CHEMISTRY COACHING CIRCLE

+2

GRAND TEST - 1

Test - 4

TOPICS:

Solutions and Surface Chemistry

Test Date: 12.05.2019 (Sunday)
Test Time: 9:00 AM to 11:00 AM

Test Venue:
Lajpat Bhawan, Madhya Marg,
Sector 15-B, Chandigarh

Empowered By:

TEST SERIES

PCB — QUANTUM Plus

PCM — INTELLIQUEST

Dr. Sangeeta Khanna, Ph.D
S.C.O. 208 (TF) Sector 24-D, Chandigarh. Ph. No. 0172-2713289 (O), 09888007880 (M).

IMPORTANT INSTRUCTIONS

- **Test Duration: 9:00 AM to 11:15 AM**
- **This test consist of 2 Levels.**

Level – I

Time: 75 Minutes [9:00 AM to 10:00 AM]

55 Qs. × 4 = 220 Marks

(Single Answer Type) [Negative Marking = – 1]

Level – II

Time: 1 hour [10:00 AM to 11:15 AM]

34 Qs = 160 Marks

- **Assertion & Reason [Negative Marking (-1)] = 10 × 4 = 40 Marks**
- **Comprehension Type [Negative Marking (-1)] = 6 × 4 = 24 Marks**
- **More than One Answer [No Negative Marking] = 10 × 5 = 50 Marks**
- **Matrix Match Type [No Negative Marking] = 2 × 8 = 16 Marks**
- **Integer Type [No Negative Marking] = 6 × 5 = 30 Marks**

- **Every candidate will get 2 OMR Sheets for answering Level – I and Level – II separately. The candidate will start with Level – I first and return Level I OMR sheet immediately at 10:00 AM after 75 minutes. So please ensure to fill up OMR on time.**
- **OMR sheet for Level – II will be collected immediately after completion of test time at 11:15 am.**
- **Usage of Mobile is strictly prohibited in the examination hall. The mobile must be kept switched off during exam time. Anybody seen using or fiddling with mobile phone will get disqualified for the test.**
- **Unfair means of any sort during exam will entail cancellation and disqualification of his/her paper.**
- **Answer Key will be given only after completion of paper. Detailed solutions will be uploaded on website.**

"BEST OF LUCK"

LEVEL – I

Time: 1 hour 15 Minutes

Section – A (Single Correct Choice Type) Negative Marking [-1]

This Section contains **55 multiple choice questions.** Each question has four choices A), B), C) and D) out of which **ONLY ONE** is correct. **55 × 4 = 176 Marks**

1. In which case should $N_2(g)$ be more soluble in water?

a. The total pressure is 5 atm and the partial pressure of N_2 is 1 atm
b. The total pressure is 1 atm and the partial pressure of N_2 is 0.03 atm.
c. The total pressure is 1 atm and the partial pressure of N_2 is 0.5 atm
d. The total pressure is 3 atm and the partial pressure of N_2 is 2 atm
D

2. Intermolecular forces in liquid A are considerably large than intermolecular forces in liquid B. Which of the following properties is NOT expected to be larger for A than B?

a. The vapour pressure at 20 °C
b. The temperature at which the vapour pressure is 100mm Hg
c. The critical temperature
d. The heat of vaporization (ΔH_{vap})
A

3. What is the molality of the 870 g solution made by dissolving 120 g Br_2 in $CHC\ell_3$. [At. Wt. of Br = 80] [M.wt of Br_2= 160]

a. 1 b. 1/2 c. 3/4 d. 1/4
A

Sol. $M = \frac{120}{160} \times \frac{1000}{[870-120]} = \frac{3}{4} \times \frac{1000}{750} = 1$

4. Gold number of a lyophilic sol is such property that:

a. the larger its value, the greater is the peptizing power
b. the lower its value, the greater is the peptizing power
c. the lower its value, the greater is the protecting power
d. the larger its value, the greater is the protective power
C

5. Cloud bursts occur due to one of the following reasons:

a. The clouds are attracted towards the electrical charge on the earth.
b. Large amount of water is present in the cloud
c. Dense clouds are present in the upper atmosphere
d. Mutual discharge of oppositely charged clouds resulting in the Coagulation of water droplets.
D

6. The colour of colloidal particles of gold obtained by different methods differ because of:

a. Variable valency of gold
b. Different concentration of gold particles
c. Different types of impurities
d. Different diameters of colloidal particles
D

7. Colloid of which of the following can be prepared by electrical dispersion method as well as reduction method:

a. Sulphur b. Ferric hydroxide c. Arsenious sulphide d. Gold
D

8. Alum help in purifying water by:

a. Forming Si complex with clay particles
b. Sulphate part which combines with the dirt & removes it
c. Aluminium ion which coagulates the mud particles
d. Making mud water soluble
C

9. When ammonia gas is brought in contact with water surface, its pressure falls due to:

a. Physical adsorption
b. Chemical adsorption
c. Absorption
d. None of the above
C

10. Y gm of a non-volatile solute of molar mass M is dissolved in 250 g of benzene. If K_b is molal elevation constant, the value of ΔT is given by:

a. $\frac{4N}{K_b Y}$ b. $\frac{4K_b Y}{M}$ c. $K_b \frac{Y}{4M}$ d. $K_b \frac{Y}{M}$
B

Sol. $\Delta T = K_b \times \frac{w_B \times 1000}{m_B \times w_A} = K_b \times \frac{Y \times 1000}{M \times 250} = \frac{4K_b Y}{M}$

11. Which of the following solutions has maximum freezing point depression at equimolal concentration?

a. $[Co(H_2O)_6]Cl_3$
b. $[Co(H_2O)_5Cl]Cl_2 \cdot H_2O$
c. $[Co(H_2O)_4Cl_2]Cl \cdot 2H_2O$
d. $[Co(H_2O)_3Cl_3] \cdot 3H_2O$
A

Sol. $[Co(H_2O)_6]Cl_3 \longrightarrow [Co(H_2O)_6]^{3+} + 3Cl^-$
This complex gives maximum number of ions, hence its depression in freezing point will also be maximum .

