

Chemistry — Quick Revision Sheet

NEET UG

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CONSTANTS & VALUES

$$R = 8.314 \text{ J mol}^{-1}\text{K}^{-1} = 0.0821 \text{ L atm mol}^{-1}\text{K}^{-1} \quad F = 96500 \text{ C mol}^{-1} \quad N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$$

$$V_m (\text{STP}) = 22.4 \text{ L (273 K, 1 atm)} \quad h = 6.626 \times 10^{-34} \text{ J s} \quad 1 \text{ atm} = 101.3 \text{ kPa} = 760 \text{ mm Hg} \quad K_w = 10^{-14} (25^\circ\text{C})$$

$$\frac{2.303RT}{F} = 0.0591 \text{ V (298 K)} \quad R_H = 2.18 \times 10^{-18} \text{ J} = 13.6 \text{ eV} \quad 1 \text{ cal} = 4.184 \text{ J}$$

Physical Chemistry

■ Mole Concept & Stoichiometry

Mole

$$n = \frac{w}{M} = \frac{N}{N_A} = \frac{V_{\text{STP}}}{22.4 \text{ L}}$$

Concentration terms

$$M = \frac{n}{V(\text{L})} \quad m = \frac{n}{w_{\text{solvent}} (\text{kg})} \quad x_A = \frac{n_A}{n_A + n_B}$$

Normality & equivalents

$$N = M \times n\text{-factor} \quad E = \frac{M}{n\text{-factor}} \quad N_1 V_1 = N_2 V_2$$

Dilution

$$M_1 V_1 = M_2 V_2 \quad M = \frac{10 d (w\%)}{M_{\text{solute}}}$$

Empirical → molecular formula: $M = n \times \text{EF mass}$; vapour density = $M/2$. Limiting reagent decides the amount of product.

★ **Tip:** n -factor: acid = basicity; base = acidity; redox = electrons exchanged per formula unit.

■ Atomic Structure

Bohr model

$$r_n = 52.9 \frac{n^2}{Z} \text{ pm} \quad E_n = -2.18 \times 10^{-18} \frac{Z^2}{n^2} \text{ J}$$

Rydberg

$$\bar{\nu} = \frac{1}{\lambda} = R_H Z^2 \left(\frac{1}{n_1^2} - \frac{1}{n_2^2} \right)$$

de Broglie & Heisenberg

$$\lambda = \frac{h}{mv} \quad \Delta x \cdot \Delta p \geq \frac{h}{4\pi}$$

Quantum numbers

$$l = 0 \dots n-1 \quad m_l = -l \dots +l \quad m_s = \pm \frac{1}{2}$$

Nodes

$$\text{radial} = n - l - 1 \quad \text{angular} = l \quad \text{total} = n - 1$$

Magnetic moment

$$\mu = \sqrt{n(n+2)} \text{ BM}$$

Electrons in a shell = $2n^2$; orbitals in a shell = n^2 . Lines from $n_2 \rightarrow n_1$: $\frac{\Delta n (\Delta n + 1)}{2}$.

Filling: Aufbau ($n + l$ rule), Pauli, Hund. Exceptions: Cr $3d^5 4s^1$; Cu $3d^{10} 4s^1$.

■ Chemical Bonding & Molecular Structure

Hybridisation

$$H = \frac{1}{2} [V + M - C + A]$$

Bond order (MOT)

$$BO = \frac{N_b - N_a}{2} \quad \mu = q \times d$$

sp linear (BeCl_2 , CO_2); sp^2 trigonal planar (BF_3), bent (SO_2); sp^3 tetrahedral (CH_4), pyramidal (NH_3), bent (H_2O).

$sp^3 d$: TBP (PCl_5), see-saw (SF_4), T-shape (ClF_3), linear (XeF_2).

$sp^3 d^2$: octahedral (SF_6), square pyramidal (BrF_5), square planar (XeF_4); $sp^3 d^3$: pentagonal bipyramidal (IF_7).

