Surface Chemistry Class 12 Formula Sheet

CBSE Class 12 Chemistry · NCERT · for boards, NEET and JEE revision

ChapterNotes

Adsorption: a surface game

adsorbate (sticks) · adsorbent (catches) · surface phenomenon

Absorption = uniform into the bulk; sorption = both together.

- Surface atoms have unbalanced residual forces that grab passing particles
- Adsorbate = caught substance; adsorbent = the surface (charcoal, silica gel)
- More surface area (porous/powdered) → more adsorption

Why adsorption is spontaneous

$\Delta G = \Delta H - T\Delta S$ ($\Delta H < 0, \Delta S < 0, \Delta G < 0$)

At equilibrium $\Delta G = 0$; no further net adsorption.

- $\Delta H < 0$ (heat released as surface energy falls) - never call it endothermic
- $\Delta S < 0$ because a free gas loses freedom on the surface
- Negative ΔH must outweigh the positive $-T\Delta S$ term for $\Delta G < 0$

Physisorption vs Chemisorption

Physisorption: $\Delta H \approx$ 20-40 kJ/mol · Chemisorption: $\Delta H \approx$ 80-240 kJ/mol

With T: physisorption falls; chemisorption rises (needs E_a) then falls.

- Physisorption: van der Waals, reversible, non-specific, multilayer, low T
- Chemisorption: chemical bonds, irreversible, highly specific, monolayer
- High critical-temp gases (CO_2) physisorb more; can convert to chemisorption on heating (H_2/Ni)

Freundlich Adsorption Isotherm

$x/m = k\,P^{(1/n)}$ ($n > 1$) → $\log(x/m) = \log k + (1/n)\log P$

Log-log plot: slope = 1/n, intercept = log k; $0 < 1/n < 1$.

- Low P: $x/m \propto P^1$; high P: $x/m \propto P^0$ (surface saturates)
- x = mass of gas adsorbed, m = mass of adsorbent
- Empirical only - fails at very high pressure; for solutions use C in place of P

Catalysis

lowers E_a · does NOT change ΔH, ΔG or K - only faster

Heterogeneous: diffusion → adsorption → reaction → desorption.

- Homogeneous = same phase (NO in lead-chamber); heterogeneous = different phase
- Memorise: Haber → Fe(+Mo) ; Contact → V_2O_5 ; hydrogenation → Ni
- Activity = how much it accelerates; selectivity = steers to one product

Enzymes & shape-selective catalysis

Enzymes: lock-and-key · Zeolites: shape-selective (pore size)

ZSM-5 zeolite converts alcohols to gasoline.

- Enzymes are protein catalysts - highly specific (maltase, urease, zymase)
- Zeolites admit only molecules of a particular size/shape
- Both are exam favourites for specificity questions

Colloids & their classification

particle size 1-1000 nm · dispersed phase + dispersion medium

Below 1 nm = true solution; above 1000 nm = suspension.

- By state: sol, aerosol, foam, gel, emulsion (read as phase-in-medium)
- Lyophilic = stable + reversible (starch, gelatin); lyophobic = unstable + needs stabiliser (metal sols, As_2S_3)
- By particle: multimolecular (S, Au sol), macromolecular (proteins), associated colloids (micelles)

Associated colloids & cleansing

micelles form above CMC and above Kraft temperature

Tail traps grease inward, head faces water outward - micelle washes away.

- CMC = critical micelle concentration; below it, soap behaves as an electrolyte
- Micelle = water-hating tails inward, water-loving heads outward
- This associated-colloid behaviour is how soap cleans grease

Properties of colloids

Tyndall (scatter) · Brownian (zig-zag) · Electrophoresis (charge)

Tyndall effect distinguishes a colloid from a true solution.

- Tyndall = light scattering makes the beam visible
- Brownian motion (uneven bombardment) gives stability, prevents settling
- Electrophoresis = charged particles drift to an electrode

Coagulation & Hardy–Schulze rule

Hardy–Schulze: higher valency of opposite ion → greater coagulating power

coagulating power ∝ 1 / coagulating value (smallest value = strongest).

- Negative sol (As_2S_3): $Al^{3+} > Ba^{2+} > Na^+$ (compare cations)
- Positive sol ($Fe(OH)_3$): $PO_4^{3-} > SO_4^{2-} > Cl^-$ (compare anions)
- Protective colloids (lyophilic) shield sols; smaller gold number = better protection

Quick revision

- Adsorption: surface phenomenon | Absorption: bulk phenomenon
- Physisorption: weak, reversible, multilayer | Chemisorption: strong, irreversible, monolayer
- Freundlich: x/m = kP^(1/n); log(x/m) vs log P → straight line
- Catalyst: lowers Ea, provides alternative pathway
- Colloids: 1-1000 nm; show Tyndall effect, Brownian motion
- Hardy-Schulze: higher valency ion → greater coagulating power
- Emulsions: O/W (milk) and W/O (butter)
- Purification: dialysis, electrodialysis, ultrafiltration
- Enzymes: biological catalysts, optimum temp 25-37°C, highly specific

Full chapter notes with solved examples and practice questions: https://chapternotes.in/cbse/class-12-chemistry/surface-chemistry-class-12-notes/