12. The van't Hoff factor for a 0.1 M $Al_2(SO_4)_3$ solution is 4.20. The degree of dissociation is

a. 80% b. 90% c. 78% d. 83%
A

Sol. $i = 1 + 4\alpha$

13. A substance will be deliquescent if its vapour pressure is

a. equal to the atmospheric pressure
b. equal to the vapour pressure of water vapour in the air
c. greater than the vapour pressure of water vapour in the air
d. less than the vapour pressure of water vapour in the air
D

14. What is the freezing point of a 0.50 m solution of Cs_2SO_4 in water? K_f for water is 1.86^0C/m.

a. -0.93^0C b. -1.9^0C c. $+2.8^0$C d. -2.8^0C
D

Sol. $i = 3$
$\Delta T_f = 1.86 \times 3 \times 0.5 = 2.79$; $T_f = -2.79°C$

15. Given below are a few electrolytes, indicate which one among them will bring about the coagulation of a gold sol (negative) quickest and in the least of concentration?

a. NaCl b. $MgSO_4$ c. $Al_2(SO_4)_3$ d. $K_4[Fe(CN)_6]$
C

Sol. An electrolyte with more valency of cation

16. The dispersed phase in colloidal iron (III) hydroxide and colloidal gold is positively and negatively charged respectively which of the following statement is not correct?

a. Magnesium chloride solution coagulate the gold sol more readily than Sodium chloride
b. Sodium sulphate solution causes coagulation in both sols
c. Mixing the sols has no effect
d. Coagulation in both sol can be brought about by electrophoresis.

C

17. Under ambient conditions, which among the following surfactants will form micelles in aqueous solution at lowest molar concentration?

a. $CH_3-(CH_2)_{13}-OSO_3^-Na^+$ b. $CH_3(CH_2)_{11}\overset{\oplus}{N}(CH_3)_3Br^-$

c. $CH_3-(CH_2)_8-COO^{\ominus}Na^+$ d. $CH_3(CH_2)_{15}\overset{\oplus}{N}(CH_3)_3\overset{\ominus}{Br}$

D

Sol. Compound with biggest alkyl gp will have lowest CMC

18. A solution at 20°C is composed of 1.5 mol of benzene and 3.5 mol of toluene. If the vapour pressure of pure benzene and pure toluene at this temperature are 74.7 torr and 22.3 torr, respectively, then the total vapour pressure of the solution and the benzene mole fraction in equilibrium with it will be, respectively :

a. 35.8 torr and 0.280 b. 35.0 torr and 0.480
c. 38.0 torr and 0.589 d. 30.5 torr and 0.389

C

Sol. $P_t = 74.7 \times \frac{1.5}{5} + 22.3 \times \frac{3.5}{5}$

$P_t = 74.7 \times 0.3 + 22.3 \times 0.7 = 38$

$\gamma_B = \frac{74.7 \times 0.3}{P_t} = \frac{22.4}{38} = 0.589$

19. The boiling points of C_6H_6, CH_3OH, $C_6H_5NH_2$ and $C_6H_5NO_2$ are 80°C, 65°C, 184°C and 212°C, respectively. Which of the following will have the highest vapour pressure at the room temperature?

(a) C_6H_6 (b) CH_3OH (c) $C_6H_5NH_2$ (d) $C_6H_5NO_2$

B

Sol. $v.p \propto \frac{1}{B.pt}$

20. The vapour pressure of water at 300 K in a closed container is 0.4 atm. If the volume of the container is doubled, its vapour pressure at 300 K will be

(a) 0.8 atm (b) 0.2 atm (c) 0.4 atm (d) 0.6 atm

C

21. The vapour pressure of a solution of two liquids, A (P° = 80 mm, X = 0.4) and B (P° = 120 mm, X = 0.6) is found to be 100 mm. It shows that the solution exhibits

(a) negative deviation from ideal behaviour (b) positive deviation from ideal behavior
(c) ideal behavior (d) positive deviation at lower concentration

A

Sol. $P_{cal} = P_A^{\circ}X_A + P_B^{\circ}X_B$; P_{cal} is more than $P_{observed}$, So –ve deviation

22. The relationship between osmotic pressure at 273 K when 10 g glucose (π_1), 10 g urea (π_2) and 10 g sucrose (π_3) are dissolved in 250 ml of water, is

(a) $\pi_1 > \pi_2 > \pi_3$ (b) $\pi_3 > \pi_1 > \pi_2$ (c) $\pi_2 > \pi_1 > \pi_3$ (d) $\pi_2 > \pi_3 > \pi_1$

C

Sol. O.P. $\propto \frac{1}{\text{M.Wt}}$

23. Among the colligative properties of solution, which one is the best method for the determination of molecular masses of proteins and polymers?

(a) osmotic pressure (b) lowering in vapour pressure
(c) lowering in freezing point (d) elevation in boiling point

A

24. At the same temperature, each of the following solution has the same osmotic pressure except

(a) 0.140 M-sucrose (b) 0.07 M-KCl
(c) 0.070 M-$Ca(NO_2)_2$ (d) 0.140 M-urea

C

25. Aqueous solutions of 0.004 M – Na_2SO_4 and 0.01 M – Glucose are isotonic. The percentage dissociation of Na_2SO_4 is

(a) 25% (b) 60% (c) 75% (d) 40%

C

Sol. $i \times 0.004 = 0.01$; $i = \frac{0.01}{0.004} = 2.5$; $i = 1 + 2\alpha$; $\alpha = 0.75$

26. pH of a 0.1 M solution of a monobasic acid is 2.0. Its osmotic pressure at a given temperature, T K is

(a) 0.1 RT (b) 0.11 RT (c) 0.09 RT (d) 0.01 RT

B

Sol. $HA \rightleftharpoons H^+ + A^-$

$10^{-2} = C\alpha$ $i = 1 + \alpha$

$10^{-2} = 0.1 \times \alpha$

$\alpha = 0.1$

$i = 1.1$

o.p. $= 1.1 \times 0.1 \times RT$

27. A solution of 'x' mole of sucrose in 100 g of water freezes at – 0.2°C. As ice separates out, the freezing point goes down to – 0.25°C. How many grams of ice would have separated?

