PART I: PHYSICAL CHEMISTRY

XI:

SECTION I: SINGLE OPTION CORRECT

1. The ionic product of water is 1×10^{-14} $(mol/l)^{2.}$ The number of H^+ ions that present in one millionth part of 1 ml of pure water is -

(A) 66.9 million (B) 52.2 million (C) 48.3 million (D) 60.3 million

2. Gas equation PV = nRT is obeyed by :

(A) only isothermal process (B) only adiabatic process
(C) both (A) and (B) (D) none of these

3. $[H^+]$ and $[OH^-]$ ion in a 8 litre solution containing 9.25 gm/l of $Ca(OH)_2$ at 25ºC, is

(A) $[OH^-] = 0.25 \times 10^{-7}$, $[H^+] = 4 \times 10^{-7}$ (B) $[OH^-] = 0.25$, $[H^+] = 4 \times 10^{-14}$
(C) $[OH^-] = 1.25 \times 10^{-7}$, $[H^+] = 4 \times 10^{-7}$ (D) $[OH^-] = 2.5$, $[H^+] = 4 \times 10^{-14}$

4. The degree of hydrolysis of a salt of weak acid and weak base in its 0.1 M solution is found to be 50%. If the molarity of the solution is 0.2 M, the percentage hydrolysis of the salt should be

(A) 100% (B) 50% (C) 25% (D) none of these

5. Molar solubility of As_2S_3 in 0.3 M Al_2S_3 solution in terms of solubility product K_{sp} or As_2S_3 is–

(A) $\sqrt{\frac{K_{sp}}{2.916}}$ (B) $3\sqrt{\frac{K_{sp}}{2.916}}$ (C) $\sqrt{\frac{K_{sp}}{1.2}}$ (D) $3\sqrt{\frac{K_{sp}}{1.2}}$

6. In a gaseous mixture at 20°C the partial pressure of the components are, :

H_2 : 150 Torr , CO_2 : 200 Torr , CH_4 : 300 Torr , C_2H_4 : 100 Torr,
Volume percent of H_2 is :

(A) 26.67 (B) 73.33 (C) 80.00 (D) 20

7. The volume of water needed to dissolve 1 g of $BaSO_4$($K_{sp} = 1.1 \times 10^{-10}$) at 25ºC is –

(A) 820 litre (B) 410 litre (C) 205 litre (D) none of these

8. The wavelength of a spectral line for an electronic transition is inversely related to :

(A) Number of electrons undergoing transition
(B) the nuclear charge of the atom
(C) the velocity of an electron undergoing transition
(D) the difference in the energy levels involved in the transition

9. Number of moles of electrons taken up when 1 mole of NO_3^- ions is reduced to 1 mole of NH_2OH is :

(A) 2 (B) 4 (C) 5 (D) 6

10. Amount of oxalic acid present in a solution can be determined by its titration with $KMnO_4$ solution in the presence of H_2SO_4. The titration gives unsatisfactory result when carried out in the presence of HCl, because HCl :

(A) furnishes H^+ ions in addition to those from oxalic acid.
(B) reduces permanganate to Mn^{2+}.
(C) oxidises oxalic acid to carbon dioxide and water.
(D) gets oxidised by oxalic acid to chlorine.

11. Which of the following statements is not true ?

(A) The ratio of the mean speed to the rms speed is independent of the temperature.
(B) The square of the mean speed of the molecules is equal to the mean squared speed at a certain temperature.
(C) Mean kinetic energy of the gas molecules at any given temperature is independent of the mean speed.
(D) The difference between rms speed and mean speed at any temperature for different gases diminishes as larger and yet larger molar masses are considered.

12. If velocity of an electron in I orbit of H atom is V, what will be the velocity of 3rd orbit of Li^{+2}

(A) V (B) V/3 (C) 3 V (D) 9 V

13. When one gram mole of $KMnO_4$ reacts with HCl, the volume of chlorine liberated at NTP will be

(A) 11.2 litres (B) 22.4 litres (C) 44.8 litres (D) 56.0 litres

14. A solution contains both Na_2CO_3 and $NaHCO_3$ was treated with excess of $CaCl_2$ solution and filtered. The precipitate weighed m_1 grams. On adding NaOH in drops to the filtrate avoiding excess, a further m_2 grams was precipitated. If after adding excess $CaCl_2$, the solution (had not been filtered) but was simply boiled and then filtered, what would be the total weight of the precipitate

(A) $(m_1 + m_2)$ grams (B) $(m_1 + m_2/2)$ grams
(C) $(m_1 + m_2)/2$ grams (D) $(m_2 + m_1/2)$ grams

15. 0.7 g of a sample of $Na_2CO_3 \cdot x\, H_2O$ were dissolved in water and the volume was made to 100 ml 20 ml of this solution required 19.8 ml of N/10 HCl for complete neutralization. The value of x is :

(A) 7 (B) 3 (C) 2 (D) 5

16. Consider the following statements : The coefficient B in the virial equation of state

$$PV_m = RT\left(1+\frac{B}{V_m}+\frac{C}{V_m^2}+.....\right)$$

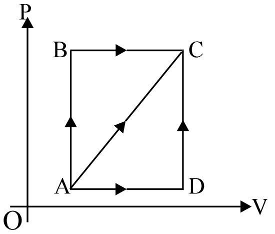
A : is independent of temperature
B : is equal to zero at Boyle temperature
C : has the dimension of molar volume

Which of the above statements are correct?

(A) A and B (B) A and C (C) B and C (D) A, B and C

17. A thermodynamic process is shown in the following figure. The pressure and volumes corresponding to some point in the figure are :

$P_A = 3 \times 10^4$ Pa , $P_B = 8 \times 10^4$ Pa , $V_A = 2 \times 10^{-3}\ m^3$, $V_D = 5 \times 10^{-3}\ m^3$



In the process AB, 600 J of heat is added to the system and in BC, 200 J of heat is added to the system. The change in internal energy of the system in the process AC would be :

(A) 560 J (B) 800 J (C) 600 J (D) 640 J

18. Which of the following statements is correct in the contact of $3d_{z^2}$ orbital?

(A) This orbital consists of two positive lobes along the ± z axis and a negative doughnut in the xy plane.

(B) This orbital consists of two negative lobes along the ± z axis and a positive doughnut in the xy plane.

(C) This orbital consists of one negative lobe along the ± z axis and a negative doughnut in the xy plane.

(D) This orbital consists of one positive lobe along the ± z axis and a negative doughnut in the xy plane.

19. 20 gm of N_2 at 300 K is compressed reversibly and adiabatically from 20 dm^3 to 10 dm^3. Change in internal energy for the process is :

(A) 284.8 J (B) 142.46 J (C) 1424.69 J (D) 3462.89 J

20. Which of the following is path function as well as an extensive property

(A) temperature (B) internal energy

(C) molar heat capacity (D) heat capacity

21. The shapes of PCl_4^+, PCl_4^- and $AsCl_5$ are respectively:

(A) square planar, tetrahedral and see-saw

(B) tetrahedral, see-saw and trigonal bipyramidal

(C) tetrahedral, square planar and pentagonal bipyramidal

(D) trigonal bipyramidal, tetrahedral and square pyramidal

22. Number of electrons having l+ m value equal to zero in $_{24}Cr$ may be:

(A) 14 (B) 10 (C) 13 (D) 12

23. If the enthalpy change for the reaction

$$CH_4(g) + Cl_2(g) \longrightarrow CH_3Cl(g) + HCl(g)$$

ΔH = –25 kcal. bond energy of C – H is 20 kcal mol^{-1} greater than the bond energy of C – Cl and bond energies of H – H and H–Cl are same in magnitude, then for the reaction :

$$\frac{1}{2}H_2(g) + \frac{1}{2}Cl_2(g) \longrightarrow HCl(g) \ ; \qquad \Delta H = ?$$

(A) –22.5 kcal/mol (B) –20.5 kcal/mol (C) –32.5 kcal/mol (D) –12.5 kcal/mol

24. The main factor responsible for weak acidic nature of B - F bond in BF_3 is ;

(A) Large electronegativity of F (B) Three centred two electron bond in BF_3

(C) $P\pi$ - $d\pi$ back bonding (D) $P\pi$ - $P\pi$ back bonding

25. Among the following species, identify the isostructural pairs : NF_3, NO_3^-, BF_3, H_3O^+, HN_3

(A) [NF_3, NO_3^-] and [BF_3, H_3O^+] (B) [NF_3, HN_3] and [NO_3^-, BF_3]

(C) [NF_3, H_3O^+] and [NO_3^-, BF_3] (D) [NF_3, H_3O^+] and [HN_3, BF_3]

26. Bond length of HCl is 1.275 Å ($q = 4.8 \times 10^{-10}$ e.s.u.) if μ = 1.02 D then HCl is :

(A) 100 % ionic (B) 83% covalent (C) 50% covalent (D) 40% ionic

SECTION II: MORE THAN ONE OPTION CORRECT

27. The dissociation of ammonium carbonate may be represented by the reaction

$$NH_2COONH_4(s) \rightleftharpoons 2NH_3(g) + CO_2$$

ΔH^o for the forward reaction is negative. the equilibrium will shift from right to left if there is

(A) a decrease in pressure
(B) an increase in temperature
(C) an increase in the concentration of ammonia
(D) an increase in the concentration of carbondioxide

28. Which of the following samples of reducing agents is /are chemically equivalent to 25 ml of 0.2 N $KMnO_4$ to be reduced to Mn^{2+} and water.

(A) 25 ml of 0.2 M $FeSO_4$ to be oxidized to Fe^{3+}
(B) 50 ml of 0.1 M H_3AsO_3 to be oxidized to H_3AsO_4
(C) 25 ml of 0.1 M H_2O_2 to be oxidized to H^+ and O_2
(D) 25 ml of 0.1 M $SnCl_2$ to be oxidized to Sn^{4+}

29. The equilibrium of which of the following reaction will not be disturbed by the addition of an inert gas at constant volume

(A) $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$
(B) $N_2O_4(g) \rightleftharpoons 2NO_2(g)$
(C) $CO(g) + 2H_2(g) \rightleftharpoons CH_3OH(g)$
(D) $C(s) + H_2O(g) \rightleftharpoons CO(g) + H_2(g)$

30. 1.2kg of iron pyrites (FeS_2) are roasted to convert sulphur in (FeS_2) to SO_2 with 80% efficiency. It is then oxidised to SO_3 which is then absorbed in water to give H_2SO_4. If the maximum and minimum possible efficiencies are 60% and 30% respectively for any of these two steps, which of the following amounts of H_2SO_4 could possibly be obtained ? (Fe = 56, S = 32)

(A) 0.8 mol (B) 1.5mol (C) 3.6mol (D) 5.7mol

31. Four gas balloons A, B, C, D of equal volumes containing H_2, H_2O, CO, CO_2 respectively were pricked with needle and immersed in a tank containing CO_2. Which of them will shrink after some time.

(A) A (B) B (C) C (D) Both A and D

32. Heisenberg uncertainty principle is not valid for

(A) moving electrons
(B) motor car
(C) stationary particles
(D) all

33. When HCl(g) is passed through a saturated solution of common salt, pure NaCl is precipitated because

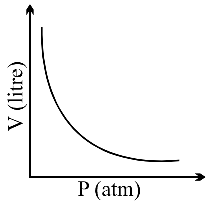
(A) HCl is highly soluble in water
(B) the ionic product $[Na^+]$ $[Cl^-]$ exceeds its solubility product (K_{sp})
(C) the K_{sp} of NaCl is lowered by the presence of Cl^- ions
(D) HCl causes precipitation

34. Which is true about an electron

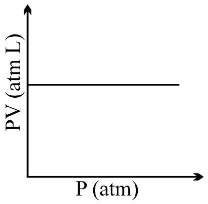
(A) Rest mass of electron is 9.1×10^{-28} gm
(B) Mass of electron increases with the increase in velocity
(C) Molar mass of electron in 5.48×10^{-4} gm/mole
(D) e/m of electrron is 1.7×10^{8} coulomb/gm

35. Boyle's law is represented by -

(A)



(B)



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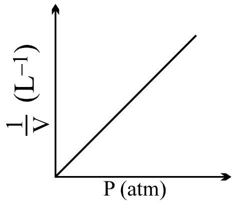
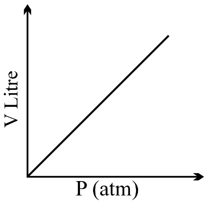


(D)



36. The incorrect order of decreasing oxidation number of S in compounds is :

(A) $H_2S_2O_7 > Na_2S_4O_6 > Na_2S_2O_3 > S_8$
(B) $H_2SO_5 > H_2SO_3 > SCl_2 > H_2S$
(C) $SO_3 > SO_2 > H_2S > S_8$
(D) $H_2SO_4 > SO_2 > H_2S > H_2S_2O_8$

37. According to Charles's law :

(A) $V \propto \frac{1}{T}$
(B) $\left(\frac{dV}{dT}\right)_P = K$
(C) $\left(\frac{dT}{dV}\right)_P = K$
(D) $\left(\frac{1}{T} - \frac{V}{T^2}\right) = 0$

38. Which of the following are correct statements?

(A) vander Waal's constant a is a measure of attractive force
(B) vander Waal's constant b is also called covolume or excluded volume
(C) b is expressed in L mol^{-1}
(D) a is expressed in atm L^2 mol^{-2}

39. Which of the following will suppress the ionization of phthalic acid in an aqueous solution

(A) KCl
(B) H_2SO_4
(C) HNO_3
(D) NaOH

40. Following are the atoms having the number of neutrons and protons as given below :

Atoms	Protons	Neutron
A	8	8
B	8	9
C	8	10
D	7	8
E	7	9

Select incorrect conclusion(s) :

(A) A, B and C, D are isotopes
(B) A and D are isotones
(C) A and E are isobars
(D) A and B are isodiaphers

41. Three gases of densities A(0.82), B(0.25), C(0.51) are enclosed in a vessel of 4L capacity. Pick up the correct statement :

(A) Gas A will tend to lie at the bottom
(B) The number of atoms of various gases A, B, C are same
(C) The gases will diffuse to form homogeneous mixture.
(D) The average kinetic energy of each gas is same.

42. In which of the following reaction is $K_p < K_c$

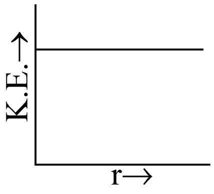
(A) $CO(g) + Cl_2(g) \rightleftharpoons COCl_2(g)$
(B) $CO(g) + 3H_2(g) \rightleftharpoons CH_4(g) + H_2O(g)$
(C) $2BrCl(g) \rightleftharpoons Cl_2(g) + Br_2(g)$
(D) $I_2(g) \rightleftharpoons 2I(g)$

43. Which of the following gases deviate fairly largely form ideal behaviour:

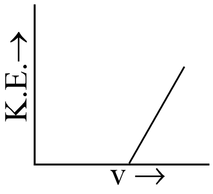
(A) CO_2 (B) SO_2 (C) C_2H_6 (D) None

44. Which is correct graph (K.E. is kinetic energy of photo electron)

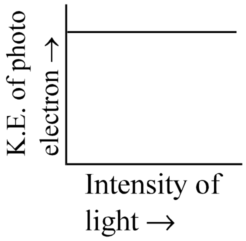
(A)



(B)



(C)



(D) None of these

45. Which of the following are redox reactions ?

(A) $NaIO_3 + NaHSO_3 \longrightarrow NaHSO_4 + Na_2SO_4 + I_2 + H_2O$
(B) $FeCl_3 + K_4[Fe(CN)_6] \longrightarrow KCl + Fe_4[(Fe(CN)_6]_3$
(C) $AgCl + Na_2S_2O_3 \longrightarrow Na_3[Ag(S_2O_3)_2] + NaCl$
(D) $NaBiO_3 + MnSO_4 + HNO_3 \longrightarrow HMnO_4 + Bi(NO_3)_3 + NaNO_3 + Na_2SO_4 + H_2O$

46. The oxidation number of Cr = +6 in

(A) $FeCr_2O_4$ (B) $KCrO_3Cl$ (C) CrO_5 (D) $[Cr(OH)_4]^-$

47. Which of the following have planar structure ?

(A) I_3^- (B) H_2O_2 (C) $Ni(CO)_4$ (D) $[Ni(CN)_4]^{2-}$

48. Which have odd-order bond ?

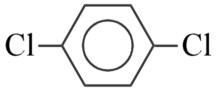
(A) O_2^+ (B) O_2^- (C) NO (D) H_2^+

49. Which of the following mathematical relations are correct for an ideal gas?

(A) $\left(\frac{\partial H}{\partial V}\right)_T = 0$ (B) $\left(\frac{\partial H}{\partial p}\right)_T = 0$ (C) $C_p - C_V > R$ (D) $\left(\frac{\partial C_V}{\partial V}\right)_T = 0$

50. Which has (have) zero value of dipole moment

(A) $[Ni(CN)_4]^{2-}$ (B) $CHCl_3$ (C) CO_2 (D)



51. The standard molar enthalpy of CO_2 is equal to

(A) the standard molar enthalpy of combustion of gaseous carbon
(B) the standard molar enthalpy of combustion of carbon (graphite)
(C) the sum of the standard molar enthalpies of formation of CO and O_2
(D) - 394 kJ mol^{-1}

52. Three centre-two electron bonds exist in –

(A) B_2H_6 (B) $Al_2(CH_3)_6$ (C) $BeH_2(s)$ (D) $BeCl_2$ (s)

53. Which of the following statements are correct ?

(A) the entropy of an isolated system increases in an irreversible process
(B) the entropy of an isolated system remains unchanged in a reversible process
(C) Entropy can never decrease
(D) ΔS(system) as well as (surroundings) are negative quantities

54. The factors that influence the heat of reaction are :

(A) the physical state of reactants and products
(B) the temperature
(C) the pressure or volume
(D) the method by which the final products are obtained

55. The condition for spontaneity in a chemical reaction is

(A) $(\Delta G)_{T, p} \leq 0$ (B) $(\Delta U)_{S, V} \leq 0$ (C) $(\Delta H)_{S, p} \leq 0$ (D) $(\Delta S)_{U, V} \geq 0$

SECTION III: COMPREHENSIONS

COMPREHENSION # 1

Paragraph for Questions Nos. 56 to 58

In the quantum mechanics there is operator $(\hat{A})$ for every physically observable property like momentum (linear or angular), position, K.E., total energy etc., and whenever the function (ψ) is operated upon by the operator of any property , we get back ψ multiplied by a constant (a) which is the value of the property under consideration. The function ψ obeying the condition is called eigenfunction of the operator $\hat{A}$ and the constant "a" is called eigen-value. Mathematically

$$\hat{A}\psi = a \cdot \psi$$

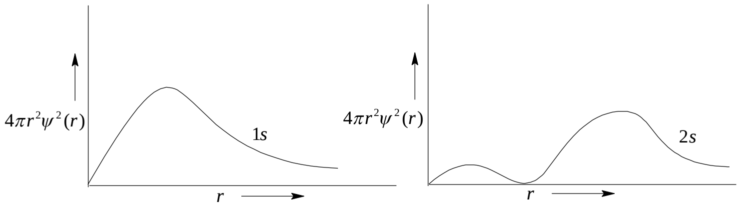
This equation is called eigen-value equation.

