ChapterNotes

chapternotes.in · free NEET & JEE prep

CHAPTER NOTES

Surface Chemistry Class 12 Notes — CBSE Chemistry Chapter 5

- ✓ Chapter-wise notes & important questions
- ✓ Free gamified practice app — streaks, levels, revision
- ✓ Free mock & prediction papers with answer keys

Source: https://chapternotes.in/cbse/class-12-chemistry/surface-chemistry-class-12-notes/

Scan to practice this chapter free in the app

Surface Chemistry Class 12 Notes — CBSE Chemistry Chapter 5

Chapter 5 — **Surface Chemistry** — explores what happens at the surface of substances. From why charcoal purifies water to how catalysts speed up industrial reactions, surface chemistry is everywhere! This chapter carries **4-5 marks** and focuses on adsorption, colloids, and catalysis. It's highly conceptual with many real-life applications.

Key Concepts

Adsorption

The accumulation of molecules on a **surface** (not in the bulk). The surface = **adsorbent**; the molecule adsorbed = **adsorbate**.

Property	Physisorption	Chemisorption
Forces	Weak van der Waals forces	Chemical bonds (covalent/ionic)
Enthalpy	Low (20-40 kJ/mol)	High (80-240 kJ/mol)
Specificity	Non-specific	Highly specific
Reversibility	Reversible	Usually irreversible
Temperature effect	Decreases with temp	Increases then decreases
Layers	Multilayer	Monolayer only
Activation energy	Low/none	Sometimes high

Remember: Physisorption is like a guest sitting on a chair (weak, temporary). Chemisorption is like nailing yourself to the chair (strong, permanent bond)!

Factors Affecting Adsorption of Gases on Solids

- **Nature of gas:** Easily liquefiable gases (NH_3, HCl, SO_2) are adsorbed more (higher critical temperature)
- **Surface area:** More surface area → more adsorption (finely divided metals are best)
- **Temperature:** Physisorption decreases; chemisorption increases initially then decreases
- **Pressure:** Adsorption increases with pressure (follows Freundlich isotherm)

Freundlich Adsorption Isotherm

x/m = kP^(1/n) (where 1/n is between 0 and 1)

Taking log: **log(x/m) = log k + (1/n) log P**

At low pressure: x/m $\propto$ P (1/n = 1)

At high pressure: x/m = constant (independent of P)

Catalysis

Homogeneous vs Heterogeneous Catalysis

Feature	Homogeneous	Heterogeneous
Phase	Same phase as reactants	Different phase
Example	H_2SO_4 in esterification	Fe in Haber process ($N_2 + H_2$)
Example	NO in lead chamber process	V_2O_5 in contact process ($SO_2 \rightarrow SO_3$)

Important Catalytic Concepts

- **Activity:** Ability of a catalyst to increase reaction rate
- **Selectivity:** Ability to direct a reaction to yield a particular product
- **Promoter:** Substance that enhances catalyst activity (e.g., Mo in Haber process with Fe catalyst)
- **Poison/Inhibitor:** Substance that decreases catalyst activity (e.g., CO poisons Fe catalyst in Haber)

Enzyme Catalysis: Enzymes are biological catalysts (proteins). They follow Michaelis-Menten kinetics. Key features: highly specific, work at optimum temperature (25-37°C) and pH (5-7), activity reduced by inhibitors.

Colloids

Classification by Particle Size

Type	Particle Size	Example
True Solution	< 1 nm	NaCl in water, sugar solution
Colloidal Solution	1 nm – 1000 nm	Milk, blood, ink, smoke
Suspension	> 1000 nm	Muddy water, chalk in water

Types of Colloidal Systems

Dispersed Phase	Dispersion Medium	Type	Example
Solid	Liquid	Sol	Paints, cell fluids
Liquid	Liquid	Emulsion	Milk, face cream
Gas	Liquid	Foam	Shaving cream, whipped cream
Solid	Gas	Aerosol (solid)	Smoke, dust
Liquid	Gas	Aerosol (liquid)	Fog, mist, cloud
Solid	Solid	Solid sol	Gemstones, coloured glass

Properties of Colloids

- **Tyndall Effect:** Scattering of light by colloidal particles (beam visible in colloid but not in true solution)
- **Brownian Motion:** Zigzag movement of colloidal particles due to bombardment by dispersion medium molecules
- **Electrophoresis:** Movement of colloidal particles under electric field (shows they carry charge)
- **Coagulation/Flocculation:** Settling of colloidal particles by adding electrolyte (neutralizes charge)

> **Hardy-Schulze Rule:** The greater the valency of the flocculating ion, the greater is its coagulating power.
> For negatively charged sol: $Al^{3+} > Ba^{2+} > Na^{+}$ (coagulating power)
> For positively charged sol: $PO_4^{3-} > SO_4^{2-} > Cl^{-}$

Emulsions

- **Oil-in-water (O/W):** Oil droplets in water — milk, vanishing cream. Stabilised by water-soluble emulsifiers.
- **Water-in-oil (W/O):** Water droplets in oil — butter, cold cream. Stabilised by oil-soluble emulsifiers.