(a) 18 g (b) 20 g (c) 80 g (d) 25 g

B

Sol. $0.2 = \frac{W}{342} \times \frac{1000}{100}$

$W = \frac{0.2 \times 342}{10} = 6.8 \text{ gm}$

$\Delta T_f = \frac{6.8}{\text{M.Wt}} \times \frac{1000}{W_{solvent}}$

$0.25 = \frac{6.8}{342} \times \frac{1000}{W}$

$W = 79.5 \approx 80$

Ice $= 100 - 80 = 20$

28. Below critical micelle concentration (CMC) :

a. salt behaves as normal electrolyte
b. substance like grease, far dissolve by emulsification
c. the viscosity of solution is very high
d. surfactant molecules undergo association to form cluster

A

Sol. Below CMC, micelles are not formed hence the salt behaves as normal electrolyte

29. 1 mol of AgI/Ag^+ is coagulated by :

a. 1 mol of KI
b. 500 mL of 1 M K_2SO_4
c. 300 mL of 1 M Na_3PO_4
d. 1 mol of AgI

A,B

Sol. 1 mol Ag^+ will combine with 1 mol I^- to form precipitate of 1 mol AgI

30. The oxidation of oxalic acid by acidified $KMnO_4$ becomes faster as the reaction progresses due to :

a. presence of MnO_4^-
b. presence of K^+
c. presence of SO_4^{2-}
d. auto catalysis by Mn^{2+}

D

31. What is the emulsifier in milk?

a. Albumin b. Soap c. Gelatin d. Caesin

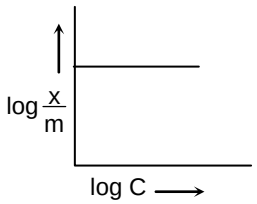
D

Sol. Caesin protein acts as emulsifier for milk

32. The degree of adsorption of solution on solid surface depends on concentration of solution:

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

In which of the conditions, we get following type of graph?



a. C = 0
b. $\frac{1}{n} = 0$
c. C = constant
d. C = 2M

B

Sol. Horizontal straight line will be possible when slop is zero, i.e., $\frac{1}{n}=0$

33. What is true for Brownian movement of colloidal particles?

a. This motion depends on nature of colloid
b. It is one of the factors responsible for stability of sols
c. It is independent of size of particles
d. This motion is faster when dispersion medium is highly viscous

B

34. Match the following

Column – I	**Column – II (Colloid)**
a. Gold sol	p. Lyophillic
b. Starch sol	q. Associate Colloid
c. Soap sol	r. Multimolecular
d. Smoke	s. Aerosol

a. a – r, b – p, c – q, d – s
b. a – s, b – p, c – q, d – r
c. a – r, b – q, c – p, d – s
d. a – r, b – s, c – q, d – p

A

35. The freezing point (in °C) of a solution containing 0.1g of $K_3[Fe(CN)_6]$ (molecular weight 329 g mol^{-1}) in 100 g of water (K_f = 1.86°C $molal^{-1}$) is

a. -2.3×10^{-2} b. -5.7×10^{-2} c. -5.7×10^{-2} d. -1.2×10^{-2}

A

Sol. The depression in freezing point is given by

$$\Delta T_f = iK_f m \qquad (1)$$

Where i can be calculated if we consider the following reaction:

$K_3[Fe(CN)_6] \rightarrow 3K^+ + [Fe(CN)_6]^{3-}$

We can calculate i = 3 + 1 = 4. Now, from Eq. (1)

$$\Delta T_f = i \times K_f \times \frac{w_B}{M_B} \times \frac{1000}{W_A} = 4 \times 1.86 \times \frac{0.1}{329} \times \frac{1000}{100}$$

$= 0.0226 = 2.26 \times 10^{-2} = 2.3 \times 10^{-2}$ °C (at freezing point of water is 0°C)

36. The number of equivalents in $\frac{1}{20}$ mol of H_2SO_4 are:

a. 0.01 b. 0.1 c. 0.05 d. 0.5

B

Sol. $ngm_{eq} = x \times mole$

no. of mol = $\frac{1}{20}$ x = 2; $n_{gm\,eq.} = \frac{2}{20} = 0.1$

But no. of equivalents = no. of mol × no. of mol cation in one mol of H_2SO_4 × Oxidation state of H^+ cation

37. The vapour pressure of pure liquid A is 0.80 atm. On mixing a non-volatile solute B to A, its vapour pressure becomes 0.6 atm. The mole fraction of B in the solution is :

a. 0.150 b. 0.25 c. 0.50 d. 0.75

B

Sol. According to Raoult's law: $\frac{P_0 - P_s}{P_0} = x_B$

$x_B = \frac{0.8 - 0.6}{0.8} = 0.25$

38. When two pure liquids are mixed to give an ideal solution:

a. The volume change, $\Delta V_m = 0$ b. The enthalpy change, $\Delta H_m = 0$

c. The entropy changes, $\Delta S_m = 0$ d. Temperature of solution does not change .

Which are correct:

a. a, b and c b. b, c and d c. a, b and d d. a, c and d

C

Sol. ΔS of mixing is always positive

39. Van't Hoff factor of 0.01 M CH_3COOH solution is 1.04. What will be the ionisation constant and pH of solution

Ka	pH	Ka	Ph	Ka	pH	Ka	pH
a. 1.27×10^{-5}	3.9	b.1.57×10^{3}	4.5	c. 1.67×10^{-5}	3.4	d.1.67×10^{-6}	3.10

C

Sol. $CH_3COOH \quad CH_3COO^- + H^+$

$C - C\alpha \quad C\alpha \quad C\alpha$

$i = 1 + \alpha$

$\alpha = 0.4$

$K_a = C\alpha^2$

$= 0.01 \times 0.04 \times 0.04$

$= 1.6 \times 10^{-5}$

$H^+ = C\alpha$

$= 0.04 \times 0.01$

$= 4 \times 10^{-4}$

Ph = 3.4

40. A solution of LiCl in water has $X_{LiCl} = 0.0800$. What is the Molality?

a. 5.01 m LiCl b. 4.4 m LiCl c. 4.83 m LiCl d. 8.70 m LiCl

C

Sol. Mole of LiCl = 0.08
Mole of H_2O = 0.92
$Wt._{H_2O}$ = 16.56

$$m = \frac{0.08 \times 1000}{16.56} = 4.83 \text{ m}$$

41. Total vapour pressure of mixture of 1 mol A (P_A^0 = 150 torr) and 2 mol B(P_B^0 = 240 torr) is 200 torr. In this case:

a. there is positive deviation from Raoult's law
b. there is negative deviation from Raoult's law
c. there is no deviation from Raoult's law
d. molecular masses of A and B are also required for calculating the deviation

B

Sol. $X_A = \frac{1}{3}$, $X_B = \frac{2}{3}$

$$P = P_A^0 X_A + P_B^0 X_B$$

$$= 150 \times \frac{1}{3} + 240 \times \frac{2}{3} = 50 + 160 = 210 \text{ mm}$$

$P_{exp.} < P_{calculated}$

$\therefore$ There is negative deviation from Raoult's law.