The Schrodinger wave equation is the energy eigen value equation. The operator for total energy is called Hamiltonion operator (H) defined as

$$H = -\frac{h^2}{8\pi^2 m}\left(\frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2} + \frac{\partial^2}{\partial z^2}\right) + V$$

Where V = PE, m = mass of microparticle.

Solving Schrodinger wave equation for H-atom after putting proper value of V, we get wave functions (ψ) and corresponding energy values. Each wave function denotes an orbital. ψ^2 measures the probability of finding the electron and $\psi^2 dx$ gives the probability if finding the electron in the region x and x + dx. $4\pi r^2 \psi^2(r)dr$ gives the probability of finding the electron in spherical shell of thickness dr at a distance r from the nucleus. A plot of radial distribution function $[4\pi r^2 \psi^2(r)]$ vs. distance from the nucleus (r) gives the radial probability distribution curve of electron. For 1s and 2s orbitals each containing only one electron, these curves are as given below



The wave functions of 1s and 2s orbitals of hydrogenic atom or ion are given below:

$$\psi_{1s} = 2\left(\frac{Z}{a_0}\right)^{1/2} e^{-Zr/a_0}$$

$$\psi_{2s} = \left(\frac{Z}{2a_0}\right)^{1/2}\left(2-\frac{Zr}{a_0}\right)e^{-Zr/2a_0}$$

In 2s-orbital there occurs a point at the radius at which curve touches X-axis. Here the probability of finding the electron is zero. This is called radial node.

On the basis of the above write-up, answer the following questions:

56. Which of the functions given below is not the eigen function of the operator $\frac{d^2}{dx^2}$?

(A) e^{-3x} (B) sin4x (C) $4x^2$ (D) cos2x

57. An electron moves along x-axis and restricted to move only between x = 0 and x = L. Hence

(A) $\int_0^L \psi^2 dx = 1$ (B) $\int_0^L \psi^2 dx = 0$ (C) $\int_0^L \psi^2 dx > 1$ (D) $\int_0^L \psi^2 dx < 1$

58. An electron is moving along X-axis in absence of any external field. The energy eigen-value of electron with $\psi = e^{-5x}$, is

(a) $\frac{25}{8}\frac{h^2}{\pi^2 m}$ (b) $\frac{3}{8}\frac{h^2}{\pi^2 m}$ (c) $\frac{h^2}{8\pi^2 m}$ (d) $\frac{h^2}{4\pi^2 m}$

COMPREHENSION # 2

Paragraph for Questions Nos. 59 to 60

From the Bohr's model and De-broglie's theory it can be proved that number of waves in an orbit is equal to its principal quantum nos.(n). The orbital motion of the electron around the nucleus is described by angular momentum of the electron which is characterised by azimuthal quantum number, l. I have all possible whole number values from 0 to n – 1 and magnitude of angular momentum is given by $(\ell / \ell + 1)^{1/2}\,\hbar$. The various sub shells are distributed as s, p, d, f, … according to the value of l = 0, 1, 2, 3, … respectively.

Angular momentum about the z-axis is quantised and given by z-component of angular momentum = $m_\ell . \hbar$ where $m_\ell = \ell(\ell+1)^{1/2}\cos\theta$ and is known as magnetic quantum number. Possible values of m range from –l through 0 to +l, thus making a total of 2l + 1 values. The possible values of m indicates the number of degenerate orbitals in a given energy sub level within a principal energy level.

59. When the value of l = 1, then the values of θ are

(A) 60°, 120°, 180° (B) 0, 90°, 180° (C) 45°, 90°, 135° (D) 30°, 60°, 90°

60. The difference between orbital angular momentum of a 2s and a 3d electron is

(A) $\sqrt{2}\hbar$ (B) 0 (C) $\sqrt{4}\hbar$ (D) $\sqrt{6}\hbar$

COMPREHENSION # 3

Paragraph for Questions Nos. 61 to 63

The radial probability at a distance r from the nucleus is given by the function $4\pi r^2 \psi^2 dr$. *In this function, as the probability factor* ψ^2 *decreases, the volume factor* $4\pi^2 dr$ *increases with increse in value of r. The probability increases gradually as the distance increases, goes to a maximum and then begins to decrease. For 1s orbital of hydrogen atom, the maximum value is found by differentiating adial probability distribution with respect to r and setting the derivative equal to zero as*

$$\frac{dP(r)}{dr} = \frac{4}{a_0^3}\left[-\frac{2r^2}{a_0} + 2r\right] e^{-2e/a_0} = 0.$$

The radial motion of an electron in an atom is controlled by the centrifugal force $\ell(\ell+1)/r^3$ *as well as by coulombing force of attraction* ($-Ze^2/r^2$) *or*

$$\frac{\ell(\ell+1)}{r^3} - \frac{Ze}{r^2} = 0$$

61. The probability of radial distribution function of an electron is zero becomes possible when distance r is equal to

(A) 0.529Å (B) zero (C) 2 × 0.529Å (D) $\frac{0.529}{2}$Å

62. In two different cases under similar conditions, an electron tends to stay farther from the nucleus in case I with respect to case II. It shows that

(A) Orbital angular momentum in, case I > case II
(B) Orbital angular momentum in, case I < case II
(C) Orbital angular momentum in, case I = case II
(D) None of the above

63. The electron distribution in 1s orbital is found to be symmetrical. Considering θ and ϕ be the angles involved in polar coordinate, it may be concluded that:

(A) ψ_{1s}^2 is dependent on θ (B) is dependent on ϕ
(C) is dependent on both θ and ϕ (D) is independent of θ and ϕ

COMPREHENSION # 4

Paragraph for Questions Nos. 64 to 67

In CBSE XII, a question was asked which reads as follows:

Dry air contains 80% N_2 and 20% O_2 by volume. Calculate density of dry air at 27°C and 1 atm pressure.

If relative humidity of moist air is 50% and V.P. of water at 27°C is 40 mm. Calculate the density (g/L) of moist air also. Assume ideal behavior of each gas. Relative humidity is defined as the ratio of the partial pressure of moisture in air to its V.P.

Three students "X", "Y" and "Z" solved 1st part of the problem in the following three different ways:

Solution of "X": One litre dry air contains 0.8 L N_2 and 0.2 L O_2 at the partial pressure of 0.8 atm and 0.2 atm respectively while each at 27°C i.e. 300K. He then calculated number of mole (n) of each gas using the ideal gas equation PV = nRT. He then multiplied number of mole with respective MW to get the mass of each gas in gram. Adding the masses of the two gases he was able to find the mass of 1 litre air in gram and the same he reported as the density of dry air.

Solution of "Y": One litre dry air contains 0.8 L N_2 and 0.2 L O_2 each at a pressure of 1.0 atm and temperature of 27°C i.e. 300K. Thereafter he followed the same method as adpted by "X" and reported the density of dry air.

Solution of “Z”:One litre dry air may be supposed to contain 1.0 L each of N_2 and O_2 at 27°C but at a partial pressure of 0.8 atm and 0.2 atm, respectively. Then he followed the method as adopted by his aforesaid guys, and reported the density of dry air.

64. The correct solution(s) is (are) that of:
(A) both X and Y (B) both Y and Z (C) All the three (D) Only X

65. If solution “X” is wrong what conceptual mistake he has committed:
(A) Boyle’s law is violated (B) Charle’s law is violated
(C) Graham’s law is violated (D) There is no violation of any gas law

66. If solution “Y” is wrong what conceptual mistake he has committed:
(A) Dalton’s law of partial pressure is violated
(B) Avogadro’s hypothesis has been violated
(C) Boyle’s law is violated
(D) There is no violation of any gas law

67. Solution of “Z” is wrong because
(A) Boyle’s law is violated (B) Charle’s law is violated
(C) Avogadro’s hypothesis is violated (D) The solution is correct

COMPREHENSION # 5
Paragraph for Questions Nos. 68 to 70

Compressibility factor (Z): Real gases deviate from ideal behaviour due to the following two faulty assumptions of kinetic theory of gases.

i) Actual volume occupied by the gas molecule is negligible as compared to the total volume of the gases.

ii) Forces of attraction and repulsion among the gas molecules are negligible.
To explain, the extent of deviation of the real gas from ideal behaviour in terms of compressibility or, compression factor (Z), which is function of pressure and temperature for real gases.

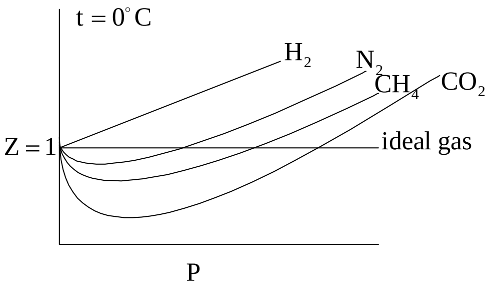
$$Z = \frac{P_0 V_0}{nRT}$$

For ideal gases Z = 1

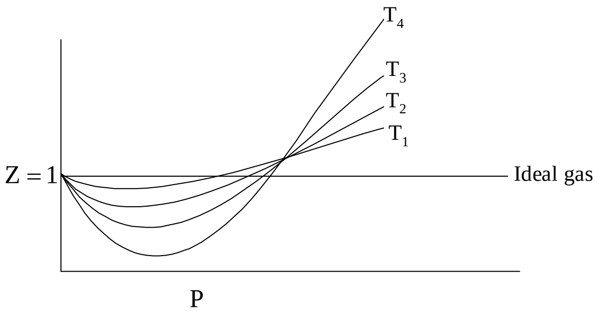
For real gases either $Z > 1$ or $Z < 1$

When $Z > 1$, then it is less compressible because force of repulsion dominates over force of attraction when $Z < 1$, force of attraction dominates over the force repulsion and it is more compressible.

Graph in between Z & P is shown as under



On increasing temperature, Z increases and approaches to unity. Graph between Z and P at different temperature for the same gases are as under:



68. Which of the following statements are correct?

(A) The compressibility factor for ideal gases dependent on temperature and pressure.

(B) $\left(\frac{dZ}{dP}\right)_T$ for real gas is independent of pressure.

(C) for all real gases have same value

(D) for different real gases have different values.

69. Which of the following is the correct order of temperature shown in the above graph Z vs P for the same gases.

(A) $T_4 > T_3 > T_2 > T_1$ (B) $T_1 > T_2 > T_3 > T_4$

(C) $T_1 > T_2 > T_{-4} > T_3$ (D) $T_3 > T_{-4} > T_2 > T_1$

70. Which of the following statements is correct for gas A having molar mass 16 g and density 0.75 g/litre at 2 atmospheric pressure and 27°C temperature?

(A) Force of attraction are dominating than force of repulsion among the gas molecules.

(B) Force of repulsion are dominating than force of attraction among the gas molecules.

(C) Gas molecules are behaving ideally

(D) None

COMPREHENSION # 6

Paragraph for Questions Nos. 71 to 73

The van der waal's equaiton of state for 1 mole real gas is ... (i)

The virial equation for 1 mole real gas is as under:

Where A, B and C are constants which are known as 2nd, third and fourth virial coefficients respectively.

Since we known that V=f(P, T, n]

Since ideal gas equation for 1 mole ideal gas is

$$PV = RT \quad ...(ii)$$

The temperature at wihch real gas obey ideal gas equation is known as Boyle's temperature i.e. T_B.

71. If equation (ii) be one of the form of equation (i), then value of "A" will be

(A) $b - \frac{a}{RT}$ (B) $a - \frac{b}{RT}$ (C) $RT - \frac{a}{b}$ (D) $\frac{RT \times b}{a}$

72. Which of the following is the correct statement about the Boyle's temperature (T_B)?

(A) Temperature at which second virial coefficient becomes zero

(B) Temperature at which first virial coefficient becomes zero

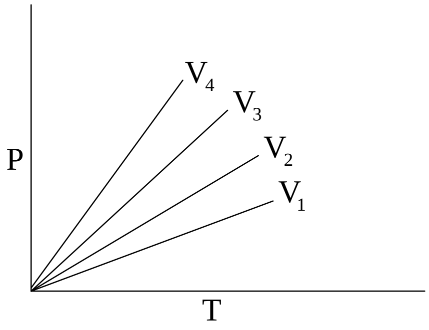
(C) The value of T_B is equal to $\frac{a}{Rb}$

(D) Both (a) and (c) are correct

73. The ideal gas equation for 1 mole of ideal gas is given as under

$$PV = nRT$$

The graph is drawn in between P and T for different isochoric process, or different constant volume, which gives different straight lines shown as under:



then which of the following is the correct order of volume?

(A) $V_4 > V_3 > V_2 > V_1$ (B) $V_1 > V_2 > V_3 > V_4$

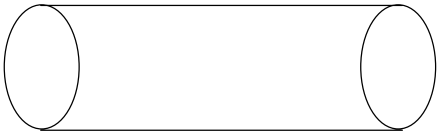
(C) $V_1 > V_2 > V_4 > V_4$ (D) $V_2 > V_1 > V_3 > V_4$

COMPREHENSION # 7
Paragraph for Questions Nos. 74 to 76

Diffusion is the one of the most striking property of the gas, due to which one gas intermixes with other against gravity at low pressure gradient at constant temperature. And according to Graham, rate of diffusion of a diffusing gas is inversely proportional to the square root of the density or molecular mass of the diffusing gas i.e.,

$$r \propto \frac{1}{\sqrt{d}} \propto \frac{1}{\sqrt{m}} \qquad \text{...(i)}$$

The rate of diffusion inside an open tube is directly proportional to the length



$$r = \frac{v}{t} = \left(\frac{A}{t}\right) \times \text{length}$$

r × length

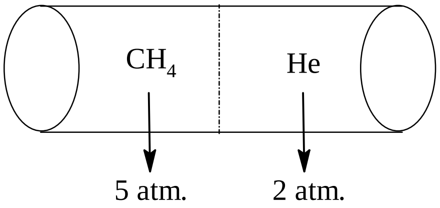
But, effusion is a special kind of diffusion, possible at high pressure gradient only. It is a kind of forced diffusion. Infact, incase of effusion rate of intermixing will be influenced by pressure gradient. So, in effusion pressure must be considered i.e.,

$$r \propto \frac{P}{\sqrt{m}} \propto \frac{P}{\sqrt{d}}$$

74. At the start of an experiment one end of a U-tube of 6 mm glass tubing is immersed in conc. NH_3 solution and the other end is immersed in conc. HCl solution. At the point in the tube where vapours of NH_3 and HCl meet, a white cloud of NH_4Cl (s) forms. At what fraction of the distance along the tube from the NH_3 solution does the white cloud first form?

