Surface Chemistry

Question1

Choose the incorrect statement from the following.

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Options:

A.

Brownian movement and Tyndall effect are shown by colloidal systems.

B.

Hardy-Schulze rule is related with coagulation.

C.

Gold number is a measure of the protection power of a lyophilic colloid.

D.

Aerosol is a colloidal system in which gas is dispersed in liquid.

Answer: D

Solution:

Option A:

Brownian movement and Tyndall effect are shown by colloidal systems.

✅ Correct — both Brownian movement and the Tyndall effect are characteristic properties of colloids.

Option B:

Hardy-Schulze rule is related with coagulation.

✅ Correct — the Hardy–Schulze rule relates the coagulating power of ions to their charge.

Option C:

Gold number is a measure of the protection power of a lyophilic colloid.

✅ Correct — the gold number represents the minimum amount of protective (lyophilic) colloid required to prevent coagulation of a standard gold sol.

Option D:

Aerosol is a colloidal system in which gas is dispersed in liquid.

❌ Incorrect — an aerosol is a *colloid in which a solid or liquid is dispersed in a gas*, not the other way around.

When gas is dispersed in a liquid, the system is called **foam** (e.g., whipped cream).

✅ **Answer: Option D**

Question2

Which of the following statements regarding adsorption theory of heterogeneous catalysis is not correct ?

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Options:

A.

The reactant molecules get adsorbed on the surface of the catalyst.

B.

The chemical reaction occurs at the surface of the catalyst.

C.

The product molecules remains permanently bound to the catalyst surface.

D.

The catalyst remains unchanged in mass and chemical composition at the end of the reaction.

Answer: C

Solution:

The statement given in option (c) is incorrect regarding adsorption theory of heterogeneous catalysis. The correct form is,

In heterogeneous catalysis, product molecules will not permanently bonded to catalyst surface.

They are intially absorbed, but then desorbed after the reaction occur allowing the catalyst to be reused.

Question3

Match the following

	List-I (Sol)		List-II (Method of preparation)
(A)	As_2S_3	I.	Bredig's arc method
(B)	Au	II.	Oxidation
(C)	S	III.	Hydrolysis
(D)	$Fe(OH)_3$	IV.	Double decomposition

The correct answer is

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Options:

A.

A-III, B-II, C-IV, D-I

B.

A-I, B-III, C-IV, D-II

C.

A-IV, B-I, C-II, D-III

D.

A-IV, B-III, C-I, D-II

Answer: C

Solution:

Let's match each sol with its appropriate method of preparation:

(A) As_2S_3 (Arsenic sulfide sol)

Arsenic sulfide sol is typically prepared by passing hydrogen sulfide (H_2S) gas through a solution of arsenious oxide (As_2O_3). This reaction is a classic example of **double decomposition**.

$As_2O_3 + 3H_2S \rightarrow As_2S_3$ (sol) $+ 3H_2O$

So, (A) matches with (IV) Double decomposition.

(B) Au (Gold sol)

Gold sol, a metallic sol, is commonly prepared by **Bredig's arc method**. This method involves striking an electric arc between two gold electrodes immersed in a dispersion medium (like water), which vaporizes the gold, and the vapor then condenses to form colloidal particles.

So, (B) matches with (I) Bredig's arc method.

(C) S (Sulfur sol)

Sulfur sol can be prepared by the **oxidation** of hydrogen sulfide (H_2S) with an oxidizing agent such as sulfur dioxide (SO_2).

$2H_2S + SO_2 \rightarrow 3S$ (sol) $+ 2H_2O$

So, (C) matches with (II) Oxidation.

(D) $Fe(OH)_3$ (Ferric hydroxide sol)

Ferric hydroxide sol is prepared by the **hydrolysis** of ferric chloride ($FeCl_3$). When a small amount of ferric chloride solution is added to hot water, it undergoes hydrolysis to form colloidal particles of ferric hydroxide.

$FeCl_3 + 3H_2O \rightarrow Fe(OH)_3$ (sol) $+ 3HCl$

So, (D) matches with (III) Hydrolysis.

Combining these matches:

A - IV

B - I

C - II

D - III

This corresponds to Option C.