42. Which statement about the composition of vapour over an ideal 1 : 1 molar mixture of benzene and toluene is correct? Assume the temperature is constant at 25°C.

Vapour pressure data (25°C):

Benzene	75 mm Hg
Toluene	22 mm Hg

a. The vapour will contain higher percentage of benzene
b. The vapour will contain higher percentage of toluene
c. The vapour will contain equal amount of benzene and toluene
d. Not enough information is given to make a prediction

A

Sol. Benzene is more volatile then toulene

A : Benzene B : Toluene

$$P = P_A + P_B$$

$$P = P_A^0 X_A + P_B^0 X_B$$

$$= 75 \times \frac{1}{2} + 22 \times \frac{1}{2}$$

$$= 37.5 + 11 = 48.5$$

Mole fraction of benzene in vapour, $Y_A = \frac{P_A}{P} = \frac{37.5}{48} = 0.78$

Similarly, mole fraction of toluene in vapour, $Y_B = 0.22$

$\therefore$ The vapour will contain higher percentage of benzene.

43. Which of the following is correct order of elevation in Boiling point.

(I) 1 N NaCl (II) 1 N Na_2SO_4 (III) 1 N Na_3PO_4 (IV) 1 N urea

a. I < II < III < IV b. IV < I < III < II c. IV < III < II < I d. IV = III < I < II

C

Sol. Convert normality to molarity & then calculate (i × M):

(ii) $M = \frac{N}{2}$; (iii) $M = \frac{N}{3}$; (iv) & (i) M = N

(i) 1 × 2 = 2 (ii) $\frac{1}{2} \times 3 = 1.5$ (iii) $\frac{1}{3} \times 4 = 1.33$ (vi) 1

44. H_2S a toxic gas with rotten egg like smell is used for qualitative analysis. If the solubility of H_2S in water at STP is 0.195 m the Henry's law constant will be

a. 286 bar b. 350 bar d. 145 bar d. 270 bar

A

Sol. Solubility of H_2S = 0.195 m = 0.l195 mole in 1 kg of solvent

1kg of solvent (water) = 1000g = $\frac{1000}{18}$ = 55.55 mole

$\therefore$ Mole fraction of H_2S gas in the solution = $\frac{0.195}{0.195+55.55}$ = 0.0035

Pressure at STP = 1 bar

According to Henry's Law; $P_{H_2S} = K_H \times x_{H_2S}$

$$K_H = \frac{P_{H_2S}}{x_{H_2S}} = \frac{1}{0.0035}\text{bar} = 286 \text{ bar}$$

45. Barium ions, CN^- & Co^{+2} form an ionic complex. If this complex is 75% ionised in aqueous solution with van't Hoff's factor equal to four. What will be the molecular formula of complex.

a. $Ba_2[Co(CN)_5]$ b. $Ba_3[Co(CN)_5]_2$ c. $Ba[Co(CN)_5]$ d. $Ba_3[Co(CN)_5]$

B

Sol. $i = 1 + (n - 1)\alpha$

$4 = 1 + (n - 1).75$

$n = 5$

46. Arrange the following electrolytes in increasing order of coagulation power for As_2S_3 sol.

A_1	A_2	A_3
K_2SO_4	$CaCl_2$	$AlPO_4$

a. $A_1 < A_2 < A_3$ b. $A_2 > A_1 > A_3$ c. $A_1 < A_3 < A_2$ d. $A_2 < A_3 < A_1$

A

Sol. Greater is the charge of cation, more effective is the coagulation of As_2S_3.

47. Pure water boils at 373 K and nitric acid at 359 K. The azeotropic mixture of water and nitric acid boils at 393.5 K. On distillation of the azeotropic mixture,

a. pure nitric acid will distil over first.
b. pure water will distil over first
c. one of them will distil over with small amount of the other.
d. both of them will distil over in the same composition as they are in the mixture.

D

48. Role of Desorption in the process of catalysis

(a) The surface is not available for the reaction to occur
(b) Making the surface available again for more reaction to occur
(c) Half of the surface is available for the reaction to occur
(d) All of these

B

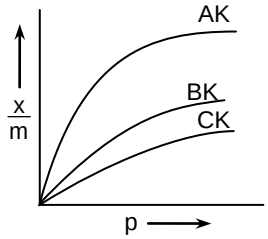
49. Which of the following statement is incorrect regarding physisorption?

(a) It occurs because of van der Waal's forces.
(b) More easily liquefiable gases are adsorbed readily.
(c) Under high pressure it results into multi molecular layer on adsorbent surface
(d) Enthalpy of adsorption ($\Delta H_{adsorption}$) is low and positive.

D

Sol. Enthalpy of adsorption in physisorption is negative

50. Relation between A, B, C



(a) A = B = C (b) A > B > C (c) A < B < C (d) A > B = C

C

51. The catalytic reaction that depends upon the pore structure of the catalyst and size of the reactant and product molecules is called

(a) Size-selective catalyst (b) Shape- selective catalyst
(c) Metal Oxides (d) Transition metals

B

52. Sulpur sol is

(a) Macromolecular colloid (b) Multimolecular colloid
(c) Associated colloid (d) Micelle

B

53. The following are the chemical methods for the preparation of colloids, the correct match is

	Set - I		Set – II
a)	$As_2O_3 + 3H_2S \rightarrow As_2S_{3(sol)} + 3H_2O$	(P)	Hydrolysis
b)	$SO_2 + H_2S \rightarrow S_{(sol)} + 2H_2O$	(Q)	Reduction
c)	$AuCl_3 + HCHO \rightarrow H_2O + Au_{(sol)} + HCOOH$	(R)	Oxidation
d)	$FeCl_3 + 3H_2O \rightarrow Fe(OH)_3(sol) + 3HCl$	(S)	Double decomposition

	a	b	c	d		a	b	c	d
(a)	P	Q	R	S	(b)	S	R,Q	Q	P
(c)	R	S	Q	P	(d)	S	P	Q	R

B

54. If a true solution is changed to colloidal solution its freezing point

(a) Unchanged (b) Increases (c) Decreases (d) May be 2 or 3

B

55. The gold number of three substances A, B and C are 0.05, 0.8 and 0.3. The substance with maximum protective power is

(a) A (b) B (c) C (d) All of these

A

Sol. $\text{Protective power} \propto \frac{1}{\text{Gold number}}$

LEVEL – II

Time: 1 hour **Total Marks = 160**

SECTION – B (Assertion and Reason) Negative Marking [-1]

This Section contains **10 multiple choice questions.** Each question has four choices A), B), C) and D) out of which **ONLY ONE** is correct. **10 × 4 = 40 Marks**

(A) Mark **a** if both **A** and **R** are correct and **R** is the correct reason of **A**.
(B) Mark **b** if both **A** and **R** are correct and **R** is not the correct reason of **A**.
(C) Mark **c** if **A** is correct and **R** is wrong.
(D) Mark **d** if **A** is wrong and **R** is correct.

