ABC CHEMISTRY

Mr. Aniket Bhardwaj · 15+ Years Mentorship

Surface Chemistry

Premium CSIR-NET PYQ Book

25 Previous-Year Questions · 22 with verified answers · Distractor Analysis

3-Slide Solutions | Distractor Analysis | Exam Tricks | Revision Sheets

CSIR-NET · GATE · IIT-JAM — 4 Topics · 25 Real PYQs

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Course Contents

4 Topics · 25 PYQs

1	**Colloids Micelles** 6 Qs E 3 · M 3 · H 0	24%	
2	**Adsorption Isotherms** 5 Qs E 0 · M 5 · H 0	20%	
3	**Surface Tension** 3 Qs E 1 · M 2 · H 0	12%	
4	**Surface Chemistry – General** 11 Qs E 3 · M 7 · H 1	44%	

Legend: **E** Easy **M** Medium **H** Hard · **%** = exam weightage (share of the chapter)

TOPIC 1

Colloids Micelles

6 questions · Easy 3 | Medium 3 | Hard 0 · PYQ frequency: High

Q1 **Dispersion of a solid in a liquid, a liquid in a gas and a liquid in a liquid are respectively known as (a) Aerosol, emulsion, sol (c) Emulsion, sol, aerosol (b) Sol, Aerosol, emulsion (d) Aerosol, sol, emulsion**

SELF-PRACTICE answer on record: (B) — options were not printed in the source.

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Colloids Micelles

PYQ FREQUENCY
High · 5 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'Opposite charge, higher valence, faster coagulation'.

Q2

The aggregation of surfactant molecules is known as

A. micelles

B. clusters

C. gel

D. colloid

QUESTION INSIGHTS

ESTIMATED TIME
1–1.5 min

DIFFICULTY
Easy

CONCEPT TESTED
Colloids Micelles

PYQ FREQUENCY
High · 5 papers

REVISION PRIORITY
★★★☆☆

EXPECTED LEVEL
Part B

MEMORY HOOK
'Opposite charge, higher valence, faster coagulation'.

Colloids Micelles

Correct Answer A micelles

CONCEPT

Colloids (1–1000 nm) are stabilised by surface charge (zeta potential, electrical double layer); coagulation follows the Hardy–Schulze rule; surfactants form micelles above the CMC and Krafft temperature; Tyndall effect, Brownian motion, electrophoresis.

↓

LOGIC / WORKING

- The aggregation of surfactant molecules is defined as micelles. Explanation as extracted from the printed page; notation may be imperfect.
- Therefore the answer is (A).

FINAL: (A) micelles

SHORTCUT / EXAM TRICK

For a negative sol the cation with the highest charge coagulates best.

COMMON MISTAKE

Thinking micelles form at any concentration — only above CMC and above the Krafft point.

EXAM TIP

Gold number: lower = better protective colloid.

MEMORY TRICK

'Opposite charge, higher valence, faster coagulation'.

Why the Other Options Are Wrong

Correct answer: A

B **clusters**

Why (A) is the key — The aggregation of surfactant molecules is defined as micelles. Explanation as extracted from the printed page; notation may be imperfect.

C **gel**

Ruled out: Thinking micelles form at any concentration — only above CMC and above the Krafft point.

D **colloid**

Ruled out: Gold number: lower = better protective colloid.

Q3

The aggregation of surfactant molecules is known as

A. micelles

B. clusters

C. gel

D. colloid Statements Reasons (A) thermodynamically unstable (C) interfacial surface tension (B) kinetically stable (D) electrical double layer

QUESTION INSIGHTS

ESTIMATED TIME
1–1.5 min

DIFFICULTY
Easy

CONCEPT TESTED
Colloids Micelles

PYQ FREQUENCY
High · 5 papers

REVISION PRIORITY
★★★☆☆

EXPECTED LEVEL
Part B

MEMORY HOOK
'Opposite charge, higher valence, faster coagulation'.

Colloids Micelles

Correct Answer A micelles

CONCEPT

Colloids (1–1000 nm) are stabilised by surface charge (zeta potential, electrical double layer); coagulation follows the Hardy–Schulze rule; surfactants form micelles above the CMC and Krafft temperature; Tyndall effect, Brownian motion, electrophoresis.

↓

LOGIC / WORKING

- Above the CMC surfactant molecules self-assemble into micelles (hydrophobic tails inward, polar heads outward).
- Therefore the answer is (A).

FINAL: (A) micelles

SHORTCUT / EXAM TRICK

For a negative sol the cation with the highest charge coagulates best.

COMMON MISTAKE

Thinking micelles form at any concentration — only above CMC and above the Krafft point.

EXAM TIP

Gold number: lower = better protective colloid.

MEMORY TRICK

'Opposite charge, higher valence, faster coagulation'.

Why the Other Options Are Wrong

Correct answer: A

B **clusters**

Why (A) is the key — Above the CMC surfactant molecules self-assemble into micelles (hydrophobic tails inward, polar heads outward).

C **gel**

Ruled out: Thinking micelles form at any concentration — only above CMC and above the Krafft point.

D **colloid Statements Reasons (A) thermodynamically unstable (C) interfacial surface tension (B) kinetically stable (D) electrical double layer**

Ruled out: Gold number: lower = better protective colloid.

Q4

When river water containing colloidal clay flows into the sea, the major cause of silting is

A. accumulation of sand at the bottom

B. flocculation and coagulation

C. decreased salinity of sea water

D. micellization

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Colloids Micelles

PYQ FREQUENCY
High · 5 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'Opposite charge, higher valence, faster coagulation'.

Correct Answer B flocculation and coagulation

CONCEPT

Colloids (1–1000 nm) are stabilised by surface charge (zeta potential, electrical double layer); coagulation follows the Hardy–Schulze rule; surfactants form micelles above the CMC and Krafft temperature; Tyndall effect, Brownian motion, electrophoresis.

↓

LOGIC / WORKING

- Sea water's electrolytes neutralise the charge on colloidal clay (Hardy–Schulze), causing flocculation/coagulation and deposition as silt at the river mouth (delta formation).
- Therefore the answer is (B).

FINAL: (B) flocculation and coagulation

SHORTCUT / EXAM TRICK

For a negative sol the cation with the highest charge coagulates best.

COMMON MISTAKE

Thinking micelles form at any concentration — only above CMC and above the Krafft point.

EXAM TIP

Gold number: lower = better protective colloid.

MEMORY TRICK

'Opposite charge, higher valence, faster coagulation'.

Why the Other Options Are Wrong

Correct answer: B

A **accumulation of sand at the bottom**

Why (B) is the key — Sea water's electrolytes neutralise the charge on colloidal clay (Hardy–Schulze), causing flocculation/coagulation and deposition as silt at the river mouth (delta formation).

C **decreased salinity of sea water**

Ruled out: Thinking micelles form at any concentration — only above CMC and above the Krafft point.

D **micellization**

Ruled out: Gold number: lower = better protective colloid.

