SELECT THE CORRECT ALTERNATIVE (ONLY ONE CORRECT ANSWER)

1. Which of the following factors affects the adsorption of a gas on solid ?
(A) T_c (critical temp.) (B) Temperature of gas (C) Pressure of gas (D) All of them

2. The volume of gases NH_3, CO_2 and CH_4 adsorbed by one gram of charcoal at 298 K are in
(A) $CH_4 > CO_2 > NH_3$ (B) $NH_3 > CH_4 > CO_2$ (C) $NH_3 > CO_2 > CH_4$ (D) $CO_2 > NH_3 > CH_4$

3. The heat of physisorption lie in the range of
(A) 1 to 10 kJ mol^{-1} (B) 20 to 40 kJ mol^{-1} (D) 40 to 200 kJ mol^{-1} (D) 200 to 400 kJ mol^{-1}

4. Which of the following is not a gel ?
(A) Cheese (B) Jellies (C) Curd (D) Milk

5. Which of the following is used to adsorb water
(A) Silica gel (B) Calcium acetate (C) Hair gel (D) Cheese

6. An emulsion is a colloidal system of
(A) two solids (B) two liquids
(C) one gas and one solid (D) one gas and one liquid

7. Which of the following is a lyophobic colloid ?
(A) Gelatin (B) Sulphur (C) Starch (D) Gum arabic

8. The nature of bonding forces in adsorption
(A) purely physical such as Vander Waal's forces (B) purely chemical
(C) both chemical and physical always (D) none of these

9. The Tyndall effect associated with colloidal particles is due to
(A) presence of electrical charges (B) scattering of light
(C) adsorption of light (D) reflection of light

10. Which one of the following is not applicable to chemisorption ?
(A) Its heat of adsorption is high (B) It takes place at high temperature
(C) It is reversible (D) It forms mono-molecular layers

11. In the colloidal state the particle size ranges
(A) below 1 nm (B) between 1 nm to 100 nm
(C) more than 100 nm (D) none of the above

12. All colloids
(A) are suspensions of one phase in another
(B) are two phase systems
(C) contain only water soluble particles
(D) are true solutions

13. Colloids can be purified by
(A) condensation (B) peptization (C) coagulation (D) dialysis

14. Milk is an example of
(A) emulsion (B) suspension (C) foam (D) sol

15. Fog is a colloidal system of
(A) gas in liquid (B) liquid in gas (C) gas in gas (D) gas in solid

16. When a colloidal solution is observed under ultramicroscope, we can see

(A) light scattered by colloidal particle (B) size of the colloidal particle

(C) shape of the colloidal particle (D) relative size of the colloidal particle

17. Colloidal solutions are classified on the basis of

(A) molecular size (B) organic or inorganic (C) surface tension value (D) pH value

18. The electrical charge on a colloidal particle is indicated by

(A) Brownian movement (B) electrophoresis (C) ultra microscope (D) molecular sieves

19. Crystalloids differ from colloids mainly in respect of

(A) electrical behaviour (B) particle nature (C) particle size (D) solubility

20. Which one of the following is lyophillic colloid?

(A) Milk (B) Gum (C) Fog (D) Blood

21. Small liquid droplets dispersed in another liquid is called

(A) suspension (B) emulsion (C) gel (D) true solution

22. The process which is catalysed by one of the product is called

(A) acid-base catalysis (B) autocatalysis

(C) negative catalysis (D) homogeneous catalysis

23. Tyndall effect would be observed in a

(A) solution (B) solvent (C) precipitate (D) colloidal sol

24. Adsorption is multilayer in case of

(A) physical adsorption (B) chemisorption (C) in both (D) none of these

25. A liquid is found to scatter a beam of light but leaves no residue when passed through the filter paper. The liquid can be described as