1. **Assertion:** A colloidal sol of $Al(OH)_3$ prepared by adding H_2O in $AlCl_3$ is more readily coagulated by 0.1 M NaCl than by 0.1 M Na_2SO_4.
Reason: The coagulating power of an electrolyte is related to the valency of the active ions.

(a) (A) (b) (B) (c) (C) (d) (D)
D

2. **Assertion:** Solubility of $Na_2SO_4 \cdot 10H_2O$ increases with temperature upto 32° then decreases with further increase in temperature.
Reason: Dissolution of glauber salt ($Na_2SO_4.10H_2O$) is exothermic

(a) (A) (b) (B) (c) (C) (d) (D)
C

3. **Assertion:** The boiling point of 0.1 m-urea solution is less than that of 0.1 m-KCl solution.
Reason: Elevation of boiling point is directly proportional to the number of species present in the solution and KCl solution will have more number of particles.

(a) (A) (b) (B) (c) (C) (d) (D)
A

4. **Assertion:** Ebullioscopy or cryoscopy cannot be used for the determination of molecular weight of polymers.
Reason: High molecular weight solute leads to very low value of ΔT_b or ΔT_f.

(a) (A) (b) (B) (c) (C) (d) (D)
A

5. **Assertion:** Reverse osmosis is used to purify saline water.
Reason: Solvent molecules pass from concentrated to dilute solution through semipermeable membrane if high pressure is applied on concentrated solution.

(a) (A) (b) (B) (c) (C) (d) (D)
A

6. **Assertion:** When SnO_2 is reacted with NaOH, then its sol particles are attracted towards cathode.
Reason: When SnO_2 is reacted with NaOH, then it gives SnO_3^{2-} which is absorbed by SnO_2, so it is negatively charged sol.

(a) (A) (b) (B) (c) (C) (d) (D)
D

Sol. Cation goes at cathode, (which is negatively charged)

$SnO_2 + NaOH \longrightarrow Na_2SnO_3 + H_2O$

$\downarrow SnO_2$

$SnO_2.SnO_3^{-2}$

But SnO_2 form –ve sol. in Base so will migrate towards anode. –ve sol.

7. **Assertion:** For Coagulation of positively charged sols, $[Fe(CN)_6]^{4-}$ ion has higher coagulating power than that of PO_4^{3-}, SO_4^{2-}, Cl^-

Reason: According to Hardy Schulze rule, higher is the valency of ions for the oppositely charged sol particles, better will be the precipitation.

(a) (A) (b) (B) (c) (C) (d) (D)

A

8. **Assertion:** Chemical adsorption increases with increase in temperature and later it decreases

Reason: Physical adsorption decreases with increases in temperature

(a) (A) (b) (B) (c) (C) (d) (D)

B

9. **Assertion:** Milk is an example of water in oil emulsions

Reason: Emulsions contains liquid dispersed in liquid.

(a) (A) (b) (B) (c) (C) (d) (D)

D

Sol. Milk is oil in water emulsion.

10. **Assertion:** Tetra ethyl lead is used to improve Antiknocking ability.

Reason: Tetra ethyl lead increases the rate of precombustion of gasoline

(a) (A) (b) (B) (c) (C) (d) (D)

C

Sol. It decreases Rate of combustion.

SECTION – C (Paragraph Type) Negative marking [-1]

This Section contains **2 Comprehension.** Each of these questions has four choices A), B), C) and D) out of which **ONLY ONE** is correct. **6 × 4 = 24 Marks**

Comprehension – 1

Gold sol is metallic sol and it is negatively charged. It can be prepared by reduction method and Bredig's arc method. When NaCl solution is added to a gold sol, it results in coagulation. But there is no coagulation of gold sol, when NaCl solution is added to a gold sol after adding gelatine. Protective action is more at low temperature. Gold sol has very little or no affinity with its dispersion medium.

1. The stability of gelatine is

a. more than that of gold sol
b. less than that of gold sol
c. equal to that of gold sol
d. it can't be compared

A

Sol. Gelatin is a lyophiolic solution.

2. If the temperature of gold sol containing sodium chloride and gelatin increases to 70°C, then

a. protective action of gelatine will increase
b. protective action of gelatine will decrease
c. protective action do not get affected by increasing temperature
d. NaCl undergo more ionisation and adsorption of Na^+ ions take place on surface of sol particle to create zeta potential

B

3. Correct order of Flocculation power of effective ion for colloidal gold sol is

a. $K_4[Fe(CN)_6] > Al_2(SO_4)_3 > BaCl_2$
b. $Al_2(SO_4)_3 > BaCl_2 > K_4[Fe(CN)_6]$
c. $BaCl_2 > Al_2(SO_4)_3 > K_4[Fe(CN)_6]$
d. $BaCl_2 = Al_2(SO_4)_3 = K_4[Fe(CN)_6]$
B

Passage – 2

The boiling point elevation and the freezing point depression of solution have a number of practical applications. Ethylene glycol ($CH_2OH{\cdot}CH_2OH$) is used in automobile radiators as an antifreeze because it lowers the freezing point of the coolant. The same substance also helps to prevent the radiator coolant from boiling away by elevating the boiling point. Ethylene glycol has low vapour pressure. We can also use glycerol as antifreeze. For boiling point elevation to occur, the solute must be non-volatile, but no such restriction applies to freezing point depression. For example, methanol (CH_3OH), a fairly volatile liquid that boils only at 65°C is sometimes used as antifreeze in automobile radiators.

