

Surface Chemistry

Question1

Identify the incorrect statement

KCET 2024

Options:

- A. Values of colligative properties of colloidal solution are of small order compared to values of true solution.
- B. Tyndall effect is observed only when diameter of the dispersed particles is not much smaller than wavelength of incident light.
- C. Colour of colloidal solution depends on the wavelength of light scattered by the dispersed particles.
- D. Brownian movement is due to balanced bombardment of molecules of dispersion medium on colloidal particles.

Answer: D

Solution:

Among the given statements incorrect statement is given in option (d). Its correct form is "Brownian movement is due to unbalanced bombardment of molecules of dispersion medium on colloidal particles".

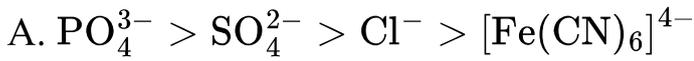
Question2

For the coagulations of positively charged hydrated ferric - oxide sol, the flocculating power of the ions is in the order:



KCET 2024

Options:



Answer: D

Solution:

Generally, greater the valence of the flocculating ion added, the greater is its power to cause precipitation. This is called as Hardy-Schulze rule.

So according to Hardy-Schulze rule the flocculating power of the ions is in the order $[\text{Fe}(\text{CN})_6]^{4-} > \text{PO}_4^{3-} > \text{SO}_4^{2-} > \text{Cl}^-$.

Question3

Gold sol is not a

KCET 2024

Options:

A. macromolecular colloid

B. lyophobic colloid

C. multimolecular colloid

D. negatively charged colloid

Answer: A



Solution:

Gold sols are multi molecular, negatively charged lyophobic colloid. Hence, among the given options it is not a macromolecular colloid.

Question4

Aqueous solution of raw sugar when passed over beds of animal charcoal, it becomes colourless. Pick the correct set of terminologies that can be used for the above example.

KCET 2023

Options:

A.

Adsorbent	Adsorbate	Process
Solution of sugar	Animal charcoal	Sorption

B.

Adsorbent	Adsorbate	Process
Animal charcoal	Solution of sugar	Absorption

C.

Adsorbent	Adsorbate	Process
Animal charcoal	Colouring substance	Adsorption

D.

Adsorbent	Adsorbate	Process
Colouring substance	Animal charcoal	Adsorption

Answer: C

Solution:

Animal charcoal-Adsorbent

It adsorbs and provide numerous sites for adsorption.

Colouring substance - Adsorbate

Colouring substance attract and binds the animal charcoal on its surface and acts as adsorbate.

This process is known as adsorption. In this process molecules or particles adhere to the surface of the adsorbent through physical or chemical interactions.

Question 5

For Freundlich adsorption isotherm, a graph of $\log(x/m)$ vs $\log(p)$ gives a straight line. The slope of line and its Y-axis intercept respectively are

KCET 2023

Options:

A. $\log\left(\frac{1}{n}\right)k$

B. $\frac{1}{n}, \log k$

C. $\log\left(\frac{1}{n}\right), \log k$

D. $\frac{1}{n}, k$

Answer: B

Solution:

We know that, Freundlich adsorption isotherm equation is given by

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

Also equation of straight line is

$$y = mx + c \dots (ii)$$

On comparing Eq. (i) and Eq. (ii), we get Slope, $m = \frac{1}{n}$

Intercept, $c = \log k$



Question6

Colloidal solution commonly used in the treatment of skin disease is

KCET 2022

Options:

- A. colloidal silver
- B. colloidal antimony
- C. colloidal gold
- D. colloidal sulphur

Answer: D

Solution:

Among the given solution colloidal sulphur is commonly used in the treatment of skin disease.

Question7

Which can adsorb larger volume of hydrogen gas?

KCET 2022

Options:

- A. Colloidal solution of palladium
- B. Finely divided platinum
- C. Colloidal $\text{Fe}(\text{OH})_3$
- D. Finely divided nickel

Answer: A



Solution:

The ability of a substance to adsorb hydrogen gas depends on the surface area and the nature of the adsorbent material. The higher the surface area and the stronger the interaction between the adsorbate (in this case, hydrogen) and the adsorbent, the greater the volume of gas that can be adsorbed.

Among the given options:

Option A: A colloidal solution of palladium has particles dispersed in a medium, which increases the surface area available for hydrogen adsorption. Palladium is particularly effective at adsorbing hydrogen due to its electronic structure and the ability to form palladium hydride (PdH_x).

