CLASS 11 CHEMISTRY — FORMULA SHEET

Chapter 7 : Redox Reactions (NCERT)

7.1 Core Concepts — Oxidation & Reduction

Concept	Definition
Oxidation	Loss of electrons / gain of oxygen / loss of hydrogen / INCREASE in oxidation number
Reduction	Gain of electrons / loss of oxygen / gain of hydrogen / DECREASE in oxidation number
Oxidising agent (oxidant)	Accepts electrons; gets REDUCED itself
Reducing agent (reductant)	Donates electrons; gets OXIDISED itself
Redox reaction	Oxidation and reduction occur simultaneously
Memory: OIL RIG	Oxidation Is Loss, Reduction Is Gain (of electrons)

7.2 Rules for Assigning Oxidation Number (ON)

Rule	Detail
Free element	ON = 0 (e.g. H_2, O_2, Na, S_8, P_4)
Monatomic ion	ON = charge on the ion (Na^+ = +1, Cl^- = −1)
Hydrogen	+1 usually; −1 in metal hydrides (NaH, CaH_2)
Oxygen	−2 usually; −1 in peroxides (H_2O_2); −½ in superoxides (KO_2); +2 in OF_2
Fluorine	Always −1 (most electronegative)
Alkali metals (Gr 1)	Always +1
Alkaline earth metals (Gr 2)	Always +2
Sum rule (neutral molecule)	Sum of all oxidation numbers = 0
Sum rule (ion)	Sum of all oxidation numbers = charge on ion

7.3 Types of Redox Reactions

Type	Description & Example
Combination	Two species combine; at least one element changes ON: $C + O_2 \rightarrow CO_2$
Decomposition	Compound breaks into simpler substances: $2H_2O \rightarrow 2H_2 + O_2$
Displacement	One element displaces another: $Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$
Metal displacement	More reactive metal displaces less reactive from salt
Non-metal displacement	$Cl_2 + 2KBr \rightarrow 2KCl + Br_2$
Disproportionation	SAME element simultaneously oxidised AND reduced: $2H_2O_2 \rightarrow 2H_2O + O_2$; $Cl_2 + 2OH^- \rightarrow Cl^- + ClO^- + H_2O$
Comproportionation	Two species of same element form a single intermediate ON product

7.4 Balancing Redox Reactions

Method	Steps
Oxidation number method	1) Assign ON 2) Identify oxidised & reduced atoms 3) Balance change in ON by suitable coefficients 4) Balance remaining atoms & charge
Ion-electron (half-reaction) method	1) Split into oxidation & reduction half-reactions 2) Balance atoms except O & H 3) Balance O with H_2O, H with H^+ 4) Balance charge with e^- 5) Equalise electrons & add
In basic medium	After acidic balancing, add OH^- equal to H^+ on both sides; combine $H^+ + OH^- \rightarrow H_2O$

7.5 Equivalent Concept (Redox Titrations)

Concept	Formula
n-factor (redox)	= total change in oxidation number per formula unit (electrons gained/lost)
Equivalent mass	= Molar mass ÷ n-factor
Equivalents	Number of equivalents = mass ÷ equivalent mass = moles × n-factor
Normality (N)	N = Molarity × n-factor ; N = equivalents ÷ volume (L)
Titration equivalence	$N_1V_1 = N_2V_2$ (equivalents of oxidant = equivalents of reductant)
n-factor of $KMnO_4$ (acidic)	5 (Mn: +7 → +2)
n-factor of $KMnO_4$ (neutral/basic)	3 (Mn: +7 → +4)
n-factor of $K_2Cr_2O_7$ (acidic)	6 (2Cr: +6 → +3 each)

7.6 Redox & Electrode Potential (Intro)

Concept	Detail
Electrochemical cell	Galvanic cell converts chemical energy → electrical energy (spontaneous)
Anode / Cathode	Oxidation at ANODE (−) ; Reduction at CATHODE (+)
Cell EMF	$E^\circ_{cell} = E^\circ_{cathode} - E^\circ_{anode}$
Spontaneity	$E^\circ_{cell} > 0$ → reaction spontaneous ($\Delta G^\circ = -nFE^\circ_{cell}$)
Standard hydrogen electrode (SHE)	Reference electrode, E° = 0.00 V by convention
Reactivity from E°	More negative E° → stronger reducing agent (e.g. Li, K) ; more positive E° → stronger oxidising agent (e.g. F_2)

★ QUICK MEMORY AIDS & TRICKS

OIL RIG	Oxidation Is Loss, Reduction Is Gain (of electrons) — the classic redox mnemonic.
Agent swap	Oxidising agent gets reduced ; Reducing agent gets oxidised (they do the opposite of their name).
Oxygen exceptions	Normal −2 ; peroxide −1 ; superoxide −½ ; OF_2 = +2 (F beats O).
Disproportionation	ONE element goes both up and down. Classic: H_2O_2, Cl_2 in cold alkali, P_4 in NaOH.
$KMnO_4$ n-factor	Acidic = 5, Neutral = 3, Basic = 1 (Mn goes +7 → +2 / +4 / +6).
$Cr_2O_7^{2-}$ n-factor	Always 6 in acidic medium (2 Cr each +6 → +3).

Normality bridge	N = M × n-factor. Titration: $N_1V_1 = N_2V_2$.
Cell electrodes	'An Ox, Red Cat' → ANode OXidation, REDuction CAThode.