(A) a suspension (B) oil (C) a colloidal sol (D) a true solution

26. The ability of an ion to bring about coagulation of a given colloid depends upon

(A) its charge (B) the sign of the charge alone

(C) the magnitude of the charge (D) both magnitude and sign of charge

27. An emulsifier is a substance

(A) which stabilises an emulsion

(B) which breaks the emulsion into its constituent liquids

(C) which can convert liquid into an emulsion

(D) which bring about coagulation of an emulsion

CHECK YOUR GRASP				ANSWER KEY							EXERCISE -1				
Que.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans.	D	C	B	D	A	B	B	D	B	C	B	B	D	A	B
Que.	16	17	18	19	20	21	22	23	24	25	26	27			
Ans.	A	A	B	C	B	B	B	D	A	C	D	A			

EXERCISE–02 BRAIN TEASERS

SELECT THE CORRECT ALTERNATIVES (ONE OR MORE THEN ONE CORRECT ANSWERS)

1. Which gas will be adsorbed on a solid to greater extent.
   (A) A gas having non polar molecule
   (B) A gas having highest critical temperature (T_c)
   (C) A gas having lowest critical temperature.
   (D) A gas having highest critical pressure.

2. Colloidal particles in a sol. can be coagulated by
   (A) heating
   (B) adding an electrolyte
   (C) adding oppositely charged sol
   (D) any of the above methods

3. Emulsifier is an agent which
   (A) accelerates the dispersion
   (B) homogenizes an emulsion
   (C) stabilizes an emulsion
   (D) aids the flocculation of an emulsion

4. Given below are a few electrolytes, indicate which one among them will bring about the coagulation of a gold sol. quickest and in the least of concentration?
   (A) NaCl (B) $MgSO_4$ (C) $Al_2(SO_4)_3$ (D) $K_4[Fe(CN)_6]$

5. The minimum concentration of an electrolyte required to cause coagulation of a sol is called
   (A) flocculation value (B) gold number (C) protective value (D) none of these

6. Smoke precipitator works on the principle of
   (A) distribution law
   (B) neutralization of charge on colloids
   (C) Le-Chaterlier's principle
   (D) addition of electrolytes

7. Which one of following statements is not correct in respect of lyophilic sols ?
   (A) There is a considerable interaction between the dispersed phase and dispersion medium
   (B) These are quite stable and are not easily coagulated
   (C) They carry charge
   (D) The particle are hydrated

8. As_2S_3 sol is
   (A) positive colloid (B) negative colloid (C) neutral colloid (D) none of the above

9. Which of the following electrolyte will be most effective in coagulation of gold sol ?
   (A) $NaNO_3$ (B) $K_4[Fe(CN)_6]$ (C) Na_3PO_4 (D) $MgCl_2$

10. At the critical micelle concentration (CMC) the surfactant molecules
   (A) decompose
   (B) dissociate
   (C) associate
   (D) become completely soluble

11. Alums purify muddy water by
   (A) dialysis (B) absorption (C) coagulation (D) forming true solution

12. Solute dispersed in ethanol is called
   (A) emulsion (B) micelle (C) hydrophilic sol. (D) alcosols

13. An arsenious sulphide sol. carries a negative charge. The maximum precipitating power of this sol. is possessed by
   (A) K_2SO_4 (B) $CaCl_2$ (C) Na_3PO_4 (D) $AlCl_3$

14. Reversible adsorption is
   (A) chemical adsorption (B) physical adsorption (C) both (D) none

15. The function of gum arabic in the preparation of Indian ink is

(A) coagulation (B) peptisation (C) protective action (D) adsorption

16. Which of the following is an example of associated colloid?

(A) Protein + water (B) Soap + water (C) Rubber + benzene (D) As_2O_3 + $Fe(OH)_3$

17. Adsorption of gases on solid surface is generally exothermic because

(A) enthalpy is positive (B) entropy decreases (C) entropy increases (D) free energy increases

18. Which of the following is/are correct statements

(A) Hardy Schulz rule is related to coagulation

(B) Brownian movement and Tyndall effect are shown by colloids

(C) When liquid is dispersed in liquid, it is called gel.

(D) Gold number is a measure of protective power of lyophillic colloid.