4. 124 g each of the two reagents glycol and glycerol are added in 5 kg water of the radiators in the two cars. Which of the following statements is wrong?

a. Both will act as antifreeze
b. Glycol will be better
c. Glycerol is better because its molar mass is greater than glycol
d. Glycol is more volatile than glycerol
C

Sol. Glycol have more number of moles due to less M.W

5. 620 g glycol is added to 4 kg water in the radiator of a car. What amount of ice will separate out at -6°C? K_f = 1.86 K Kg mol^{-1}:

a. 800 g b. 900 g c. 600 g d. 1000 g
B

Sol. $\Delta T = K_f \times \frac{w_B \times 1000}{m_B \times w_A}$

$6 = 1.86 \times \frac{620 \times 1000}{62 \times w_A}$

W_A = 3100 g (Mass of water)

Amount of ice = 4000 – 3100 = 900 g

6. If cost of glycerol, glycol and methanol per kg are same, then the sequence of economy to use these compounds as antifreeze will be:

a. glycerol > glycol > methanol
b. methanol > glycol > glycerol
c. methanol = glycol = glycerol
d. methanol > glycol < glycerol
B

Sol. Methanol will have maximum number of moles per kg.

SECTION – D (More than One Answer Type) No Negative Marking

This Section contains **10 multiple choice questions.** Each question has four choices A), B), C) and D) out of which **One or More than one answer** may be correct. 10 **× 5 = 50 Marks**

1. Blood cells in the human body have semipermeable membrane and depending upon concentration of solution inside blood cells and outside (in the blood), **'Lysis'** (expansion of blood cells) and **'Crenation'** (contraction of blood cells) may occur. Kidneys are responsible for keeping solution inside blood cell and blood at same concentration. Identify the correct information(s).

(a) Lysis will occur when blood cells are kept in a solution which is isotonic with blood
(b) Crenation will occur when blood cells are kept in a solution which is hypertonic with blood.
(c) Blood cells will have normal shape when placed in a solution isotonic with blood
(d) Lysis will occur when blood cells are kept in a solution which is hypotonic with blood
B,C,D

2. Which of the following are correct about the catalyst?

a. They participate in the reaction but recovered at last
b. It does not affect ΔG
c. It does not affect ΔH
d. It alters the mechanism of reaction
A,B,C,D

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

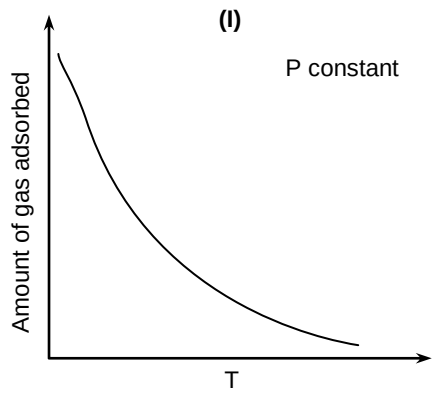
a. Adsorption is always exothermic
b. Physisorption may transform into chemisorption at high temperature
c. Physisorption increases with increasing temperature but chemisorption decreases with increasing temperature
d. Chemisorption is more exothermic than physisorption, however it is very slow due to higher energy of activation
A,B,D

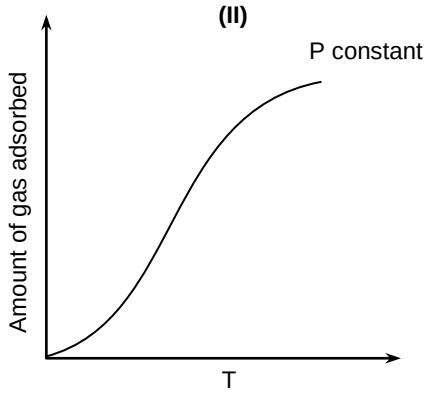
Sol. Physisorption does not increase with increase in temperature. Hence, option (c) is wrong statement

4. Choose the correct reason(s) for the stability of the **lyophobic** colloidal particles.

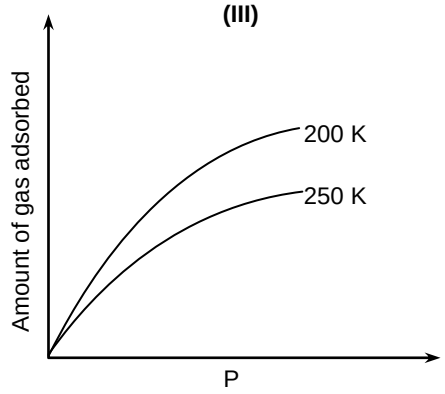
a. Preferential adsorption of ions on their surface from the solution
b. Preferential adsorption of solvent on the surface from the solution
c. Attraction between different particles having opposite charges on their surface
d. Potential difference between the fixed layer and the diffused layer of opposite charges around the colloidal particles
A,D

5. 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?

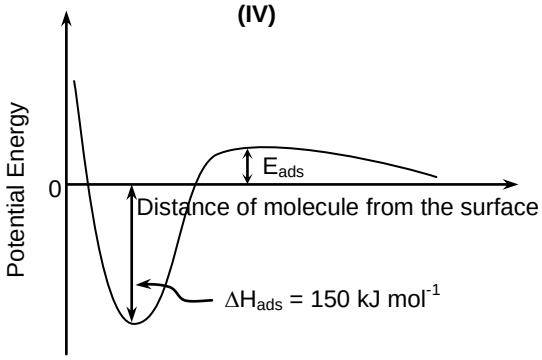




(III)



(IV)



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

A,C

6. The colligative properties of a solution may depend on

a. Temperature
b. Nature of solute
c. Nature of solvent
d. Amount of solution

A,C

7. $AgI + \underset{(excess)}{KI} \rightarrow AgI|I^-$

With respect to the above reaction

(a) the fixed layer is formed by I^- ions
(b) the diffused layer is formed by K^+ ions
(c) the negative charge on the above colloid is due to preferential adsorption of I^- ions
(d) fixed and diffused layers lead to the development of zero potential

A,B,C

8. Benzene and naphthalene form an ideal solution at room temperature. For this process, the true statement(s) is(are)

(a) ΔG = +ve (b) ΔS_{system} = +ve (c) $\Delta S_{surrounding} = 0$ (d) $\Delta H = 0$

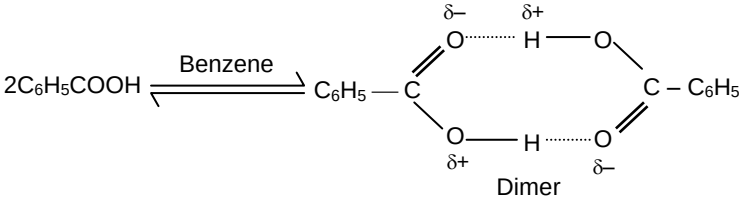
B,C,D

9. Consider the following solutions:
I. 1 M aqueous glucose
II. 1 M aqueous NaCl
III. 1 M C_6H_5COOH in C_6H_6
IV. 1 M $(NH_4)_3PO_4$

a. All are isotonic solutions
b. III is hypotonic to I, II, IV
c. I, II, IV are hypertonic to III
d. IV is hypertonic to I, II, III

B,C,D

Sol. I, II and IV are hypertonic to III because benzoic acid undergoes association when dissolved in benzene.



