

Titration Calculations

Titres, mole ratios, dilutions and back titrations

Name _____ Class _____ Date _____

DATA

$n = c \times V$ (V in L) · concordant titres agree within 0.10 mL · each burette reading ± 0.05 mL

Molar masses (g/mol): Na_2CO_3 105.99 · KHP ($\text{KHC}_8\text{H}_4\text{O}_4$) 204.22 · CH_3COOH 60.05 · $\text{Mg}(\text{OH})_2$ 58.32

$\text{Na}_2\text{CO}_3 + 2\text{HCl} \rightarrow 2\text{NaCl} + \text{H}_2\text{O} + \text{CO}_2$ · $\text{KHP} + \text{NaOH} \rightarrow \text{KNaP} + \text{H}_2\text{O}$ (1 : 1)

Write the balanced equation and mole ratio first. Show units in every step.

A. Titres

1. Define: titre, aliquot, end point, equivalence point, concordant titres.

2. 25.00 mL of hydrochloric acid is titrated with 0.1050 mol/L NaOH. Titres: rough 23.10 mL, then 22.60 mL, 22.70 mL and 22.65 mL. (a) Calculate the mean titre and its standard deviation. (b) Calculate the concentration of the acid.

B. Standardisation

3. 1.325 g of anhydrous sodium carbonate is dissolved and made up to 250.0 mL. A 25.00 mL aliquot needs 24.80 mL of HCl. Calculate (a) the concentration of the Na_2CO_3 solution (b) the concentration of the HCl.

4. 0.5105 g of potassium hydrogen phthalate (KHP) needs 24.95 mL of NaOH. Calculate the concentration of the NaOH.

C. Diprotic acids and dilutions

5. 25.00 mL of sulfuric acid needs 18.25 mL of 0.2000 mol/L NaOH. Calculate the concentration of the acid.

6. 20.00 mL of vinegar is diluted to 250.0 mL. A 25.00 mL aliquot needs 23.30 mL of 0.1000 mol/L NaOH. Calculate the concentration of ethanoic acid in the original vinegar.

D. Back titration

7. An antacid tablet of mass 0.300 g contains magnesium hydroxide. It is added to 25.00 mL of 0.5000 mol/L HCl (an excess). The leftover acid needs 11.20 mL of 0.2500 mol/L NaOH. $\text{Mg}(\text{OH})_2 + 2 \text{HCl} \longrightarrow \text{MgCl}_2 + 2 \text{H}_2\text{O}$. Calculate the percent by mass of $\text{Mg}(\text{OH})_2$ in the tablet.

E. Challenge

8. Each burette reading has an uncertainty of ± 0.05 mL. Calculate the percent uncertainty of the mean titre in question 2, and explain how a student could reduce it.