19. Which statement is/are correct ?

(A) Physical adsorption is multilayer non-directional and non-specific

(B) Chemical adsorption is generally monolayer and specific in nature

(C) Physical adsorption is due to free valence of atoms

(D) Chemical adsorption is stronger than physical adsorption

20. Which is the following is/are correct for lyophillic sols ?

(A) Its surface tension is lower than that of H_2O

(B) Its viscosity is higher than that of water

(C) Its surface tension is higher than that of water

(D) Its viscosity is equal to that of water

21. Which statement(s) is/are correct

(A) A solution is prepared by addition of excess of $AgNO_3$ solution in KI solution. The charge likely to develop on colloidal particle is positive.

(B) The effects of pressure on physical adsorption is high if temperature is low.

(C) Ultracentrifugation process is used for preparation of lyophobic colloids.

(D) Gold number is the index for extent of gold plating done.

22. Colloidal solution can be purified by

(A) Dialysis (B) Electrodialysis (C) Electrophoresis (D) ultrafiltration

23. Coagulation of colloids can be achieved by

(A) Centrifugation (B) Adding electrolyte (C) Change in pH (D) Adding water

24. When –vely charged colloid like As_2S_3 sol is added to +vely charged $Fe(OH)_3$ sol in suitable amounts

(A) Both the sols are precipitated simultaneously

(B) This process is called mutual coagulation

(C) They become +vely charged colloid

(D) They become –vely charged colloid

25. Which of the following is not lyophillic

(A) Gelatin sol (B) Silver sol (C) Sulphur sol (D) As_2S_3 sol

26. Colloidal Gold can be prepared by

(A) Bredig's are method (B) Reduction of $AuCl_3$ (C) Hydrolysis (D) Peptization

27. The coagulation of sol particles may be brought about by

(A) heating (B) addition oppositely charged sol

(C) addition electrolyte (D) persistent dialysis

28. Which one is not lyophobic in nature ?

(A) Gelatin (B) Sulphur (C) Starch (D) Protein

29. Which of the following are colloids?

(A) Milk (B) Ice cream (C) Urea solution (D) Blood

30. Which are the properties of sols.

(A) Adsorption (B) Tyndall effect (C) Flocculation (D) Paramagnetism

31. The migration of colloidal particles under the influence of an electrical field is known as

(A) electro osmosis (B) electrophoresis (C) electrodialysis (D) None

BRAIN TEASERS					ANSWER KEY					EXERCISE -2					
Que.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans.	B	D	C	C	A	B	C	B	D	C	C	D	D	B	C
Que.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Ans.	B	B	A,B,D	A,B,D	A,B	A,B	A,B	A,B,C	A,B	B,C,D	A,B	B,D	A,C,D	A,B,D	A,B,C
Que.	31														
Ans.	B														

EXERCISE–03 MISCELLANEOUS TYPE QUESTIONS

TRUE / FALSE

1. Physisorption is non-specific.
2. Chemisorption needs activation energy.
3. A graph of x/m vs temperature at constant pressure is called adsorption isotherm.
4. Suspensions have solute particles with size less than 1 nm.
5. $Fe(OH)_3$ sol contains positively charged colloidal particles.
6. Chemisorption is irreversible.
7. Adsorption isobars of chemisorption and physisorption are of the same type.
8. Milk is an example of water in oil emulsions.
9. Gold sol can be prepared by Bredig's arc method.
10. Gel is a system in which liquid is the dispersed phase and solid is the dispersion medium.

FILL IN THE BLANKS

1. The substance on whose surface adsorption takes place is called an ..... .
2. Removal of adsorbate from the surface of adsorbent is called ..... .
3. Migration of colloidal particles under the effect of electric field is called ..... .
4. The heat of adsorption in case of physisorption is approximately ..... .
5. The phenomenon of zig-zag motion of colloidal particles is known as ..... .
6. Lyophilic sols are ..... stable than lyophobic sols.
7. Electrical properties of a colloidal solution are demonstrated by ..... .
8. Tyndall effect takes place due to ..... of light by colloidal particles.
9. The liquid-liquid colloidal dispersions are called ..... .
10. The movement of dispersion medium under the influence of an electric field is called ..... .
11. Smoke is a colloidal solution of ..... in ..... .
12. The adhering of the molecules of a gas on the surface of a solid is called ..... .
13. The protective action of different colloids is compared in term of ..... .
14. The colloidal dispersion of a liquid in a liquid is called ..... .
15. The colloidal dispersions of liquids in solid media are called ..... .

