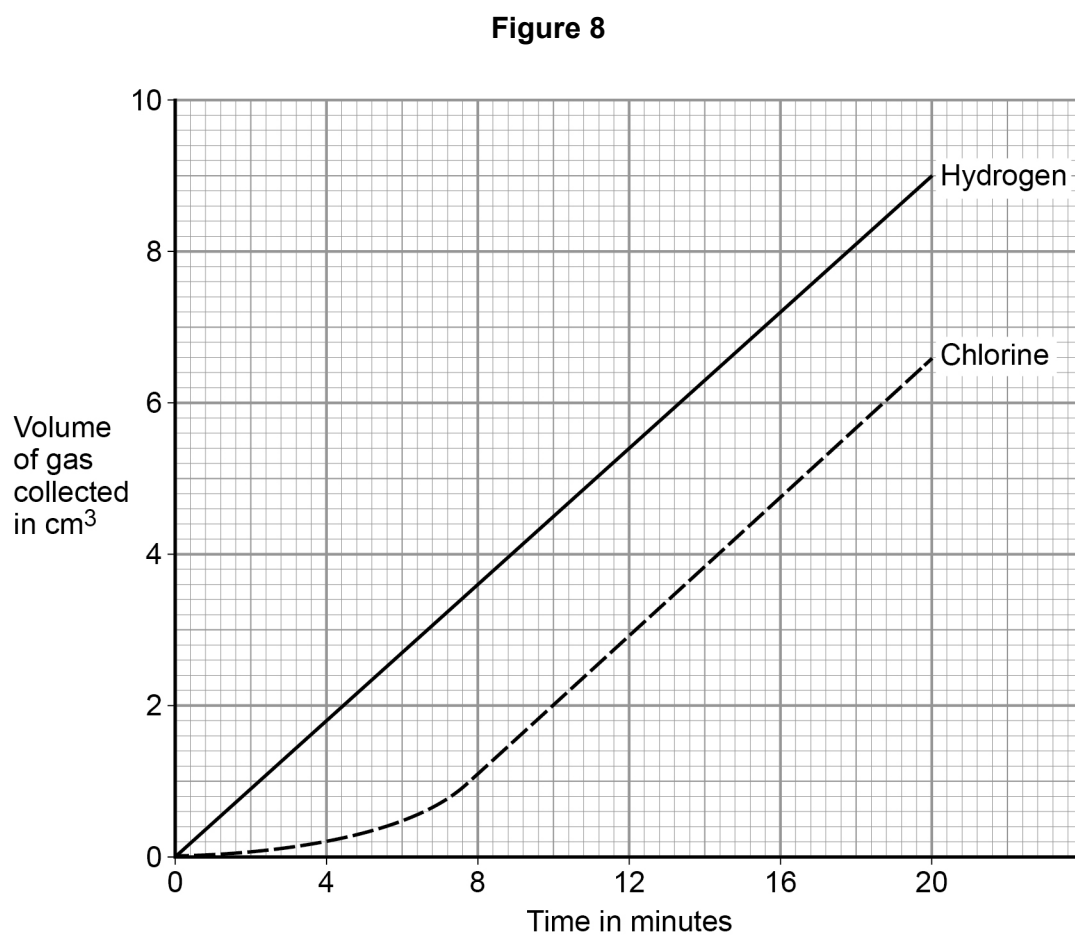
Relative formula mass (M_r): NiO = 75

Give your answer to 3 significant figures.

[3 marks]

Percentage atom economy = _____ %

Figure 8 shows the student's results.



[2.1] The number of moles of each gas produced at the electrodes is the same.

No gas escapes from the apparatus.

Suggest **one** reason for the difference in volume of each gas collected.

[1 mark]

[2.2] Calculate the amount in moles of chlorine collected after 20 minutes.

Use **Figure 8**.

The volume of one mole of any gas at room temperature and pressure is 24.0 dm^3

Give your answer in standard form.

[3 marks]

Moles of chlorine = _____ mol

[3.1] For a **Stage 2** reaction the percentage yield was 92.3%

The theoretical maximum mass of titanium produced in this batch was 13.5 kg.

Calculate the actual mass of titanium produced.

[2 marks]

Mass of titanium = _____ kg

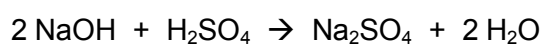
A student titrated 25.0 cm³ portions of dilute sulfuric acid with a 0.105 mol/dm³ sodium hydroxide solution.

[4.1] **Table 4** shows the student's results.

Table 4

	Titration 1	Titration 2	Titration 3	Titration 4	Titration 5
Volume of sodium hydroxide solution in cm ³	23.50	21.10	22.10	22.15	22.15

The equation for the reaction is:



Calculate the concentration of the sulfuric acid in mol/dm³

Use only the student's concordant results.

Concordant results are those within 0.10 cm³ of each other.