MO order: $\sigma_{2s} < \sigma_{2s}^* < \pi_{2p} < \sigma_{2p} < \pi_{2p}^* < \sigma_{2p}^*$ up to N_2 ; for O_2 , F_2 , σ_{2p} lies below π_{2p} . O_2 is paramagnetic (BO 2).

★ **Tip:** Fajans: small, highly charged cation + large anion → more covalent. H-bonding raises boiling point; intramolecular H-bond (o-nitrophenol) lowers it.

■ States of Matter

Gas laws

$$PV = nRT \quad \frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2} \quad P = \sum p_i$$

Graham's law

$$\frac{r_1}{r_2} = \sqrt{\frac{M_2}{M_1}}$$

Molecular speeds

$$u_{\text{rms}} = \sqrt{\frac{3RT}{M}} \quad u_{\text{avg}} = \sqrt{\frac{8RT}{\pi M}} \quad u_{\text{mp}} = \sqrt{\frac{2RT}{M}}$$

van der Waals

$$\left(P + \frac{an^2}{V^2} \right) (V - nb) = nRT$$

Critical constants

$$T_c = \frac{8a}{27Rb} \quad P_c = \frac{a}{27b^2} \quad V_c = 3b \quad T_B = \frac{a}{Rb}$$

Compressibility

$$Z = \frac{PV}{nRT}$$

$Z < 1$: attraction dominates; $Z > 1$: repulsion dominates; ideal at high T , low P .

Chemical Thermodynamics

First law

$$\Delta U = q + w \quad w = -P_{ext} \Delta V \quad \Delta H = \Delta U + \Delta n_g RT$$

Reversible isothermal

$$w = -2.303 nRT \log \frac{V_2}{V_1}$$

Hess's law

$$\Delta H^\circ = \sum \Delta_f H^\circ_{prod} - \sum \Delta_f H^\circ_{react}$$

Bond enthalpy

$$\Delta H = \sum BE_{react} - \sum BE_{prod}$$

Gibbs energy

$$\Delta G = \Delta H - T\Delta S \quad \Delta G^\circ = -RT \ln K \quad \Delta G^\circ = -nFE^\circ$$

Entropy

$$\Delta S = \frac{q_{rev}}{T} \quad \Delta S = nC_v \ln \frac{T_2}{T_1} + nR \ln \frac{V_2}{V_1}$$

Spontaneous if $\Delta G < 0$. $\Delta H < 0, \Delta S > 0$: always; $\Delta H > 0, \Delta S < 0$: never. $C_p - C_v = R$. Kirchhoff: $\Delta H_2 - \Delta H_1 = \Delta C_p (T_2 - T_1)$.

Chemical Equilibrium

Equilibrium constants

$$K_p = K_c (RT)^{\Delta n_g} \quad \Delta G = \Delta G^\circ + RT \ln Q$$

van't Hoff equation

$$\ln \frac{K_2}{K_1} = \frac{\Delta H^\circ}{R} \left(\frac{1}{T_1} - \frac{1}{T_2} \right)$$

Degree of dissociation

$$\text{PCl}_5 \rightleftharpoons \text{PCl}_3 + \text{Cl}_2: K_p = \frac{\alpha^2 P}{1 - \alpha^2}$$

$Q < K$: forward; $Q > K$: backward. Catalyst does not change K . Le Chatelier: adding reactant shifts forward; raising T favours endothermic direction.