Q5

An intense purple colour (Plasmon band) is exhibited by a colloid consisting of spherical

A. silver particles of 10 mm diameter

B. silicon particles of 5 mm diameter

C. gold particles of 5 nm diameter

D. iron particles of 3 mm diameter

QUESTION INSIGHTS

ESTIMATED TIME
1–1.5 min

DIFFICULTY
Easy

CONCEPT TESTED
Colloids Micelles

PYQ FREQUENCY
High · 5 papers

REVISION PRIORITY
★★★☆☆

EXPECTED LEVEL
Part B

MEMORY HOOK
'Opposite charge, higher valence, faster coagulation'.

Colloids Micelles

Correct Answer C gold particles of 5 nm diameter

CONCEPT

Colloids (1–1000 nm) are stabilised by surface charge (zeta potential, electrical double layer); coagulation follows the Hardy–Schulze rule; surfactants form micelles above the CMC and Krafft temperature; Tyndall effect, Brownian motion, electrophoresis.

↓

LOGIC / WORKING

- Nanoscale gold (≈ 5–20 nm) shows a surface-plasmon absorption near 520 nm, giving ruby-red to purple colloids; millimetre-size particles show no plasmon band.
- Therefore the answer is (C).

FINAL: (C) gold particles of 5 nm diameter

SHORTCUT / EXAM TRICK

For a negative sol the cation with the highest charge coagulates best.

COMMON MISTAKE

Thinking micelles form at any concentration — only above CMC and above the Krafft point.

EXAM TIP

Gold number: lower = better protective colloid.

MEMORY TRICK

'Opposite charge, higher valence, faster coagulation'.

Why the Other Options Are Wrong

Correct answer: C

A **silver particles of 10 mm diameter**

Why (C) is the key — Nanoscale gold (≈ 5–20 nm) shows a surface-plasmon absorption near 520 nm, giving ruby-red to purple colloids; millimetre-size particles show no plasmon band.

B **silicon particles of 5 mm diameter**

Ruled out: Thinking micelles form at any concentration — only above CMC and above the Krafft point.

D **iron particles of 3 mm diameter**

Ruled out: Gold number: lower = better protective colloid.

Q6

Above the critical micelle concentration (CMC), the option which correctly describes the variation of molar conductivity with increase in concentration of sodium dodecylsulphate in aqueous solution is

A. molar conductivity increases sharply, but the solution does not remain colloidal

B. molar conductivity decreases sharply, but the solution remains colloidal

C. molar conductivity decreases sharply and dissociation into monomers also occurs sharply

D. molar conductivity increases sharply with large loss of entropy

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Colloids Micelles

PYQ FREQUENCY
High · 5 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'Opposite charge, higher valence, faster coagulation'.

Correct Answer B molar conductivity decreases sharply, but the solution remains colloidal

CONCEPT

Colloids (1–1000 nm) are stabilised by surface charge (zeta potential, electrical double layer); coagulation follows the Hardy–Schulze rule; surfactants form micelles above the CMC and Krafft temperature; Tyndall effect, Brownian motion, electrophoresis.

↓

LOGIC / WORKING

- Above the CMC added surfactant goes into micelles, which carry counter-ions and move slowly; molar conductivity falls sharply while the solution stays colloidal (association colloid).
- Therefore the answer is (B).

FINAL: (B) molar conductivity decreases sharply, but the solution remains colloidal

SHORTCUT / EXAM TRICK

For a negative sol the cation with the highest charge coagulates best.

COMMON MISTAKE

Thinking micelles form at any concentration — only above CMC and above the Krafft point.

EXAM TIP

Gold number: lower = better protective colloid.

MEMORY TRICK

'Opposite charge, higher valence, faster coagulation'.

Why the Other Options Are Wrong

Correct answer: B

A **molar conductivity increases sharply, but the solution does not remain colloidal**

Why (B) is the key — Above the CMC added surfactant goes into micelles, which carry counter-ions and move slowly; molar conductivity falls sharply while the solution stays colloidal (association colloid).

C **molar conductivity decreases sharply and dissociation into monomers also occurs sharply**

Ruled out: Thinking micelles form at any concentration — only above CMC and above the Krafft point.

D **molar conductivity increases sharply with large loss of entropy**

Ruled out: Gold number: lower = better protective colloid.

TOPIC REVISION

Colloids Micelles

6 PYQs · Last-minute revision

TOPIC SUMMARY

Colloids (1–1000 nm) are stabilised by surface charge (zeta potential, electrical double layer); coagulation follows the Hardy–Schulze rule; surfactants form micelles above the CMC and Krafft temperature; Tyndall effect, Brownian motion, electrophoresis.

IMPORTANT FORMULA SHEET

- Hardy–Schulze: coagulating power $\propto z^6$ ($Al^{3+} \gg Mg^{2+} \gg Na^{+}$)
- CMC lowers with longer hydrophobic tail
- Zeta potential ≈ 0 at the isoelectric point

FREQUENTLY ASKED CONCEPTS

- Hardy–Schulze rule
- Lyophilic vs lyophobic sols
- CMC dependence on chain length and T
- Emulsion types

COMMON MISTAKES & QUICK NOTES

Watch out:
Thinking micelles form at any concentration — only above CMC and above the Krafft point.
Gold number: lower = better protective colloid.

MOST-REPEATED PYQs & EXPECTED IN EXAM

PYQs in this topic: Q1 Q2 Q3 Q4 Q5 Q6

Expect 1 question(s) next session on Colloids Micelles.

TOPIC 2

Adsorption Isotherms

5 questions · Easy 0 | Medium 5 | Hard 0 · PYQ frequency: Occasional

Q7

The adsorption of a gas is described by the Langmuir isotherm with the equilibrium constant K = 0.9 kPa^{-1} at 25Â°C. The pressure (in kPa) at which the fractional surface coverage is 0.95, is

A 1/11.1

B 21.1

C 11.1

D 42.2

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Adsorption Isotherms

PYQ FREQUENCY
Occasional · 4 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'Kp over 1 plus Kp'.

Correct Answer B 21.1

CONCEPT

Langmuir (monolayer, θ = Kp/(1+Kp)), Freundlich (empirical, x/m = kp^(1/n)), BET (multilayer with p_0), Temkin; adsorption is exothermic so it falls as T rises; isotherm type (I–V) indicates pore structure.

↓

LOGIC / WORKING

- θ = Kp/(1 + Kp) → p = θ/(K(1 − θ)) = 0.95/(0.9 × 0.05) = 21.1 kPa.
- Therefore the answer is (B).

FINAL: (B) 21.1

SHORTCUT / EXAM TRICK

Langmuir at low pressure is first order in p, at high pressure zero order.

COMMON MISTAKE

Using the total pressure instead of p/p_0 in BET.

EXAM TIP

Freundlich 1/n between 0 and 1; n > 1 means favourable adsorption.

MEMORY TRICK

'Kp over 1 plus Kp'.

Why the Other Options Are Wrong

Correct answer: B

A **1/11.1**

Why (B) is the key — $\theta = Kp/(1 + Kp) \rightarrow p = \theta/(K(1 - \theta)) = 0.95/(0.9 \times 0.05) = 21.1$ kPa.