ASSERTION & REASON

These questions contains, Statement I (assertion) and Statement II (reason).

(A) Statement-I is true, Statement-II is true ; Statement-II is correct explanation for Statement-I.

(B) Statement-I is true, Statement-II is true ; Statement-II is NOT a correct explanation for statement-I

(C) Statement-I is true, Statement-II is false

(D) Statement-I is false, Statement-II is true

1. **Statement-I :** Isoelectric point is pH at which colloidal can move towards either of electrode
   Because
   Statement-II : At isoelectric point, colloidal particles become electrically neutral.
2. **Statement-I :** When $AgNO_3$ is treated with excess of potassium iodide, colloidal particles gets attracted towards anode.
   Because
   Statement-II : Precipitate adsorb common ions (excess) and thus become charged.

3. **Statement-I :** For adsorption ΔG, ΔH, ΔS all have –ve values

Because

Statement-II : Adsorption is a spontaneous exothermic process in which randomness decreases due to force of attraction between adsorbent and adsorbate.

4. **Statement-I :** A gas with higher critical temperature gets adsorbed to more extent than a gas with lower critical temperature.

Because

Statement-II : The easily liquifiable gases get adsorbed to more extent.

5. **Statement-I :** Micelles are formed by surfactant molecules above the critical micellar concentration (CMC).

Because

Statement-II : The conductivity of a solution having surfactant molecules decreases sharply at the CMC.

COMPREHENSION BASED QUESTIONS

Comprehension # 1

Question No. 46 to 50 (5 questions)

Whenever a mixture of gases is allowed to come in contact with a particular adsorbent under the same conditions, the more strong adsorbate is adsorbed to greater extent irrespective of its amount present, e.g., H_2O is adsorbed to more extent on silica gel than N_2 and O_2. This shows that some adsorbates are preferentially adsorbed. It is also observed that preferentially adsorbable adsorbents can displace a weakly adsorbed substance from the surface of an adsorbent.

1. Which of the following gases is adsorbed to maximum extent :

(A) He (B) Ne (C) Ar (D) Xe

2. Which of the gas can displace remaining all the gases

(A) O_2 (B) N_2 (C) CO (D) H_2

3. When temperature is increased

(A) extent of adsorption increases (B) extent of adsorption decreases

(C) no effect on adsorption (D) extent of adsorption first decreases, then increases

4. Chromatogarphic separations are based on

(A) differential solubility (B) differential adsorption (C) differential absorption (D) None of these

5. Activated charcoal is prepared by

(A) heated charcoal with steam so that it becomes more porous

(B) addition $Ca_3(PO_4)_2$ to charcoal

(C) addition impurity to charcoal

(D) reacted with conc. HNO_3

Comprehension # 2

Question No. 51 to 54 (4 questions)

The clouds consist of charged particles of water dispersed in air. Some of them are +vely charged, others are negatively charged. When +vely charged clouds come closer they have cause lightening and thundering whereas when +ve and –ve charged colloids come closer they cause heavy rain by aggregation of minute particles. It is possible to cause artificial rain by throwing electrified sand or silver iodide from an aeroplane and thus coagulation the mist hanging in air.