The final answer is $\boxed{C}$

Question4

Observe the following reactions

I. $\mathrm{N_2}(g) + 3\mathrm{H_2}(g) \xrightarrow[773\ \mathrm{K}, 200\ \mathrm{atm}]{x} 2\mathrm{NH_3}(g)$

II. $\mathrm{CO(g) + H_2O(g)} \xrightarrow[673\ \mathrm{K}]{Y} \mathrm{CO_2(\ g) + H_2(\ g)}$

III. $\mathrm{CH_4}(g) + \mathrm{H_2O}(g) \xrightarrow[1270\ \mathrm{K}]{\mathrm{z}} \mathrm{CO}(g) + 3\mathrm{H_2}(g)$

Catalysts X, Y, Z respectively are

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Options:

A.

iron, sodium arsenite, cobalt

B.

iron, zinc, cobalt

C.

cobalt, zinc, nickel

D.

iron, iron chromate, nickel

Answer: D

Solution:

$(i)\mathrm{N_2}(g) + 3\mathrm{H_2}(g) \xrightarrow[200\ \mathrm{atm}]{\mathrm{Fe}, 773\ \mathrm{K}} 2\mathrm{NH_3}(g)$:

Haber's process

$X = \mathrm{Fe(\ iron\ )}$

$$\text{(ii) } \underset{(Y)}{CO(g)} + H_2O(g) \xrightarrow{Fe,Cr_2O4} CO_2(g)+H2(g)$$

Water gas shift reaction Y = Iron chromate

$$\text{(iii) } CH_4(g) + H_2O(g) \xrightarrow{Ni,1270\ K} CO(g) + 3H_2O(g)$$

Steam reforming of methane
Z = Nickel

Question5

What is the indicator used in argentometric titrations?

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Options:

A.

Starch solution

B.

Eosin dye

C.

$KMnO_4$ solution

D.

Phenolphthalein

Answer: B

Solution:

The correct answer is:

✅ **Option B — Eosin dye**

Explanation:

- **Argentometric titrations** are titrations involving **silver nitrate ($AgNO_3$)** as the titrant, typically used for the determination of halide ions such as Cl^-, Br^-, and I^-.
- One common method is the **Fajans method**, where an **adsorption indicator**, such as **fluorescein or eosin**, is used.
- Before the equivalence point, halide ions are present in excess, and the precipitate surface (AgX) is negatively charged.
- After the equivalence point, excess Ag^+ ions make the surface positively charged, allowing the negatively charged dye ions (like eosin) to adsorb on the surface and cause a visible color change — signaling the end point.

Hence, **Eosin dye** (an adsorption indicator) is used in argentometric titrations by Fajans' method.

Question6

In a Freundlich adsorption isotherm, if the slope is unity and k is 0.1 , the extent of adsorption at 2 atm is ($\log 2 = 0.30$)

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Options:

A.

0.6

B.

0.4

C.

0.2

D.

0.8

Answer: C

Solution:

Let's recall the **Freundlich adsorption isotherm**:

$x/m = k\,p^{1/n}$

Or, taking logarithms on both sides:

$\log(x/m) = \log k + \frac{1}{n}\log p$

Given data

- Slope = 1 $\Rightarrow \frac{1}{n} = 1 \Rightarrow n = 1$
- $k = 0.1$
- $p = 2$ atm
- $\log 2 = 0.30$

Calculation

$x/m = k\,p^{1/n} = 0.1 \times 2^1 = 0.1 \times 2 = 0.2$

✅ **Extent of adsorption = 0.2**

Correct option: (C) 0.2

Question7

Match the following

List-I (Colloidal solution)		List-II (Use)	
(a)	Colloidal antimony	(I)	Eye lotion
(b)	Argyrol	(II)	Intramuscular injection
(c)	Colloidal gold	(III)	Kalaazar
(d)	Milk of magnesia	(IV)	Stomach disorders

The correct answer

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Options:

A.

A-III, B-I, C-II, D-IV

B.

A-III, B-I, C-IV, D-II

C.

A-IV, B-II, C-I, D-III

D.

A-II, B-I, C-IV, D-III

Answer: A

Solution:

(a) Colloidal antimony → Used in treatment of Kala-azar

→ (III)

(b) Argyrol (colloidal silver) → Used as an eye lotion

→ (I)

(c) Colloidal gold → Used for intramuscular injections (tonic for nervous disorders)

→ (II)

(d) Milk of magnesia → Used for stomach disorders (antacid/laxative)

→ (IV)

✅ **Correct match:**

(a) – (III), (b) – (I), (c) – (II), (d) – (IV)

Hence, the correct answer is:

Option A: A-III, B-I, C-II, D-IV

Question8

Adsorption of a gas on solids follows Freundlich adsorption isotherm. The graph drawn between $\log \frac{x}{m}$ (on y-axis) and $\log p$ (on x-axis) is a straight line with slope equal to 3 and intercept equal to 0.30 . What is the value of $\frac{x}{m}$ at a pressure of 2 atm ?

(Given: $\log 2 = 0.3$ **)**

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Options:

A.

48

B.

32

C.

16

D.

8

Answer: C

Solution:

Given:

Freundlich adsorption isotherm:

$\frac{x}{m} = kp^{1/n}$

Taking log on both sides:

$\log \frac{x}{m} = \log k + \frac{1}{n}\log p$

Given from the question:

slope $= \frac{1}{n} = 3$

intercept $= \log k = 0.30$

We are asked to find $\frac{x}{m}$ at $p = 2$ atm, given $\log 2 = 0.3$.