C **11.1**

Ruled out: Using the total pressure instead of p/p_0 in BET.

D **42.2**

Ruled out: Freundlich 1/n between 0 and 1; n > 1 means favourable adsorption.

Q8 For the non dissociative Langmuir type adsorption of a gas on a solid surface at a particular temperature, the fraction of surface coverage is 0.6 at 30 bar. The Langmuir isotherm constant (in bar^{-1} units) at this temperature is

A. 0.05

B. 0.20

C. 2.0

D. 5.0

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Adsorption Isotherms

PYQ FREQUENCY
Occasional · 4 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'Kp over 1 plus Kp'.

Correct Answer A 0.05

CONCEPT

Langmuir (monolayer, θ = Kp/(1+Kp)), Freundlich (empirical, x/m = kp^(1/n)), BET (multilayer with p_0), Temkin; adsorption is exothermic so it falls as T rises; isotherm type (I–V) indicates pore structure.

↓

LOGIC / WORKING

- $K = \theta/[(1 - \theta)p] = 0.6/(0.4 \times 30) = 0.05\ bar^{-1}$.
- Therefore the answer is (A).

FINAL: (A) 0.05

SHORTCUT / EXAM TRICK

Langmuir at low pressure is first order in p, at high pressure zero order.

COMMON MISTAKE

Using the total pressure instead of p/p_0 in BET.

EXAM TIP

Freundlich 1/n between 0 and 1; n > 1 means favourable adsorption.

MEMORY TRICK

'Kp over 1 plus Kp'.

Why the Other Options Are Wrong

Correct answer: A

B **0.20**

Why (A) is the key — $K = \theta/[(1 - \theta)p] = 0.6/(0.4 \times 30) = 0.05\ bar^{-1}$.

C **2.0**

Ruled out: Using the total pressure instead of p/p_0 in BET.

D **5.0**

Ruled out: Freundlich 1/n between 0 and 1; n > 1 means favourable adsorption.

Q9

In a Langmuir-type adsorption, a solid adsorbs 0.25 mg of a gas when the pressure of the gas is 50 bar and 0.2 mg of the gas at 20 bar pressure. The percentage of surface coverage at 50 bar is close to:

A 75

B 38

C 57

D 83

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Adsorption Isotherms

PYQ FREQUENCY
Occasional · 4 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'Kp over 1 plus Kp'.

Adsorption Isotherms

Correct Answer D 83

CONCEPT

Langmuir (monolayer, θ = Kp/(1+Kp)), Freundlich (empirical, x/m = kp^(1/n)), BET (multilayer with p_0), Temkin; adsorption is exothermic so it falls as T rises; isotherm type (I–V) indicates pore structure.

↓

LOGIC / WORKING

- m = m_∞Kp/(1 + Kp): 0.25(1 + 50K) = 50Km_∞ and 0.20(1 + 20K) = 20Km_∞. Dividing: 0.005(1 + 50K) = 0.01(1 + 20K) → K = 0.1 bar^{-1}. θ(50 bar) = 5/(1 + 5) = 0.83 → 83 %.
- Therefore the answer is (D).

FINAL: (D) 83

SHORTCUT / EXAM TRICK

Langmuir at low pressure is first order in p, at high pressure zero order.

COMMON MISTAKE

Using the total pressure instead of p/p_0 in BET.

EXAM TIP

Freundlich 1/n between 0 and 1; n > 1 means favourable adsorption.

MEMORY TRICK

'Kp over 1 plus Kp'.

Why the Other Options Are Wrong

Correct answer: D

A **75**

Why (D) is the key — $m = m_\infty Kp/(1 + Kp)$: $0.25(1 + 50K) = 50Km_\infty$ and $0.20(1 + 20K) = 20Km_\infty$. Dividing: $0.005(1 + 50K) = 0.01(1 + 20K) \rightarrow K = 0.1\ bar^{-1}$. $\theta(50\ bar) = 5/(1 + 5) = 0.83 \rightarrow 83\ \%$.

B **38**

Ruled out: Using the total pressure instead of p/p_0 in BET.

C **57**

Ruled out: Freundlich 1/n between 0 and 1; n > 1 means favourable adsorption.

Q10 At 273 K and 10 bar, the langmuir adsorption of a gas on a solid surface gave the fraction of surface coverage as 0.01. The Langmuir adsorption isotherm constant is _____ bar^{-1}.
(Numerical answer type — write the value.)

ANSWER: 1.01×10^{-3} bar^{-1}

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Adsorption Isotherms

PYQ FREQUENCY
Occasional · 4 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
$K = \theta/[(1-\theta)p] = 0.01/(0.99 \times 10) = 1.01\times10^{-3}\ bar^{-1}$.

Q11

For low partial pressure of ozone (O_3), the adsorption of ozone on graphite surface is the fully dissociative in nature and follows Langmuir isotherm. Under these conditions, if the dependence of the surface coverage of graphite (θ) on partial pressure of ozone (P_{O_3}) is given by $\theta \propto (P_{O_3})^x$, the value of x is ___ (Upto two decimal places) (Numerical answer type — write the value.)

ANSWER: 0.50

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Adsorption Isotherms

PYQ FREQUENCY
Occasional · 4 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
Dissociative Langmuir: $\theta = (Kp)^{1/2}/(1 + (Kp)^{1/2})$; at low pressure $\theta \approx (Kp)^{1/2} \propto p^{0.5} \rightarrow x = 0.50$.

TOPIC REVISION

Adsorption Isotherms

5 PYQs · Last-minute revision

TOPIC SUMMARY

Langmuir (monolayer, θ = Kp/(1+Kp)), Freundlich (empirical, x/m = kp^(1/n)), BET (multilayer with p_0), Temkin; adsorption is exothermic so it falls as T rises; isotherm type (I–V) indicates pore structure.

IMPORTANT FORMULA SHEET

- θ = Kp/(1+Kp) → p/V = 1/(KV_m) + p/V_m
- log(x/m) = log k + (1/n) log p
- BET surface area = V_m N_A σ/V_mol

FREQUENTLY ASKED CONCEPTS

- Linear forms and what slope/intercept give
- Limiting cases of Langmuir (low p: θ ∝ p; high p: θ → 1)
- BET surface area calculation

COMMON MISTAKES & QUICK NOTES

Watch out:
Using the total pressure instead of p/p_o in BET.
Freundlich 1/n between 0 and 1; n > 1 means favourable adsorption.

MOST-REPEATED PYQs & EXPECTED IN EXAM

PYQs in this topic: Q7 Q8 Q9 Q10 Q11

Expect 1 question(s) next session on Adsorption Isotherms.

TOPIC 3

Surface Tension

3 questions · Easy 1 | Medium 2 | Hard 0 · PYQ frequency: Rare

Q12

A liquid of density 1.1 g cm^{-3} climbs to a height of 5.0 cm when a capillary with internal radius of 0.2 mm is dipped into it. The surface tension (in N m^{-1}) of the liquid is closest to

A 0.05

B 0.108

C 0.018

D 0.005

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Surface Tension

PYQ FREQUENCY
Rare · 2 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'Drop 2, Bubble 4'.