Option B: Finely divided platinum has a high surface area due to its particulate form, and platinum is also known to adsorb hydrogen effectively. However, it does not form a hydride as readily as palladium, so it may adsorb slightly less hydrogen under similar conditions.

Option C: Colloidal $\text{Fe}(\text{OH})_3$ or ferric hydroxide is not particularly known for its ability to adsorb hydrogen. While it might have a reasonable surface area in its colloidal form, its interaction with hydrogen is not as strong as that of the noble metals.

Option D: Finely divided nickel has a decent adsorption capacity for hydrogen due to its surface area and can adsorb hydrogen to form nickel hydride. However, it is generally less effective than palladium in adsorbing hydrogen.

Considering the above factors, the most likely answer would be:

Option A: Colloidal solution of palladium

Palladium has the unique ability to adsorb large volumes of hydrogen, and when in a colloidal solution, its surface area is maximized, making it the most efficient adsorbent for hydrogen among the given options.

Question8

A colloidal solution is subjected to an electric field than colloidal particles more towards anode. The amount of electrolytes of BaCl_2 , AlCl_3 and NaCl required to coagulate the given colloid is in the order

KCET 2021

Options:

A. $\text{NaCl} > \text{BaCl}_2 > \text{AlCl}_3$

B. $\text{BaCl}_2 < \text{AlCl}_3 > \text{NaCl}$





Answer: A

Solution:

The amount of electrolyte required to coagulate the given colloid is in order



Because as colloids move towards anode they must be negatively charge.

According to Hardy Schulze rule,

$$\text{Coagulation value} \propto \frac{1}{\text{Coagulating power (Charge an electrolyte)}}$$

The charge on the electrolyte; Na^+ , Ba^{2+} and Al^{3+} are 1, 2 and 3 respectively.

Question9

Zeta potential is

KCET 2021

Options:

A. potential required to bring about coagulation of a colloidal sol.

B. potential required to give the particle a speed of 1 cm s^{-1}

C. potential difference between fixed charged layer and the diffused layer having opposite charges

D. potential energy of the colloidal particles.

Answer: C

Solution:

Zeta potential is potential difference between fixed charged layer and the diffused layer having opposite charges.



Question10

A sol of AgI is prepared by mixing equal volumes of 0.1 M AgNO₃ and 0.2 M KI, which of the following statement is correct?

KCET 2020

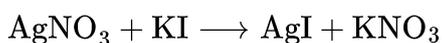
Options:

- A. Sol obtained is a negative sol with NO₃⁻ adsorbed on AgI.
- B. Sol obtained is a positive sol with Ag⁺ adsorbed on AgI.
- C. Sol obtained is a positive sol with K⁺ adsorbed on AgI.
- D. Sol obtained is a negative sol with I⁻ adsorbed on AgI.

Answer: D

Solution:

Whenever a sol of silver iodide is prepared by mixing equal volumes of 0.1 M AgNO₃ and 0.2 M KI, the sol will be a negative sol with I⁻ adsorbed on AgI. The reaction will be.



Here, molarity of KI is more than that of AgNO₃ and hence, I⁻ will be adsorbed on AgI to produce a negative sol.

Question11

During adsorption of a gas on a solid at low temperature

KCET 2020

Options:



A. $\Delta G < 0, \Delta H < 0, \Delta S < 0$

B. $\Delta G > 0, \Delta H > 0, \Delta S > 0$

C. $\Delta G < 0, \Delta H < 0, \Delta S > 0$

D. $\Delta G < 0, \Delta H > 0, \Delta S < 0$

Answer: A

Solution:

Adsorption is an exothermic process with $\Delta H =$ negative and since, gas is being adsorbed to a solid the randomness of the gas is decreasing making $\Delta S < 0$.

Also, $\Delta G = \Delta H - T\Delta S$

Here, $T\Delta S$ is small negative value at low temperature and hence, $\Delta G < 0$.

Which supports the spontaneity of the adsorption.

Question12

Which of the following is an example of homogeneous catalysis?

KCET 2019

Options:

A. oxidation of NH_3 in Ostwald's process

B. oxidation of SO_2 in contact process

C. oxidation of SO_2 in lead chamber process

D. manufacture of NH_3 by Haber's process

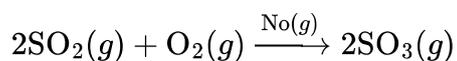
Answer: C

Solution:

Key Idea In homogeneous catalysis, reactants and catalyst are in the same phase whereas in heterogeneous catalysis, reactants and catalyst are in different phase.