Step 1: Write the equation

$\log \frac{x}{m} = 0.30 + 3\log p$

Step 2: Substitute $\log p = \log 2 = 0.3$

$\log \frac{x}{m} = 0.30 + 3(0.3)$

$\log \frac{x}{m} = 0.30 + 0.90 = 1.20$

Step 3: Find $\frac{x}{m}$

$\frac{x}{m} = 10^{1.20}$

We know $10^{1.2} = 10 \times 10^{0.2} \approx 10 \times 1.58 = 15.8 \approx 16$

✅ **Final Answer:**

$$\boxed{\frac{x}{m} = 16}$$

Correct Option: C) 16

Question9

The adsorption of a gas on a solid surface follows Freundlich adsorption isotherm.At $T(\mathrm{K})$, the gas pressure is 2 atm . What is the value of $\frac{x}{m}$?($n = 2$ and $k =$ constant)

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Options:

A.

$\frac{x}{m} = 4k$

B.

$\frac{x}{m} = \frac{1.414}{k}$

C.

$\frac{x}{m} = \frac{k}{1.414}$

D.

$\frac{x}{m} = 1.414k$

Answer: D

Solution:

Using Freundlich adsorption isotherm equation,

$\frac{x}{m} = kp^{1/n}$

$p = 2, n = 2 \Rightarrow \frac{x}{m} = k(2)^{1/2}$

$\frac{x}{m} = k\sqrt{2}$ or $\frac{x}{m} = 1.414\text{k}$

Question10

In a colloidal solution, both the dispersed phase and dispersion medium are in liquid phase. What is the type of colloid?

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Options:

A.

Gel

B.

Emulsion

C.

Foam

D.

Aerosol

Answer: B

Solution:

When both the **dispersed phase** and the **dispersion medium** are **liquid**, the colloid is known as an **emulsion**.

✅ **Correct Answer: Option B — Emulsion**

Explanation:

- **Sol:** Solid dispersed in liquid
- **Gel:** Liquid dispersed in solid

- **Foam:** Gas dispersed in liquid
- **Aerosol:** Solid or liquid dispersed in gas
- **Emulsion:** Liquid dispersed in liquid (e.g. milk, mayonnaise)

Hence, the type of colloid is **emulsion**.

Question11

The equation which represents Freundlich adsorption isotherm is (x = amount of gas, m = mass of solid)

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Options:

A.

$\log \frac{x}{m} = \log p + \frac{1}{n}\log k$

B.

$\log \frac{x}{m} = \log k + \frac{1}{n}\log p$

C.

$\frac{x}{m} = k + \frac{1}{n}\log p$

D.

$\frac{x}{m} = \log p + \frac{1}{n}\log k$

Answer: B

Solution:

Let's recall the **Freundlich adsorption isotherm** formula:

$\frac{x}{m} = kp^{1/n}$

Taking logarithms on both sides:

$\log \frac{x}{m} = \log k + \frac{1}{n}\log p$

✅ **Correct option: Option B**

$\log \frac{x}{m} = \log k + \frac{1}{n}\log p$

Question12

Which one of the following is not the correct characteristic property of physical adsorption?

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Options:

A.

It is not specific in nature.

B.

Enthalpy of adsorption of this is low.

C.

It increases with increase of temperature.

D.

It is a multilayer adsorption under high pressure.

Answer: C

Solution:

The incorrect property of physical adsorption is,

It increases with increase of temperature. The correct form is, It decreases with increase of temperature.

Question13

In each of four separate beakers (I, II, III, IV), X mL of $y\mathrm{MFe_2O_3}x\mathrm{H_2O}$ colloidal solution is present. Equal volume and

equal concentration of KCl , $K_4[Fe(CN)_6], K_3PO_4$ and K_2SO_4 was added into I, II, III and IV respectively.

The efficiency of precipitations in these beakers follows the order

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Options:

A.

II > III > IV > I

B.

II > III > I > IV

C.

I > IV > III > II

D.

III > IV > I > II

Answer: A

Solution:

The correct order is,

II > III > IV > I

Identify the counter-ions in each electrolyte

$KCl : Cl^-, K_4[Fe(CN)_6] : [Fe(CN)_6]^{4-},$

$K_3PO_4 : PO_4^{3-}, K_2SO_4 : SO_4^{2-}$

Charge $-1, -4, -3, -2$

Now applying Hardy-Schulze rule

The higher the charge of counter ions, the greater is precepitals power

$Fe(CN_6)^{4-} > PO_4^{3-} > SO_4^{2-} > Cl^-$

Question14

Match the following

	List-I (Compound)		List-II (Use)
(A)	Kieselghur	(I)	Chromatographic material
(B)	Silica gel	(II)	Softening of hard Water
(C)	ZSM-5	(III)	Filtration plants
(D)	Hydrated zeolites	(IV)	To convert alcohol directly into gasoline

The correct answer is

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Options:

A.