Correct Answer A 0.05

CONCEPT

Surface tension γ = work per unit area; Young–Laplace Δp = 2γ/r; Kelvin equation raises vapour pressure of small drops; Gibbs adsorption links γ change to surface excess; capillary rise h = 2γcosθ/ρgr.

↓

LOGIC / WORKING

- Capillary rise γ = hρgr/2 (cos θ = 1) = 0.050 × 1100 × 9.8 × 2×10⁻⁴/2 = 0.054 N m⁻¹ ≈ 0.05.
- Therefore the answer is (A).

FINAL: (A) 0.05

SHORTCUT / EXAM TRICK

A bubble has two surfaces → 4γ/r.

COMMON MISTAKE

Forgetting cosθ for non-wetting liquids (mercury depresses).

EXAM TIP

γ decreases with temperature and vanishes at the critical point.

MEMORY TRICK

'Drop 2, Bubble 4'.

Why the Other Options Are Wrong

Correct answer: A

B **0.108**

Why (A) is the key — Capillary rise $\gamma = h\rho gr/2$ ($\cos\theta = 1$) = $0.050 \times 1100 \times 9.8 \times 2\times10^{-4}/2 = 0.054$ N $m^{-1} \approx 0.05$.

C **0.018**

Ruled out: Forgetting $\cos\theta$ for non-wetting liquids (mercury depresses).

D **0.005**

Ruled out: γ decreases with temperature and vanishes at the critical point.

Q13

The surface tension of dilute soap solution is lower than that of pure water because

A. soap molecules accumulate more at the surface than in the bulk solution

B. soap molecules accumulate more in the bulk than on the surface

C. the soap molecules aggregate uniformly in the bulk and the surface

D. soap molecules form micellar structures at low concentration

QUESTION INSIGHTS

ESTIMATED TIME
1–1.5 min

DIFFICULTY
Easy

CONCEPT TESTED
Surface Tension

PYQ FREQUENCY
Rare · 2 papers

REVISION PRIORITY
★★★☆☆

EXPECTED LEVEL
Part B

MEMORY HOOK
'Drop 2, Bubble 4'.

Correct Answer A soap molecules accumulate more at the surface than in the bulk solution

CONCEPT

Surface tension γ = work per unit area; Young–Laplace Δp = 2γ/r; Kelvin equation raises vapour pressure of small drops; Gibbs adsorption links γ change to surface excess; capillary rise h = 2γcosθ/ρgr.

↓

LOGIC / WORKING

- Gibbs adsorption: a solute that lowers γ has positive surface excess (Γ = −(c/RT)dγ/dc > 0) — soap concentrates at the surface, not the bulk.
- Therefore the answer is (A).

FINAL: (A) soap molecules accumulate more at the surface than in the bulk solution

SHORTCUT / EXAM TRICK

A bubble has two surfaces → 4γ/r.

COMMON MISTAKE

Forgetting cosθ for non-wetting liquids (mercury depresses).

EXAM TIP

γ decreases with temperature and vanishes at the critical point.

MEMORY TRICK

'Drop 2, Bubble 4'.

Why the Other Options Are Wrong

Correct answer: A

B **soap molecules accumulate more in the bulk than on the surface**

Why (A) is the key — Gibbs adsorption: a solute that lowers γ has positive surface excess ($\Gamma = -(c/RT)d\gamma/dc > 0$) — soap concentrates at the surface, not the bulk.

C **the soap molecules aggregate uniformly in the bulk and the surface**

Ruled out: Forgetting cosθ for non-wetting liquids (mercury depresses).

D **soap molecules form micellar structures at low concentration**

Ruled out: γ decreases with temperature and vanishes at the critical point.

Q14

Liquid A has half the surface tension and twice the density of liquid B at 30Â°C. The contact angles of A and B are the same. If A rises 10 cm in a capillary, then the rise (in cm) of liquid B in the same capillary at the same temperature will be equal to

A 60

B 10

C 40

D 20

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Surface Tension

PYQ FREQUENCY
Rare · 2 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'Drop 2, Bubble 4'.

Correct Answer C 40

CONCEPT

Surface tension γ = work per unit area; Young–Laplace Δp = 2γ/r; Kelvin equation raises vapour pressure of small drops; Gibbs adsorption links γ change to surface excess; capillary rise h = 2γcosθ/ρgr.

↓

LOGIC / WORKING

- h = 2γcosθ/(ρgr) ∝ γ/ρ. B has 2γ_A and ρ_A/2 → h_B = 4 h_A = 40 cm.
- Therefore the answer is (C).

FINAL: (C) 40

SHORTCUT / EXAM TRICK

A bubble has two surfaces → 4γ/r.

COMMON MISTAKE

Forgetting cosθ for non-wetting liquids (mercury depresses).

EXAM TIP

γ decreases with temperature and vanishes at the critical point.

MEMORY TRICK

'Drop 2, Bubble 4'.

Why the Other Options Are Wrong

Correct answer: C

A — **60**

Why (C) is the key — $h = 2\gamma\cos\theta/(\rho g r) \propto \gamma/\rho$. B has $2\gamma_A$ and $\rho_A/2 \rightarrow h_B = 4\,h_A = 40$ cm.

B — **10**

Ruled out: Forgetting $\cos\theta$ for non-wetting liquids (mercury depresses).

D — **20**

Ruled out: γ decreases with temperature and vanishes at the critical point.

TOPIC REVISION

Surface Tension

3 PYQs · Last-minute revision

TOPIC SUMMARY

Surface tension γ = work per unit area; Young–Laplace Δp = 2γ/r; Kelvin equation raises vapour pressure of small drops; Gibbs adsorption links γ change to surface excess; capillary rise h = 2γcosθ/ρgr.

IMPORTANT FORMULA SHEET

- Δp = 2γ/r (drop), 4γ/r (bubble)
- h = 2γ cosθ/(ρ g r)
- $\ln(p/p_0) = 2\gamma V_m/(rRT)$
- Γ = −(c/RT)(dγ/dc)

FREQUENTLY ASKED CONCEPTS

- Capillary rise
- Kelvin equation
- Surfactants lower γ (Γ > 0)
- Contact angle and wetting

COMMON MISTAKES & QUICK NOTES

Watch out:
Forgetting cosθ for non-wetting liquids (mercury depresses).
γ decreases with temperature and vanishes at the critical point.

MOST-REPEATED PYQs & EXPECTED IN EXAM

PYQs in this topic: Q12 Q13 Q14

Expect 2 question(s) next session on Surface Tension.

TOPIC 4

Surface Chemistry – General

11 questions · Easy 3 | Medium 7 | Hard 1 · PYQ frequency: High

Q15

Stability of lyophobic dispersions is determined by

A. inter-particle electric double layer repulsion and intra-particle van der Waals attraction

B. inter-particle electric double layer attraction and intra-particle van der Waals repulsion

C. inter-particle excluded volume repulsion and intra-particle van der Waals attraction

D. inter-particle excluded volume attraction and intra-particle van der Waals repulsion

QUESTION INSIGHTS

ESTIMATED TIME
1–1.5 min

DIFFICULTY
Easy

CONCEPT TESTED
Surface Chemistry – General

PYQ FREQUENCY
High · 6 papers

REVISION PRIORITY
★★★☆☆

EXPECTED LEVEL
Part B

MEMORY HOOK
'Langmuir = monolayer, BET = multilayer'.