Oxidation of SO_2 into SO_3 in the presence of nitric oxide (NO) in the lead chamber process is an example of homogeneous catalysis.



Other options such as oxidation of NH_3 in Ostwald's process, oxidation of SO_2 in contact process and manufacture of NH_3 by Haber's process are examples of heterogeneous catalysis.

Question13

Critical Micelle concentration for a soap solution is $1.5 \times 10^{-4} \text{ mol L}^{-1}$. Micelle formation is possible only when the concentration of soap solution in mol L^{-1} is

KCET 2019

Options:

- A. 2.0×10^{-3}
- B. 4.6×10^{-5}
- C. 7.5×10^{-5}
- D. 1.1×10^{-4}

Answer: A

Solution:

The formation of micelles takes place only above a particular concentration called critical micelle concentration (CMC). 2×10^{-3} concentration is higher than CMC value (i.e. $1.5 \times 10^{-4} \text{ mol/L}$). All other options have lower value of CMC. Hence, micelle formation is possible only at this concentration.

Question14

Which of the following electrolytes will have maximum coagulating value for AgI/Ag^+ sol?

KCET 2018

Options:

A. Na_2S

B. Na_3PO_4

C. Na_2SO_4

D. NaCl

Answer: B

Solution:

For the positive sols more be the negative charge over the electrolyte more be its coagulating value. Among the given electrolytes

$\text{Na}_2\text{S} \rightarrow$ Has 2 negative charge over S -atom.

$\text{Na}_3\text{PO}_4 \rightarrow$ Has 3 negative charge over $(\text{PO}_4)^{3-}$ group.

$\text{Na}_2\text{SO}_4 \rightarrow$ Has 2 negative charge over $(\text{SO}_4)^{2-}$ group.

$\text{NaCl} \rightarrow$ Has 1 negative charge over Cl^- atom.

\therefore (b) is the correct answer.

Question15

Gold sol is not a

KCET 2018

Options:

A. lyophobic sol

B. negatively charged sol

C. macromolecular sol

D. multimolecular colloid



Answer: C

Solution:

The correct answer is Option C: macromolecular sol.

Here's why:

Gold sol is a lyophobic sol:

"Lyophobic" means that the dispersed phase (gold particles) has little affinity for the dispersion medium (usually water). Gold sol is prepared by reducing gold salts where the resulting colloidal particles are not inherently soluble in water but are stabilized by adsorbed ions.

Gold sol is negatively charged:

In most preparations (for example, using citrate reduction), citrate ions adsorb onto the surface of gold particles, imparting a negative charge. This negative charge helps keep the particles from aggregating.

Gold sol is a multimolecular colloid:

The particles in gold sol are composed of a large number of gold atoms aggregated together. This is what makes it a colloid – the particles are much larger than individual molecules and consist of multiple atoms.

Gold sol is not a macromolecular sol:

A macromolecular sol consists of individual macromolecules (like polymers or proteins) that are dispersed uniformly in the solvent. In gold sol, the particles are aggregates of many gold atoms; they do not form single, covalently bonded macromolecules.

Thus, gold sol is not a macromolecular sol.

Question16

The process which is responsible for the formation of delta at a place where rivers meets the sea is

KCET 2017

Options:

- A. coagulation
- B. colloid formation
- C. peptisation
- D. emulsification

Answer: A

Solution:

River water is a colloidal solution of clay and sea water contains various electrolytes. When river water comes in contact with sea water, then the electrolytes present in sea water coagulate the suspended colloidal particles which ultimately settle down at the point of contact.

Question 17

Which of the following is not a favourable condition for physical adsorption?

KCET 2017

Options:

- A. High temperature
- B. High pressure
- C. Higher critical temperature of adsorbate
- D. Low temperature

Answer: A

Solution:

The unfavorable condition for physical adsorption is:

High temperature

Here's why:

Low Temperature Favours Adsorption: Physical adsorption is an exothermic process, meaning that it releases heat. According to Le Chatelier's principle, lower temperatures shift the equilibrium toward adsorption.

High Pressure Favours Adsorption: High pressure increases the concentration of gas molecules near the surface of the adsorbent, which promotes more adsorption.