A-IV, B-III, C-II, D-I

B.

A-IV, B-I, C-II, D-III

C.

A-III, B-IV, C-I, D-II

D.

A-III, B-I, C-IV, D-II

Answer: D

Solution:

(A) Kieselguhr (Diatomaceous earth)

→ Used for **filtration** (it is a fine, porous, siliceous material).

✅ So, (A) → (III) *Filtration plants*

(B) Silica gel

→ Used in **chromatography** as an adsorbent.

✅ So, (B) → (I) *Chromatographic material*

(C) ZSM-5 (a type of zeolite catalyst)

→ Used **to convert alcohol directly into gasoline** (in petrochemical industry).

✅ So, (C) → (IV) *To convert alcohol directly into gasoline*

(D) Hydrated zeolites

→ Used in **softening of hard water** (by ion exchange).

✅ So, (D) → (II) *Softening of hard water*

Now, putting it all together:

(A)–III, (B)–I, (C)–IV, (D)–II

✅ **Correct Answer: Option D**

Question15

Identify the catalytic reaction in which both reactants are in different phases.

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Options:

A.

Ammonia synthesis by Haber process

B.

Synthesis of sulphur trioxide by lead chamber process

C.

Hydrogenation of vegetable oils

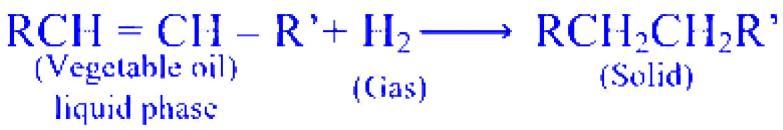
D.

Hydrolysis of methyl acetate

Answer: C

Solution:

In the catalytic reaction of hydrogenation of vegetable oil, both reactants are in different phase.



Question16

Consider the following.

Statement-I : Gold sol is prepared by Bredig's arc method.

Statement-II : Bredig's arc method involves only dispersion but not condensation.

The correct answer is

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Options:

A.

both statement-I and statement-II are correct

B.

both statement-I and statement-II are not correct

C.

statement-I is correct, but statement-II is not correct

D.

statement-I is not correct, but statement-II is correct

Answer: C

Solution:

Statement I: *Gold sol is prepared by Bredig's arc method.*

- **True.**

  Bredig's arc method is indeed used for preparing *metal sols* like gold, platinum, and silver sols.

  In this method, an electric arc is struck between metal electrodes under water containing a stabilizer. Metal vapors formed are condensed to give colloidal particles (the sol).

Statement II: *Bredig's arc method involves only dispersion but not condensation.*

- **False.**

  Bredig's arc method is actually a combination of **dispersion and condensation** methods:

- The metal is *dispersed* (broken up) by vaporization (dispersion).
- The vaporized metal atoms *condense* to form colloidal particles (condensation).

Hence, both processes are involved.

✅ **Correct answer: Option C**

Statement-I is correct, but Statement-II is not correct.

Question17

Identify the correct statement from the following

I. Sulphur sol is an example for multi molecular colloid.

II. Starch sol is an example for associated colloid.

III. Artificial rubber is an example for macromolecular colloid.

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Options:

A.

I, II, III

B.

I, II only

C.

II, III only

D.

I, III only

Answer: D

Solution:

Among the given options, I and III are correct. The correct form of II is Starch is an example of macromolecular colloids.

Question18

Two statements are given below

Statements I : Adsorption of a gas on the surface of charcoal is primarily an exothermic reaction.

Statement II : A closed vessel contains O_2, H_2, Cl_2, NH_3 gases. Its pressure is p (atm). About 1 g of charcoal is added to this vessel and after some time its pressure was found to be less than p (atm)

The correct answer is

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Options:

A. Both Statement I and Statement II are correct.

B. Both Statement I and Statement II are not correct.

C. Statement I is correct but Statement II is not correct.

D. Statement I is not correct and Statement II is correct.

Answer: A

Solution:

Option A

• Statement I is true. Adsorption (both physisorption and chemisorption) releases heat, so it is an exothermic process.

• Statement II is also true. When you add charcoal to a closed vessel containing gases, some molecules stick to the charcoal surface, decreasing the number of gas-phase molecules and hence lowering the pressure below the original value p.