Ionic Equilibrium

pH

$$pH = -\log [H^+] \quad pH + pOH = 14 \quad K_a K_b = K_w$$

Weak acid

$$\alpha = \sqrt{\frac{K_a}{C}} \quad [H^+] = \sqrt{K_a C}$$

Buffer

$$pH = pK_a + \log \frac{[\text{salt}]}{[\text{acid}]}$$

Salt hydrolysis

$$pH = 7 + \frac{1}{2} (pK_a + \log C) \quad (\text{WA+SB})$$

$$pH = 7 + \frac{1}{2} (pK_a - pK_b) \quad (\text{WA+WB})$$

Solubility product

$$K_{sp} = x^x y^y S^{x+y} \quad (A_x B_y)$$

Precipitation if ionic product $> K_{sp}$. Common-ion effect lowers solubility. Buffer is most effective when $pH \approx pK_a$ (ratio 1:1).

Redox & Electrochemistry

Cell potential

$$E^\circ_{cell} = E^\circ_{cathode} - E^\circ_{anode} \quad \log K = \frac{nE^\circ}{0.0591}$$

Nernst equation

$$E = E^\circ - \frac{0.0591}{n} \log Q \quad (298 \text{ K})$$

Faraday's law

$$w = \frac{EIt}{96500} = ZIt$$

Conductance

$$\kappa = G \frac{l}{A} \quad \Lambda_m = \frac{1000 \kappa}{M} \quad \Lambda_m = \Lambda_m^\circ - A \sqrt{c}$$

Kohlrausch

$$\Lambda_m^\circ = \lambda_+^\circ + \lambda_-^\circ$$

Concentration cell: $E = \frac{0.0591}{n} \log \frac{C_2}{C_1}$. Electrolysis products depend on E° and overpotential.

Chemical Kinetics

Rate law

$$r = k [A]^m [B]^n \quad \text{unit of } k = (\text{mol L}^{-1})^{1-n} \text{s}^{-1}$$

Zero order

$$[A] = [A]_0 - kt \quad t_{1/2} = \frac{[A]_0}{2k}$$

First order

$$k = \frac{2.303}{t} \log \frac{a}{a-x} \quad t_{1/2} = \frac{0.693}{k}$$

Second order

$$\frac{1}{[A]} = \frac{1}{[A]_0} + kt \quad t_{1/2} = \frac{1}{k[A]_0}$$

Arrhenius

$$k = Ae^{-E_a/RT} \quad \log \frac{k_2}{k_1} = \frac{E_a}{2.303R} \left(\frac{1}{T_1} - \frac{1}{T_2} \right)$$

Order is experimental; molecularity is theoretical (1, 2, 3 only). $t_{1/2} \propto a^{1-n}$. Catalyst lowers E_a , not ΔH .

Solutions

Raoult's law

$$p_A = x_A p_A^\circ \quad \frac{p^\circ - p}{p^\circ} = x_B \quad p = K_H x \quad (\text{Henry})$$

Colligative properties

$$\Delta T_b = i K_b m \quad \Delta T_f = i K_f m \quad \pi = i CRT$$

van't Hoff factor

$$i = 1 + (n-1) \alpha \quad (\text{dissociation})$$

$$i = 1 - \alpha \left(1 - \frac{1}{n} \right) \quad (\text{association})$$

Molar mass

$$M_B = \frac{K_f w_B \times 1000}{\Delta T_f w_A}$$

Ideal solution: $\Delta H_{mix} = 0, \Delta V_{mix} = 0$. Positive deviation $\rightarrow$ minimum-boiling azeotrope (ethanol-water); negative $\rightarrow$ maximum-boiling (HNO₃-water).

■ Solid State

Density

$$\rho = \frac{ZM}{a^3 N_A}$$

Atoms per cell Z

sc = 1 bcc = 2 fcc = 4

Radius relation

sc: $a = 2r$ bcc: $\sqrt{3}a = 4r$ fcc: $\sqrt{2}a = 4r$

Packing efficiency

sc = 52.4% bcc = 68% fcc/hcp = 74%

Coordination number: sc 6, bcc 8, fcc/hcp 12. Per atom: 1 octahedral and 2 tetrahedral voids. Schottky lowers density; Frenkel does not.