Higher Critical Temperature of Adsorbate: A higher critical temperature indicates that a substance condenses easily, making it more likely to be adsorbed.

Therefore, high temperature (Option A) is not favorable for physical adsorption.

Question 18

Pick the correct statement among the following statement.

KCET 2017

Options:

- A. Sodium dodecyl benzene sulphonate used in tooth paste is a cationic detergent.
- B. Non-ionic detergents is formed when polyethylene glycol reacts with adipic acid
- C. Cetyl trimethyl ammonium bromide is a popular cationic detergent used in air conditioner
- D. Sodium lauryl sulphate forms an insoluble scum with hard water

Answer: C

Solution:

First, let's briefly recall some key facts about the detergents mentioned in the options:

Anionic detergents generally carry a negatively charged head group (often sulfonate $-\text{SO}_3^-$ or sulfate $-\text{OSO}_3^-$ groups).

Cationic detergents generally carry a positively charged head group (often ammonium N^+ -based).

Non-ionic detergents do not carry a net charge; they often consist of long-chain compounds with polar (but uncharged) functional groups, e.g., poly(ethylene glycol) chains attached to a fatty moiety.

Analyzing the statements

(A) "Sodium dodecyl benzene sulphonate used in toothpaste is a cationic detergent."

In reality, sodium dodecyl benzene sulphonate is an **anionic** detergent because it has a negatively charged sulfonate (SO_3^-) head group.

Therefore, (A) is false.

(B) "Non-ionic detergents are formed when polyethylene glycol reacts with adipic acid."

Typical **non-ionic** detergents are formed by reacting ethylene oxide (or poly(ethylene glycol)) with a fatty acid or alkyl phenol (e.g., nonylphenol), creating an $\text{O}-(\text{CH}_2\text{CH}_2\text{O})_n-$ group.

Adipic acid ($\text{HOOC}-(\text{CH}_2)_4-\text{COOH}$) is a di-acid mainly used in nylon production and certain plasticizers. Reaction with polyethylene glycol would yield a polyester, not a common non-ionic detergent.

Therefore, (B) is not a standard route to non-ionic detergents and is generally considered false.

(C) "Cetyl trimethyl ammonium bromide (CTAB) is a popular cationic detergent used in air



Cetyl trimethyl ammonium bromide is indeed a well-known **cationic** detergent (a quaternary ammonium compound). Its typical uses include hair conditioners, fabric softeners, and disinfectants.

While the statement says “used in air conditioner,” it is well known that quaternary ammonium compounds (including CTAB) can be used as disinfectants in HVAC systems. However, it’s *most famously* used in **hair** conditioners.

But from a chemistry standpoint (cationic nature), (C) is **essentially correct** about its being a cationic detergent.

(D) “Sodium lauryl sulphate forms an insoluble scum with hard water.”

One big advantage of **detergents** (like sodium lauryl sulfate, SLS) over soaps is that they **do not** form insoluble scum in hard water. Soaps (carboxylate salts) do, but sulfates/sulfonates are much more soluble even in the presence of Ca^{2+} or Mg^{2+} .

Therefore, **(D) is false**.

Conclusion

The only statement that holds up upon close scrutiny is:

(C) “Cetyl trimethyl ammonium bromide (CTAB) is a popular cationic detergent ... ”

Hence, the **correct choice** is **Option C**.

Question19

Hydrogenation of vegetable oils in presence of finely divided nickel as catalyst. The reaction is

KCET 2017

Options:

- A. enzyme catalysed reaction
- B. homogeneous catalysis
- C. heterogeneous catalysis
- D. liquid catalysed reaction

Answer: C

Solution:



The hydrogenation of vegetable oils in the presence of finely divided nickel as a catalyst is an example of a process where the reactants and the catalyst exist in different phases.

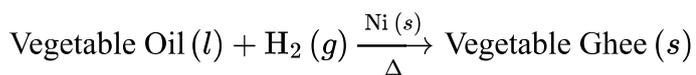
In this reaction:

Vegetable oil is in the liquid phase.

Hydrogen (H₂) is in the gaseous phase.

Nickel (Ni), which acts as the catalyst, is in the solid phase.

This is illustrated by the following chemical equation:



Since the phases of the reactants (liquid and gas) differ from that of the catalyst (solid), this reaction represents a case of heterogeneous catalysis.