Question19

The critical temperature of A, B, C, D gases are 190 K , $630\ \text{K}, 261\ \text{K}, 400\ \text{K}$ respectively. The quantity of gas adsorbed per gram of charcoal at same pressure is least for the gas

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Options:

A. D

B. C

C. B

D. A

Answer: D

Solution:

Adsorption by charcoal is stronger for more easily liquefiable gases (i.e. those with higher critical temperatures), because stronger van der Waals forces enhance physisorption. Hence, at the same pressure (and temperature):

Amount adsorbed $\propto$ (critical temperature)

The gas with the lowest critical temperature (190 K) is A, so it will be adsorbed the least.

Answer: Option D.

Question20

' A ' is a protecting colloid. The following data is obtained for preventing the coagulation of 10 mL of gold sol to which 1 mL of $10\%NaCl$ is added. What is the gold number of ' A '?

Expt. No.	Wt (in mg) of A added to gold sol	Coagulation
1	40	Prevented
2	35	Prevented
3	25	Not prevented
4	32	Not prevented
5	33	Prevented

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Options:

A. 32

B. 33

C. 35

D. 40

Answer: B

Solution:

The gold number is defined as the minimum mass (in milligrams) of a protecting colloid required to prevent the coagulation of 10 mL of gold sol when 1 mL of 10% sodium chloride solution is added.

Looking at the data:

• Experiment 3: 25 mg A – Not prevented

• Experiment 4: 32 mg A – Not prevented

• Experiment 5: 33 mg A – Prevented

• Experiment 2: 35 mg A – Prevented

• Experiment 1: 40 mg A – Prevented

Since 32 mg does not prevent coagulation and 33 mg does, the minimum effective mass is 33 mg.

Thus, the gold number of A is:

Gold Number $= 33$ mg

The correct option is Option B: 33.

Question21

The following data is obtained for coagulating a positively charged sol in 2 hours

Conc. of Cl^- in $molL^{-1}$	Result
5×10^{-5}	Sol not precipitated
6×10^{-5}	Sol not precipitated
7×10^{-5}	Sol precipitated
8×10^{-5}	Sol precipitated
1×10^{-4}	Sol precipitated

What is the coagulating value of electrolyte for this sol?

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Options:

A. 7×10^{-5}

B. 7×10^{-2}

C. 5×10^{-2}

D. 9×10^{-2}

Answer: B

Solution:

The minimum concentration of electrolyte in millimoles required to cause coagulation of one litre of colloidal solution is called coagulation value from the experimental data, minimum concentration of Cl^-

when coagulation just started is 7×10^{-5} mol/L. We need to convert it into millimoles.
7×10^{-5} mol/L $= 7 \times 10^{-2}$ millimoles /L

Question22

Match List - I, with List-II.

	List I		List II
I	Colloidal antimony	A	Kalaazar
II	Silver sol	B	Intermuscular injection
III	Milk of magnesia	C	Eye lotion
IV	Gold sol	D	Stomach disorder

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Options:

A. I-B, II-A, III-C, IV-D

B. I-A, II-C, III-D, IV-B

C. I-A, II-B, III-C, IV-D

D. I-A, II-D, III-B, IV-C

Answer: B

Solution:

Let's analyze each pair step by step:

Colloidal antimony has historically been used in the treatment of Kala-azar (a form of visceral leishmaniasis). Thus, it matches with:

Colloidal antimony $\rightarrow$ Kalaazar (A)

Milk of magnesia is a suspension of magnesium hydroxide commonly used as an antacid and laxative. It helps in relieving stomach disorders. Therefore:

Milk of magnesia $\rightarrow$ Stomach disorder (D)

Silver sol is a colloidal silver solution known for its antimicrobial properties and has been used topically, for example as an eye lotion.

Silver sol → Eye lotion (C)

Gold sol (colloidal gold) was used in the past in the treatment of rheumatoid arthritis and similar conditions via intramuscular injections.

Gold sol → Intermuscular injection (B)

Putting it all together, the correct matching is:

I → A

II → C

III → D

IV → B

Thus, the correct answer is Option B.

Question23

Identify the method of preparation of a colloidal sol from the following.

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Options:

A. Ultafiltration

B. Peptisation

C. Dialysis

D. Electro-dialysis

Answer: B

Solution:

Colloidal sols can be prepared using the method of peptisation. This process involves converting a precipitate into a colloidal sol by shaking it with a dispersion medium.

Question24

The correct statement regarding chemisorption is

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Options:

A. it is multilayered adsorption.

B. the process is reversible in nature.

C. the process is not specific in nature.

D. enthalpy of adsorption is in the range of $80 - 240 \text{ kJ mol}^{-1}$.

Answer: D

Solution:

Chemiosorption is a form of adsorption in which the adsorbed material is held together by chemical bonds.

It has high specificity and occur only when there is a chemical bond between adsorbent and adsorbate. It is proportional to surface area.

Enthalpy of adsorption in chemiosorption is in the range of $80 - 240 \text{ kJ/mol}$

Question25

Which of the following is incorrectly matched?