1. When excess of $AgNO_3$ is treated with KI solution, AgI forms

(A) +ve charged sol (B) –vely charged sol (C) neutral sol (D) true solution

2. Clouds are colloidol solution of

(A) liquid in gas (B) gas in liquid (C) liquid in liquid (D) solid in liquid

3. AgI helps in artificial rain because

(A) It helps in coagulation (B) It helps in dispersion process

(C) Both (D) None

4. Electrical chimneys are made on the principle of

(A) Electroosmosis (B) Electrophoresis (C) Coagulation (D) All of these

Comprehension # 3

Question No. 55 to 58 (4 questions)

In macromolecular type of colloids, the dispersed particles are themselves large molecules (usually polymers). Since these molecules have dimensions comparable to those of colloidal particles, their dispersions are called macromolecular colloids. Most lyophilic sols belong to this category. There are certain colloids which behave as normal strong electrolytes at low concentrations, but exhibit colloidal properties at higher concentrations due to the formation of aggregate particles. These are known as micelles or associated colloids. Surface active agents like soaps and synthetic detergent belong to this class.

- Critical micelle concentration (CMC) is the lowest concentration at which micelle formation appears. CMC increases with the total surfactant concentration. At concentration higher than CMC, they form extended parallel sheets known as lamellar micelles which resemble biological membranes. With two molecules thick, the individual molecule is perpendicular to the sheets such that hydrophilic groups are on the outside in aqueous solution and on the inside in a non-polar medium
- In concentrated solution, micelles take the form of long cylinders packed in hexagonal arrays and are called lytotropic mesomorphs.
- In an aqueous solution (polar medium), the polar group points towards the periphery and the hydrophobic hydrocarbon chains point towards the centre forming the core of the micelle.
- Micelles from the ionic surfactants can be formed only above a certain temperature called the **Kraft temperature.**
- They are capable of forming ions.
- Molecules of soaps and detergents consist of lyophilic as well as lyophobic parts which associate together to form micelles.
- Micelles may contains as many as 100 molecules or more.

1. Select incorrect statement(s) :

(A) Surface active agent like soaps and synthetic detergents are micelles

(B) Soaps are emulsifying agents

(C) $C_{17}H_{35}$ (hydrocarbon part) and $-COO^-$ (carboxylate part) of stearate ion ($C_{17}H_{35}COO^-$) both are hydrophobic

(D) All are incorrect statements

2. Which part of the soap ($RCOO^-$) dissolved grease and forms micelle ?

(A) R part (called tail of the anion) (B) $-COO^-$ part (called head of the anion)

(C) both (A) and (B) (D) none of these

3. In multimolecular colloidal sols, atoms or molecules are held together by:

(A) H-bonding (B) vander Waals forces

(C) ionic bonding (D) polar covalent bonding

4. Cleansing action of soap occurs because :

(A) oil and grease can be absorbed into the hydrophobic centres of soap micelles and washed away

(B) oil and grease can be absorbed into hydrophilic centres of soap micelles acid washed away

(C) oil and grease can be absorbed into both hydrophilic and hydrophobic centres but not washed away

(D) cleansing action is not related to micelles

Comprehension # 4

Question No. 59 to 61 (3 questions)

The protective power of the lyophilic colloids is expressed in terms of gold number a term introduced by Zsigmondy. Gold number is the number of milligram of the protective colloid which prevent the coagulation of 10 mL of red gold sol. when 1 mL of a 10 percent solution of sodium chloride is added to it. Thus, smaller the gold number of lyophilic colloid, the greater is the protective power.

1. On addition of one mL of solution of 10% NaCl to 10 mL of red gold sol in presence of 0.025 g of starch, the coagulation is just prevented. The gold number of starch is

(A) 0.025 (B) 0.25 (C) 2.5 (D) 25

2. Which of the following statement(s) is/are correct

(A) Higher the gold number, more protective power of colloid

(B) Lower the gold number, more the protective power

(C) Higher the coagulation value, more the coagulation power

(D) Lower the coagulation value, higher the coagulation power

3. Gold number gives an indication of

(A) protective nature of colloids (B) purity of gold in suspension

(C) the charge on a colloidal solution of gold (D) g-mole of gold per litre

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MISCELLANEOUS TYPE QUESTION — ANSWER KEY — EXERCISE -3

- ***True / False***

1. T	2. T	3. F	4. F
5. T	6. T	7. F	8. F
9. T	10. T		

- ***Fill in the Blanks***

1. absorbent	2. desorption	3. electrophoresis	4. 20–40 kJ-mol^{-1}
5. Brownian movement		6. more	7. electrophoresis
8. scattering	9. emulsions	10. electro-osmosis	11. solid in gas
12. adsorption	13. gold number	14. emulsion	15. gel