Correct Answer A inter-particle electric double layer repulsion and intra-particle van der Waals attraction

CONCEPT

Adsorption (physisorption vs chemisorption), Langmuir and Freundlich isotherms, BET for multilayers, surface tension and Gibbs adsorption, colloids, micelles (CMC), heterogeneous catalysis.

↓

LOGIC / WORKING

- DLVO: kinetic stability of lyophobic sols comes from the balance between electric double-layer repulsion and van der Waals attraction between particles.
- Therefore the answer is (A).

FINAL: (A) inter-particle electric double layer repulsion and intra-particle van der Waals attraction

SHORTCUT / EXAM TRICK

Langmuir linear plot: p/V vs p — slope 1/V_m, intercept 1/(KV_m).

COMMON MISTAKE

Applying Langmuir to multilayer adsorption; confusing Γ sign for surfactants (positive adsorption lowers γ).

EXAM TIP

Chemisorption: $\Delta H \approx -40$ to -400 kJ mol^{-1}, monolayer, specific; physisorption: ≈ -20 kJ mol^{-1}, multilayer.

MEMORY TRICK

'Langmuir = monolayer, BET = multilayer'.

Why the Other Options Are Wrong

Correct answer: A

B **inter-particle electric double layer attraction and intra-particle van der Waals repulsion**

Why (A) is the key — DLVO: kinetic stability of lyophobic sols comes from the balance between electric double-layer repulsion and van der Waals attraction between particles.

C **inter-particle excluded volume repulsion and intra-particle van der Waals attraction**

Ruled out: Applying Langmuir to multilayer adsorption; confusing Γ sign for surfactants (positive adsorption lowers γ).

D **inter-particle excluded volume attraction and intra-particle van der Waals repulsion**

Ruled out: Chemisorption: $\Delta H \approx -40$ to -400 kJ mol^{-1}, monolayer, specific; physisorption: ≈ -20 kJ mol^{-1}, multilayer.

Q16 When 1×10^{-5} g of a fatty acid (M=602.3 g/mol) was placed on water as a surface film, a monomolecular layer of area 100 cm^2 was formed on compression. The cross-sectional area (in mathrmmathringA^2) of the acid molecule is

A 50

B 100

C 150

D 200

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Surface Chemistry – General

PYQ FREQUENCY
High · 6 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'Langmuir = monolayer, BET = multilayer'.

Correct Answer B 100

CONCEPT

Adsorption (physisorption vs chemisorption), Langmuir and Freundlich isotherms, BET for multilayers, surface tension and Gibbs adsorption, colloids, micelles (CMC), heterogeneous catalysis.

↓

LOGIC / WORKING

- Molecules = $(10^{-5}/602.3) \times 6.022\times10 = 1.0\times10^{6}$; area per molecule = 100 cm $(10^{8})/10^{6}$ = 100 .
- Therefore the answer is (B).

FINAL: (B) 100

SHORTCUT / EXAM TRICK

Langmuir linear plot: p/V vs p — slope 1/V_m, intercept 1/(KV_m).

COMMON MISTAKE

Applying Langmuir to multilayer adsorption; confusing Γ sign for surfactants (positive adsorption lowers γ).

EXAM TIP

Chemisorption: ΔH ≈ −40 to −400 kJ mol^{-1}, monolayer, specific; physisorption: ≈ −20 kJ mol^{-1}, multilayer.

MEMORY TRICK

'Langmuir = monolayer, BET = multilayer'.

Why the Other Options Are Wrong

Correct answer: B

A **50**

Why (B) is the key — Molecules = $(10^{-5}/602.3) \times 6.022\times10 = 1.0\times10^{6}$; area per molecule = 100 cm $(10^{8})/10^{6} = 100$.

C **150**

Ruled out: Applying Langmuir to multilayer adsorption; confusing Γ sign for surfactants (positive adsorption lowers γ).

D **200**

Ruled out: Chemisorption: $\Delta H \approx -40$ to -400 kJ mol^{-1}, monolayer, specific; physisorption: ≈ -20 kJ mol^{-1}, multilayer.

Q17

The volume of a gas adsorbed on a solid surface is 10.0 mL, 11.0 mL, 11.2 mL, 14.5 mL and 22.5 mL at 1.0, 2.0, 3.0, 4.0 and 5.0 atm. pressure, respectively. These data are best represented by

A. Gibbs's isotherm

B. Langmuir isotherm

C. Freundlich isotherm

D. BET isotherm

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Surface Chemistry – General

PYQ FREQUENCY
High · 6 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'Langmuir = monolayer, BET = multilayer'.

Correct Answer D BET isotherm

CONCEPT

Adsorption (physisorption vs chemisorption), Langmuir and Freundlich isotherms, BET for multilayers, surface tension and Gibbs adsorption, colloids, micelles (CMC), heterogeneous catalysis.

↓

LOGIC / WORKING

- CSIR JUNE 2016 Explanation as extracted from the printed page; notation may be imperfect.
- Therefore the answer is (D).

FINAL: (D) BET isotherm

SHORTCUT / EXAM TRICK

Langmuir linear plot: p/V vs p — slope 1/V_m, intercept 1/(KV_m).

COMMON MISTAKE

Applying Langmuir to multilayer adsorption; confusing Γ sign for surfactants (positive adsorption lowers γ).

EXAM TIP

Chemisorption: $\Delta H \approx -40$ to -400 kJ mol^{-1}, monolayer, specific; physisorption: ≈ -20 kJ mol^{-1}, multilayer.

MEMORY TRICK

'Langmuir = monolayer, BET = multilayer'.

Why the Other Options Are Wrong

Correct answer: D

A **Gibbs's isotherm**

Why (D) is the key — CSIR JUNE 2016 Explanation as extracted from the printed page; notation may be imperfect.

B **Langmuir isotherm**

Ruled out: Applying Langmuir to multilayer adsorption; confusing Γ sign for surfactants (positive adsorption lowers γ).

C **Freundlich isotherm**

Ruled out: Chemisorption: $\Delta H \approx -40$ to -400 kJ mol^{-1}, monolayer, specific; physisorption: ≈ -20 kJ mol^{-1}, multilayer.

Q18

The order of a surface catalyzed unimolecular reaction, at very low and very high pressures of the reactant, would be, respectively

A. 0, 0

B. 1, 0

C. 0, 1

D. 1, 1

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Surface Chemistry – General

PYQ FREQUENCY
High · 6 papers

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
'Langmuir = monolayer, BET = multilayer'.

Correct Answer B 1, 0

CONCEPT

Adsorption (physisorption vs chemisorption), Langmuir and Freundlich isotherms, BET for multilayers, surface tension and Gibbs adsorption, colloids, micelles (CMC), heterogeneous catalysis.