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Options:

A. Multi molecular colloid - S_8

B. Macro molecular colloid - enzyme

C. $As_2 S_3$ sol - positively charged sol

D. Starch sol - Iyophilic sol

Answer: C

Solution:

As_2S_3 sol is a negatively charged sol.

A sol is a colloidal suspension made out of tiny solid particle in continuous liquid medium.

Question26

Which of the following general reaction is an example for heterogeneous catalysis?

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Options:

A. $A_2(g) + B_2(g) \xrightarrow{C(g)} 2AB(g)$

B. $A(s) + B(s) \xrightarrow{C(s)} D(s)$

C. $A(g) + B(g) \xrightarrow{C(s)} D(g)$

D. $A_2(g) + B_2(g) \xrightarrow{C(g)} D(s)$

Answer: C

Solution:

Heterogeneous catalysis occurs when the catalyst is in a different phase than the reactants and products. For example, in the reaction:

$A(g) + B(g) \xrightarrow{C(s)} D(g)$

The catalyst C is in the solid phase, while both the reactants A and B, and the product D, are in the gaseous phase. This difference in phase between the catalyst and the other substances involved characterizes heterogeneous catalysis.

Question27

Match List I with List II.

List I	List II
A. Aerosol	I. Milk

B. Foam	II. Soap lather
C. Emulsion	III. Cheese
D. Gel	IV. Smoke

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Options:

A. A-II, B-I, C-III, D-IV

B. A-IV, B-I, C-II, D-III

C. A-I, B-II, C-IV, D-III

D. A-IV, B-II, C-I, D-III

Answer: D

Solution:

Let's analyze each pairing:

Aerosol: An aerosol is a dispersion of fine solid particles or liquid droplets in a gas. Smoke is a common example, as it consists of tiny particles suspended in air.

- Match: Aerosol – Smoke (IV)

Foam: A foam is a mass of small bubbles formed in or on a liquid. Soap lather is a familiar example of a foam.

- Match: Foam – Soap lather (II)

Emulsion: An emulsion is a mixture of two or more liquids that are normally immiscible. Milk is an emulsion where fat droplets are dispersed in water.

- Match: Emulsion – Milk (I)

Gel: A gel is a semi-solid system in which a liquid is dispersed in a solid network. Cheese is an example, as it has a gel-like structure formed by protein networks.

- Match: Gel – Cheese (III)

This matching corresponds to Option D:

A-IV, B-II, C-I, D-III.

Question28

' X ' is a protecting colloid. The following data is obtained for preventing the coagulation of 10 mL of gold sol to which 1 mL of $10\%NaCl$ is added. What is the gold number of ' X '?

Expt No.	Weight of X (in mg) added to gold sol	Coagulation
1	24	Not prevented
2	23	Not prevented
3	26	Prevented
4	27	Prevented
5	25	Prevented

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Options:

A. 24

B. 26

C. 27

D. 25

Answer: D

Solution:

The gold number is defined as the minimum mass (in mg) of a protecting colloid that is required to prevent the coagulation of 10 mL of gold sol when 1 mL of 10% NaCl solution is added.

Looking at the provided data:

• Experiment 1: 24 mg → Coagulation not prevented

• Experiment 2: 23 mg → Coagulation not prevented

• Experiment 3: 26 mg → Coagulation prevented

• Experiment 4: 27 mg → Coagulation prevented

• Experiment 5: 25 mg → Coagulation prevented

Since the smallest mass at which coagulation is prevented is 25 mg (from Experiment 5), the gold number of substance X is:

Gold Number $= 25$ mg

Thus, the correct option is:

Option D: 25

Question29

Which sol is used as intramuscular injection?

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Options:

A. Antimony sol

B. Silver sol

C. Emulsion of milk of magnesia

D. Gold sol

Answer: D

Solution:

The correct answer is Option D – Gold sol.

Here's a brief explanation:

• In pharmaceutical dosage forms, a "sol" is a colloidal dispersion where tiny solid particles are dispersed in a liquid medium. For an injection, the formulation must be sterile, non-irritant, and biocompatible.

• Gold sol (a colloidal gold suspension) has been used historically for its anti-inflammatory properties in the treatment of rheumatoid arthritis. This form of chrysotherapy involves intramuscular injections.

• The other options are not used as intramuscular injections:

– Antimony sol is not typically administered by injection in its colloidal form.

– Silver sol is used more for topical applications (like in wound dressings) rather than injections.

– The emulsion of milk of magnesia is formulated for oral use as an antacid and laxative, not for injection.

Thus, gold sol is the only sol among the options that is used as an intramuscular injection.

Question30

Which of the following has maximum coagulating power in the coagulation of positively charged sol?

