

Raffles Institution Year 5 H2 Chemistry 2025

Tutorial 1 – The Mole Concept and Stoichiometry

Practice Questions

It is recommended that drinking water contain fluoride (F⁻) for prevention of tooth decay. During the purification process, fluoride ions are added to 1000 cm³ of reservoir water. A 10.00 cm³ sample of the fluorinated water is taken and transferred to a volumetric flask. Deionised water is added to make a total volume of 100.0 cm³ of the diluted solution. This diluted solution contains 0.16 ppm of fluoride ions.

(1 ppm of fluoride ions = 1 mg of fluoride ions in 1000 cm³ of solvent.)

- (a) Calculate the mass of F^- ions present in 1000 cm³ fluorinated reservoir water.
- (b) Fluoride is provided by hydrogen hexafluorosilicate, H_2SiF_6 . Calculate the mass of H_2SiF_6 added to the reservoir water given that six F⁻ ions are formed per unit of H_2SiF_6 .

 $[M_r \text{ of } H_2 \text{SiF}_6 = 144.1]$

2 A carbonate M₂CO₃ of mass 5.30 g was dissolved in deionised water to produce a 500 cm³ solution. During titration, 25.0 cm³ of this solution required 26.0 cm³ of 0.192 mol dm⁻³ HC*l* for complete neutralisation. Calculate the concentration of M₂CO₃ in g dm⁻³, and determine the relative atomic mass of M.

3 <u>2014 CT Qn B2(b)</u>

Propane, C_3H_8 , is a gaseous hydrocarbon fuel that undergoes combustion to produce carbon dioxide and water. 10 cm³ of C_3H_8 and **z** cm³ of N₂ were sparked with excess O₂ in a flask and the flask was then cooled to room temperature. NO₂(g) was the only N containing product formed. The gaseous mixture was then passed through 50 cm³ of 0.50 mol dm⁻³ NaOH(aq). The excess NaOH required 24.40 cm³ of 0.35 mol dm⁻³ H₂SO₄(aq) for complete reaction.

- (a) Write balanced equations with state symbols for the two combustion reactions, where C_3H_8 and N_2 each reacted with O_2 .
- (b) Calculate the volume of gaseous product(s) formed from the combustion of C_3H_8 .
- (c) Calculate the amount of NaOH that has reacted with the gaseous mixture.
- (d) NO₂ reacts with NaOH according to the following reaction:

 $2NO_2(g) + 2NaOH(aq) \rightarrow NaNO_2(aq) + NaNO_3(aq) + H_2O(l)$

Determine the value of **z**.

- 4 The percentage of nitrogen in foodstuffs gives an indication of how much protein is present. It can be estimated by the following method.
 - I. The foodstuff is weighed and boiled under reflux with concentrated sulfuric acid for some time. This converts all the nitrogen into ammonium sulfate.
 - II. An excess of aqueous sodium hydroxide is added, and the mixture again boiled. The liberated ammonia gas is passed into a known excess of dilute hydrochloric acid.
 - III. The unreacted hydrochloric acid is then titrated with aqueous sodium hydroxide of known concentration.
 - (a) Write equations for the two reactions occurring in step II.
 - (b) When 1.00 g of a foodstuff was subjected to the above procedure, and the gas in step II was passed into 50.0 cm³ of 0.100 mol dm⁻³ HC/, it was found that only 20.0 cm³ of 0.100 mol dm⁻³ NaOH were needed to neutralise the unreacted acid.

Calculate the percentage by mass of nitrogen in the foodstuff.