↓

LOGIC / WORKING

- Rate = kθ = kKp/(1 + Kp): at low p, θ ≈ Kp → first order; at high p, θ → 1 → zero order.
- Therefore the answer is (B).

FINAL: (B) 1, 0

SHORTCUT / EXAM TRICK

Langmuir linear plot: p/V vs p — slope 1/V_m, intercept 1/(KV_m).

COMMON MISTAKE

Applying Langmuir to multilayer adsorption; confusing Γ sign for surfactants (positive adsorption lowers γ).

EXAM TIP

Chemisorption: ΔH ≈ −40 to −400 kJ mol^{-1}, monolayer, specific; physisorption: ≈ −20 kJ mol^{-1}, multilayer.

MEMORY TRICK

'Langmuir = monolayer, BET = multilayer'.

Why the Other Options Are Wrong

Correct answer: B

A **0, 0**

Why (B) is the key — Rate = kθ = kKp/(1 + Kp): at low p, θ ≈ Kp → first order; at high p, θ → 1 → zero order.

C **0, 1**

Ruled out: Applying Langmuir to multilayer adsorption; confusing Γ sign for surfactants (positive adsorption lowers γ).

D **1, 1**

Ruled out: Chemisorption: ΔH ≈ −40 to −400 kJ mol^{-1}, monolayer, specific; physisorption: ≈ −20 kJ mol^{-1}, multilayer.

Q19

The correct statement about chemisorption is

A. Chemisorption results in multi molecular layer adsorption

B. Chemisorption is reversible in nature

C. Chemisorption has lower specificity than physisorption

D. Chemisorption occurs due to formation of chemical bonds

QUESTION INSIGHTS

ESTIMATED TIME
1–1.5 min

DIFFICULTY
Easy

CONCEPT TESTED
Surface Chemistry – General

PYQ FREQUENCY
High · 6 papers

REVISION PRIORITY
★★★☆☆

EXPECTED LEVEL
Part B

MEMORY HOOK
'Langmuir = monolayer, BET = multilayer'.

Correct Answer D Chemisorption occurs due to formation of chemical bonds

CONCEPT

Adsorption (physisorption vs chemisorption), Langmuir and Freundlich isotherms, BET for multilayers, surface tension and Gibbs adsorption, colloids, micelles (CMC), heterogeneous catalysis.

↓

LOGIC / WORKING

- Chemisorption involves chemical bond formation: monolayer, highly specific, usually irreversible, with large enthalpy (40–400 kJ mol^{-1}).
- Therefore the answer is (D).

FINAL: (D) Chemisorption occurs due to formation of chemical bonds

SHORTCUT / EXAM TRICK

Langmuir linear plot: p/V vs p — slope 1/V_m, intercept 1/(KV_m).

COMMON MISTAKE

Applying Langmuir to multilayer adsorption; confusing Γ sign for surfactants (positive adsorption lowers γ).

EXAM TIP

Chemisorption: ΔH ≈ −40 to −400 kJ mol^{-1}, monolayer, specific; physisorption: ≈ −20 kJ mol^{-1}, multilayer.

MEMORY TRICK

'Langmuir = monolayer, BET = multilayer'.

Why the Other Options Are Wrong

Correct answer: D

A **Chemisorption results in multi molecular layer adsorption**

Why (D) is the key — Chemisorption involves chemical bond formation: monolayer, highly specific, usually irreversible, with large enthalpy (40–400 kJ mol^{-1}).

B **Chemisorption is reversible in nature**

Ruled out: Applying Langmuir to multilayer adsorption; confusing Γ sign for surfactants (positive adsorption lowers γ).

C **Chemisorption has lower specificity than physisorption**

Ruled out: Chemisorption: $\Delta H \approx -40$ to -400 kJ mol^{-1}, monolayer, specific; physisorption: ≈ -20 kJ mol^{-1}, multilayer.

Q20

A dilute silver nitrate solution is added to a slight excess iodide solution. A solution of AgI is formed whose surface adsorbs.

A. I^-

B. NO_3^-

C. Na^+

D. Ag^+

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Surface Chemistry – General

PYQ FREQUENCY
High · 6 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'Langmuir = monolayer, BET = multilayer'.

Correct Answer A I^-

CONCEPT

Adsorption (physisorption vs chemisorption), Langmuir and Freundlich isotherms, BET for multilayers, surface tension and Gibbs adsorption, colloids, micelles (CMC), heterogeneous catalysis.

↓

LOGIC / WORKING

- Paneth–Fajans–Hahn rule: the lattice preferentially adsorbs its own ion present in excess — I^- here, giving a negatively charged AgI sol.
- Therefore the answer is (A).

FINAL: (A) I^-

SHORTCUT / EXAM TRICK

Langmuir linear plot: p/V vs p — slope 1/V_m, intercept 1/(KV_m).

COMMON MISTAKE

Applying Langmuir to multilayer adsorption; confusing Γ sign for surfactants (positive adsorption lowers γ).

EXAM TIP

Chemisorption: $\Delta H \approx -40$ to -400 kJ mol^{-1}, monolayer, specific; physisorption: ≈ -20 kJ mol^{-1}, multilayer.

MEMORY TRICK

'Langmuir = monolayer, BET = multilayer'.

Why the Other Options Are Wrong

Correct answer: A

B NO_3^-

Why (A) is the key — Paneth–Fajans–Hahn rule: the lattice preferentially adsorbs its own ion present in excess — I^- here, giving a negatively charged AgI sol.

C Na^+

Ruled out: Applying Langmuir to multilayer adsorption; confusing Γ sign for surfactants (positive adsorption lowers γ).

D Ag^+

Ruled out: Chemisorption: $\Delta H \approx -40$ to -400 kJ mol^{-1}, monolayer, specific; physisorption: ≈ -20 kJ mol^{-1}, multilayer.

Q21

For a reaction on a surface At low pressure of H, the rate is proportional to

A. H_2

B. $1 / H_2$

C. H_2 ¹ / 2

D. $1 /[H_2]^1 / 2$

QUESTION INSIGHTS

ESTIMATED TIME
1–1.5 min

DIFFICULTY
Easy

CONCEPT TESTED
Surface Chemistry – General

PYQ FREQUENCY
High · 6 papers

REVISION PRIORITY
★★★☆☆

EXPECTED LEVEL
Part B

MEMORY HOOK
'Langmuir = monolayer, BET = multilayer'.

Correct Answer C H_2 ¹ / 2

CONCEPT

Adsorption (physisorption vs chemisorption), Langmuir and Freundlich isotherms, BET for multilayers, surface tension and Gibbs adsorption, colloids, micelles (CMC), heterogeneous catalysis.

↓

LOGIC / WORKING

- H_2 adsorbs dissociatively, θ ≈ (Kp)^½ at low pressure, so the rate ∝ p(H_2)^½.
- Therefore the answer is (C).

FINAL: (C) H_2 ¹ / 2

SHORTCUT / EXAM TRICK

Langmuir linear plot: p/V vs p — slope 1/V_m, intercept 1/(KV_m).