■ Surface Chemistry

Adsorption isotherm

$$\frac{x}{m} = kP^{1/n} \quad (\text{Freundlich})$$

Physisorption: weak, reversible, multilayer, falls with T ; chemisorption: strong, irreversible, monolayer. Hardy-Schulze: coagulating power $\propto$ (charge)^{high}. Tyndall effect shows colloids.

Inorganic Chemistry

■ Periodic Table & Periodicity

Across a period: atomic size ↓, IE ↑, EN ↑, metallic character ↓.
Down a group: size ↑, IE ↓, EN ↓.

IE exceptions: Be > B, Mg > Al, N > O, P > S. Electron gain enthalpy: Cl > F > Br > I; S > O.

Isoelectronic species: size decreases as Z rises ($O^{2-} > F^- > Na^+ > Mg^{2+}$). Diagonal pairs: Li-Mg, Be-Al, B-Si.

■ s-Block Elements

Alkali metals: reactivity, hydration of ions $Li^+ > Na^+ > K^+$; flame: Li crimson, Na golden yellow, K lilac, Rb red-violet, Cs blue.

Group 2: sulphate and carbonate solubility decreases down the group; hydroxide solubility increases. Flame: Ca brick red, Sr crimson, Ba apple green.

Compounds: Na_2CO_3 (Solvay), NaOH (Castner-Kellner), plaster of Paris $CaSO_4 \cdot \frac{1}{2}H_2O$, gypsum $CaSO_4 \cdot 2H_2O$, quicklime CaO.

★ **Tip:** Li shows anomalies (covalent character, Li_3N forms, $LiNO_3$ gives $Li_2O + NO_2 + O_2$).

■ p-Block Elements

Group 13: B_2H_6 has 3c-2e bonds; borax $Na_2B_4O_7 \cdot 10H_2O$; BF_3 is a Lewis acid; Al is amphoteric; inert-pair effect: Tl^+ more stable.

Group 14: allotropes of C (diamond sp^3 , graphite sp^2 , fullerene); CO is a neutral oxide; SiO_2 is a network solid; silicones (R_2SiO)_n.

Group 15: NH_3 (Haber), HNO_3 (Ostwald), PH_3 is less basic than NH_3 ; H_3PO_3 is dibasic, H_3PO_2 monobasic; white P is the most reactive.

Group 16: O_3 (oxidant, bent); H_2SO_4 by Contact process (V_2O_5); SO_2 is a reducing bleach; acid strength $H_2Te > H_2Se > H_2S > H_2O$.

Group 17: oxidising power $F_2 > Cl_2 > Br_2 > I_2$; acid strength $HI > HBr > HCl > HF$; oxoacid strength $HClO_4 > HClO_3 > HClO_2 > HClO$.

Group 18: XeF_2 linear, XeF_4 square planar, XeF_6 distorted octahedral, XeO_3 pyramidal, $XeOF_4$ square pyramidal.

■ d- & f-Block Elements

Magnetic moment

$$\mu = \sqrt{n(n+2)} \text{ BM}$$

Colour arises from $d-d$ transitions; Zn^{2+} , Sc^{3+} , Cu^+ (no unpaired e^-) are colourless.

$KMnO_4$: acidic medium Mn^{2+} ($5e^-$); neutral MnO_2 ($3e^-$); basic MnO_4^{2-} ($1e^-$). $K_2Cr_2O_7$: Cr^{3+} ($6e^-$); chromate-dichromate interconvert with pH.

Lanthanoid contraction makes 4d and 5d elements (Zr/Hf) nearly equal in size. Variable oxidation states in d -block; Mn shows +2 to +7.

■ Coordination Compounds

Spectrochemical series:

$I^- < Br^- < Cl^- < F^- < OH^- < H_2O < NH_3 < en < CN^- < CO$.
Strong field $\rightarrow$ low spin ($\Delta_o > P$).