Preparation of Colloids

Chemical methods: Double decomposition (As_2S_3 sol), oxidation, reduction (gold sol by reducing $HAuCl_4$ with HCHO)

Physical methods: Bredig's arc method (metal sols), peptization (adding electrolyte to precipitate)

Purification of Colloids

- **Dialysis:** Removal of dissolved ions through semipermeable membrane
- **Electrodialysis:** Faster dialysis under electric field

- **Ultrafiltration:** Using ultrafilter paper to separate colloid from true solution

Important Definitions

Term	Definition
Adsorption	Accumulation of molecules on the surface of a substance
Adsorbent	The surface on which adsorption takes place
Catalyst	Substance that changes reaction rate without being consumed
Colloid	Heterogeneous system with particle size between 1-1000 nm
Tyndall Effect	Scattering of light by colloidal particles
Coagulation	Settling of colloidal particles by neutralising their charge
Peptization	Converting a precipitate into a colloidal sol by adding electrolyte
Emulsion	Colloidal system of two immiscible liquids

Solved Examples — NCERT Based

Example 1: Hardy-Schulze Rule

Q: Arrange the following in increasing order of coagulating power for a negatively charged As_2S_3 sol: NaCl, $BaCl_2$, $AlCl_3$

Solution:

For negatively charged sol, the coagulating ion is the cation. By Hardy-Schulze rule, higher charge → greater coagulating power.

Na^+ (1+) < Ba^{2+} (2+) < Al^{3+} (3+)

Increasing coagulating power: **NaCl < $BaCl_2$ < $AlCl_3$**

Example 2: Identifying Colloid Type

Q: Classify the following colloids: (a) Smoke (b) Milk (c) Fog (d) Butter

Solution:

(a) Smoke — solid in gas → **Aerosol (solid)**

(b) Milk — liquid in liquid → **Emulsion (O/W type)**

(c) Fog — liquid in gas → **Aerosol (liquid)**

(d) Butter — liquid in solid (water droplets in fat) → **Gel / W/O emulsion**

Example 3: Adsorption Type

Q: At low temperature, N_2 gas shows adsorption on iron surface. At high temperature, the same gas shows adsorption with higher enthalpy. Explain.

Solution:

At low temperature → **physisorption** (weak van der Waals forces, low enthalpy, reversible)

At high temperature → **chemisorption** (N_2 molecules gain enough energy to break N≡N bond and form chemical bonds with Fe surface, high enthalpy)

This is exactly what happens in the Haber process — N_2 chemisorbs on Fe catalyst at high temperature.

Example 4: Freundlich Isotherm

Q: For adsorption of a gas on charcoal, log(x/m) vs log P gives a straight line with slope 0.5 and intercept 1.2. Find k and 1/n in the Freundlich equation.

Solution:

log(x/m) = log k + (1/n) log P

Slope = 1/n = **0.5**

Intercept = log k = 1.2 → k = 10^1.2 = **15.85**

Important Questions for Board Exams

1 Mark Questions

1. What is the difference between adsorption and absorption?
2. What is Tyndall effect?
3. Name the type of colloid formed when a liquid is dispersed in a gas.
4. What is peptization?

2 Mark Questions

1. Distinguish between physisorption and chemisorption (any 4 points).
2. What is an emulsion? Name two types with examples.
3. State Hardy-Schulze rule with an example.
4. What are lyophilic and lyophobic colloids?

3 Mark Questions

1. Write the Freundlich adsorption isotherm. How can it be verified graphically?
2. What are the various methods of preparing colloids? Explain any two chemical methods.
3. Explain the mechanism of enzyme catalysis.
4. What is electrophoresis? How does it show that colloidal particles are charged?

5 Mark Questions

1. Discuss the properties of colloidal solutions: Tyndall effect, Brownian motion, electrophoresis, and coagulation.
2. What is adsorption? Compare physisorption and chemisorption. Write the Freundlich isotherm and explain the effect of temperature and pressure on adsorption.

Quick Revision Points

- 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

← Previous: Chemical Kinetics

Next: Isolation of Elements →