- ***Assertion - Reason Questions***

1. B 2. C 3. C 4. C 5. D

- ***Comprehension Based Questions***

Comprehension # 1:	**1.** (D)	**2.** (C)	**3.** (B)	**4.** (B)	**5.** (A)
Comprehension # 2:	**1.** (A)	**2.** (A)	**3.** (C)	**4.** (B)	
Comprehension # 3:	**1.** (C,D)	**2.** (C)	**3.** (B)	**4.** (A)	
Comprehension # 4:	**1.** (D)	**2.** (B,D)	**3.** (A)		

1. The volume of a colloidal particle, V_C as compared to the volume of a solute particle in a true solution V_S, could be :- **[AIEEE-2005]**

(1) $\frac{V_C}{V_S} \simeq 1$ (2) $\frac{V_C}{V_S} \simeq 10^{23}$ (3) $\frac{V_C}{V_S} \simeq 10^{-3}$ (4) $\frac{V_C}{V_S} \simeq 10^{3}$

2. The disperse phase in colloidal iron (III) hydroxide and colloidal gold is positively and negatively charged, respectively. Which of the following statement is NOT correct **[AIEEE-2005]**

(1) Magnesium chloride solution coagulates, the gold sol more readily than the iron (III) hydroxide sol

(2) Sodium sulphate solution cause coagulation in both sols

(3) Mixing the sols has no effect

(4) Coagulation in both sols can be brought about by electrophoresis

3. Which of the following statements is incorrect regarding physissorptions ? **[AIEEE-2009]**

(1) Under high pressure it results into multi molecular layer on adsorbent surface

(2) Enthalpy of adsorption ($\Delta H_{adsorption}$) is low and positive

(3) It occurs because of Van der Waal's forces

(4) More easily liquefiable gases are adsorbed readily

4. According to Freundlich adsorption isotherm, which of the following is correct ? **[AIEEE-2012]**

(1) $\frac{x}{m} \propto p^0$ (2) $\frac{x}{m} \propto p^1$ (3) $\frac{x}{m} \propto p^{1/n}$

(4) All the above are correct for different ranges of pressure

MISCELLANEOUS TYPE QUESTION **ANSWER KEY** EXERCISE -4(A)

Que.	1	2	3	4
Ans	4	3	2	4

EXERCISE - 04 [B] JEE-[ADVANCED] : PREVIOUS YEAR QUESTIONS

Q.1 Among the following, the surfactant that will from micelles in aqueous solution at the lowest molar concentration at ambient conditions is **[JEE 2008]**

(A) $CH_3(CH_2)_{15}N^+(CH_3)_3Br^-$ (B) $CH_3(CH_2)_{11}OSO_3^-Na^+$

(C) $CH_3(CH_2)_6COO^-Na^+$ (D) $CH_3(CH_2)_{11}N^+(CH_3)_3Br^-$

Q.2 Among the electrolytes Na_2SO_4, $CaCl_2$, $Al_2(SO_4)_3$ and NH_4Cl, the most effective coagulation agent for Sb_2S_3 sol is **[JEE 2009]**

(A) Na_2SO_4 (B) $CaCl_2$ (C) $Al_2(SO_4)_3$ (D) NH_4Cl

Q.3 The correct statement(s) pertaining to the adsorption of a gas on a solid surface is (are) -