$[Ni(CN)_4]^{2-}$ dsp^2 square planar (diamagnetic); $[NiCl_4]^{2-}$ sp^3 tetrahedral; $[Fe(CN)_6]^{3-}$ d^2sp^3 ; $[FeF_6]^{3-}$ sp^3d^2 .

Isomerism: geometrical ($[Ma_2b_2]$ square planar, $[Ma_3b_3]$ fac/mer), optical ($[M(en)_3]$), linkage, ionisation, hydrate, coordination.

■ Metallurgy

Concentration: froth flotation (sulphides), magnetic separation, leaching (Al_2O_3 by Bayer's, Au/Ag by cyanide).

Calcination: carbonate/hydrate in limited air; roasting: sulphide in excess air. Ellingham: ΔG° of oxide formation vs T ; metal reduces oxide of another if its line is lower.

Refining: Mond (Ni), van Arkel (Ti, Zr), electrolytic (Cu), zone refining (Si, Ge). Al: Hall-Héroult with cryolite. Cu: self-reduction in Bessemer converter.

Organic Chemistry

Nomenclature & Isomerism

Degree of unsaturation

$$DU = \frac{2C + 2 + N - H - X}{2}$$

Isomerism: chain, position, functional, metamerism, tautomerism (structural); geometrical and optical (stereo). Priority of groups: acid > anhydride > ester > acid halide > amide > nitrile > aldehyde > ketone > alcohol > amine.

General Organic Chemistry (GOC)

Carbocation stability: $3^\circ > 2^\circ > 1^\circ > \text{CH}_3^+$; allyl and benzyl are extra stable. Carbanion: $\text{CH}_3^- > 1^\circ > 2^\circ > 3^\circ$.

—I groups: $\text{NO}_2 > \text{CN} > \text{COOH} > \text{F} > \text{Cl} > \text{Br} > \text{I}$. +R: —OH, —NH₂; —R: —NO₂, —CHO, —CN.

Acidity: $\text{RCOOH} > \text{phenol} > \text{H}_2\text{O} > \text{ROH} > \text{HC} \equiv \text{CH} > \text{NH}_3 > \text{alkane}$. Basicity (aq., ethyl): $2^\circ > 3^\circ > 1^\circ > \text{NH}_3 > \text{aniline}$.

Aromatic: planar, cyclic, conjugated, $(4n + 2) \pi$ electrons (Hückel). Hyperconjugation: α -H count decides alkene and cation stability.

Stereochemistry

Number of stereoisomers

$$2^n \text{ (unsymmetrical) } \quad 2^{n-1} + 2^{\frac{n}{2}-1} \text{ (symmetrical, even } n \text{)}$$

Chiral carbon: four different groups. Meso compound: internal mirror plane, optically inactive. Enantiomers: same properties except rotation; diastereomers differ in properties.

CIP priority by atomic number; E/Z by higher priority on same/opposite side; R/S by clockwise/anticlockwise with lowest priority away. Racemic mixture is inactive (external compensation).

Hydrocarbons

Alkane halogenation (free radical): reactivity $3^\circ > 2^\circ > 1^\circ$; Br is more selective than Cl. Wurtz: $2\text{RX} + 2\text{Na} \rightarrow \text{R-R} + 2\text{NaX}$.

Alkenes: Markovnikov addition (carbocation); anti-Markovnikov with HBr/peroxide only; hydroboration-oxidation (syn, anti-Markovnikov); ozonolysis gives carbonyls.

Alkynes: terminal C-H acidic; Lindlar's catalyst $\rightarrow$ cis-alkene; Na / NH₃ $\rightarrow$ trans-alkene; hydration (Kucherov) $\rightarrow$ ketone ($\text{HC} \equiv \text{CH}$ gives ethanal).

EAS: o/p-directors: —OH, —NH₂, —R, halogens (deactivating). m-directors: —NO₂, —CN, —CHO, —COOH, —SO₃H. Friedel-Crafts fails on deactivated rings.