Dimer

10. Which of the following are correct about the binary homogeneous liquid mixture?

a. H_2O and C_2H_5OH
$\Delta H_{sol.} > 0$, $\Delta V_{sol.} > 0$

b. C_6H_6 and $C_6H_5CH_3$
$\Delta H_{sol.} = 0$, $\Delta V_{sol.} = 0$

c. CH_3COCH_3 and $CHCl_3$ — $\Delta H_{sol.} < 0$, $\Delta V_{sol.} < 0$

d. H_2O and HCl — $\Delta H_{sol.} > 0$, $\Delta V_{sol.} < 0$

A,B,C

Sol. ($H_2O + C_2H_5OH$) $\rightarrow$ Shows positive deviation from Raoult's law. Therefore, $\Delta H_{mix} > 0$, $\Delta V_{mix} > 0$

($C_6H_6 + C_6H_5CH_3$) $\rightarrow$ It is ideal solution therefore, $\Delta H_{mix} = 0$, $\Delta V_{mix} = 0$

($CH_3COCH_3 + CHCl_3$) $\rightarrow$ Shows negative deviation from Raoult's law, therefore, $\Delta H_{sol.} < 0$, $\Delta V_{sol.} < 0$

SECTION – E (Matrix Type) No Negative Marking

This Section contains **2 questions.** Each question has four choices (A, B, C and D) given in **Column I** and five statements (p, q, r, and s) in **Column II.** Any given statement in **Column I** can have correct matching with one or more statement(s) given in **Column II.** **8 × 2 = 16 Marks**

1. Match the column – I with column – II. **(One or More than one match)**

Column I	**Column II**
(A) Acetone + $CHCl_3$	**(p)** $\Delta S_{mix.} > 0$
(B) Ethanol + Water	**(q)** $\Delta V_{mix.} > 0$
(C) $C_2H_5Br + C_2H_5I$	**(r)** $\Delta H_{mix.} < 0$
(D) Acetone + Benzene	**(s)** Maximum boiling azeotropes
	(t) Minimum boiling azeotropes

Sol. A → p, s, r, B → p, q, t; C → p; D → p, q, t

A → -ve deivation; B = +ve deviation; C = Ideal solution; D = Positive deviation

2. Match the entries of column I with appropriate entries of column II. **(More than one match)**

Column – I		**Column - II**	
(A)	$Al_2(Cr_2O_7)_3 \longrightarrow Cr^{+3}$	**(p)**	eq. Wt. = $\frac{M.Wt}{18}$
(B)	$H_2O_2 \longrightarrow O_2$	**(q)**	Reduction Reaction
(C)	$Ba(MnO_4)_2 \longrightarrow BaMnO_4$	**(r)**	eq. Mass = $\frac{M.Wt}{2}$
(D)	$As_2O_5 \longrightarrow As_2O_3$	**(s)**	Oxidation reaction

Sol. A → p, q; B → r, s; C → q, r; D → q

SECTION – F (Integer Type) No Negative Marking

This Section contains **6 questions**. The answer to each question can be between from 0 to 100.

6 × 5 = 30 Marks

1. The coagulation of 10 ml colloidal solution of gold is completely prevented by addition of 0.02 gm of a substance X to it before addition of 1 ml of 10% NaCl solution. The gold number of X is 2×10^n n is

Sol. 1

Mass in milligm = 0.02×10^3

$= 20$

$= 2 \times 10^1$

2. van't Hoff factor of an electrolyte A_2B_3 assuming that it ionizes 75% in the solution is _____.

Sol. 4 ($i = 1 + 4\alpha$)

3. A complex is represented as $CoCl_3.xNH_3$. Its 0.1 molal solution in aqueous solution shows $\Delta T_f = 0.558°C$. K_f for H_2O is 1.86 K $molal^{-1}$. Assuming 100% ionization of complex and coordination number of Co as 6, find the value of x.

Sol. 5

4. At 17°C, the osmotic pressure of sugar solution is 580 torr. The solution is diluted and the temperature is raised to 57°C, when the osmotic pressure is found to be 165 torr. The extent of dilution is:

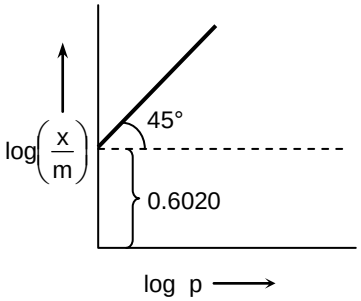
Sol. 4

$\pi_1 = \frac{nRT_1}{V_1}$, $\pi_2 = \frac{nRT_2}{V_2}$

Hence, $\frac{\pi_1}{\pi_2} = \frac{580}{165} = \frac{V_2T_1}{V_1T_2} = \frac{V_2 \times 290}{V_1 \times 330}$ $\Rightarrow \frac{V_2}{V_1} = 4$

5. Graph between $\log\left(\frac{x}{m}\right)$ and log P is straight line at angle of 45° with the intercept of 0.6020.

The extent of adsorption $\left(\frac{x}{m}\right)$ at a pressure of 1 atm is:



Sol. 4

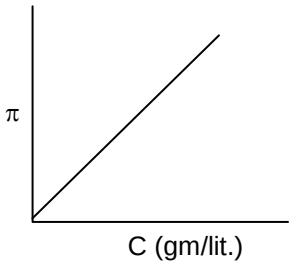
$$\log\left(\frac{x}{m}\right) = \log K + \frac{1}{n}\log P$$

$$= 0.602 + 1 \log 1$$

$$= 0.602$$

$$\therefore \quad \frac{x}{m} = 4$$

6. Insulin $(C_6H_{10}O_5)_n$ dissolved in a medium shows osmotic pressure π (atm) at C gm/lit concentration and 300 K temperature. The slope of plot of π against C is 4.1×10^{-3}. Molecular mass of insulin in gm (6×10^x) gm x is:



Sol. 3

$$\pi = CRT; \qquad \pi = \frac{n}{V}RT; \qquad \pi = \frac{W_B}{M_B}\frac{RT}{V}$$

$\pi =$

$$\pi = \text{atm}\,\frac{W_B}{V}\frac{RT}{M_B}$$

W_B = gm

V = lit.