COMMON MISTAKE

Applying Langmuir to multilayer adsorption; confusing Γ sign for surfactants (positive adsorption lowers γ).

EXAM TIP

Chemisorption: ΔH ≈ −40 to −400 kJ mol^{-1}, monolayer, specific; physisorption: ≈ −20 kJ mol^{-1}, multilayer.

MEMORY TRICK

'Langmuir = monolayer, BET = multilayer'.

Why the Other Options Are Wrong

Correct answer: C

A H_2

Why (C) is the key — H_2 adsorbs dissociatively, $\theta \approx (Kp)^{1/2}$ at low pressure, so the rate $\propto p(H_2)^{1/2}$.

B $1 / H_2$

Ruled out: Applying Langmuir to multilayer adsorption; confusing Γ sign for surfactants (positive adsorption lowers γ).

D $1 /[H_2]^1 / 2$

Ruled out: Chemisorption: $\Delta H \approx -40$ to -400 kJ mol^{-1}, monolayer, specific; physisorption: ≈ -20 kJ mol^{-1}, multilayer.

Q22

In Freundlich isotherm, a linear relationship is obtained in the plot of (θ = surface coverage and p = partial pressure of the gas)

A. θ vs p

B. ln(θ) vs ln(p)

C. ln(θ) vs p

D. θ vs ln(p)

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Surface Chemistry – General

PYQ FREQUENCY
High · 6 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'Langmuir = monolayer, BET = multilayer'.

Correct Answer B ln(θ) vs ln(p)

CONCEPT

Adsorption (physisorption vs chemisorption), Langmuir and Freundlich isotherms, BET for multilayers, surface tension and Gibbs adsorption, colloids, micelles (CMC), heterogeneous catalysis.

↓

LOGIC / WORKING

- Freundlich θ = kp^(1/n) → ln θ = ln k + (1/n) ln p: linear in ln θ vs ln p.
- Therefore the answer is (B).

FINAL: (B) ln(θ) vs ln(p)

SHORTCUT / EXAM TRICK

Langmuir linear plot: p/V vs p — slope 1/V_m, intercept 1/(KV_m).

COMMON MISTAKE

Applying Langmuir to multilayer adsorption; confusing Γ sign for surfactants (positive adsorption lowers γ).

EXAM TIP

Chemisorption: ΔH ≈ −40 to −400 kJ mol⁻¹, monolayer, specific; physisorption: ≈ −20 kJ mol⁻¹, multilayer.

MEMORY TRICK

'Langmuir = monolayer, BET = multilayer'.

Why the Other Options Are Wrong

Correct answer: B

A **θ vs p**

Why (B) is the key — Freundlich θ = kp^(1/n) → ln θ = ln k + (1/n) ln p: linear in ln θ vs ln p.

C **ln(θ) vs p**

Ruled out: Applying Langmuir to multilayer adsorption; confusing Γ sign for surfactants (positive adsorption lowers γ).

D **θ vs ln(p)**

Ruled out: Chemisorption: ΔH ≈ −40 to −400 kJ mol^{-1}, monolayer, specific; physisorption: ≈ −20 kJ mol^{-1}, multilayer.

Q23

Adsorption of N_2 on TiO_2 was carried out at 75 K. A plot of (z)/((1-z)V) versus z (z = p/p⁰) gives a straight line with an intercept, 4.0×10^{-6} mm^{-3} and slope, 1.0×10^{-3} mm^{-3}. The volume (rounded off to the nearest integer) corresponding to the monolayer coverage is:

A. 555 mm³

B. 690 mm³

C. 785 mm³

D. 996 mm³

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Surface Chemistry – General

PYQ FREQUENCY
High · 6 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'Langmuir = monolayer, BET = multilayer'.

Correct Answer D 996 mm³

CONCEPT

Adsorption (physisorption vs chemisorption), Langmuir and Freundlich isotherms, BET for multilayers, surface tension and Gibbs adsorption, colloids, micelles (CMC), heterogeneous catalysis.

↓

LOGIC / WORKING

- BET linear form $z/[(1 - z)V] = 1/(V_mC) + (C - 1)z/(V_mC)$; slope + intercept = $1/V_m$ → $V_m = 1/(1.0\times10^{-3} + 4\times10^{-6}) = 996$ mm³.
- Therefore the answer is (D).

FINAL: (D) 996 mm³

SHORTCUT / EXAM TRICK

Langmuir linear plot: p/V vs p — slope 1/V_m, intercept 1/(KV_m).

COMMON MISTAKE

Applying Langmuir to multilayer adsorption; confusing Γ sign for surfactants (positive adsorption lowers γ).

EXAM TIP

Chemisorption: ΔH ≈ −40 to −400 kJ mol⁻¹, monolayer, specific; physisorption: ≈ −20 kJ mol⁻¹, multilayer.

MEMORY TRICK

'Langmuir = monolayer, BET = multilayer'.

Why the Other Options Are Wrong

Correct answer: D

A **555 mm³**

Why (D) is the key — BET linear form $z/[(1 - z)V] = 1/(V_mC) + (C - 1)z/(V_mC)$; slope + intercept = $1/V_m \rightarrow V_m = 1/(1.0\times10^{-3} + 4\times10^{-6}) = 996$ mm³.

B **690 mm³**

Ruled out: Applying Langmuir to multilayer adsorption; confusing Γ sign for surfactants (positive adsorption lowers γ).

C **785 mm³**

Ruled out: Chemisorption: $\Delta H \approx -40$ to -400 kJ mol^{-1}, monolayer, specific; physisorption: ≈ -20 kJ mol^{-1}, multilayer.

Q24

Physisorbed particles undergo desorption at 27^circC with an activation energy of 16.628 kJ mol^{-1}. Assuming first-order process and a frequency factor of 10^{12} Hz, the average residence time (in seconds) of the particles on the surface is

A. 8×10^{-10}

B. 8×10^{-11}

C. 2×10^{-9}

D. 1×10^{-12}

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Surface Chemistry – General

PYQ FREQUENCY
High · 6 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'Langmuir = monolayer, BET = multilayer'.

Correct Answer A 8×10^{-10}

CONCEPT

Adsorption (physisorption vs chemisorption), Langmuir and Freundlich isotherms, BET for multilayers, surface tension and Gibbs adsorption, colloids, micelles (CMC), heterogeneous catalysis.

↓

LOGIC / WORKING

- $k_{des} = A e^{(-Ea/RT)} = 10^{12} \times e^{(-16628/(8.314 \times 300))} = 10^{12} \times e^{(-6.667)} = 1.27 \times 10^{9}\ s^{-1}$; residence time $\tau = 1/k = 7.9 \times 10^{-10} \approx 8 \times 10^{-10}$ s.
- Therefore the answer is (A).

FINAL: (A) 8×10^{-10}

SHORTCUT / EXAM TRICK

Langmuir linear plot: p/V vs p — slope 1/V_m, intercept 1/(KV_m).

COMMON MISTAKE

Applying Langmuir to multilayer adsorption; confusing Γ sign for surfactants (positive adsorption lowers γ).

