

Redox Reactions and Electrochemistry: one-page cheat sheet

NEET Chemistry · Unit 7 · Physical Chemistry

1 • Oxidation numbers

Oxidation	loss of electrons; O.N. rises (reductant is oxidised)
Fixed values	free element 0; alkali metals +1; alkaline earths +2; F always -1
Oxygen	-2; peroxide -1; superoxide $-\frac{1}{2}$; OF_2 +2
Hydrogen	+1; metal hydrides (NaH , CaH_2) -1
Fractional	C_3O_2 + $\frac{4}{3}$; Br_3O_8 + $\frac{16}{3}$; $\text{S}_4\text{O}_6^{2-}$ +2.5 (average)
Disproportion	same element is oxidised and reduced: H_2O_2 , or Cl_2 in OH^-
Other types	combination, decomposition, displacement

2 • Balancing & titrations

Acidic medium	split into half-reactions; balance O with H_2O , H with H^+ , charge with e^- ; equalise electrons
Basic medium	balance as acidic, then add OH^- to both sides to neutralise the H^+
	$\text{Cr}_2\text{O}_7^{2-} + 14\text{H}^+ + 6\text{Fe}^{2+} \rightarrow 2\text{Cr}^{3+} + 6\text{Fe}^{3+} + 7\text{H}_2\text{O}$
	$2\text{MnO}_4^- + 5\text{C}_2\text{O}_4^{2-} + 16\text{H}^+ \rightarrow 2\text{Mn}^{2+} + 10\text{CO}_2 + 8\text{H}_2\text{O}$
<i>n</i>-factor	MnO_4^- (acid) 5; $\text{Cr}_2\text{O}_7^{2-}$ 6; $\text{C}_2\text{O}_4^{2-}$ 2; Fe^{2+} 1
KMnO_4	self-indicator; first permanent light pink at the end point
Iodometry	$\text{I}_2 + 2\text{S}_2\text{O}_3^{2-} \rightarrow 2\text{I}^- + \text{S}_4\text{O}_6^{2-}$; starch, blue to colourless

3 • Galvanic cells & Nernst

Daniell cell	$\text{Zn} \mid \text{Zn}^{2+} \parallel \text{Cu}^{2+} \mid \text{Cu}$; anode Zn (-), cathode Cu (+) $E_{\text{cell}}^\circ = E_{\text{cathode}}^\circ - E_{\text{anode}}^\circ = 0.34 - (-0.76) = 1.10 \text{ V}$ $E_{\text{cell}} = E_{\text{cell}}^\circ - \frac{0.0591}{n} \log Q \quad (298 \text{ K})$
SHE	0.00 V at all temperatures: $\text{Pt} \mid \text{H}_2 (1 \text{ bar}) \mid \text{H}^+ (1 \text{ M})$
E° (V)	Ag^+/Ag +0.80; Cu^{2+}/Cu +0.34; Fe^{2+}/Fe -0.44; Zn^{2+}/Zn -0.76
Higher E°	stronger oxidising agent

4 • Cell thermodynamics

	$\Delta_r G = -nFE_{\text{cell}}^\circ, \quad \Delta_r G^\circ = -nFE_{\text{cell}}^\circ$
	$\log K_c = \frac{nE_{\text{cell}}^\circ}{0.0591}, \quad F = 96500 \text{ C mol}^{-1}$
Spontaneous	$E_{\text{cell}} > 0 \Rightarrow \Delta_r G < 0$; at equilibrium $E_{\text{cell}} = 0$

5 • Galvanic vs electrolytic

	Galvanic	Electrolytic
Energy	chemical to electrical	electrical to chemical
Reaction	spontaneous	non-spontaneous
Anode	negative	positive
Cathode	positive	negative

Oxidation is always at the anode, reduction at the cathode.

Six traps to remember

- $E_{\text{cell}}^\circ = E_{\text{cathode}}^\circ - E_{\text{anode}}^\circ$; no sign change for stoichiometry.
- $\Delta G = -nFE$: positive E means spontaneous.
- Cell constant = $R \times \kappa$, in cm^{-1} .

6 • Conductance

	$G = \frac{1}{R} = \kappa \frac{A}{l}, \quad G^* = \frac{l}{A} = R\kappa \text{ (cell constant)}$
	$\Lambda_m = \frac{1000 \kappa}{C} \text{ (S cm}^2 \text{ mol}^{-1}\text{)}, \quad \alpha = \frac{\Lambda_m}{\Lambda_m^\circ}$
Strong	$\Lambda_m = \Lambda_m^\circ - A\sqrt{c}$; extrapolate to get Λ_m°
Weak	rises steeply on dilution; Λ_m° cannot be extrapolated
Kohlrausch	$\Lambda_m^\circ = \nu_+ \lambda_+^\circ + \nu_- \lambda_-^\circ$
K_a	$\frac{c\alpha^2}{1-\alpha} = \frac{c\Lambda_m^2}{\Lambda_m^\circ(\Lambda_m^\circ - \Lambda_m)}$

7 • Electrolysis

	$w = Zit = \frac{MIt}{n \times 96500}, \quad \frac{w_1}{w_2} = \frac{E_1}{E_2} \text{ (series)}$
Cathode	species with the higher reduction potential discharges first
Anode	species with the lower reduction potential oxidises first
Trap	Dilute H_2SO_4 with Pt electrodes: O_2 at the anode, H_2 at the cathode.

8 • Batteries & corrosion

Dry cell	Zn anode; graphite + MnO_2 cathode; NH_4Cl + ZnCl_2 paste; 1.5 V
Mercury cell	Zn-Hg anode; HgO + C cathode; KOH + ZnO ; 1.35 V
Lead storage	Pb anode, PbO_2 cathode, 38% H_2SO_4 ($d = 1.30$) $\text{Pb} + \text{PbO}_2 + 2\text{H}_2\text{SO}_4 \xrightarrow{\text{discharge}} 2\text{PbSO}_4 + 2\text{H}_2\text{O}$
Fuel cell	H_2 - O_2 in alkaline medium; about 70% efficient; product water
Rusting	anode: Fe oxidised to Fe^{2+} (-0.44 V); cathode: O_2 reduced (+1.23 V). Rust is $\text{Fe}_2\text{O}_3 \cdot x\text{H}_2\text{O}$
Protection	galvanising (Zn) or Mg sacrificial blocks

Seen in NEET 2026

Mass of Cu from CuSO_4 with 1.5 A for 10 min ($\text{Cu} = 63$).

$$Q = 1.5 \times 600 = 900 \text{ C}, \quad w = \frac{63}{2 \times 96487} \times 900 = 0.2938 \text{ g}$$

Seen in NEET 2021

 Λ° of CH_3COOH from NaCl (126.45), HCl (426.16), CH_3COONa (91.0).

$$91.0 + 426.16 - 126.45 = 390.71 \text{ S cm}^2 \text{ mol}^{-1}$$