(A) 0.068 (B) 6.82 (C) 0.422 (D) 4.22

75. A long cylindrical glass tube, equipped with a process disc at the centre contain CH_4 gas at 5 atm. on one side and He gas at 2 atm on the other side of the disc as shown in the diagram.



Disc is permeable to both gases and rate of diffusion is directly proportional to the gas pressure and inversely proportional to square root of molar masses as;

$$-\frac{dP}{dt} = \frac{kP}{\sqrt{M}}$$

If K for the CH_4 is 2.5×10^{-2} sec^{-1}, determine time after which pressure of CH_4 chamber will drop to 4 atm?

(A) 8.778 sec. (B) 87.88 sec. (C) 48.2 sec. (D) 40 sec.

76. If a space capsule is filled with Ne gas at 1 atm and 290K. The gas effuses through a pin-hole into outer space at such a rate that the pressure drops by 0.30 torr/s. If the capsule were filled with NH_3 at the same temperature and pressure what would be the rate of pressure drop?

(A) 0.33 torr/s (B) 0.20 torr/s (C) 0.13 torr/s (D) 3.3 torr/s

COMPREHENSION # 8
Paragraph for Questions Nos. 77 to 79

"Percentage of available chlorine in the sample of blaching power"
Bleaching powder is a mixture of calcium hypochlorite ($CaOCl_2$) and the basic chloride $CaCl_2.Ca(OH)_2.H_2O$ free slaked lime is also present in addition.
Available chlorine in bleaching powder is the amount of chlorine liberated by the action of dilute acids on bleaching powder according to the equation.

$OCl^- + Cl^- + 2H^+ \longrightarrow$

The available chlorine is expressed as the percentage by weight of the bleaching powder. It is measured by iodometric titration. The bleaching powder solution or suspension is treated with an excess of KI and then acidified with acetic acid where I_2 is liberated

$$OCl^- + 2I^- + 2H^+ \longrightarrow Cl^- + I_2 + H_2O$$

The liberated I_2 is determined with standard $Na_2S_2O_3$ solution using starch as indicator near the end point

$$I_2 + 2S_2O_3^{2-} \longrightarrow 2I^- + S_4O_6^{2-}$$

77. 0.05 moles of $CaOCl_2$ reacts with excess of KI and liberated $I_2$is titrated with V ml of 0.1M hypo solution then value of V is

(A) 500 ml (B) 1000 ml (C) 2000 ml (D) 250 ml

78. A 20 ml (specific gravity 1.02) of chlorine water is treated with excess of KI and the liberated Iodine required 25 ml of 0.2 N $Na_2S_2O_3$. The percentage of free chlorine in chlorine water is

(A) 0.87 (B) 87 (C) 0.78 (D) 0.82

79. The volume of 0.2 M $Na_2S_2O_3$ equivalent to I_2 liberated by the oxidation of excess KI by 10 millimole of bleaching powder (pure) is

(A) 50 ml (B) 20 ml (C) 25 ml (D) 100 ml

COMPREHENSION # 9

Paragraph for Questions Nos. 80 to 83

Like acid base titration, in redox titration also, the equivalence point is reached when the reducing agent is completely oxidized by the oxidizing agent. But contrary to the acid-base titrations, oxidizing agents can themselves be used as internal indicator in redox titration e.g. $Cr_2O_7^{2-}$ (orange yellow), Cr^{3+} (green), MnO_4^- (purple), Mn^{2+} (light pink), where strength of the solution may be expressed as molarity i.e. number of moles of solute per litre of solution.

80. In a titration experiment, a student finds that 23.48 ml of a NaOH solution are needed to neutralize 0.5468g of KHP (molecular formula $KHC_8H_4O_4$). What is the concentration in molarity of NaOH solution?

(A) 0.114 M (B) 0.228M (C) 0.057M (D) 0.028 M

81. A 16.42 ml volume of 0.1327M $KMnO_4$ solution is needed to oxidize 25.00 ml of a $FeSO_4$ solution in an acidic medium. What is the number of moles of $FeSO_4$ being oxidized for the reaction

$$5Fe^{2+} + MnO_4^- + 8H^+ \longrightarrow Mn^{2+} + 5Fe^{3+} + 4H_2O$$

(A) 2.18×10^{-2} ml (B) 1.09×10^{-2} ml (C) 0.545×10^{-2} ml (D) 0.272×10^{-2} ml

82. A purple coloured solution is added from a burette to $FeSO_4$ solution kept in the flask. After sometime, the purple colour changes to light pink. The ion formed from that solution is

(A) MnO_4^- (B) Fe^{2+} (C) Fe^{3+} (D) Mn^{2+}

83. Concentrated aqueous sulphuric acid is 98% H_2SO_4 by mass and has a density of 1.84 g/ml. What volume of the concentrated acid is required to make 5 litre of 0.50M H_2S_4 solution.

(A) 271.7 ml (B) 13.5 ml (C) 135.85 ml (D) 27.1 ml

COMPREHENSION # 10

Paragraph for Questions Nos. 84 to 86

Double Titration

1. **Methyl orange as an indicator**

The volume of 0.1 NHCl used in the titration will correspond the neutralization as directed.

$NaHCO_3 + HCl \longrightarrow NaCl + CO_2 + H_2O$ *(colour change)*
$Na_2CO_3 + 2HCl \longrightarrow NaCl + CO_2 + H_2O$ *(colour change)*
$NaOH + HCl \longrightarrow NaCl + H_2O$ *(colour change)*

The volume of 0.1M NaOH in the titration will neutralize as directed
HA (mono basic acid) $+ NaOH \longrightarrow NaA$ *(colour change)*
H_2A *(di basic acid)* $+ NaOH \longrightarrow NaHA$ *(colour change)*
H_3A *(tribasic acid)* $+ NaOH \longrightarrow NaH_2A$ *(colour change)*

2. ***Phenolphthelien as an indicator***

The volume of 0.1 NHCl used in the titration will correspond the neutralization as directed.
$NaHCO_3 + HCl \longrightarrow$ *(no colour change)*
$Na_2CO_3 + HCl \longrightarrow NaHCO_3$ *(colour change)*
$NaOH + HCl \longrightarrow NaCl$ *(colour change)*

The volume of 0.1M NaOH in the titration will neutralize as directed
HA (mono basic acid) $+ NaOH \longrightarrow NaA$ *(colour change)*
H_2A *(di basic acid)* $+ 2NaOH \longrightarrow Na_2A$ *(colour change)*
H_3A *(tribasic acid)* $+ 2NaOH \longrightarrow Na_2HA$ *(colour change)*

84. 0.01 mole of H_3PO_4 and 0.01 mole H_3PO_2 reacts with V ml standard NaOH in presence of phenolpthelien indicator volume of NaOH used is

(A) 500 ml (B) 400 ml (C) 300 ml (D) 200 ml

85. 20 ml of x M HCl neutralizes completely 10 ml of 0.1 M solution and a further 5 ml of 0.2 M solution to methyl orange end point. The value of x is:

(A) 0.167 M (B) 0.133M (C) 0.15 M (D) 0.2 M

86. Certain moles of is dissolved in excess of NaOH. The resulting solution is divided into two equal parts. One part needs 30 ml of 2.5 N HCl and other part needs 40 ml of 2.5 N HCl using phenolphthalein and methyl orange indicator respectively. The mass of dissolved is:

(A) 2.5×10^{-2} (B) 5×10^{-2} (C) 10×10^{-2} (D) 1.5×10^{-2}

COMPREHENSION # 11

Paragraph for Questions Nos. 87 to 89

Bond length is the average distance between the nuclei of the two atoms held by a bond. This represents the internuclear distance corresponding to minimum potential energy for the system. Main factors which affect the bond length are given below:—

i) Multiple bonds are shorter than corresponding single bonds

ii) Sometimes single bond distances are some what larger than double of their respective covalent radii (e.g. F_2). It is due to strong repulsive interaction between the lone-pair electrons on adjacent atoms.

iii) Some times single bond distances are some what shorter than double of their respective covalent radii because bonds acquire some partial double bond character. This normally happens when one atom having vacant orbital and another atom containing lone pair. It is also possible it become shorter due to high ionic character in the covalent bond.

87. Which is not true about the N – N bond length among the following species

I. $H_2N — NH_2$ II. N_2

III. $H\overset{+}{N}— NH_2$ IV. N_2O

(A) N — N bond length is shortest in II

(B) N — N bond length in I is shorter than that of in III

(C) N — N bond length in III is shorter than that of in I

(D) N — N bond length IV is intermediate between I and III

88. The correct order about of C—O bond length is

I. CO, II. CO_2 III. CO_3^{2-}

(A) II < I < III (B) III < II < I (C) I < II < III (D) I < III < II

89. The bond angle is Cl_2O is more than that in F_2O because of so many reasons like

(a) $p_\pi - d_\pi$ overlap in Cl_2O which is not possible in F_2O

(b) There is no lp – lp repulsion in Cl_2O which is present in F_2O

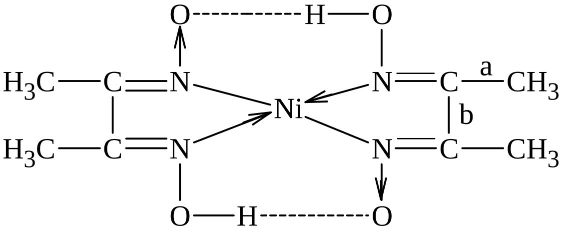
(c) F is more electronegative than oxygen while Cl is less electronegative than oxygen

The correct reason is (are)

(A) both a and b (B) only a (C) only b (D) all the three

COMPREHENSION # 12
Paragraph for Questions Nos. 90 to 92

“Dimethyl glyoxime is an important reagent, which is used in the detection of Ni^{2+} ion in fourth group of qualitative analysis and also in its gravimetric estimation. The compound formed by Ni^{2+} ions with dimethyl glyoxime is diamagnetic with the structure as given below.



‘a’ and ‘b’ are c—c bond length”.

90. Wchih of the following is correct regarding the bond length ‘a’ and ‘b’.

(A) a = b (B) a > b (C) b > a (D) none of the above

91. The necessary conditions for the formation of intramolecular hydrogen bonding is

(A) The ring formed as a result of hydrogen bond should be planar
(B) A five or six membered ring should be formed
(C) Interacting atoms should be placed in such a way that there is minimum strain during the ring formation
(D) All of these

92. The atomic orbitals which the central atom is using in hybridisation are:

(A) $4s, 4p_x, 4p_y and 4p_z$ (b) $3dz^2, 4s, p_x$ and $4p_y$

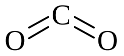
(C) $3d_{x^2-y^2}, 4s, 4p_x$ and $4p_y$ (d) $3d_{x^2-y^2}, 4s, 4p_y$ and $4p_z$

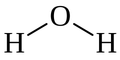
COMPREHENSION # 13
Paragraph for Questions Nos. 93 to 95

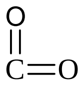
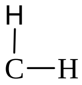
The formal charge is the difference between the number of valence electrons in an isolated (i.e. free) atom and the number of electrons assigned to that atom in a Lewis structure. While as a result of polarization, the molecule possesses a dipole moment which is the product of charge on the dipole and distance between them. For a molecule, the net dipole moment is the vector addition of all the dipole moment. Just as all the covalent bonds have some partial ionic character the ionic bonds also have partial covalent character. The polarizing power of the cation, the polarisability of the anion and the extent of distortion of anion are the factors, which determine the percent covalent character of the ionic bond.

93. Experiment shows that H_2O has a dipole moment whereas CO_2 has not. Point out the structures which best illustrate these factor.

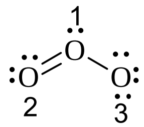
(A) O = C = O, H – O – H

(B)  , H—O—H

(C) O=C=O , 

(D) 
$$\overset{\displaystyle O}{\overset{\|}{C}}{=}O$$
, 
$$\overset{\displaystyle H}{\overset{|}{C}}{-}H$$

94. It has been seen that in O_3, the central O atom is bonded to two other oxygen atoms as

,


Arrange oxygen atoms marked as 1, 2 and 3 in order of their decreasing formal charge:

(A) $1 < 2 < 3$ (B) $1 > 3 > 2$ (C) $1 > 2 > 3$ (D) $2 > 1 > 3$

95. Among LiCl, $BeCl_2$, BCl_3 and CCl_4, covalent bond character follows the order:

(A) $LiCl > BeCl_2 > BCl_3 > CCl_4$ (B) $LiCl < BeCl_2 < BCl_3 < CCl_4$

(C) $LiCl > BeCl_2 > CCl_4 > BCl_3$ (D) $LiCl < BeCl_2 < BCl_3 > CCl_4$

COMPREHENSION # 14
Paragraph for Questions Nos. 96 to 98

The delpletion of ozone in the stratosphere has been a matter of great concern among scientists in recent years. It believed that ozone can react with nitric oxide (NO) that is discharged from the high altitude jet plane. The reaction is:

$$O_3 + NO \rightarrow O_2 + NO_2$$

96. If 0.740 g of O_3 reacts with 0.670 g of NO, how many gram of NO_2 will be produced ?

(A) 0.71 g (B) 0.74 g (C) 0.68 g (D) 0.81 g

97. Which compound is the limiting reactant?

(A) NO (B) O_3

(C) Both are in equimolar ratio (D) Both are in stoichiometric ratio

98. Number of moles of the excess reactant remaining at the end of the reaction is

(A) 0.007 mol O_3 (B) 0.014 mol O_3 (C) 0.007 mol NO (D) 0.014 mol NO

COMPREHENSION # 15
Paragraph for Questions Nos. 99 to 101

8.7 gm of a sample of is used in a chemical reaction with HCl to release . Released is used to displace from excess of KI solution. The iodine hence released is estimated using hypo and consumes 100 ml of hypo solution.. 12.5 ml of same hypo solution is required for complete reaction with 25 ml of 0.5 N solution.

99. % purity of is

(A) 4.35 (B) 43.5 (C) 50 (D) 6.25

100. Wt. of which may be completely neutralized by the amount of HCl made to react quantitatively with pure in the sample is

(A) 106 g (B) 10.6 g (C) 5.3 g (D) 53 g

101. Number of milli moles of iodine in the solution used with hypo are

(A) 6.25 (B) 12.5 (C) 10 (D) 20

COMPREHENSION # 16

Paragraph for Questions Nos. 102 to 104

Whenever any solute is dissolved in a given solvent, a solution is formed . Solution may be homogeneous or heterogeneous. Homogenous solution is termed as true solution and in this concentration of solution is defined as mole or mass of solute present in the given weight or volume of solution. Units which depends on mass are temperature independent while which depends on volume are temperature dependent. Answer following question after reading passage–

102. Which of the following unit is temperature dependent
(A) molality (B) ppm (C) mole fraction (D) molarity

103. If aqueous solution of KOH contains 28% by weight of KOH hence mole fraction of KOH is
(A) (B) (C) (D)

104. Mass of glucose ($C_6H_{12}O_6$) present in 50 ml of its 2 molar solution is
(A) 18000 gm (B) 180 gm (C) 18 gm (D) 1800 gm

COMPREHENSION # 17

Paragraph for Questions Nos. 105 to 108

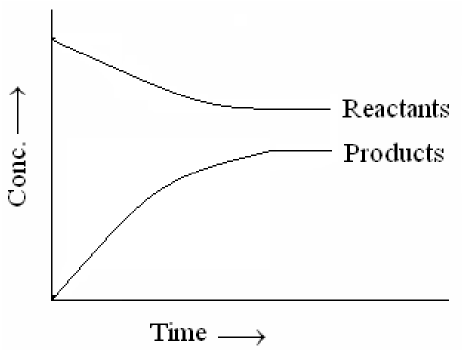
In a reversible chemical reaction, the rate of forward reaction decreases and that of backward reaction increases with the passage of time; at equilibrium the rate of forward and backward reactions become same.