[5 marks]

Concentration of sulfuric acid = _____ mol/dm³

- [4.2] Explain why the student should use a pipette to measure the dilute sulfuric acid and a burette to measure the sodium hydroxide solution.

[2 marks]

- [4.3] Calculate the mass of sodium hydroxide in 30.0 cm^3 of a 0.105 mol/dm^3 solution.

Relative formula mass (M_r): NaOH = 40

[2 marks]

Mass of sodium hydroxide = _____ g

The student tested two samples of dilute sulfuric acid, **P** and **Q**.

[6 marks]

[illegible]

[6.1] Calculate the volume of 150 kg of chlorine gas at room temperature and pressure.

The volume of one mole of any gas at room temperature and pressure is 24.0 dm^3

Relative formula mass (M_r): $\text{Cl}_2 = 71$

[2 marks]

Volume = _____ dm^3

The student found that 15.5 cm³ of 0.500 mol/dm³ dilute sulfuric acid completely reacted with 25.0 cm³ of potassium hydroxide solution.

$$2\text{KOH} + \text{H}_2\text{SO}_4 \rightarrow \text{K}_2\text{SO}_4 + 2\text{H}_2\text{O}$$

Relative atomic masses (A_r): H = 1 O = 16 K = 39

[6 marks]

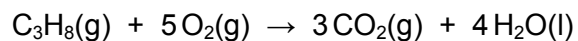
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Concentration in mol/dm³ = mol/dm³

Concentration in g/dm^3 = g/dm^3

[8.1] Propane burns to form carbon dioxide and water.

The equation for the reaction is:



3.60 dm³ carbon dioxide is produced when a sample of propane is burned in 7.25 dm³ oxygen.

Calculate the volume of unreacted oxygen.

Give your answer in cm³

[4 marks]

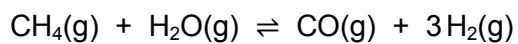
Volume of unreacted oxygen = _____ cm³

Hydrogen is used to produce ammonia in the Haber process.

The hydrogen is made in two stages.

Stage 1 is the reaction of methane and steam to produce carbon monoxide and hydrogen.

The equation for the reaction is:



[9.1] Calculate the atom economy for the formation of hydrogen in **stage 1**.

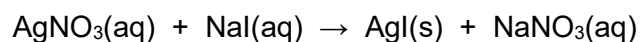
Relative atomic masses (A_r): H = 1 C = 12 O = 16

[2 marks]

Atom economy = _____ %

- [10.1] Calculate the percentage atom economy for the production of silver iodide in this reaction.

The equation for the reaction is:



Give your answer to 3 significant figures.

Relative formula masses (M_r): $\text{AgNO}_3 = 170$ $\text{NaI} = 150$ $\text{AgI} = 235$ $\text{NaNO}_3 = 85$

[4 marks]

Percentage atom economy (3 significant figures) = _____ %

- [10.2] Give **one** reason why reactions with a high atom economy are used in industry.

[1 mark]

- [11.1] The energy needed for a car powered by a hydrogen fuel cell to travel 100 km is 58 megajoules (MJ).

The energy released when 1 mole of hydrogen gas reacts with oxygen is 290 kJ

The volume of 1 mole of a gas at room temperature and pressure is 24 dm³

Calculate the volume of hydrogen gas at room temperature and pressure needed for the car to travel 100 km

[4 marks]

Volume of hydrogen gas = _____ dm³

The student used a solution of citric acid to determine the concentration of a solution of sodium hydroxide by titration.

- [12.1] The student made 250 cm^3 of a solution of citric acid of concentration 0.0500 mol/dm^3 . Calculate the mass of citric acid ($\text{C}_6\text{H}_8\text{O}_7$) required.

Relative atomic masses (A_r): H = 1 C = 12 O = 16

[3 marks]

Mass = _____ g

This is part of the method the student used for the titration.

1. Measure 25.0 cm^3 of the sodium hydroxide solution into a conical flask using a pipette.
2. Add a few drops of indicator to the flask.
3. Fill a burette with citric acid solution.

- [12.2] Describe how the student would complete the titration.

[3 marks]

[12.3] Give **two** reasons why a burette is used for the citric acid solution.

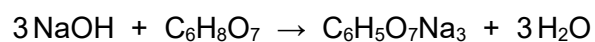
[2 marks]

1 _____

2 _____

[12.4] 13.3 cm³ of 0.0500 mol/dm³ citric acid solution was needed to neutralise 25.0 cm³ of sodium hydroxide solution.

The equation for the reaction is:



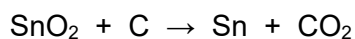
Calculate the concentration of the sodium hydroxide solution in mol/dm³

[3 marks]

Concentration = _____ mol/dm³

[13.1] Carbon is used to extract tin (Sn) from tin oxide (SnO₂).

The equation for the reaction is:



Calculate the percentage atom economy for extracting tin in this reaction.