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Options:

A. Cl^-

B. SO_4^{2-}

C. PO_4^{3-}

D. $[Fe(CN)_6]^{4-}$

Answer: D

Solution:

In coagulation of colloidal sols, the effectiveness of a coagulating ion depends mainly on its charge. A higher charge on the ion neutralizes the charge on the sol particles more efficiently, requiring a lower amount to induce coagulation. This observation is encapsulated in the Schulze-Hardy rule.

Here's the reasoning using the given options:

For a positively charged sol, the anion with the highest negative charge will have the maximum coagulating power.

The given ions and their charges are:

Cl^- has a charge of -1.

SO_4^{2-} has a charge of -2.

PO_4^{3-} has a charge of -3.

$[Fe(CN)_6]^{4-}$ has a charge of -4.

Among these, $[Fe(CN)_6]^{4-}$ has the highest negative charge.

Therefore, in the coagulation of a positively charged sol, $[Fe(CN)_6]^{4-}$ will have the maximum coagulating power.

The correct answer is: Option D.

Question31

Given below are two statements.

Statements I Easily liqueflable gases are readily adsorbed.

Statements II Adsorption enthalpy for physisorption is less compared to adsorption enthalpy for chemisorption.

The correct answer is

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Options:

A. Both Statement I and Statement Il are correct.

B. Both Statement I and Stastement II are not correct.

C. Statement I is correct but Statement Il is not correct,

D. Statement I is not correct but Statement II is correct.

Answer: A

Solution:

Let's evaluate each statement:

Statement I: "Easily liquefiable gases are readily adsorbed."

Gases that are easily liquefiable typically have higher critical temperatures, indicating stronger intermolecular forces.

These stronger forces favor adsorption onto surfaces, making such gases more likely to be adsorbed.

Statement II: "Adsorption enthalpy for physisorption is less compared to adsorption enthalpy for chemisorption."

Physisorption involves weak van der Waals forces and usually has an enthalpy change in the range of about 20–40 kJ/mol.

In contrast, chemisorption involves the formation of chemical bonds, leading to a much higher enthalpy change.

Since both statements accurately reflect the principles of adsorption:

The correct answer is Option A: Both Statement I and Statement II are correct.

Question32

The validity of Freundlich isotherm can be verified by plotting

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Options:

A. $\log \frac{x}{m}$ on y-axis and $\log p$ on x-axis

B. $\frac{x}{m}$ on y-axis and $\log p$ on x-axis

C. $\log \frac{x}{m}$ on x-axis and $\log p$ on y-axis

D. $\frac{x}{m}$ on x-axis and $\log p$ on y-axis

Answer: A

Solution:

According to Freundlich, there is an empirical relationship between the amount of gas adsorbed by a unit mass of solid adsorbent and the pressure at a given temperature:

$\frac{x}{m} = k \cdot p^{1/n} \quad (\text{for } n > 1)$

Here, x represents the mass of gas adsorbed, m is the mass of the adsorbent, and p is the pressure. The constants k and n are specific to the system being examined.

By taking the logarithm of both sides of the equation, we have:

$\log \frac{x}{m} = \log k + \frac{1}{n} \log p \quad \ldots (\text{i})$

To verify the validity of the Freundlich isotherm, you can plot $\log \frac{x}{m}$ on the y-axis and $\log p$ on the x-axis. If the plot forms a straight line, the isotherm is valid. If not, it indicates a lack of alignment with the Freundlich equation.

Question33

The correct order of coagulating power of the following ions to coagulate the positive sol is

$$\underset{\text{I}}{[\text{Fe(CN)}_6]^{4-}}, \underset{\text{II}}{\text{Cl}^-}, \underset{\text{III}}{\text{SO}_4^{2-}}$$

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Options:

A. I > II > III

B. III > II > I

C. I > II > III

D. I > III > II

Answer: D

Solution:

Coagulating power $\propto$ Charge

Charge on $[Fe(CN)_6]^{4-} > SO_4^{2-} > Cl^-$

$\therefore$ Correct order of coagulating power is

I > III > II

Question34

The macromolecular colloids of the following are

I. Starch solution

II. Sulphur sol

III. Synthetic detergent

IV. Synthetic rubber

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Options:

A. I, II

B. II, III

C. III, IV

D. I, IV

Answer: D

Solution:

Macromolecular colloids are the colloids in which macromolecules form a solution. The size of the particles lies in the range of colloidal particles size. Starch solution is a naturally occurring macromolecular colloid. Synthetic rubber is a synthetic or artificial macromolecular colloid,

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Question35

Assertion (A) Animal skins are colloidal in nature.

Reason (R) Animal skin has positively charged particles.