Let us consider the formation of SO_3 in the following reversible reaction:

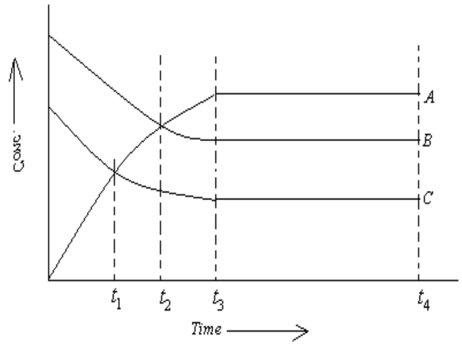
$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$$

Following graphs are plotted for this reaction:

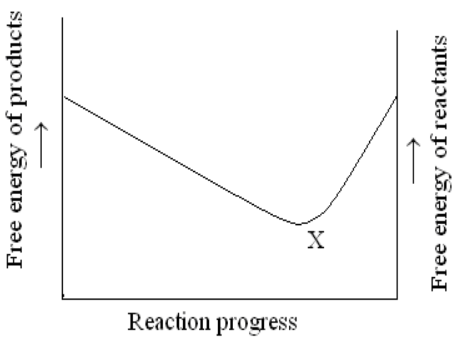
Graph – 1



Graph - 2



Graph - 3



105. In the graph(1), the equilibrium state is reached at:
(A) t_1 (B) t_2 (C) t_3 (D) t_4

106. If pressure decreases when the reaction is in the state of equilibrium, then the reaction may shifted towards–

(A) SO_3

(B) SO_2 & O_2

(C) No change as all the molecules are gases

(D) Not specified

107. The graph(2) tells us that:
(A) equilibrium is never achievable
(B) equilibrium is achieved after the concentrations of reactants and products become equal
(C) equilibrium is achieved before the concentrations of reactants and products become equal
(D) none of these

108. From the graph(3), it can be interpreted that:
(A) equilibrium is achieved at X (B) reaction is nearer to the completion
(C) $\Delta G=0$ at X (D) all of the above

COMPREHENSION # 18
Paragraph for Questions Nos. 109 to 111

When 306 g of NH_4HS is introduced in a 4.1 litre evacuated flask and heated to 227°C then solid NH_4HS decomposes into gaseous ammonia and hydrogen sulphide. At equilibrium, it is found that 170 gm of H_2S are present in the container.

109. Mass of solid remaining in the container is -
(A) 51 g (B) 136 g (C) 68 g (D) 100 g

110. If after establishment of equilibrium, H_2S is added in the container in such a way that partial pressure of H_2S now equals to original total pressure, then partial pressure of NH_3 at new equilibrium is -
(A) 50 atm (B) 25 atm (C) 100 atm (D) 75 atm

111. If at 227°C, ammonia also starts decomposing into nitrogen and hydrogen and establishes equilibrium ($2NH_3 \rightleftharpoons N_2 + 3H_2$) then K_p for the reaction $NH_4HS(s) \rightleftharpoons NH_3(g) + H_2S(g)$ and total pressure developed in the container will -
(A) decreaes, increases (B) increases, decreases
(C) no change, no change (D) no change, increases

COMPREHENSION # 19
Paragraph for Questions Nos. 112 to 114

Law of mass action can also be applied to the study of equilibria in which the substances are not in the same phase. Considering the decomposition of solid $NaHCO_3$ to produce solid Na_2CO_3, gaseous CO_2 and H_2O.

$$2NaHCO_3(s) \rightleftharpoons Na_2(CO_3(s) + CO_2(g) + H_2O\ (g)$$

Applying the law of mass action.

$$K_C' = \frac{[Na_2CO_3][CO_2][H_2O]}{[NaHCO_3]^2}$$

It involves two pure solids, Na_2CO_3 and $NaHCO_3$. It is customary not to include the concentrations of pure solids in equilibrium expressions.

$$\frac{K_C'[NaHCO_3]^2}{[Na_2CO_3]} = [CO_2]\,[H_2O] \qquad \text{or} \qquad K_C = [CO_2]\,[H_2O]$$

In terms of partial pressures we have $K_p = p_{CO_2} \times p_{H_2O}$. Similarly, in reactions in which a reactant or product occurs as a pure liquid phase, the concentration of that substance in the pure liquid is also constant. As a result, the concentrations of pure solid and pure liquid phases do not appears in the equilibrium constant expression.

112. Ammonium hydrogen sulphide dissociates according to the equation

$$NH_4HS(s) \rightleftharpoons NH_3(g) + H_2S(g)$$

If the observed pressure at equilibrium is 2280 torr atm at 380 K, what is the equilibrium constant K_p of the reaction?

(A) 1.5 (B) 2.25 (C) 3 (D) 4.5

113. A vessel at 1000 K contains carbon dioxide with a pressure of 0.5 atm. Some of the carbon dioxide is converted to carbon monoxide on addition of graphite. Calculate the value of K_p if total pressure at equilibrium is 0.8 atm.

(A) 1.8 atm (B) 0.8 atm (C) 3.6 atm (D) 4 atm

114. A sample of $CaCO_3(s)$ is introduced into a sealed container of volume 0.64 litre and heated to 1000 K until equilibrium is reached. The equilibrium constant for the reaction,

$$CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g),$$

is 4×10^{-2} atm at this temperature. Calculate the mass of CaO (in mg) present at equilibrium.

(A) 3.584 (B) 1.792 (C) 17.92 (D) 35.84

COMPREHENSION # 20
Paragraph for Questions Nos. 115 to 117

Buffer Solutions : In general, a buffer solution is one which is resistant to change of pH upon the addition of a small amount of acid or alkali. Such solutions usually consist of a micture of a weak acid and salt of its conjugate base, e.g. HAc and NaAc (called acidic buffers), or of a weak base and salt of its conjugate acid, e.g. NH_4OH and NH_4Cl (called basic buffers). A salt of a weak acid and a weak base, e.g.NH_4Ac, also has a buffer action.

The pH of an acidic buffer and basic buffer is expressed by Henderson-Hasselbalch equations

$$pH = pK_a + \log\frac{[\text{conjugate base}]}{[\text{weak acid}]} \qquad pOH = pK_b + \log\frac{[\text{conjugate acid}]}{[\text{weak base}]}$$

But limitations of the above equations is that it works only for buffer solutions that fit the following criteria

* The ratio, [conjugate base] / [weak acid] has a value between 0.1 and 10.

* Both [conjugate base] and [weak acid] exceed K_a by a factor of 100 or more.

The resistance to the charge in pH, on the addition of an acid or alkali is called 'Buffer action'. This buffer action ismeasured by 'Buffer capacity' (β). It is expressed as $\beta = \frac{db}{dpH}$

where dbis no. of moles of base added to one litre buffer solution and dpH is charge in pH. The buffer capacity (β) is maximum when the acid and the salt are pesent in equal concentrations.

115. The acetate-acetic acid buffer is suitable in the pH range (assume K_b of $CH_3COO^- = 10^{-9}$)

(A) 8 – 10 (B) 4 – 6 (C) 5 – 7 (D) 5.5 – 7.5

116. A solution of pH = 6 will be maintained by acidic buffer. Below are the few options given to a chemist. Which option will the chemist choose ?

(A) HA (0.1 M), NaA (1M) K_b of $A^- = 10^{-9}$ (B) HB (0.01 M), NaB (1 M) K_b of $B^- = 10^{-10}$
(C) HC (1 M), NaX (0.01 M) K_b of $X^- = 10^{-6}$ (D) Any one of the above

117. pH of a mixture of 1 M benzoic acid (pKa = 4.20) and 1 M C_6H_5COONa is 4.5 what is the volume of benzoic acidrequired to repare a 300 ml buffer [log 2 = 0.3] ?

(A) 200 ml (B) 150 ml (C) 100 ml (D) 50 ml

COMPREHENSION # 21

Paragraph for Questions Nos. 118 to 117

In a mixture of strong acid and a strong base , concentration of H^+ions or OH^- ions can be calculated as

$[H^+]$ or $[OH^-]$ = meq of S.A -meq of S.B / total volume in ml of the mixture or volume given

At equivalence point of titration of a strong acid with strong base pH=7 at 25^{0}C. Salt formed does not under go salt hydrolysis.

In case of weak acid with strong base, before the equivalence point, pHis calculated using the concept of acid buffer. At the equivalence point pH is calculated taking into consideration salt hydrolysis. pH= ½(pKw+pka+logC)

Beyond the equivalence point, there is excess of base, which mainly determines the pH. In case of weak base with strong acid, before the equivalence point buffer concept is used, at the equivalence point salt hydrolysis is taken into consideration.

pH= ½(pKw-pkb-logC)

In case of titration of weak acid and weak base at equivalence point pH is calculated on the basis of salt hydrolysis pH= ½(pKw+pka-pkb)

118. 100ml of 0.1 M mono acid weak base, Kb=2x10^{-5} is titrated with 0.1M HCl. pH of the reaction mixture at the titre value of 50ml and 100 ml are respectively.

(A) 9.3, 9.3 (B) 9.3 , 6.6 (C) 9.3 , 5.3 (D) 4.7, 6.6

119. When 50ml of 0.2M HA ,Ka =1.0x10^{-5} is mixed with 50ml of 0.2M KOH at 25^0 C pH of the resulting mixture would be

(A) 9.0 (B) 9.15 (C) 8.50 (D) 8.2

120. 100ml of 0.1M HCl is titrated with 0.1M NaOH . The pH of the reaction mixture after the addition of 50ml, 100ml, 150ml are respectively

(A) 1.3, 7.0, 9.23 (B) 1.48, 7.0, 12.3 (C) 1.7, 7.0 12.3 (D) 7.0, 1.3, 12.3

COMPREHENSION # 22

Paragraph for Questions Nos. 121 to 123

$$K_{sp} \text{ of } CdS = 8\times10^{-27}, K_{sp} \text{ of } ZnS = 1\times10^{-21}, K_a \text{ of } H_2S = 1\times10^{-21}$$

121. Which metal sulphide is precipitated first when H_2S is added

(A) ZnS (B) CdS
(C) Both at same time (D) Both do not form ppt.

122. What $\left[H^+\right]$ must be maintained in a saturated $H_2S(0.1M)$ to precipitate CdS but not ZnS , if $\left[Cd^{+2}\right]=\left[Zn^{+2}\right]=0.1M$ initially

(A) $>0.1M$ (B) $>0.01M$ (C) $>0.2M$ (D) $>0.02M$

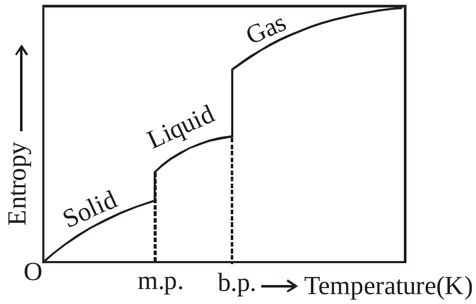
123. When ZnS starts precipitating. What is the concentration of Cd^{+2} is left

(A) 8×10^{-7} (B) 0.1 (C) 4×10^{-10} (D) 2×10^{-9}

COMPREHENSION # 23

Paragraph for Questions Nos. 124 to 126

Entropy is associated with the orientation and distribution of molecules in space. Disordered crystals have higher entropy than ordered crystals and diffused gases have higher entropy than compressed gases.



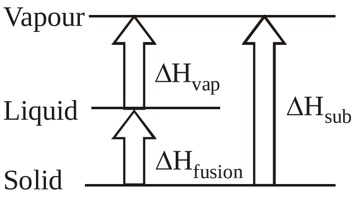
Entropy is also associated with molecular motion. As the temperature of a substance increases, random molecular motion increases hence entropy increases. Figure gives variation of entropy with temperature. At absolute zero (–273ºC) every substance is in solid state whose particle are rigidly fixed in a crystalline structure. If there is no residual orientational disorder, like that in CO, entropy of the substance at 0 K will be zero. Third law of thermodynamics states that. **“At the absolute zero of temperature the entropy of every substance may become zero and does become zero in case of perfectly crystalline structure.”**

$$\lim_{T \to 0} s = 0$$

In case of CO and NO molecules in solid state, there is randomness even at 0 K due to their dipole moment hence entropy in such cases is not zero even at 0 K.

As the temperature is raised, the molecules begin to vibrate. The number of ways in which the vibrational energy can be distributed increases with increase in temperature and the entropy of the solid increases steadily as the temperature increases. At the melting point (m.p.) of a solid, there is a discontinuous jump in entropy because there are many more ways of arranging the molecules in the liquid than in the solid. An even greater jump in entropy is observed at the boiling point (b.p.) because molecules in the gas are free to occupy a more larger volume and randomness increases.

124. From the figure representing enthalpy change of various transition as indicated, a substance has maximum enthalpy when present in:



(A) solid state (B) liquid state
(C) gaseous state (D) equal in all states

125. For the following reaction, $CaCO_3(s) \longrightarrow CaO(s) + CO_2(g)$

If at 0 K, ΔS of this reaction is x cal mol^{-1} then entropy of CO_2 (g) at 0 K is :

(A) – x cal (B) –2x cal (C) + x cal (D) 0 cal

126. Which has the highest entropy per mol of the substance?

(A) H_2 at 25ºC at 1 atm (B) H_2 at STP
(C) H_2 at 100 K at 1 atm (D) H_2 at 0 K at 1 atm

COMPREHENSION # 24

Paragraph for Questions Nos. 127 to 129

Enthalpy of reaction : It is used for the heat change accompaining any reaction. depending upon the nature of the reaction the enthalpy of the reaction is named accordingly

For example : In the reaction

$CH_4(g) + O_2(g) \longrightarrow CO_2(g) + H_2O(l)$ $\Delta H = -890.4$ kJ/mole

This reaction shown that 890.4 kJ of heat is produced when methane is completely burnt it is known as heat of combustion .

for example: In the reaction

$C(s) + O_2(g) \longrightarrow CO_2(g)$ $\Delta H = -393.5$ kJ/mole

when $CO_2(g)$ is formed from its elements i.e. from C(s) and $O_2(g)$ 393.5 kJ of heat is produced and the process in heat of formation.

127. The enthalpy of formation of methane from the following data

(i) $C(s) + O_2(g) \longrightarrow CO_2(g)$ $\Delta H = -393.7$ kJ/mole

(ii) $H_2(g) + \frac{1}{2}O_2(g) \longrightarrow H_2O(l)$ $\Delta H = -285.8$ kJ/mole

(iii) $CH_4(g) + 2O_2(g) \longrightarrow CO_2(g) + 2H_2O(l)$ $\Delta H = -\ 890.4$ kJ/mol

(A) –74.9 kJ/mole (B) 54.6 kJ/mole (C) 99.7 kJ/mole (D) –89.6 kJ/mole

128. Calculate the enthalpy of formation of sucrose ($C_{12}H_{22}O_{11}$) from the following data:

(i) $C_{12}H_{22}O_{11} + 12O_2(g) \longrightarrow 12CO_2(g) + 11H_2O(l)$, $\Delta H = -5200.7$ kJ mol^{-1}

(ii) $C(s) + O_2(g) \longrightarrow CO_2(g)$, $\Delta H = -\ 394.5$ kJ mol^{-1}

(iii) $H_2(g) + \frac{1}{2}O_2(g) \longrightarrow H_2O(l)$, $\Delta H = -\ 285.8$ kJ mol^{-1}

(A) –10.3 kJ/mole (B) + 863.4 kJ/mole

(C) –2677.1 kJ/mole (D) –4321.3 kJ/mole

129. Calculate the enthalpy of combustion of benzene from the following data:

(i) $6C(s) + 3H_2(g) \longrightarrow C_6H_6(l)$, $\Delta H = 49.0$ kJ mol^{-1}

(ii) $H_2(g) + \frac{1}{2}O_2(g) \longrightarrow H_2O(l)$, $\Delta H = -285.8$ kJ mol^{-1}

(iii) $C(s) + O_2(g) \longrightarrow CO_2(g)$, $\Delta H = -389.3$ kJ mol^{-1}

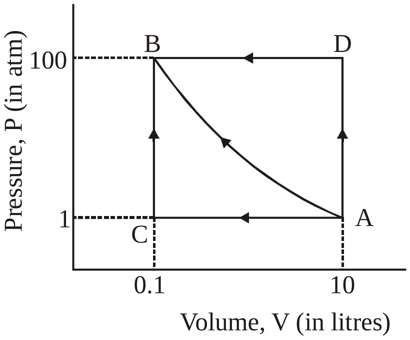
(A) + 463.6 kJ/mole (B) +32.4 kJ/mole

(C) –1432.3 kJ/mole (D) –3242.2 kJ/mole

COMPREHENSION # 25

Paragraph for Questions Nos. 130 to 132

Assume perfect gas behaviour in the following isotherm AB. Take $C_v = \frac{3}{2}R$, temperature of the isotherm = 313 K



130. Number of moles of gas in this system at the start is:
(A) 0.39 mol (B) 0.17 mol (C) 0.78 mol (D) 0.34 mol

131. Work done on the gas along the isotherm AB is:
(A) –4.78 kJ (B) –8 kJ (C) +4.78 kJ (D) + 71 kJ

132. ΔE (Change in internal energy) for path ACB or ADB is:
(A) 19.7 kJ (B) 0.00 kJ (C) 51.2 kJ (D) 3.0 kJ

SECTION IV: MATCH THE FOLLOWING

133. If volume strength of H_2O_2 solution is 'X-V' then its

	Column I		**Column II**
(a)	Strength in g/L	(i)	$\frac{X}{11.2}$
(b)	Volume strength X	(ii)	$\frac{X}{5.6}$
(c)	Molarity	(iii)	$\frac{17X}{5.6}$
(d)	Normality	(iv)	5.6 × N

(A) (a)-(iii), (b)-(i), (c)-(iv), (d)-(ii)
(B) (a)-(iv), (b)-(i), (c)-(ii), (d)-(i)
(C) (a)-(iii), (b)-(iv), (c)-(i), (d)-(ii)
(D) (a)-(iii), (b)-(ii), (c)-(iv), (d)-(i)

134.