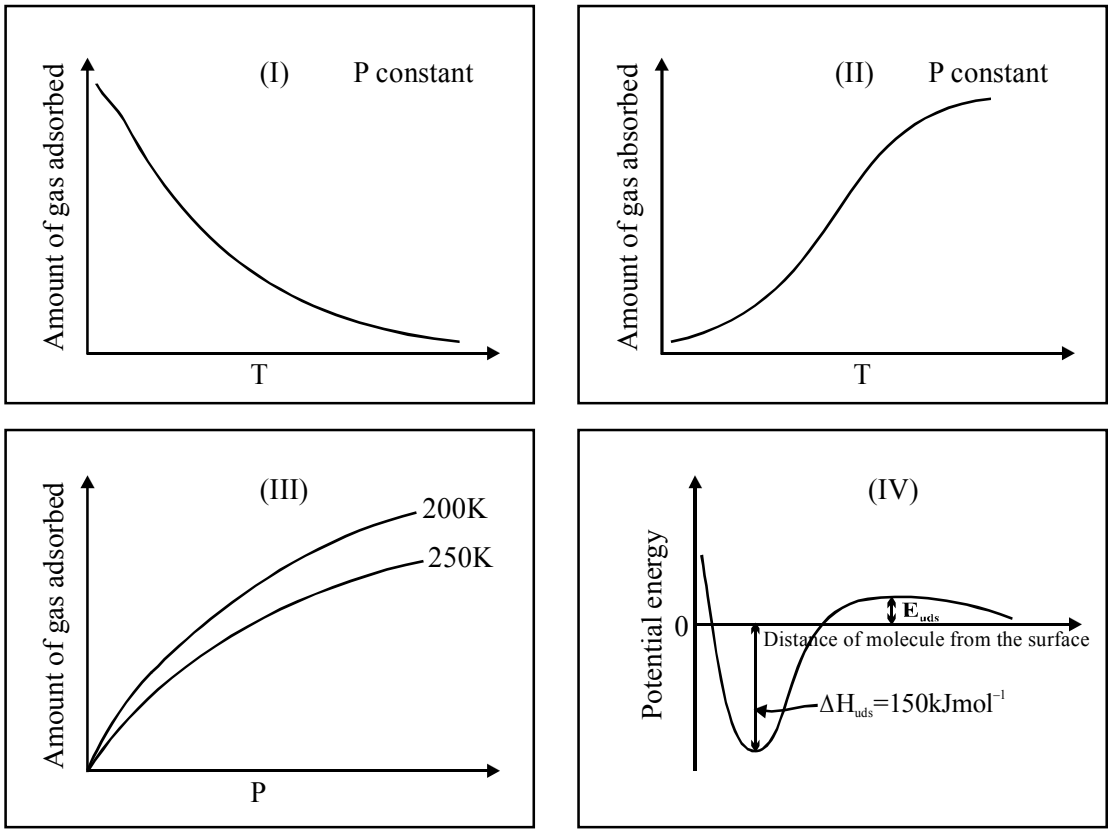
(A) Adsorption is always exothermic **[JEE 2011]**

(B) Physisorption may transform into chemisorption at high temperature

(C) Physisorption increases with increasing temperature but chemisorption decreases with increasing temperature

(D) Chemisorption is more exothermic than physisorption, however it is very slow due to higher energy of activation

Q.4 The given graphs / data **I, II, III and IV** represent general trends observed for different physisorption and chemisorption processes under mild conditions of temperature and pressure. Which of the following choice(s) about **I, II, III and IV** is (are) correct ? **[JEE 20112]**



(A) **I** is physisorption and **II** is chemisorption

(B) **I** is physisorption and **III** is chemisorption

(C) **IV** is chemisorption and **II** is chemisorption

(D) **IV** is chemisorption and **III** is chemisorption

Q.5 Choose the correct reason(s) for the stability of the **lyophobic** colloidal particle. **[JEE 2012]**

(A) Preferential adsorption of ions on their surface from the solution

(B) Preferential adsorption of solvent on their surface from the solution

(C) Attraction between different particles having opposite charges on their surface

(D) Potential difference between the fixed layer and the diffused layer of opposite charges around the colloidal particles

MISCELLANEOUS TYPE QUESTION	ANSWER KEY	EXERCISE -4(B)

Q.1 A Q.2 C Q.3 A,B,D Q.4 A, C Q.5 A, D