M_B = M.Wt.

$$\pi = \left(\frac{w_B}{V}\right)\frac{RT}{m_B}$$

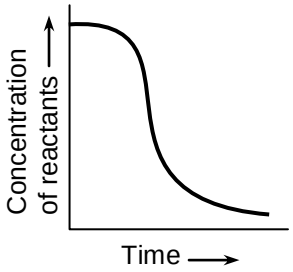
When π is plotted against C, the slope will be equal to $\frac{RT}{m_B}$

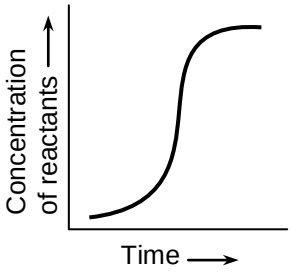
$$\therefore \quad 4.1 \times 10^{-3} = \frac{0.082 \times 300}{m_B}$$

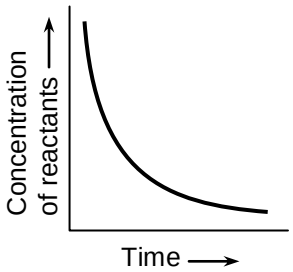
$$m_B = 6 \times 10^3$$

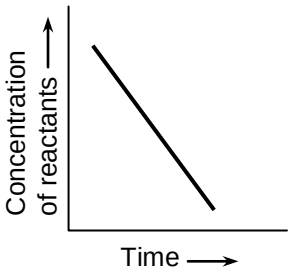
Extra

56. In the reaction of autocatalysis, the variation of concentration with time is correctly represented by which of the following plots ?

a. 

b. 

c. 

d. 

A

57. Two solutions labeled as 3M HCl and 1M HCl are mixed in the ratio of x : y by volume and the molarity of mixture solution becomes 1.5 M. What is the molarity of the resulting solution if they are mixed in the ratio of y : x by volume?

a. 4 M b. 3M c. 2M d. 2.5M

D

Sol. $1.5 = \frac{3x+y}{x+y}$ or $1.5x + 1.5y = 3x + y$ or $1.5x = 0.5y$ or $\frac{x}{y} = \frac{1}{3}$

when the solution is mixed in the ratio $\frac{y}{x}$ i.e., $\frac{3}{1}$

$$M = \frac{3\times3+1\times1}{4} = \frac{10}{4} = 2.5\ M$$

58. Suppose the radiator of an automobile contains 11.0 L water. What is the freezing point on addition of 4.6 kg of prestone [glycol, $C_2H_4(OH)_2$]? Also calculate the amount of zerone [methyl alcohol, CH_3OH], that would be needed to produce the same result. Assume 100% purity of compounds added (K_f = 1.86 °C/m).

a. 3.37 kg; 12.5°C
b. 2.37 kg; –12.5°C
c. 2.37 gm; –12.5°C
d. 23.7 gm; –10.4°C

B

Sol. Mol. wt. of glycol $C_2H_4(OH)_2$ = (2 × 12) + (4 × 1) + 2 (16 + 1) = 62 g mol^{-}. Mol. wt. of methyl alcohol, CH_3OH = 12 + (3 × 1) + 16 + 1 = 32 g mol^{-}; wt. of glycol, W_2 = 4.6 kg; Wt. of solvent, W_1 = Volume × density = 11.0 L × 1 g (mL)$^{-}$ = 11 × 1000 mL × 1 g (mL)$^{-}$ = 11000 g; $K_f = \frac{1.86°C}{m}$ = 1.86°C kg mol^{-}; ΔT_f = ? we know that:

$$\Delta T_f = \frac{K_f\,(\text{in °C kg mol}^{-}) \times W_2\,(\text{in g})}{M_2 \text{ in g mol}^{-} \times \left(\frac{W_1 \text{ in g}}{1000}\right)\text{kg}} = \frac{1.86\ °\text{C kg mol}^{-} \times 4.6 \times 1000\ \text{g}}{62\ \text{g mol}^{-} \times \frac{11000}{1000}\text{kg}}$$

ΔT_f = 12.5 °C. Hence freezing point = -12.5 °C

In order to get the same freezing point depression with CH_3OH, we require same number of mol as of glycol. But:

$$\text{no. of mol of glycol} = \frac{\text{wt.of glycol (in g)}}{\text{mol wt.of glycerol in g mol}^{-}} = \frac{4.6 \times 1000\ \text{g}}{62\ \text{g mol}^{-}}$$

= 74.19 mol

∴ no. of mol of CH_3OH = 74.19 mol

∴ wt. of CH_3OH = 74.19 mol × $\frac{32\ \text{g}}{1\text{mol}} \times \frac{1\text{kg}}{1000\ \text{g}}$ = **2.37 kg Ans.**

59. Number of millitre of 0.25 M H_2SO_4 required to dissolve 2.1 g magnesium carbonate (at. wt., Mg = 24, C = 12, O = 16) is: [$MgCO_3 + H_2SO_4 \longrightarrow MgSO_4 + CO_2 + H_2O$]

a. 200 mL b. 100 mL c. 50 mL d. 20.0 mL

B

Sol. 1000 mL of 1 M H_2SO_4 react with $MgCO_3$ = g. mol. wt. of $MgCO_3$ = 84 g

∴ x mL of 0.25 M H_2SO_4 react with Mg CO_3 = $\frac{84}{1000} \times x \times 0.25$ g $MgCO_3$

So : $\frac{84 \times x \times 0.25}{1000}$ = 2.1 g $MgCO_3$ (given). **Or** x = 100 Ml

11. Colloidal solution (A) $\xrightarrow{\text{Physical process}}$ B + C

Osmotic pressure of B and C are found respectively higher and lower than A. It indicates that:

a. B is suspension b. B is true solution

c. C is suspension d. C is true solution

B, C

Sol. 'B' will be true solution because these solutions have greater number of particles present per unit volume hence they have high osmotic pressure. 'C' on the other hand will be suspension having low osmotic pressure.