	Column I **Reactant**		**Column II** **n-factor**
(a)	H_3PO_3	(i)	11/3
(b)	H_3PO_4	(ii)	2
(c)	$3MnO_4^- \longrightarrow 2Mn^{2+} + Mn^{+6}$	(iii)	3
(d)	$FeC_2O_4 \longrightarrow Fe^{3+} + 2CO_2$		
(e)	$2H_2O_2 \longrightarrow O_2 + 2H_2O$		

(A) (a)-(ii), (b)-(iii), (c)-(i), (d)-(iii), (e)-(ii)
(B) (a)-(i), (b)-(ii), (c)-(iii), (d)-(ii), (e)-(i)
(C) (a)-(ii), (b)-(i), (c)-(ii), (d)-(iii), (e)-(ii)
(D) (a)-(iii), (b)-(ii), (c)-(i), (d)-(ii), (e)-(iii)

135.

	Column I		**Column II**
(a)	$HClO_4$	(i)	Oxidising agent
(b)	H_2S	(ii)	Reducing agent
(c)	$Na_2S_2O_7$	(iii)	Oxidising as well as reducing agent
(d)	SO_2		
(e)	HNO_2		

(A) (a)-(ii), (b)-(iii), (c)-(i), (d)-(iii), (e)-(ii)
(B) (a)-(i), (b)-(ii), (c)-(iii), (d)-(ii), (e)-(i)
(C) (a)-(ii), (b)-(i), (c)-(ii), (d)-(iii), (e)-(ii)
(D) (a)-(i), (b)-(ii), (c)-(ii), (d)-(iii), (e)-(iii)

136. When mixture of 0.1 equivalent of each of the reactants mentioned under column I are reacted with 1 M HCl solution. in presence of indicator phenolphthalein, the volume required in ml of HCl solution for complete neutralization will be:

	Column I		**Column II**
(a)	$Na_2CO_3 + NaHCO_3$	(i)	100 ml
(b)	$NaOH + NaHCO_3$	(ii)	150 ml
(c)	$Na_2CO_3 + Na_2CO_3$	(iii)	50 ml
(d)	$Na_2CO_3 + NaHCO_3 + NaOH$		

(A) (a) - (i) , (b) - (iii) , (c) - (i) , (d) - (ii) (B) (a) - (i) , (b) - (ii) , (c) - (iii) , (d) - (ii)

(C) (a) - (ii) , (b) - (i) , (c) - (ii) , (d) - (iii) (D) (a) - (iii) , (b) - (i) , (c) - (ii) , (d) - (ii)

137.

	Column I		**Column II**
(a)	M_R on mixing two acidic solutions	(i)	$\frac{x \times d \times 10}{M_{solute}}$
(b)	M_R on mixing two basic solutions	(ii)	n × M × V ml
(c)	M_R on mixing acidic and basic solutions	(iii)	$\frac{M_1V_1 - M_2V_2}{V_1 + V_2}$
(d)	milliequivalent	(iv)	$\frac{M_1V_1}{V_2}$
(e)	Molarity	(v)	$\frac{M_1V_1 + M_2V_2}{V_1 + V_2}$

(A) (a) - (i) , (b) - (iii) , (c) - (i) , (d) - (ii), (e)-(iv)

(B) (a) - (v) , (b) - (v) , (c) - (iii) , (d) - (ii), (e)-(i, iv)

(C) (a) - (ii) , (b) - (i) , (c) - (ii) , (d) - (iii), (e)-(ii)

(D) (a) - (i) , (b) - (ii) , (c) - (ii) , (d) - (iii), (e)-(iii)

138. Match the following

	List I		**List II**
(a)	$N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_3$	(P)	$K_P = K_C$
(b)	$H_{2(g)} + S_{(s)} \rightleftharpoons H_2S_{(g)}$	(Q)	$K_P > K_C$
(c)	$H_{2(g)} + I_{2(g)} \rightleftharpoons 2HI_{(g)}$	(R)	$K_P < K_C$
(d)	$2NaHCO_{3(s)} \rightleftharpoons Na_2CO_{3(s)} + CO_{2(g)} + H_2O_{(g)}$		

(A) a-Q, b-P, c-P, d-R (B) a-P, b-P, c-Q, d-R

(C) a-Q, b-R, c-P, d-R (D) a-R, b-P, c-P, d-Q

139. Match the following

	List I		**List II**
(a)	$K_{eq} < 1$	(P)	Affected by temperature
(b)	Degree of dissociation	(Q)	Affected by pressure
(c)	Equilibrium constant	(R)	$K_f < K_b$
(d)	Melting of ice	(S)	$K_f > K_b$

(A) a-R, b-P, c-S, d-Q (B) a-R, b-P,Q, c-P, d-P,Q

(C) a-R, b-S c-P, d-Q (D) a-Q, b-R, c-S, d-P

140. Match the following

List I (Reaction)	**List II (units)**
(a) $N_2 + O_2 \rightleftharpoons 2NO$	(P) $K_c = m/l$
(b) $N_2 + 3H_2 \rightleftharpoons 2NH_3$	(Q) no unit
(c) $PCl_5 \rightleftharpoons PCl_3 + Cl_2$	(R) $k_p = atm^{-2}$
(d) $A_{(l)} \rightleftharpoons B_{(g)}$	(S) $K_p = atm$

(A) a-Q, b-R,c-P,S, d-P,S
(B) a-Q, b-R,c-P, d-S
(C) a-S, b-Q,c-P,R, d-P,S
(D) a-R, b-Q,c-P,S, d-S

141. Match the following (Give correct match according to law of equivalence)

Oxidising agent	**Reducing agent**
(A) 25 ml , 0.2 N $KMnO_4 \rightarrow Mn^{2+}$	(P) 50 ml 0.1 M $H_3AsO_3 \rightarrow H_3AsO_4$
(B) 25 ml , 0.1 M $K_2Cr_2O_7 \rightarrow Cr^{+3}$	(Q) 25 ml 0.2 M $FeSO_4 \rightarrow Fe^{+3}$
(C) 50 ml , 0.1 M $Br_2/H_2O \rightarrow Br^-$	(R) 25 ml 0.15 M $H_2O_2 \rightarrow H^+$ and O_2
(D) 25 ml , 0.1 M $HNO_3 \rightarrow NO$	(S) 25 ml 0.3 M $SnCl_2 \rightarrow Sn^{+4}$

142. **Match the following :**

Column I	**Column II**
(A) NH_3	(P) Non polar molecule
(B) PF_2Cl_3	(Q) Polar molecule
(C) XeF_2	(R) Bonding taking place in ground state
(D) H_2S	(S) Bonding taking place in excited state.

143. Match the following :

Column I	**Column II**
(i) A process carried out infinitesimally slowly	(a) $\Delta E = 0, \Delta H = 0$
(ii) A process in equilibrium	(b) sublimation
(iii) $A(s) \longrightarrow A(g)$	(c) $\Delta G = 0$
(iv) Cyclic process	(d) reversible

(A) i-c, ii-d, iii-a, iv-b
(B) i-c, ii-d, iii-b, iv-a
(C) i-d, ii-c, iii-a, iv-b
(D) i-d, ii-c, iii-b, iv-a

144. Match the following

Column I	**Column II**
(i) Extensive properties P, V & T	(a) density (at constant pressure)
(ii) closed system	(b) bursting of tyre
(iii) path function	(c) additive in nature
(iv) adiabatic	(d) $E \neq$ constant
(v) intensive properties	(e) heat

(A) i-c, ii-d, iii-e, iv-b, v-a
(B) i-d, ii-c, iii-b, iv-e, v-a
(C) i-c, ii-e, iii-d, iv-b, v-a
(D) i-e, ii-d, iii-c, iv-a, v-b

145. Match the following

Column I	**Column II**
(i) Exothermic	(a) ΔH positive
(ii) Endothermic	(b) $\Sigma\Delta H_{f(P)} - \Sigma\Delta H_{f(R)}$
(iii) Heat of reaction	(c) ΔH negative
(iv) Change in free energy	(d) $\Sigma BE_R - \Sigma BE_P$
(v) Spontaneous process	(e) ΔG negative
	(f) $\Delta H - T\Delta S$

(A) i-c, ii-a, iii-bd, iv-f, v-e
(B) i-d, ii-c, iii-b, iv-e, v-a
(C) i-c, ii-e, iii-d, iv-b, v-a
(D) i-e, ii-d, iii-c, iv-a, v-b

146. Match the following

	Column I		Column II			
			ΔG	ΔH	ΔS	T
(i)	non spontaneous, exothermic	(a)	–ve	+ve	+ve	high
(ii)	spontaneous, endothermic	(b)	+ve	+ve	+ve	low
(iii)	non spontaneous, increase in entropy	(c)	+ve	–ve	–ve	high

(A) i-c , ii-a , iii-b
(B) i-a , ii-b , iii-c
(C) i-b , ii-a , iii-c
(D) i-c , ii-b , iii-a

147. **Match the following :**

Column I	Column II
(a) 10 vol H_2O_2	(P) 0.05 N
(b) 2.25 g/L $H_2C_2O_4$ as reducing agent	(Q) 3%(w/v)
(c) 2.5%(w/w) NaOH (density=1.2g/ml)	(R) 10 ppm
(d) 5 mg CaF_2 in 500 gm paste	(S) 0.625 m

148.

Column - I (Pair of species)	Column - I (Identical Property in pairs of species)
(A) PCl_3F_2 and PCl_2F_3	(P) Hybridisation of central atom
(B) BF_3 and BCl_3	(Q) Shape of molecule/ion
(C) CO_2 and CN_2^{-2}	(R) μ (dipole moment)
(D) C_6H_6 and $B_3N_3H_6$	(S) Total number of electrons

149. **Match the following (1 to 1 matching):**

Column I	Column II
(a) Rydberg Formula	(P) Weak electrolyte
(b) Ostwald isolation method	(Q) Spectrum of H atom
(c) Ostwald–Walker method	(R) Determination of kinetic order
(d) Ostwald dilution law	(S) Determination of vapor pressure

(A) (a – Q, b – R, c – S, d – P)
(B) (a – P, b – R, c – S, d – Q)
(C) (a – Q, b – R, c – P, d – S)
(D) (a – Q, b – S, c – R, d – P)

150.

Column-I (Compounds)	Column-II (Properties)
(A) XeF_4, $[ClF_4O]^-$, $[XeO_6]^{4-}$, IF_5	(p) same hybridisation of central atom
(B) XeO_3, $[ClF_2O]^+$, ClO_3^-, SO_3^{2-}	(q) same shape of the molecule/ion
(C) XeO_4 , $[XeO_6]^{4-}$, PCl_3F_2 , I_3^-	(r) all have zero dipole moment
(D) XeO_2F_2 , ClF_3O , XeF^+ , ICl^-	(s) all have atleast one lone pair of electrons on the central atom

151. **Match the column**

Column I Measurement of pressure	Column II Device used
(i) Pressure of gas is less than atm pressure	(A) Sphygmomanometer
(ii) Pressure of gas is more than atm pressure	(B) Barometer
(iii) Absolute pressure of gas	(C) open arm manometer
(iv) Atmospheric pressure	(D) closed arm manometer

(a) (i) - CD; (ii) - CD; (iii)-D ; (iv) - B
(b) (i) - AD; (ii) - BC; (iii)-A ; (iv) - B
(c) (i) - AC; (ii) - CD; (iii)-A ; (iv) -D
(d) (i) - AD; (ii) - BC; (iii)-B ; (iv) - A

152. Match the following

List I **Components present in solution**	**List II** **Method of determination of pH**
(a) $CH_3COOH + HCl$	(P) Basic buffer
(b) $NH_4OH + NH_4Cl$	(Q) Stronge base
(c) NH_4Cl	(R) Strong acid
(d) $NH_4OH + NaOH$	(S) Salt hydrolysis

(A) a-Q, b-R, c-S, d-P
(B) a-R, b-S, c-P, d-Q
(C) a-Q, b-S, c-P, d-R
(D) a-R, b-P, c-S, d-Q

153. Match the following

List I **Salt**	**List II** **pH**
(a) HCOONa	(P) 7
(b) NH_4Cl	(Q) < 7
(c) $MgSO_4$	(R) > 7
(d) CH_3COONH_4	

(A) a–Q, b-P, c-R, d-P
(B) a–P, b-Q, c-Q, d-R
(C) a–R, b-Q, c-P, d-P
(D) a–R, b-R, c-Q, d-P

154. A weak acid HA having $K_a = 10^{-4}$ is given 100 ml of 0.1 M acid is taken in container. Now 0.1 M NaOH is added in the container List I contains volume of NaOH added and List II contains pH. Match them.

List I	**List II**
(a) 10 ml NaOH solution	(P) $\frac{1}{2}[pK_w + pK_a + \log c]$
(b) 25 ml NaOH solution	(Q) $pK_a + \log 3$
(c) 75 ml NaOH solution	(R) $pK_a - \log 3$
(d) 100 ml NaOH solution	(S) $pK_a - 2\log 3$.

(A) a-S, b-R, c-Q, d–P
(B) a-P, b-Q, c-R, d–S
(C) a-Q, b-R, c-S, d–P
(D) a-S, b-P, c-Q, d–R

155. **Match the column**

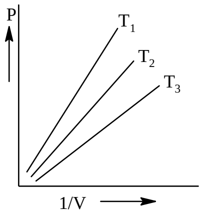
Column I	**Column II**
(i) Boyle's law	(A) Mass = constant
(ii) Charle's law	(B) Pressure = constant
(iii) Gaylussac's law	(C) Temperature = constant
(iv) Avogadro's law	(D) Volum = constant

(a) (i) - A, C ; (ii) - A, D ; (iii) - A,B ; (iv) - B, C
(b) (i)- B, D ; (ii) - A, C ; (iii) - A, C ; (iv) - A, B, C, D
(c) (i)- A, D ; (ii) - D, C ; (iii) - A, C ; (iv) - A, C
(d) (i)- B, C ; (ii) - C, D ; (iii) - D, C ; (iv) - A, D

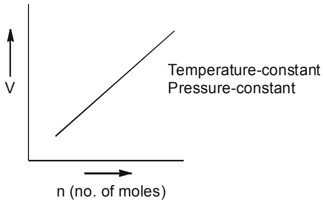
156. **Match the column**

Column I **Column II**

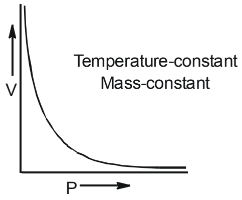
(i) $T_1 > T_2 > T_3$ (A)



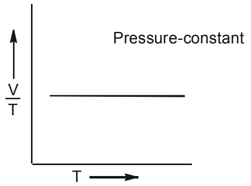
(ii) Charle's Law (B)



(iii) Boyle's law (C)



(iv) Avogadro's law (D)



(a) (i) - CD; (ii) - CD; (iii)-D ; (iv) - B
(b) (i) - AD; (ii) - BC; (iii)-A ; (iv) - B
(c) (i) - AC; (ii) - CD; (iii)-A ; (iv) -D
(d) (i) - A; (ii) - D; (iii) - A,C; (iv) - B

157. **Match the following :**

	Column I		**Column II**
(a)	For a gas repulsive tendency dominates	(P)	Effects in 'a' and 'b' compensates each other.
(b)	At T_B = – 3 °C for a gas in high pressure region	(Q)	There is no difference between liquid and gas.
(c)	at T_C	(R)	Z > 1
(d)	for He gas at 0°C in all pressure region	(S)	T_C = 80 K

SECTION V: INTEGER TYPE

158. 3 moles of hydrogen are compressed isothermally and reversibly from 60 dm^3 to 20 dm^3 and 13.695 kJ of work is done on it. Assuming ideal behaviour, calculate the temperature of gas.
[R = 8.3 J/mol–K , ln 3 = 1.1]

159. A compound which contains one atom of X and two atoms of Y for each three atoms of Z is made by mixing 5.00 g of X , 1.15×10^{23} atoms of Y and 0.03 mole Z atoms . Given that only 4.40 g of compound results . Calculate the atomic weight of Y if the atomic weights of X and Z are 60 and 80 amu respectively .

160. If the oxidation number of Fe in $[Fe(CN)_6]^{-3}$, $[Fe(CN)_6]^{-4}$, $[Fe(SNC)]^{+2}$ and $[Fe(H_2O)_6]^{+3}$ respectively would be ABCD, the the value of that 4 digit integer will be:

161 The Enthalpy change involved in the oxidation of glucose is -2880 kJ mol^{-1} . 25 % of this energy is available for muscular work . If 100 kJ of muscular work is needed to walk one km. What is the maximum distance (in m) a person will be able to walk after eating 120 g of glucose.