EXAM TIP

Chemisorption: $\Delta H \approx -40$ to -400 kJ mol^{-1}, monolayer, specific; physisorption: ≈ -20 kJ mol^{-1}, multilayer.

MEMORY TRICK

'Langmuir = monolayer, BET = multilayer'.

Why the Other Options Are Wrong

Correct answer: A

B 8×10^{-11}

Why (A) is the key — k_des = A e^(−Ea/RT) = 10^{12} × e^(−16628/(8.314 × 300)) = 10^{12} × e^(−6.667) = 1.27×10^{9} s^{-1}; residence time τ = 1/k = 7.9×10^{-10} ≈ 8×10^{-10} s.

C 2×10^{-9}

Ruled out: Applying Langmuir to multilayer adsorption; confusing Γ sign for surfactants (positive adsorption lowers γ).

D 1×10^{-12}

Ruled out: Chemisorption: ΔH ≈ −40 to −400 kJ mol^{-1}, monolayer, specific; physisorption: ≈ −20 kJ mol^{-1}, multilayer.

Q25

According to conventional transition state theory, for elementary bimolecular reactions, the molar entropy of activation Δ S⁰ddagger is:

A. Positive

B. Zero

C. Negative

D. Positive for endothermic and negative for exothermic reactions

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Surface Chemistry – General

PYQ FREQUENCY
High · 6 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'Langmuir = monolayer, BET = multilayer'.

Correct Answer C Negative

CONCEPT

Adsorption (physisorption vs chemisorption), Langmuir and Freundlich isotherms, BET for multilayers, surface tension and Gibbs adsorption, colloids, micelles (CMC), heterogeneous catalysis.

↓

LOGIC / WORKING

- Two reactant molecules combine into one activated complex: translational and rotational freedom is lost, so ΔS‡ is negative for bimolecular reactions.
- Therefore the answer is (C).

FINAL: (C) Negative

SHORTCUT / EXAM TRICK

Langmuir linear plot: p/V vs p — slope 1/V_m, intercept 1/(KV_m).

COMMON MISTAKE

Applying Langmuir to multilayer adsorption; confusing Γ sign for surfactants (positive adsorption lowers γ).

EXAM TIP

Chemisorption: ΔH ≈ −40 to −400 kJ mol^{-1}, monolayer, specific; physisorption: ≈ −20 kJ mol^{-1}, multilayer.

MEMORY TRICK

'Langmuir = monolayer, BET = multilayer'.

Why the Other Options Are Wrong

Correct answer: C

A **Positive**

Why (C) is the key — Two reactant molecules combine into one activated complex: translational and rotational freedom is lost, so ΔS‡ is negative for bimolecular reactions.

B **Zero**

Ruled out: Applying Langmuir to multilayer adsorption; confusing Γ sign for surfactants (positive adsorption lowers γ).

D **Positive for endothermic and negative for exothermic reactions**

Ruled out: Chemisorption: ΔH ≈ −40 to −400 kJ mol^{-1}, monolayer, specific; physisorption: ≈ −20 kJ mol^{-1}, multilayer.

TOPIC REVISION

Surface Chemistry – General

11 PYQs · Last-minute revision

TOPIC SUMMARY

Adsorption (physisorption vs chemisorption), Langmuir and Freundlich isotherms, BET for multilayers, surface tension and Gibbs adsorption, colloids, micelles (CMC), heterogeneous catalysis.

IMPORTANT FORMULA SHEET

- Langmuir: θ = Kp/(1+Kp); p/V = 1/(KV_m) + p/V_m
- Freundlich: x/m = k p^(1/n)
- BET: $p/V(p_0-p) = 1/V_mC + (C-1)p/(V_mC\ p_0)$
- Gibbs: Γ = −(1/RT)(dγ/d ln c)

FREQUENTLY ASKED CONCEPTS

- Langmuir vs Freundlich vs BET plots
- Physisorption vs chemisorption (ΔH, reversibility, layers)
- CMC and micelle shape
- Kelvin/Young–Laplace

COMMON MISTAKES & QUICK NOTES

Watch out:
Applying Langmuir to multilayer adsorption; confusing Γ sign for surfactants (positive adsorption lowers γ).
Chemisorption: ΔH ≈ −40 to −400 kJ mol^{-1}, monolayer, specific; physisorption: ≈ −20 kJ mol^{-1}, multilayer.

MOST-REPEATED PYQs & EXPECTED IN EXAM

PYQs in this topic: Q15 Q16 Q17 Q18 Q19 Q20 Q21 Q22 Q23 Q24 Q25

Expect 2 question(s) next session on Surface Chemistry – General.

FOR STUDENTS AND EDUCATORS

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FOR EDUCATORS

Teach from the Question Bank, one question at a time

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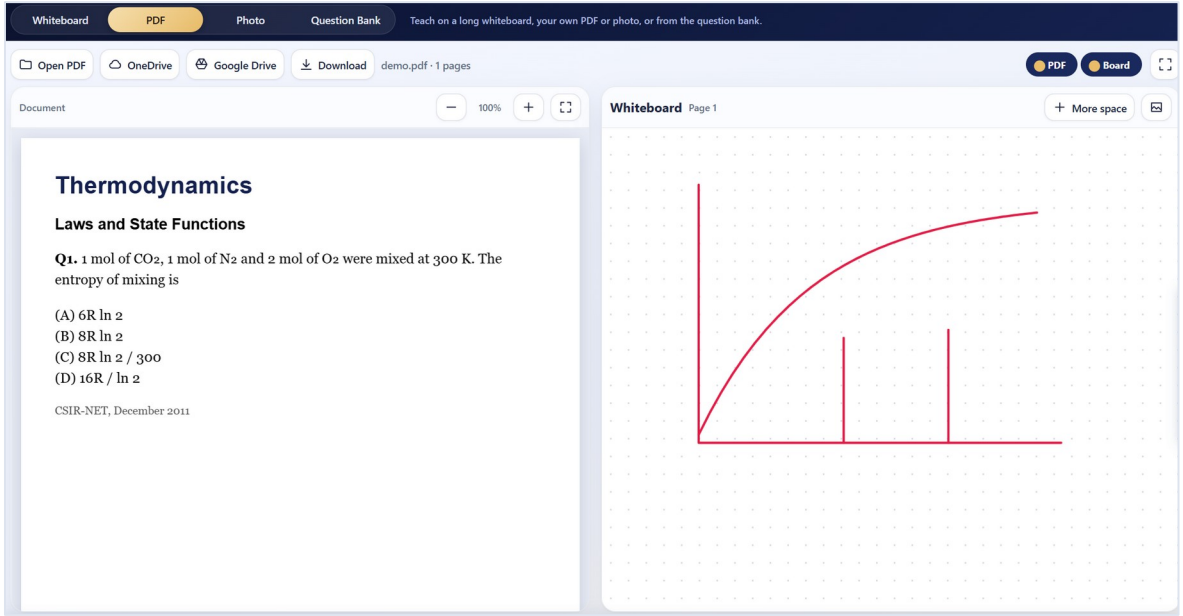
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