Haloalkanes & Haloarenes

S_N2 : $1^\circ > 2^\circ > 3^\circ$, one step, inversion, strong nucleophile, polar aprotic solvent.

S_N1 : $3^\circ > 2^\circ$, carbocation, racemisation, polar protic solvent. Leaving group: $\text{I}^- > \text{Br}^- > \text{Cl}^- > \text{F}^-$.

Elimination: E2: small strong base (EtO^-) follows Zaitsev (more substituted alkene); bulky base (*t*-BuOK) gives the Hofmann product. Finkelstein (NaI/acetone), Swarts (AgF), Sandmeyer (CuCl/CuBr).

★ Tip: Aryl halides are inert to S_N (partial double bond); —NO₂ at o/p activates $S_N\text{Ar}$.

Alcohols, Phenols & Ethers

Lucas test ($\text{ZnCl}_2 / \text{HCl}$): 3° immediate turbidity, 2° in ~5 min, 1° none at room temperature.

Oxidation: $1^\circ \text{ ROH} \rightarrow \text{aldehyde (PCC)} \rightarrow \text{acid (KMnO}_4)$; $2^\circ \rightarrow \text{ketone}$. Dehydration: 443 K alkene; 413 K ether.

Phenol: Reimer-Tiemann ($\text{CHCl}_3 / \text{NaOH} \rightarrow \text{salicylaldehyde}$), Kolbe ($\text{CO}_2 \rightarrow \text{salicylic acid}$), Br₂ water $\rightarrow$ 2,4,6-tribromophenol; $\text{FeCl}_3 \rightarrow$ violet.

Williamson: $\text{R-O}^- \text{Na}^+ + \text{R}'\text{X} \rightarrow \text{R-O-R}'$ (use 1° halide). Ether cleavage with HI: smaller alkyl gives RI (S_N2); 3° via S_N1 .

Aldehydes, Ketones & Carboxylic Acids

Nucleophilic addition reactivity: $\text{HCHO} > \text{RCHO} > \text{RCOR} > \text{ArCHO}$.

Tests: Tollens' (silver mirror) and Fehling's for aldehydes; iodoform (I_2 / NaOH) for $\text{CH}_3\text{CO}-$ and $\text{CH}_3\text{CH}(\text{OH})-$; 2,4-DNP for all carbonyls.

Aldol: needs α -H (dil. base) $\rightarrow \beta$ -hydroxy carbonyl. Cannizzaro: no α -H (conc. base) $\rightarrow$ acid + alcohol.

Reductions: Clemmensen ($\text{Zn-Hg} / \text{HCl}$), Wolff-Kishner ($\text{NH}_2\text{NH}_2 / \text{KOH}$) $\rightarrow >\text{C}=\text{O} \rightarrow >\text{CH}_2$; Rosenmund ($\text{RCOCl} \rightarrow \text{RCHO}$); Stephen ($\text{RCN} \rightarrow \text{RCHO}$).

Acids: HVZ ($\text{X}_2 / \text{P} \rightarrow \alpha$ -halo acid); decarboxylation (soda lime); acidity rises with —I groups ($\text{FCH}_2\text{COOH} > \text{ClCH}_2\text{COOH}$); benzoic acid > aliphatic (except formic).

Amines

Preparation: Gabriel phthalimide (pure 1° only), Hofmann bromamide ($\text{RCONH}_2 \rightarrow \text{RNH}_2$, one carbon less), reduction of nitro/nitrile.

Tests: carbylamine ($\text{CHCl}_3 / \text{KOH}$, 1° only $\rightarrow$ foul smell); Hinsberg: 1° gives soluble sulphonamide, 2° insoluble, 3° no reaction.

Diazonium salts (ArN_2^+ , 273–278 K): Sandmeyer (CuX), Gattermann (Cu / HX), KI $\rightarrow$ ArI, $\text{H}_3\text{PO}_2 \rightarrow \text{ArH}$, $\text{H}_2\text{O} \rightarrow \text{ArOH}$, coupling $\rightarrow$ azo dye (*p*-position).

