CHEMWHIZ QUICK REFERENCE

TOPIC 11

Solution Stoichiometry & Titrations

n = MV stoichiometry, acid-base and redox titrations, standards, purity, and gravimetric analysis.

01 Balance first — CORE RULE

A titration is stoichiometry in solution. Write and balance the reaction before any calculation.

02 n = MV — CORE RULE

Moles from a solution: n = M × V (V in litres). Rearrange: V = n / M. Use it wherever a mass-based path would use molar mass.

03 Titration vocabulary — REFERENCE

Titrant: known solution from the buret. Analyte: unknown being measured. Equivalence point: titrant volume delivering the exact stoichiometric amount (equal moles only for a 1:1 reaction). Endpoint: measured volume (indicator colour change). Primary standard: high-purity weighable solid (e.g. KHP).

04 KHP acid standard — CORE RULE

KHP ($KHC_8H_4O_4$, 204.22 g/mol) is a monoprotic solid acid that reacts 1:1 with NaOH; used to standardize base solutions.

05 Polyprotic neutralization — CORE RULE

Polyprotic acids neutralize stepwise (a separate equivalence point per proton). At complete neutralization: H_3PO_4 needs 3 NaOH; H_2SO_4 and $H_2C_2O_4$ each need 2 NaOH.

06 Unknown concentration — METHOD

mol titrant (M × V) → mol analyte (stoichiometric factor) → divide by analyte volume: M = n / V.

07 Purity of a solid — METHOD

Titration → mass of pure analyte; percent purity = (mass analyte / total sample mass) × 100.

08 Redox titrations — REFERENCE

Titrant	Balanced half-context (acidic)
$K_2Cr_2O_7$	$Cr_2O_7^{2-} + 14H^+ + 6Fe^{2+} \rightarrow 2Cr^{3+} + 7H_2O + 6Fe^{3+}$
$KMnO_4$	$MnO_4^- + 8H^+ + 5Fe^{2+} \rightarrow Mn^{2+} + 5Fe^{3+} + 4H_2O$

09 Limiting reactant in solution — CORE RULE

Same as with pure substances, but moles come from n = MV. Compare each reactant's moles against the balanced ratio to find the limiting one.

10 Precipitation & gravimetric — METHOD

Identify the precipitate (solubility rules), find moles of each reactant, pick the limiting one, then compute precipitate mass.

Gravimetric: mass of precipitate → mol precipitate (÷ MM) → mol analyte (ratio) → mass analyte; mass % = (mass analyte / sample mass) × 100.

11 Hydrated reagents — WATCH OUT

For a hydrated base (e.g. $LiOH \cdot H_2O$), molar mass includes the water, but the stoichiometry uses the base formula, so one mole of hydrate gives one mole of LiOH.