162. Work done is expansion of an ideal gas from 4 litre to 6 litre against a constant external pressure of 2.5 atm was used to heat up 1 mole of water at 293 K. If specific heat of water is 4.184 J g^{-1} K^{-1}, what is the final temperature of water (in K) to the nearest integer?

163 For 10 minutes each, at 27ºC, from two identical holes nitrogen and an unknown gas are leaked into a common vessel of 3 litre capacity . The resulting pressure is 4.18 bar and the mixture contains 0.4 mole of nitrogen. What is the molar mass (in gm/mol) of the unknown gas ? Give your answer to the nearest integer

164. A drug marijuana owes its activity to tetrahydro cannabinol , which contains 70 % as many as carbon atoms as hydrogen atoms and 15 times as many hydrogen atoms as oxygen atoms . The number of mole in a gram of tetrahydro cannabinol is 0.00318 . If it's molecular formula is **$C_x H_y O_z$,** Then find (x+y*z)

165 Calculate the pH at which $Mg(OH)_2$ begins to precipitate from a solution containing 0.10 M Mg^{+2} ions. K_{sp} of $Mg(OH)_2 = 1 \times 10^{-11}$.

166. A mixture of $(NH_4)_2SO_4$ and NH_4Cl in the ratio 43.7 % and 56.3 % respectively was dissolved in water to prepare 1 litre solution . 25 mL of this solution was boiled with 50 mL of N/10 NaOH until all the NH_3 was evolved . The excess of NaOH was neutralized by 24.3 mL of N/10 HCl . Calculate the weight of each component in mixture .

167. 13.6 eV is needed for ionisation of a hydrogen atom. An electron in a hydrogen atom in its ground state absrobs 1.50 times as much energy as the minimum energy required for it to escape from the atom. What is the wavelength of the emitted electron in Angstrom? (Answer to the nearest integer)
($m_e = 9.109 \times 10^{-31}$ kg, e = 1.602×10^{-19} coulomb, h = 6.63×10^{-34} J.s)

168. A series limit of the Balmer series of hydrogen is given by 3.65×10^{-5} cm . An element is found to give k_α line of wavelength 10^{-8} cm . Find out the atomic number of the element .

169. The maximum possible number of hydrogen bonds in which a water (H_2O) molecule can participate?

170 For the reaction $Ag(CN_2)^- \rightleftharpoons Ag^+ + 2CN^-$, the K_C at 25°C is 4×10^{-19}. If the $[Ag^+]$ concentration is (ab × 10^{-cd}) in solution which was originally 0.1 M in KCN and 0.03 M in $AgNO_3$. Give the value of 4 digit integer 'abcd' eg. 1234.

171. When light of frequency v is thrown on a metal surface with threshold frequency v_0 , Photoelectrons are emitted with maximum kinetic energy = 1.3×10^{-18} J . If the ratio , $v : v_0 = 3 : 1$, calculate the threshold frequency v_0 .

172. The ionization constant of benzoic acid is 6.46×10^{-5} and K_{sp} for silver benzoate is 2.5×10^{-13}. How many times is silver benzoate more soluble in a buffer of pH 3.19 compared to its solubility in pure water. Answer to the nearest integer.

173. A balloon of diameter 20 m weighs 100 kg. Calculate payload if it is filled with He at 1 atm and 27^0C. Density of air = 1.2 kg/m^3 . Answer tp the nearest integer

174. 0.1 g sample of chromite was fused with excess of Na_2O_2 and brought into solution according to reaction , $2\ Fe(CrO_2)_2 + 7\ Na_2O_2 \longrightarrow 2\ NaFeO_2 + 4\ Na_2CrO_4 + 2\ Na_2O$
The solution was acidified with dilute HCl and 1.2 g mohr salt (molecular weight 392) added . The excess of Fe^{2+} required 24 mL of 0.05 N $K_2Cr_2O_7$ for titration . What is percent of Cr in sample ?

175. How many unpaired electrons are present in N_2^+ ?

176. Calculate the root mean square velocity of ozone kept in a closed vessel at 20ºC and 82 cm mercury pressure.

177. The angle between the bonding orbitals of a molecule AX_3 with zero dipole moment is?

178 At 27^0C, hydrogen is leaked through a tiny hole into a vessel for 20 minutes. Another unknown gas at the same temperature and pressure as that of H_2 is leaked through the same hole for 20 minutes . After the effusion of the gases the mixture exerts a pressure of 6 atm. The hydrogen content of the mixture is 0.7 mole . If the volume of the container is 3 litre , what is molecular weight of unknown gas.

179. The dissociation pressure of solid ammonium hydro-sulphide at 27 ºC is 60 cm . What will be the total pressure when it dissociates at the same temperature in presence of NH_3 at a pressure of 45 cm ? Assume NH_4HS dissociates completely into NH_3 and H_2S .

180. In the following reaction , $KAl + LFe_3O_4 \rightarrow MAl_2O_3 + NFe$
The values of the 4 digit integer KLMN is?

181. The rate of disappearance of A at two temperature for the equilibrium $A \rightleftharpoons B$ is given by,

$$-\frac{dA}{dt} = 2 \times 10^{-2}\ [A] - 4 \times 10^{-3}\ [B] \text{ at } 300\text{ K}$$

$$-\frac{dB}{dt} = 4 \times 10^{-2}\ [A] - 16 \times 10^{-4}\ [B] \text{ at } 400\text{ K}$$

Calculate : (i) equilibrium constants at 300 K and 400 K and
(ii) heat of reaction

182. How will the concentration of Ag^+ in a saturated solution of AgCl diminish if such an amount of HCl is added to it that the concentration of Cl^- in the solution becomes equal to 0.03 mol litre^{-1} ?
[$K_{sp_{AgCl}} = 1.8 \times 10^{-10}$]

XII

SECTION I: SINGLE OPTION CORRECT

183. Lowering of vapour pressure due to a solute in 2 molal solution at 100ºC is -

(A) 13.44 Torr (B) 14.12 Torr (C) 312 Torr (D) 26.4 Torr

184. An aqueous solution containing liquid A (M. wt. = 128) 64% by weight has a V. P. of 145 mm. If the vapour pressure of water is 155 mm then vapour pressure of A at the same temperature will be -

(A) 205 mm (B) 105 mm (C) 185 mm (D) 52.5 mm

185. Liquids A and B form an ideal solution and the B has stronger intermolecular forces. If X_A and X'_A are the mole fractions of A in the solution and vapour in equilibrium, then -

(A) $\frac{X'_A}{X_A} = 1$ (B) $\frac{X'_A}{X_A} > 1$ (C) $\frac{X'_A}{X_A} < 1$ (D) $X'_A + X_A = 1$

186. A solution of a non-volatile solute in water has a boiling point of 375. 3 K. The vapour pressure of water above this solution at 338 K is -

[Given p_0 (water) = 0.2467 atm at 338 K and K_b for water =0.52 K kg mol^{-1}]

(A) 0.18 atm (B) 0.23 atm (C) 0.34 atm (D) 0.42 atm

187. Which of the following is wrong :

(A) Enthalpy (numerical value) of physisorption is greater than that of chemisorption

(B) Physisorption is not very specific but chomisorption is highly specific

(C) Chemisorption takes place at relatively high temperatures

(D) In physisorption generally multi–molecular layers are formed on the adsorbent

188. Which of the following gases, will be adsorbed maximum on a solid surface :

(A) CO_2 (B) O_2 (C) N_2 (D) H_2

189. Which of the following has minimum gold number?

(A) Potato starch (B) Gum arabic (C) Gelatin (D) Albumin

190. Which of the following is a mismatch :

(A) Lyophilic colloids – reversible sols

(B) Associated collides – micelles

(C) Tyndall effect – scattering of light by colloidal particle

(D) Electrophoresis – movement of dispersion medium under the influence of electric field

191. Which of the following ions will be most effective in coaogulating the As_2S_3 sol :

(A) Fe^{3+} (B) Ba^{2+} (C) Cl^- (D) PO_4^{3-}

192. When freshly precipated $Fe(OH)_3$ is shaken with aqeous solution of $FeCl_3$, a colloidal solution is formed. This process is known as :

(A) Emulsification (B) Coagulation (C) Petpization (D) Electro–osmosis

193. (i) At 298 K the volume of NH_3 adsorbed by 1g of charcoal is higher than that of H_2 under similar conditions.

(ii) The movement of collodial particles towards the oppositely charged electrodes on passing electric current is known as Brownian movement.

(A) T, T (B) T, F (C) F, T (D) F, F

194. Two solution of $CH_2ClCOOH$ and CH_3COOH are prepared separately molarity of both in 0.1 M and osmotic pressure are P_1 & P_2. The correct relationship between the osmotic pressure is

(A) $P_2 > P_1$ (B) $P_1 > P_2$ (C) $P_1 = P_2$ (D) $\frac{P_1}{P_1+P_2} = \frac{P_2}{P_1+P_2}$

195. The f.p of a 0.08 molal solution of $NaHSO_4$ is –0.372°C. The dissociation constant for the reaction , $HSO_4^- \longrightarrow H^+ + SO_4^{2-}$; is - [K_f for water = 1.86°C]

(A) 2×10^{-4} (B) 4×10^{-4} (C) 2×10^{-2} (D) 4×10^{-2}

196. 1 g of monobasic acid in 100 g of water lowers the freezing point by 0.168°. If 0.2 g of same acid requires 15.1 mL of N/10 alkali for complete neutralization, degree of dissociation of acid will be - [K_f for H_2O is 1.86 K mol^{-1} kg]

(A) 16.8% (B) 22.4% (C) 19.6% (D) 26.2%

197. Which of the following expressions is true in case of sodium chloride unit cell :

(A) $r_c + r_a = a$ (B) $r_c + r_a = \frac{a}{2}$ (C) $r_c + r_a = 2a$ (D) $r_c + r_a = \sqrt{2}\,a$

198. Two electro chemical cells are assembled in which the following reactions occur,

$V^{2+} + VO^{2+} + 2H^+ \longrightarrow 2V^{3+} + H_2O$; $E^o_{cell} = 0.616$ V

$V^{3+} + Ag^+ + H_2O \longrightarrow VO^{2+} + 2H^+ + Ag(s)$; $E^o_{cell} = 0.439$ V

then E° for the half reaction , $V^{3+} + e^- \longrightarrow V^{2+}$, is : [Given : $E^o_{Ag+|Ag} = 0.799$ V]

(A) –0.256 V (B) +0.256 V (C) –1.05 V (D) +1.05 V

199. For the cell reaction , $\underset{(C_1)}{Cu^{2+}}(aq) + Zn(s) \longrightarrow \underset{(C_2)}{Zn^{+2}}(aq) + Cu(s)$

of an electrochemical cell , the change in free energy ΔG at a given temperature is a function of :

(A) $\ell n(C_1)$ (B) $\ell n(C_2/C_1)$ (C) $\ell n(C_1 + C_2)$ (D) $\ell n(C_2)$

200. Consider the reaction of extraction of gold from its ore

$$Au + 2CN^- (aq.) + \frac{1}{4}O_2(g) + \frac{1}{2}H_2O \longrightarrow Au(CN)_2^- + OH^-$$

Use the following data to calculate $\Delta G°$ for the reaction

$K_f\{Au(CN)_2^-\} = X$

$O_2 + 2H_2O + 4e^- \longrightarrow 4OH^-$; E° = + 0.41 volt

$Au^{3+} + 3e^- \longrightarrow Au$; E° = + 1.5 volt

$Au^{3+} + 2e^- \longrightarrow Au^+$; E° = + 1.4 volt

(A) $-RT\,ln\,X + 1.29\,F$ (B) $-RT\,ln\,X - 2.11\,F$

(C) $-RT\,ln\,\frac{1}{X} + 2.11\,F$ (D) $-RT\,ln\,X - 1.29\,F$

201. The activity of a radionuclide (X^{100}) is 6.023 curie. If the disintegration constant is 3.7×10^{4} sec^{-1}, the mass of radionuclide is:
(A) 10^{-14} g (B) 10^{-6} g (C) 10^{-15} g (D) 10^{-3} g

202. The ionization constant of a weak electrolyte is 64×10^{-6} while the equivalent conductance of its 0.01 M solution is 20 s cm^{2} eq^{-1}. The equivalent conductance of the electrolyte at infinite dilution (in S cm^{2} eq^{-1}) will be :
(A) 250 (B) 196 (C) 392 (D) 384

203. The conductivity of 0.35 M solution of univalent weak electrolyte XY is 0.0175 Ω^{-1} cm^{-1}. The value of Λ_m^{∞} of XY is 500 Ω^{-1} cm^{2} mol^{-1}. the value of Ostwald dilution constant of AB is :
(A) 3.89×10^{-3} (B) 2.5×10^{-4} (C) 2.8×10^{-3} (D) 2.8×10^{-4}

204. Solid CO_2 is an example of the crystal type :
(A) ionic (B) covalent (C) metallic (D) molecular

205. Name the crystal class for which all the four types of unit cells are possible.
(A) hexagonal (B) tetragonal (C) monoclinic (D) orthorhombic

206. Co-ordination ratio changes to lower number e.g. 8 : 8 to 6 :6 on :
(A) applying pressure (B) increasing temperature
(C) a and b (D) change in catalyst

207. Radium has atomic weight 226 and half life of 1600 year. The number of disintegration produced per sec. from 1 g are:
(A) 4.8×10^{10} (B) 3.7×10^{10} (C) 9.2×10^{6} (D) 3.7×10^{8}

208. NaCl shows schottky defects, AgCl frenkel defects. Their electrical conductivity is due to :
(A) motion of ions and not motion of electrons
(B) motion of electrons and not motion of ions
(C) lower co-ordination number of KCl
(D) higher co-ordination number of AgCl

209. In a crystalline solid, anion B are arranged in CCP lattice and cations A occupy 50% of the octahedral voids and 50% of the tetrahedral voids. What is the formula of the solid?
(A) AB (B) A_3B_2 (C) A_2B_2 (D) A_2B_3

210. An aqueous solution containing one mole per litre each of $Cu(NO_3)_2$, $AgNO_3$, $Hg_2(NO_3)_2$, $Mg(NO_3)_2$ is being electrolysed by using inert electrodes. The value of standard potentials are

$$E^{\circ}_{Ag^{+}|Ag} = 0.80V, E^{\circ}_{Hg_2^{2+}|Hg} = 0.79V,\ E^{\circ}_{Cu^{2+}|Cu} = 0.34V \text{ and } E^{\circ}_{Mg^{2+}|Mg} = -2.3V$$

With increasing voltage, the sequence of deposition of metals on the cathode will be
(A) Ag, Hg, Cu, Mg (B) Mg, Cu, Hg, Ag (C) Ag, Hg, Cu (D) Cu, Hg, Ag

211. If 'a' is the edge length of the unit cell of an atomic crystal having face centered cubic lattice, then what is the distance of closest approach between the two atoms in the crystal ?
(A) $\sqrt{2}\,a$ (B) $\frac{a}{2}$ (C) $\frac{\sqrt{2}}{a}$ (D) $\frac{1}{2}(\sqrt{2}a)$

212. The number of β-particle emitted during the change ${}_{a}X^{c} \longrightarrow {}_{d}Y^{b}$ is:
(A) $\frac{a-b}{4}$ (B) $d + \left[\frac{a-b}{2}\right] + c$ (C) $d + \left[\frac{c-b}{2}\right] - a$ (D) $d + \left[\frac{a-b}{2}\right] - c$

213. Which is correct relation in between $\frac{dC}{dt}$, $\frac{dn}{dt}$ and $\frac{dP}{dt}$ where C, n, P, represents concentration, mole and pressure terms for gaseous phase reactant $A(g) \longrightarrow$ product.