■ Biomolecules

Glucose: open chain with 5 -OH and -CHO; α and β anomers (cyclic pyranose); sucrose (α -D-glucose + β -D-fructose) is non-reducing.

Amino acids exist as zwitterions; at isoelectric point net charge is zero. Proteins: primary (sequence), secondary (α -helix, β -sheet), tertiary, quaternary; denaturation destroys secondary/tertiary.

DNA: A=T (2 H-bonds), G=C (3 H-bonds); RNA has uracil, ribose. Purines: A, G; pyrimidines: C, T, U. Vitamins: C, B water-soluble; A, D, E, K fat-soluble.

■ Polymers

Addition: polythene, PVC, Teflon, polystyrene, PAN; Buna-S ($\text{CH}_2 = \text{CH} - \text{CH} = \text{CH}_2$ + styrene), Buna-N, neoprene; natural rubber = cis-polyisoprene.

Condensation: nylon-6,6 (hexamethylenediamine + adipic acid), nylon-6 (caprolactam), terylene (ethylene glycol + terephthalic acid), Bakelite (phenol + HCHO), melamine.

■ Practical & Analytical Organic

Kjeldahl

$$\% N = \frac{1.4 \times N \times V}{w}$$

Dumas

$$\% N = \frac{28}{22400} \times \frac{V_{STP}}{w} \times 100$$

Carius

$$\% S = \frac{32}{233} \times \frac{w_{\text{BaSO}_4}}{w} \times 100 \quad \% \text{Cl} = \frac{35.5}{143.5} \times \frac{w_{\text{AgCl}}}{w} \times 100$$

Lassaigne's test: Na fusion; N $\rightarrow$ NaCN (Prussian blue with $\text{Fe}^{2+}/\text{Fe}^{3+}$); S $\rightarrow$ Na_2S (violet with nitroprusside); halogens $\rightarrow$ AgX. Kjeldahl does not work for nitro, azo, nitrogen in ring.

Separation: crystallisation, distillation (large bp gap), fractional, steam (immiscible, decomposes at bp), chromatography (R_f = solute / solvent distance).

NEET Extras

■ Environmental Chemistry

Greenhouse gases: CO_2 , CH_4 , N_2O , CFCs, O_3 , water vapour. Acid rain: pH < 5.6 (SO_2 , NO_2).

Ozone depletion: CFCs release Cl. in the stratosphere (catalytic chain); Antarctic ozone hole forms in polar stratospheric clouds. Montreal Protocol (1987) controls CFCs.

Smog: classical (London) — SO_2 + smoke + fog, reducing; photochemical (Los Angeles) — NO_x + hydrocarbons + sunlight $\rightarrow$ PAN, O_3 , oxidising.

Water: BOD high = more polluted (clean water < 5 ppm); eutrophication from excess phosphate/nitrate lowers dissolved oxygen.

■ Chemistry in Everyday Life

Analgesics: non-narcotic (aspirin, paracetamol), narcotic (morphine, codeine). Antipyretics: paracetamol, aspirin. Antacids: NaHCO_3 , $\text{Mg}(\text{OH})_2$, ranitidine.

Antihistamines: brompheniramine, terfenadine. Tranquillisers: equanil, barbiturates, valium. Antibiotics: penicillin, chloramphenicol, ofloxacin (broad-spectrum).

Antiseptics act on living tissue (dettol, 0.2% phenol, tincture of iodine); disinfectants on non-living things (1% phenol, chlorine).

Sweeteners: saccharin, aspartame (unstable on cooking), alitame, sucralose. Preservatives: sodium benzoate, sorbic acid salts.

Soaps: Na/K salts of fatty acids (not effective in hard water). Detergents: anionic (sodium lauryl sulphate), cationic (cetyltrimethylammonium bromide), non-ionic; unbranched chains are biodegradable.