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Options:

A. Both A and R are correct and R is the correct explanation of A.

B. Both A and R are correct and R is not the correct explanation of A.

C. A is correct but R is incorrect.

D. A is incorrect but R is correct.

Answer: B

Solution:

Animal skin is colloidal in nature and has positively charged particles. When animal skin is soaked in tannin, which contains negatively charged colloidal particles, mutual coagulation takes place. This results in the hardening of leather. Both Assertion and Reason are correct but Reason is not a correct explanation of Assertion.

Question36

The diameters range of colloidal particles is approximately.

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Options:

A. 1 to 1000 nm

B. 1000 to 2000 nm

C. 2000 to 3000 nm

D. 3000 to 4000 nm

Answer: A

Solution:

A colloid is a mixture in which one of the substances split into very minute particles which are dispersed throughout a second substance. The size of colloid particles generally ranges between 1 nm to 1000 nm .

Question37

Which statements among the following are correct?

1. Freundlich isotherm fails at high pressure of the gas.

2. $\Delta H < 0$ for both physical and chemical adsorption.

3. Physical adsorption in non-selective.

4. Chemical adsorption is reversible, whereas physical adsorption is irreversible.

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Options:

A. 1, 2, 3 and 4

B. 1, 2 and 3

C. 1, 3 and 4

D. 2 and 4

Answer: B

Solution:

Statements (1), (2) and (3) are correct.

(1) Adsorption isotherm is a curve that expressesthe variation in the amount of gas adsorbed byadsorbent with temperature at constantpressure. It fails at high pressure.

(2) During adsorption, enthalpy and entropy ofsystem are negative and ΔG must be negative,so, process is spontaneous.

(3) Physical adsorption is non-specific in nature asthere are more significantly strong attractionbetween solute and solvent. Any gas can beadsorbed on surface of solid to some extant.

(4) Due to presence of strong attraction betweensolute and solvent, chemical adsorption isirreversible while physisorption is reversible.

Question38

In an adsorption experiment, a graph between $\log(x/m)$ versus $\log p$ was found to be linear with a slope of 45°. The intercept on $\log(x/m)$ axis was found to be 0.3010. The amount of gas adsorbed per gram of charcoal under a pressure of 0.5 atm is

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Options:

A. 0.5 g

B. 1.0 g

C. 1.5 g

D. 0.75 g

Answer: B

Solution:

$\frac{x}{m} = kp^{1/n}$ [adsorption isotherm]

$\log \frac{x}{m} = \log k + \frac{1}{n} \log p$

$\therefore$ Plot of $\log \frac{x}{m} vs \log p$ is linear with slope $= \frac{1}{n}$ and intercept $= \log k$

Hence, $l/n = \tan\theta = \tan 45\Upsilon = 1$ i.e. $n = 1$

$\log k = 0.3010$

or $k = \text{antilog}(0.3010) = 2$

At $p = 0.5$ atm,

$x/m = kp^{1/n} \Rightarrow x/m = 2 \times (0.5)^1 = 1.0$

Question39

Among the following, in which type of chromatography, both stationary and mobile phases are in liquid state?

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Options:

A. Gas-liquid chromatography

B. Ascending paper chromatography (Partition chromatography)

C. High performance liquid chromatography (HPLC)

D. Thin layer chromatography (TLC)

Answer: B

Solution:

Partition or ascending paper chromatographyis used to separate coloured chemicals orsubstance. It is an analytical technique in whichthe mobile phase moves upward through thestationary phase.

Mobile phase → Liquid (solvent)

Stationary phase → Liquid (Whatmann, papercontain cellulose).

While in gas- liquid chromatography, gas isstationary phase and liquid is mobile phase, TLCcontain silica which is solid (stationary phase) andsolvent (mobile phase).

Question40

The protective power of a lyophilic colloidal sol is expressed in terms of

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Options:

A. critical micelle concentration

B. standard reduction potential

C. gold number

D. oxidation number

Answer: C

Solution:

Lyophilic colloid or sol are unstable, so theyare stabilised by adding some protective whichprotect them from precipitation. Thus, lyophiliccolloids are protecting colloids. Their protectingpower is denoted in terns of gold number.

It defined as the minimum amount of lyophiliccolloid in mg which present the flocculation of10 mL gold sol by the addition of 1mL of 10%NaCl solution. Lesser the gold number, higher theprotecting power.

Question41

A plot of $\log(x/m)$ versus $\log(p)$ for adsorption of a gas on a solid gives a straight line with a slope of

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Options:

A. $-\log k$

B. $\log(1/n)$

C. $\frac{1}{n}$

D. antilog $(1/n)$

Answer: C

Solution:

The empirical relation $x/m = kp^{1/n}$ put forward by Freundlich is known as Freundlich adsorption isotherm.

Taking logarithm, $\log \frac{x}{m} = \log k + \frac{1}{n}\log p$

Compare with, $y = mx + c$

Slope $(m) = 1/n$

y-axis $= \log \frac{x}{m}$; x-axis $= \log p$