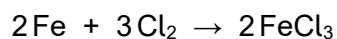
Relative atomic masses (*A_r*): C = 12 O = 16 Sn = 119

[3 marks]

Percentage atom economy = _____ %

[14.1] Iron chloride is produced by heating iron in chlorine gas.

The equation for the reaction is:



Calculate the volume of chlorine needed to react with 14 g of iron.

You should calculate:

- the number of moles of iron used
- the number of moles of chlorine that react with 14 g of iron
- the volume of chlorine needed.

Relative atomic mass (A_r): Fe = 56

The volume of 1 mole of gas = 24 dm³

[3 marks]

Volume of chlorine = _____ dm³

A student investigated the concentration of a solution of sodium hydroxide by titration with a 0.0480 mol/dm^3 ethanedioic acid solution.

This is the method used.

1. Measure 25.0 cm^3 of the sodium hydroxide solution into a conical flask using a 25.0 cm^3 pipette.
2. Add two drops of indicator to the sodium hydroxide solution.
3. Fill a burette with the 0.0480 mol/dm^3 ethanedioic acid solution to the 0.00 cm^3 mark.
4. Add the ethanedioic acid solution to the sodium hydroxide solution until the indicator changes colour.
5. Read the burette to find the volume of the ethanedioic acid solution used.

- [15.1] Suggest **two** improvements to the method that would increase the accuracy of the result.

[2 marks]

1 _____

2 _____

[15.2] Ethanedioic acid is a solid at room temperature.

Calculate the mass of ethanedioic acid ($\text{H}_2\text{C}_2\text{O}_4$) needed to make 250 cm^3 of a solution with concentration 0.0480 mol/dm^3

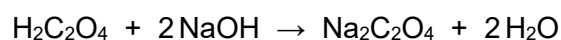
Relative formula mass (M_r): $\text{H}_2\text{C}_2\text{O}_4 = 90$

[2 marks]

Mass = _____ g

[15.3] The student found that 25.0 cm^3 of the sodium hydroxide solution was neutralised by 15.00 cm^3 of the 0.0480 mol/dm^3 ethanedioic acid solution.

The equation for the reaction is:



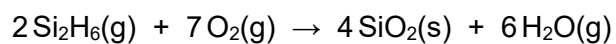
Calculate the concentration of the sodium hydroxide solution in mol/dm^3

[3 marks]

Concentration = _____ mol/dm^3

[16.1] Si_2H_6 reacts with oxygen.

The equation for the reaction is:



30 cm³ of Si_2H_6 is reacted with 150 cm³ (an excess) of oxygen.

Calculate the total volume of gases present after the reaction.

All volumes of gases are measured at the same temperature and pressure.

[4 marks]

Volume of gases = _____ cm³

- [17.1] A student titrated 25.00 cm³ of hydrochloric acid with 0.100 mol/dm³ barium hydroxide solution.

Table 2 shows the results.

Table 2

Titration number	1	2	3	4	5
Volume of barium hydroxide solution used in cm ³	23.90	23.45	23.55	23.55	23.45

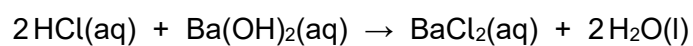
The student calculated the volume of barium hydroxide solution to be used in the titration calculation as 23.50 cm³.

Explain why the student used a volume of 23.50 cm³ of barium hydroxide solution in the titration calculation.

[2 marks]

- [17.2] 25.00 cm³ of the hydrochloric acid reacted with 23.50 cm³ of the 0.100 mol/dm³ barium hydroxide solution.

The equation for the reaction is:



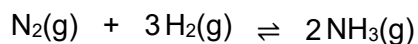
Calculate the concentration of the hydrochloric acid in mol/dm³.

[4 marks]

Concentration of the hydrochloric acid = _____ mol/dm³

The raw materials for the Haber process are nitrogen and hydrogen.

The equation for the reaction is:



0 7 . 1

Give the sources of the nitrogen and of the hydrogen used in the Haber process.

[2 marks]

Nitrogen _____

Hydrogen _____

[18.1]

How does the equation for the reaction show that the atom economy of the forward reaction is 100%?

[1 mark]

[19.1] 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.

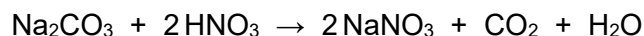
☐

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

☐

[19.2] 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:

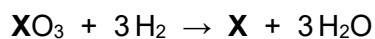
- the number of moles of sodium carbonate in 25.0 cm³ of the solution
- the number of moles of nitric acid in 23.6 cm³ of the nitric acid
- the concentration of the nitric acid in mol/dm³.

[5 marks]

Concentration (3 significant figures) = _____ mol/dm³

[20.1] 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) = _____

$$\text{TiO}_2 + 2\text{Cl}_2 + 2\text{C} \rightarrow \text{TiCl}_4 + 2\text{CO}$$

Relative atomic masses (A_r): O = 16 Ti = 48

The volume of one mole of gas = 24 dm^3

[6 marks]

[illegible]

Volume = dm³