(A) $-\frac{dC}{dt} = -\frac{1}{V}\frac{dn}{dt} = -\frac{1}{RT}\frac{dP}{dt}$ (B) $\frac{dC}{dt} = \frac{dn}{dt} = -\frac{dP}{dt}$

(C) $\frac{dC}{dt} = \frac{RT}{V}\frac{dn}{dt} = -\frac{dP}{dt}$ (D) All

214. For the reaction, $H_2(g) + Br_2(g) = 2HBr(g)$, the reaction rate = $K [H_2] [Br_2]^{1/2}$. Which statement is true about this reaction :

(A) The reaction is of second order (B) Molecularity of the reaction is 3/2

(C) The unit of K is sec^{-1} (D) Molecularity of the reacion is 2

215. A radioactive isotope having a half life of 3 day was received after 12 day. It was found that there were 3 g of the isotope in the container. The initial weight of the isotope when packed was:

(A) 12 g (B) 24 g (C) 36 g (D) 48 g

216. The rate constant for a reaction is 10.8×10^{-5} mol $litre^{-1}$ sec^{-1}. The rection obeys :

(A) First order (B) Zero order (C) Second order (D) Half order

217. Salts of A (atomic weight = 7), B (atomic weight =27) and C (atomic weight = 48) were electrolysed under identical conditions using the same quantity of electricity. It was found that when 2.1 g of A was deposited, the weights of B and C deposited were 2.7 and 7.2 g. The valencies of A, B and C respectively are

(A) 3, 1 and 2 (B) 1, 3 and 2 (C) 3, 1 and 3 (D) 2, 3 and 2

218. The $^{238}_{92}U$ disintegrates to give 4 α-and 6-β particles. The atomic number of the end product is

(A) 92 (B) 96 (C) 84 (D) 90

219. What is the order of reaction ,

$A_2 + B_2 \longrightarrow 2\,AB$; having following mechanism

$A_2 \rightleftharpoons A + A$ .... (fast)

$A + B_2 \longrightarrow AB + B$ .... (slow)

$A + B \longrightarrow AB$ .... (fast)

(A) 2 (B) 1 (C) 3/2 (D) 1/2

SECTION II: MORE THAN ONE OPTION CORRECT

220. 1 mol benzene ($P^o_{benzene}$ = 42 mm) and 2 mol toluene ($P^o_{toluene}$ = 30 mm) will have
(A) total pressure 38 mm
(B) mol fraction of vapours of benzene above liquid mixture is 7/19
(C) positive deviation from Raoult's law
(D) negative deviation from Raoult's law

221. Which of the following statements are correct ?
(A) The rate of the reaction involving the conversion of ortho-hydrogen to parahydrogen is

$$-\frac{d[H_2]}{dt} = k[H_2]^{3/2}$$

(B) The rate of the reaction involving the thermal decomposition of acetaldehyde is $k[CH_3CHO]^{3/2}$
(C) In the formation of phosgene gas from CO and Cl_2, the rate of the reaction is $k[CO][Cl_2]^{1/2}$
(D) In the decomposition of H_2O_2, the rate of the reaction is $k[H_2O_2]$.

222. Emulsion can be destroyed by
(A) the addition of an emulsifier which tends to form an emulsion of the same type
(B) electrophoresis with a high potential
(C) freezing
(D) all of these

223. Which of the following statements are correct
(A) ΔE_{cell} is temperature independent
(B) A reaction is spontaneous from left to right if $Q < K_{eq}$ in which case $\Delta E_{cell} > 0$
(C) A reaction occurs from right to left if $K_{eq} < Q$, in which case $\Delta E_{cell} < 0$
(D) none of these

224. During discharging of lead storage battery, which of the following is/are true ?
(A) H_2SO_4 is produced
(B) H_2O is consumed
(C) $PbSO_4$ is formed at both electrodes
(D) Density of electrolytic solution decreases

225. Isoelectric point is the pH at which colloidal particles
(A) coagulate
(B) becomes electrically neutral
(C) can move toward either electrode
(D) none of these

226. To 10 mL of 1 M $BaCl_2$ solution 5 mL of 0.5 M K_2SO_4 is added, $BaSO_4$ is precipitated out. What will happen?
(A) F. pt. is increased
(B) B. pt. is increased
(C) F. pt. is lowered
(D) B. pt. is lowered

227. Which of the following is/are correct
(A) α-rays are more penetrating than β-rays
(B) α-rays have greater ionizing power than β-rays
(C) β-particles are not present in the nucleus, yet they are emitted from the nucleus
(D) γ-rays are not emitted simultaneously with α and β-rays

228. Which of the following arrangement will produce oxygen at anode during electrolysis ?
(A) Dilute H_2SO_4 solution with Cu electrodes.
(B) Dilute H_2SO_4 solution with inert electrodes.
(C) Fused NaOH with inert electrodes.
(D) Dilute NaCl solution with inert electrodes.

229. The azeotropic solution of two miscible liquids
(A) can be separated by simple distillation
(B) may show positive or negative deviation from raoult's law
(C) are super saturated solutions
(D) behave like a single component and boil at a constant temperature

230. Which of the following are macromolecular colloids
(A) starch (B) soap (C) detergent (D) cellulose

231. Which of the following statements is correct for electrophoresis ?
(A) colloids are uncharged particles and do not migrate towards the electrodes when electric field is applied
(B) in electrophoresis, solution migrates either to the anode or to the cathode depending on the positively or negatively charged solution
(C) electrophoresis is a useful method for finding the charge of a solution
(D) none of these

232. The basic theory of Arrhenius's equation is that
(A) the number of effective collisions is proportional to the number of molecules above a certain threshold energy
(B) as the temperature increases, the number of molecules with energies exceeding the threshold energy increases
(C) the rate constant is a function of temperature
(D) activation energy and pre-exponentional factors are always temperature independent

233. Pick out the **correct** statements among the following from inspection of standard reduction potentials (Assume standard state conditions).

Cl_2 (aq.) + 2e l $2Cl^-$(aq.) $E^o_{Cl_2/Cl^-}$ = + 1.36 volt

Br_2 (aq.) + 2e l $2Br^-$(aq.) $E^o_{Br_2/Br^-}$ = + 1.09 volt

I_2(s) + 2e l $2I^-$ (aq.) $E^o_{I_2/I^-}$ = + 0.54 volt

$S_2O_8^{2-}$ (aq.) + 2e l $2SO_4^{2-}$ (aq.) $E^o_{S_2O_8^{2-}/SO_4^{2-}}$ = + 2.00 volt

(A) Cl_2 can oxidise SO_4^{2-} from solution
(B) Cl_2 can oxidise Br^- and I^- from aqueous solution
(C) $S_2O_8^{2-}$ can oxidise Cl^-, Br^- and I^- from aqueous solution
(D) $S_2O_8^{2-}$ is added slowly, Br^- can be reduce in presence of Cl^-

234. Effect of adding a non volatile solute to a solvent is
(A) to lower the vapour pressure (B) to increase its freezing point
(C) to increase its boiling point (D) to decrease its osmotic pressure

235. Methods used for the preparation of colloidal solutions are
(A) peptisation (B) hydrolysis
(C) ultrasonic dispersion (D) coagulation

236. The correct starting material and product of different disintegration series are
(A) ^{232}Th, ^{208}Pb (B) ^{235}U, ^{206}Pb (C) ^{238}U, ^{207}Pb (D) ^{237}Np, ^{209}Bi

237. Surfactant molecules or ions can cluster together as micelles, which
(A) are colloid-sized cluster of molecules
(B) due to their hydrophobic tails tend to congregate
(C) due to their hydrophobic head provide protection
(D) none of these

238. Which of the following are correctly matched?
(A) Butter-gel (B) Milk-emulsion (C) Fog-aerosol (D) Dust-solid sol

239. Which of the following are incorrect statements?
(A) Hardy schulz rule is related to coagulation
(B) Brownian moment and Tyndall effect are the characteristic of colloids.
(C) In gel, the liquid is dispersed in liquid
(D) Lower the gold number, more is the protective power of lyophillic sols.

240. Which of the following are multimolecular colloids?
(A) Sulphur (B) Egg albumin in water
(C) Gold sol (D) Soap solution

241. The origin of charge on colloidal solution is
(A) Frictional rubbing
(B) Electron capture during Bredig's arc method
(C) Selective adsorption of ion on their surface
(D) It is due to addition of protective colloids

242. Which of the following are based on Tyndall effect.
(A) Ultra microscope (B) Deltas (C) Blue colour of sky (D) Coagulation

243. If 270.0 g of water is electrolysed during an experiment performed by miss Abhilasha with 75% current efficiency then
(A) 168 L of O_2 (g) will be evolved at anode at 1 atm & 273 K
(B) Total 504 L gases will be produced at 1 atm & 273 K.
(C) 336 L of H_2 (g) will be evolved at anode at 1 atm & 273 K
(D) 45 F electricity will be consumed

244. Which of the following reactions is of the first order ?
(A) The decomposition of ammonium nitrate in an aqueous solution
(B) The inversion of cane-sugar in the presence of an acid
(C) The acidic hydrolysis of ethyl acetate
(D) All radioactive decays.

245. If two solution are isotonic then : [C is concentration of solution and i is vant Hoff factor]
(A) $C_1 = C_2$ (if both are non-electrolyte)
(B) $i \times C_1 = C_2$ (If one is electrolyte and another is non-electrolyte)
(C) $i_1 \times C_1 = i_2 \times C_2$ (if both are electrolytes)
(D) none of these

246. Which of the following is correctly matched (where Z is number of atoms per unit cell, a is edge lenght of cube and r is radius of atom)

(A)	SCC	Z = 1	a = $\sqrt{2}$ r
(B)	BCC	Z = 2	a = $\frac{4}{\sqrt{3}}$ r
(C)	FCC	Z = 4	a = 2$\sqrt{2}$ r
(D)	HCP	Z = 4	a = 2 r

247. Which of the following statements are correct ?
(A) the work done by the system on the surrounding is negative
(B) the work done on the system by the surroundings is positive
(C) the heat absorbed by the system from the surroundings is positive
(D) the heat absorbed by the surroundings from the system is negative

248. Oxygen and hydrogen gas are produced at anode and cathode during the electrolysis of dilute aqueous solution of
(A) Na_2SO_4 (B) $AgNO_3$ (C) H_2SO_4 (D) NaOH

249. The calculation of the pre-exponential factor is based on the
(A) idea that, for a reaction to take place, the reactant species must come together
(B) Calculation of the molecularity of the reaction
(C) idea that the reactant species must come together, leading to the formation of the transition state which then transforms into the products
(D) calculation of the order of the reaction

250. In which of the following ways does an activated complex differ from an ordinary molecule ?
(A) It is quite unstable and has no independent existence.
(B) ΔH°_f is probably positive
(C) The system has a greater vibrational character.
(D) The system has no vibrational character.

251. $Zn + 2H^+ \longrightarrow Zn^{2+} + H_2$
Half-life period is independent of concentration of zinc at constant pH. For the constant concentration of Zn, rate becomes 100 times when pH is decreased from 3 to 2. Hence
(A) $\frac{dx}{dt} = k[Zn]^0[H^+]2$
(B) $\left(\frac{dx}{dt}\right) = k\,[Zn]\,[H^+]^2$
(C) rate is not affected if concentration of zinc is made four times and that of H^+ ions is halved.
(D) rate becomes four times if concentration of H^+ ion is doubled at constant Zn concentration,.

252. Which of the following statements are correct ?
(A) The electrolysis of aqueous NaCl produces hydrogen gas at the cathode and chlorine gas at the anode.
(B) The electrolysis of a dilute solution of sodium fluoride produces oxygen gas at the anode and O_2 gas at the cathode.
(C) The electrolysis of concentrated sulphuric acid produces SO_2 gas at the anode and O_2 gas at the cathode.
(D) After the electrolysis of aqueous sodium sulphate, the solution becomes acidic.

253. Which of the following statements are correct ?

(A) The electrolysis of concentrated H_2SO_4 at 0–5ºC using a Pt electrode produces $H_2S_2O_8$.

(B) The electrolysis of a brine solution produces $NaClO_3$ and NaClO.

(C) The electrolysis of a $CuSO_4$ solution using Pt electrodes causes the liberation of O_2 at the anode and the deposition of copper at the cathode

(D) All electrolytic reactions are redox reactions.

254. In an electrochemical process , a slat bridge is used :

(A) to maintain electroneutrality in each solution

(B) to complete the circuit so that current can flow

(C) as an oxidizing agent

(D) as a colour indicator

255. The decomposition of hydrogen peroxide is an example of

(A) Exothermic reaction (B) Endothermic reaction

(C) Negative catalysis (D) Auto-oxidation

256. A concentration cell is a galvanic cell in which :

(A) the electrode material and the solutions in both half-cells are composed of the same substances

(B) only the concentrations of the two solutions differ

(C) $\Delta E^0_{cell} = 0$

(D) the Nernst equation reduces to $\Delta E_{cell} = -\left(\frac{0.0592}{n}\right) \log Q$ at 25ºC

257. $Pb(s) | \underset{\substack{\text{saturated}\\ \text{solution}}}{PbSO_4} | \underset{\substack{\text{saturated}\\ \text{solution}}}{PbI_2} | Pb(s)$

Which of the following expressions represent the emf of the above cell at 25 ºC ?

(A) $E = \frac{0.0592}{2} \log \frac{(a_{pb^{2+}})_2}{(a_{pb^{2+}})_1}$

(B) $E = \frac{0.0592}{2} \log \frac{(a_{pb^{2+}})_1}{(a_{pb^{2+}})_2}$

(C) $E = \frac{0.0592}{2} \log \frac{[K_{sp}(PbI_2)]^{1/3}}{[K_{sp}(PbSO_4)]^{1/2}}$

(D) $E = \frac{0.0592}{2} \log \frac{K_{sp}(PbI_2)}{K_{sp}(PbSO_4)}$

258. When a non-volatile solute is added to a pure solvent, the

(A) vapour pressure of the solution becomes lower than that of the pure solvent

(B) rate of evaporation of the pure solvent is reduced

(C) solute does not affect the rate of condensation

(D) rate of evaporation of the solution is equal to the rate of condensation of the solution at a lower vapour pressure than that in the case of the pure solvent.

259. Which of the following combinations are correct for a binary solution, in which the solute as well as the solvent are liquid?

(A) C_6H_6 and $C_6H_5CH_3$; $\Delta H_{soln} > 0$; $\Delta V_{sol} = 0$

(B) CH_3COCH_3 and $CHCl_3$; $\Delta H_{soln} < 0$; $\Delta V_{sol} < 0$

(C) H_2O and HCl; $\Delta H_{soln} > 0$; $\Delta V_{sol} < 0$

(D) H_2O and C_2H_5OH; $\Delta H_{soln} > 0$; $\Delta V_{sol} > 0$

260. Which of the following statements are correct for a binary solution which shows negative deviation from Raoult's law?

(A) The negative deviation from linearity diminishes and tends to zero as the concentration of the solution component approaches unity.
(B) When solutions from, their volumes are smaller than the sum of the volumes of their components
(C) Heat is released during the formation of the solution.
(D) Heat is absorbed during the formation of the solution.

261. Which of the following structures have layered lattices ?

(A) cadmium iodide (B) ice
(C) graphite (D) diamond

262. A binary liquid (AB) shows positive deviation from Raoult's law wen

(A) $p_A > p_A^0 X_A^{liq} > p_B^0 X_B^{liq}$ (B) intermolecular forces: A–A, B–B > A–B
(C) $\Delta V_{mix} > 0$ (D) $\Delta H_{mix} > 0$

263. Lead metal has a density of 11.34 g/cm^3 and crystallizes in a face–centered lattice. Choose the correct alternatives

(A) the volume of one unit celt is 1.214×10^{-22} cm^3
(B) the volume of one unit cell is 1.214×10^{-19} cm^3
(C) the atomic radius of lead is 165 pm
(D) the atomic radius of lead is 155.1 pm

264. Consider following solutions:

I : 1 M aq. glucose II : 1 M aq. sodium chloride
III : 1 M benzoic acid in benzene IV : 1 M ammonium phosphate

Select correct statement (s)

(A) all are isotonic solutions (B) III is hypotonic of I, II, IV
(C) I, II, IV are hypertonic of III (D) IV is hypertonic of I, II, III

265. Which of the following is (are) lyophobic colloids?

(A) Gold sol (B) $As_2 S_3$ sol (C) Starch sol (D) $Fe(OH)_3$ sol

266. The ionic radii of Cs and Cl are 0.165 nm and 0.181nm respectively. Their atomic weights are 133 and 35.5. Then,

(A) the lattice parameter is 0.4 nm
(B) the lattice parameter can not be determined from this data
(C) the density of CsCl is 4.37×10^3 kg/m^3
(D) the CsCl structure has a fcc structure with a basis

267. Which of the following statements are correct about half-life period

(A) it is proportional to initial concentration for zeroth order
(B) average life = 1.44 half-life for first order reaction
(C) time of 75% reaction is thrice of half-life period in second order
(D) 99.9% reaction takes place in 100 minutes for the case when rate constant is 0.0693 min^{-1}

268. Which type of crystals contain one Bravais lattice?

(A) hexagonal (B) triclinic (C) rhombohedral (D) monoclinic

269. TiO_2(rutile) shows 6 : 3 coordination.Which of the following solids have a rutile-like structure ?

(A) MnO_2 (B) ZnS (C) KCl (D) SnO_2

270. The hcp and ccp structure for a given element would be expected to have

(A) the same coordination number (B) the same density
(C) the same packing fraction (D) all the above

271. Two reaction A → products and B → products have rate constant k_A and k_B at temperature T and activation energies E_A and E_B respectively. If $k_A > k_B$ and $E_A < E_B$ and assuming that A for both the reactions is same, then
(A) at higher temperatures k_A will be greater than k_B
(B) at lower temperatures k_A and k_B will be close to each other in magnitude
(C) as temperature rises, k_A and k_B will be close to each other in magnitude
(D) at lower temperatures $k_B > k_A$

272. Which of the following statements are correct for the rock-salt structure ?
(A) the tetrahedral sites are smaller than the octahedral sites
(B) the octahedral sites are occupied by cations and the tetrahedral sites are empty
(C) the radius ratio is 0.732
(D) the radius ratio is 0.999

273. Which of the following statements are correct ?
(A) the coordination number of each type of ion in a CsCl crystal is eight
(B) a metal that crystallizes in a bcc structure has a coordination number of twelve
(C) a unit cell of an ionic crystal shares some of its ions with other unit cells
(D) the length of the unit cell is NaCl is 552 pm (given that $r_{Na^+} = 95$ pm and $r_{Cl^-} = 181$ pm)

274. Which of the followings are examples of pseudo-unimolecular reaction :

(A) $CH_3CO_2C_2H_5 + H_2O \xrightarrow{H^{\oplus}} CH_3CO_2H + C_2H_5OH$

(B) $C_{12}H_{22}O_{11} + H_2O \xrightarrow{H^{\oplus}} \underset{\text{(glucose)}}{C_6H_{12}O_6} + \underset{\text{(Fructose)}}{C_6H_{12}O_6}$

(C) $CH_3COCl + H_2O \longrightarrow CH_3CO_2H + HCl$

(D) $CH_3CO_2C_2H_5 + H_2O \xrightarrow{OH^{\ominus}} CH_3CO_2H + C_2H_5OH$

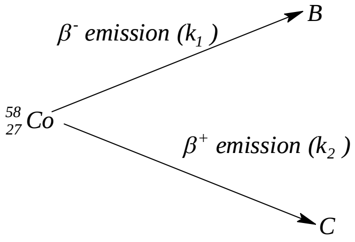
275. Which of the following compounds represent a normal 2 : 3 spinel structure ?
(A) $Mg^{II}Al_2^{III}O_4$ (B) $Co^{II}(Co^{III})_2O_4$ (C) $Zn(TiZn)O_4$ (D) $Ni(CO)_4$

SECTION III: COMPRHENSIONS

COMPREHENSION # 26

Paragraph for Questions Nos. 276 to 279

In a parallel reaction reactant cobalt which is a transition metal decays by parallel pathways to form 2 products B and C.



