

Titration Calculations Gas Volumes

GCSE Chemistry · Written to the shared content for AQA, Edexcel and OCR

Name _____ Class _____ Date _____

1. Worked example

25.0 cm³ of 0.100 mol/dm³ sodium hydroxide is neutralised by 20.0 cm³ of hydrochloric acid. Calculate the concentration of the acid. $\text{NaOH} + \text{HCl} \rightarrow \text{NaCl} + \text{H}_2\text{O}$ (3 marks)

Step 1 · Moles of NaOH

$$0.100 \times 25.0 \div 1000 = 0.00250 \text{ mol}$$

Step 2 · Ratio 1 : 1

$$0.00250 \text{ mol HCl}$$

Step 3 · Concentration

$$0.00250 \div 0.0200 = 0.125 \text{ mol/dm}^3$$

Answer: 0.125 mol/dm³

Check: Less acid than alkali was needed, so the acid is more concentrated ✓

2. Now try one with the steps

25.0 cm³ of 0.200 mol/dm³ NaOH is neutralised by 12.5 cm³ of sulfuric acid. Calculate the concentration of the acid. $\text{H}_2\text{SO}_4 + 2\text{NaOH} \rightarrow \text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O}$ (3 marks)

Step 1 · Moles of NaOH

Step 2 · Ratio acid : alkali = 1 : 2

Step 3 · Concentration

Answer:

3. Practice

Show your working. The marks tell you how much is expected.

- 1.** State the volume, in dm³, occupied by one mole of any gas at room temperature and pressure. [1]

- 2.** Calculate the volume, in dm³, of 0.50 mol of nitrogen at room temperature and pressure. [1]

- 3.** Calculate the number of moles in 6.0 dm³ of a gas at room temperature and pressure. [1]

4. Calculate the volume, in dm^3 , of 4.4 g of carbon dioxide at room temperature and pressure. (C = 12, O = 16) [2]

5. Calculate the mass, in g, of 6.0 dm^3 of oxygen, O_2 , at room temperature and pressure. (O = 16) [2]

6. State what is meant by concordant titres. [1]

7. A student records titres of 22.40 cm^3 (rough), 22.10 cm^3 , 22.15 cm^3 and 22.05 cm^3 . Calculate the mean titre, in cm^3 , using concordant results. [2]

8. 25.0 cm^3 of 0.100 mol/dm^3 NaOH is neutralised by 20.0 cm^3 of HCl. Calculate the concentration of the HCl in mol/dm^3 . [3]

9. Convert 0.125 mol/dm^3 hydrochloric acid into g/dm^3 . Give your answer to 3 significant figures. (H = 1, Cl = 35.5) [2]

10. 25.0 cm^3 of 0.200 mol/dm^3 NaOH is neutralised by 12.5 cm^3 of H_2SO_4 . $\text{H}_2\text{SO}_4 + 2\text{NaOH} \rightarrow \text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O}$. Calculate the concentration of the acid in mol/dm^3 . [3]

11. Calculate the volume of 0.150 mol/dm^3 NaOH, in cm^3 , needed to neutralise 25.0 cm^3 of 0.120 mol/dm^3 HCl. [3]

12. Calculate the volume of oxygen, in cm^3 , needed to react completely with 100 cm^3 of hydrogen. $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$ [1]

13. Calculate the volume, in dm^3 , of carbon dioxide at room temperature and pressure made from 10.0 g of calcium carbonate with excess acid. $\text{CaCO}_3 + 2\text{HCl} \rightarrow \text{CaCl}_2 + \text{H}_2\text{O} + \text{CO}_2$ ($\text{Ca} = 40$, $\text{C} = 12$, $\text{O} = 16$) [3]

14. Calculate the volume of hydrogen, in cm^3 , at room temperature and pressure made when 0.12 g of magnesium reacts with excess acid. $\text{Mg} + 2\text{HCl} \rightarrow \text{MgCl}_2 + \text{H}_2$ ($\text{Mg} = 24$; $1 \text{ mol of gas} = 24\,000 \text{ cm}^3$) [3]

4. Before you hand it in

Using cm^3 in moles = concentration $\times$ volume

Divide cm^3 by 1000 first.

Including the rough titre in the mean

Average only concordant titres (within 0.10 cm^3).

Forgetting the 1 : 2 ratio for sulfuric acid

Moles of $\text{H}_2\text{SO}_4 = \text{moles of NaOH} \div 2$.

Using 24 dm^3 for liquids or solids

Use it only for gases at room temperature and pressure.