The ratio of concentration of [B] : [C] are 2 : 98 and the half life Co is 22 years.

276. The decay constant for (B) should be

(A) $63 \times 10^{-5}\ y^{-1}$ (B) $126 \times 10^{-5}\ y^{-1}$ (C) $863 \times 10^{-3}\ y^{-1}$ (D) None of these

277. The decay constant for C is

(A) $0.03\ y^{-1}$ (B) $1.5\ y^{-1}$ (C) $0.09\ y^{-1}$ (D) None of these

278. The product B will be

(A) Copper (B) Manganese (C) Nickel (D) Zinc

279. The product C will be

(A) Copper (B) Manganese (C) Nickel (D) Iron

COMPREHENSION # 27

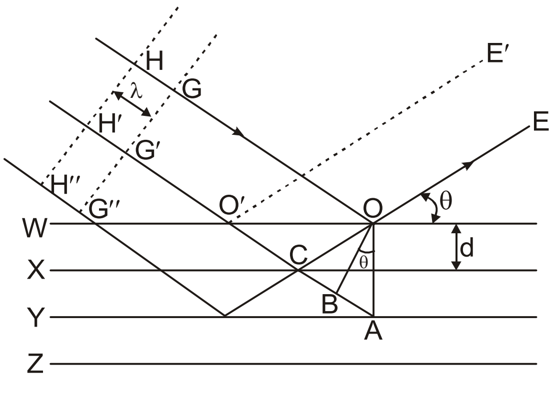
Paragraph for Questions Nos. 280 to 282

THE BRAGG METHOD OF CRYSTAL ANALYSIS

A simple method of crystal analysis is that suggested by W.H. and W.L. Bragg, and this is discussed below.

The Braggs first called attention to the fact, since a crystal is composed of a series of equally spaced atomic planes, it may be employed as a reflection grating. A beam of X rays striking the atoms which constitute these planes will be diffracted then in such a manner as to cause either interference with or reinforcement of the beam diffracted from the first, or outer plane, and the whole beam will behave as if it had been *reflected* from the surface of the crystal.

To understand better the theory of this method consider, as shown in figure,



Reflection of X rays by parallel planes

A wave front GG′G″ of X rays approaching at an angle θ a series of parallel, equidistant planes, W, X, Y, Z, etc., which constitute the atomic planes of the crystal. Part of the beam HGO will be reflected at O along OE at the angle of reflection θ, which is the same as the angle of incidence. Similarly , the beam H′G′O′ will be reflected party at O′ along O′E′, and then again at C on the second plane along COE. In order to emerge along OE the second beam has to travel a longer distance than the first, namely, the distance H′ G′ O′ CO as against the distance HGO. If the difference in distance of the two paths is exactly equal to an integral multiple of the wave length of the radiation, the two beam will be in phase at O, will reinforce each other, and the intensity of the reflected rays will be at a maximum. When the two beams are out of phase, however interference will result, and the intensity of the reflected beam will be less than the maximum. The condition for maximum reflection intensity is then that the distance

$$G'CO - GO = n\lambda$$

where λ is the wave length of the X rays employed, while n is an integer taking on the values 1, 2, 3, ... and known as the *order of reflection*. If a perpendicular is drawn now from O to the extension of the line G′O′C, while another is dropped from O to A perpendicular to W, X, and Y, it follows that

$$G'CO = G'A - CA + CO$$
$$= G'A$$

Since CO = CA from the construction of the figure. But

$$GO = G'B$$

Therefore, $$G'CO - GO = G'A - G'B$$
$$= BA$$

and hence $$BA = n\lambda$$

It can readily be shown that the angle BOA is also θ. Then, since OB was constructed perpendicular to G′A,

$$\sin\theta = \frac{BA}{OA}$$

and $$BA = OA\sin\theta$$
$$= 2d\sin\theta$$

Where d is the distance between any two atomic planes in the crystal.

Therefore, $$n\lambda = 2d\sin\theta$$

This simple equation connect directly wave length and order of reflection of X rays with the interplanar distance d and the angle of maximum reflection θ. Without any further information the ration λ/d is deducible by measuring n and θ. On the other hand, if λ is known, d may be calculated; or vice versa, if d is known, the crystal may be employed to determine the wave length of the X rays.

280. The longest X-ray wavelength that may be used to determine a lattice spacing of 1Å by the Bragg reflection method is

(A) 1Å (B) 2Å (C) 3Å (D) 4Å

281. Using X-rays of wavelength 20 pm, it was found that the first order reflection from the face planes and planes parallel to face planes containing Cl^- ions, of a crystal of KCl (NaCl type structure) at 25°C is at $\theta = 1.8°$. The density of the crystal determined is therefore nearly . K – 39, Cl – 35.5

(Take $\frac{1}{\pi} = 0.3183$)

(A) 3.84 g/cc (B) 1.92 g/cc (C) 2.91 g/cc (D) 4.83 g/cc

282. What is the size of the K^+ ion if the size of the Cl^- ion is 1.8Å ? Take data from the above question.

(A) 0.9 Å (B) 1.0 Å (C) 1.18Å (D) 1.38 Å

COMPREHENSION # 28
Paragraph for Questions Nos. 283 to 287

IMPERFECTION IN IONIC SOLIDS:

In an ideal crystal there must be regular repeating arrangement of the constituting particles and its entropy must be zero at absolute zero temperature. However, it is impossible to obtain an ideal crystal and it suffers from certain defects called imperfections, In pure crystal, these defects arise either due to disorder or dislocation of the constituting particles from their normal positions or to the movement of the particles even at absolute zero temperature. Such defects increase with rise in temperature. In addition to this, certain defects arise due to the presence of some impurities. Such defects not only modify the existing properties of the crystalline solids but also impart certain new characteristics to them.

In pure crystal, e.g. silicon or germanium at 0 K, the electrons are present in fully occupied lowest energy states and are not expected to conduct any electricity. However at temperature above 0K, some electrons leave their bonds and become free to move in the crystal lattice, giving rise to electrical conductivity. The electron deficient bonds, called holes (+ively charged) and thermally mobile electrons move in opposite directions under the electric field.

Stoichiometric point defects include (1) Schottky defects, which arise due to missing of both cations and anions from their lattice sites without disturbing the stoichiometry and (2) Frenkel defects, which arise due to misplacement of certain ions in the crystal lattice. The former defect gives rise to decrease in density of the crystal and the latter leads to no change of density.

Another type of defects are non-stoichiometric defects where the cations and anions are not present in the stoichiometric ratio. In metal excess defect, metal ions or positive ions are in excess as compared to anions of non-metals stoichiometrically. On the other hand in metal deficient defect, the cations are in lesser proportion than stoichiometric value. Since the crystal is neutral electrically, the balance of charge is maintained by free electrons or extra positive charges. The metal excess defects give rise to conduction of electricity due to the presence of free electrons. Also crystals having metal excess defects are paramagnetic and coloured due to the presence of electrons in the anions vacancies.

Impurity defects arise when some foreign atoms are present at the lattice sites in place of the host atoms or at the vacant interstitial sites.

When 15 group elements like P or As are doped into Si or Ge, the added impurity atoms occupy the lattice sites forming four covalent bonds with 4 Si/Ge atoms leaving an extra electron free to move. Such a crystal is said to be n-type semi conductor because the conduction of electricity is due to the movement of extra unbonded electrons.

If doping of a covalent crystals of 14 group elements are caused by addition of small amounts of elements of group 13, e.g. Al or Ga with three valence electrons, one covalent bond formed will be electron deficient and acts as a positive hole. The presence of such holes in the crystal leads to electrical conductivity and the crystal is said to be p-type semiconductor.

283. When LiCl is heated into the vapour of lithium, the crystal acquires pink colour. This is due to

(A) Schottkty defects (B) Frenkel defects

(C) Metal excess defect leading to F-centres (D) Electronic defect

284. Strongly heated ZnO crystal can conduct electricity. This is due to

(A) Movement of extra Zn^{2+} ions present in the interstitial sites

(B) Movement of electrons in the anion vacancies

(C) Movement of both Zn^{2+} ions and electrons

(D) None of these

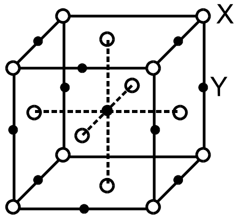
285. AgCl is crystallized from molten AgCl containing a little $CdCl_2$. The solid obtained will have
(A) cationic vacancies equal to number of Cd^{2+} ions incorporated
(B) cationic vacancies equal to double the number of Cd^{2+} ions
(C) anionic vacancies
(D) neither cationic nor anionic vacancies

286. Lattice defect per 10^{15} NaCl is 1. What is the number of lattice defects in mole of NaCl?
(A) 6.02×10^{23} (B) 6.02×10^{8} (C) 10^{14} (D) None of these

287. Which of the following statements is correct about the conduction of electricity in pure crystal of silicon at room temperature?
(A) The conduction is due to electrons present in fully occupied lowest energy states
(B) The conduction is due to only some electrons capable of leaving the bonds at room temperature
(C) The conduction is only due to the holes formed following release of electrons
(D) The conduction is due to the movement of both the electrons released and holes formed.

COMPREHENSION # 29
Paragraph for Questions Nos. 288 to 291

Consider the figure given for solid XY. Answer the following questions



288. The site Y represents
(A) tetrahedral void (B) Octahedral void (C) triangular void (D) cubical void.

289. The number of XY units per unit cell is
(A) 4 (B) 3 (C) 3 (D) 8

290. Co-ordination number of Y is
(A) 3 (B) 4 (C) 6 (D) 8

291. Which of the following type of solid adopt above crystal structure?
(A) CaCl (B) CaF_2 (C) ZnS (D) NaCl.

COMPREHENSION # 30
Paragraph for Questions Nos. 292 to 295

The arrhenius equation
$K = Ae^{-Ea/RT}$
The represents the variation of the specific rate constant with temperature.
exponential term represents the fraction of molecules having the energy to cross the energy barrier i.e. to reach the transition state and A signifies the number of collisions / unit time with effectiveness in order to form the product. $3.6 \times 10^{-16}\%$ of reactant molecules exists in the activated state of a reaction.

292. The energy of activation is
(A) 100 kJ (B) 200 kJ (C) 150 kJ (D) 250 kJ

293. If a graph is plotted between K against 1/T the intercept obtained is

(A) logK (B) logA (C) $-\frac{Ea}{2.303R}$ (D) $\log\frac{1}{T}$

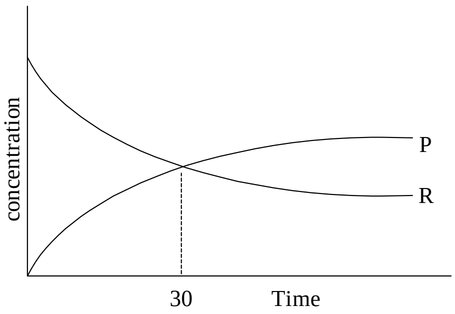
294. The dimension of A will be

(A) dimensionless (B) time (C) Joules/mol (D) time^{-1}

295. If a graph is plotted between K against 1/T the slope obtained is

(A) logK (B) logA (C) $+\frac{Ea}{2.303R}$ (D) $-\frac{Ea}{2.303R}$

COMPREHENSION # 31
Paragraph for Questions Nos. 296 to 299



The above graph shows the variation of the reactants product w.r.t time for a given reaction at 27°C for a first order reaction.

296. The half life of the reaction is

(A) 15 minutes (B) 60 mintues (C) 30 minutes (D) infinite

297. The specific rate constant of the reaction is

(A) 0.0462 min^{-1} (B) zero (C) 0.0231 min^{-1} (D) infinite

298. 3/4th life period of the reaction is

(A) 20 (B) 80 (C) 60 (D) none of these

299. The plot log $[A]_t$ vs time will have a intercept equal to

(A) –K (B) +K (C) A (D) logA

COMPREHENSION # 32
Paragraph for Questions Nos. 300 to 301

(Read the following passage and answer the questions. They have only one correct option)
In HCP or CCP, constituent particles occupy 74% of the available space. The remaining space (26%) in between the spheres, remains unoccupied and is called interstitial voids or holes. Considering the close packing arrangement, each sphere in the second layer rests on the hollow space of the first layer, touching each other. The void created is called tetrahedral void. If R is the radius of the sphere in the close packed arrangement, then

r (radius of tetrahedral void) = 0.225 R

In a close packing arrangement, the interstitial void formed by the combination of two triangular voids of the first and second layer is called octahedral void. Thus, double triangular void is surrounded by six spheres. The centre of these sphere on joining, forms octahedron. If R is the radius of the sphere in a close packed arrangement, then r (radius of octahedral void = 0.414 R.

300. If the anions (A) form hexagonal close packing and cations (B) occupy only 2/3rd octahedral voids in it, then the general formula of the compound is

(A) AB (B) A_3B_2 (C) A_2B (D) AB_2

301. If the spinel structure, oxide ions are cubic close whereas 1/8th of tetrahedral voids are occupied by A^{2+} cations and 1/2 of octahedral voids are occupied by B^{3+} cations. The general formula of the compound having spinel structure is:

(A) $A_2B_2O_4$ (B) AB_2O_4 (C) $A_2B_4O_2$ (D) $A_4B_2O_2$

COMPREHENSION # 33
Paragraph for Questions Nos. 302 to 307

(Read the following passage and answer the questions. They have only one correct option)

The Colloidal particles are electrically charged as is indictated by their migration toward cathode or anode under the applied electric field. In a particular colloidal system, all particles carry either positive charge or negative charge.

The electric charge on colloidal particles originate in several ways. According to preferential adsorption theory, the freshly obtained precipitate particles adsorb ions from the dispersion medium, which are common to their lattice and acquire the charge of adsorbed ions. For example, freshly obtained $Fe(OH)_3$ precipitated is dispersed, by a little $FeCl_3$, into colloidal solution owing to the adsorptions of Fe^{3+} ions in preference. Thus sol particles will be positively charged.

In some cases the colloidal particles are aggregates of cations or anions having ampiphilic character. When the ions possess hydrophobic part (hydrocarbon end) as well as hydrophilic part (polar end group), they undergo association in aqueous solution to form particles having colloidal size. The formation of such particles, called micelles plays a very important role in the solubilization of water insoluble substances, (hydrocarbon, oils, fats, grease etc.). In micelles, the polar end groups are directed towards water and the hydrocarbon ends into the centre.

The charge on sol particles of proteins depends on the pH. At low pH, the basic group of protein molecule is ionized (protonated) and at higher pH (alkaline medium), the acidic group in ionized. At Isoelectric pH, characteristic to the protein, both basic and acidic groups are equally ionized.

The stability of colloidal solution is attributed largely to the electric charge of the dispersed particles. This charge causes them to be coagulated or precipitated. On addition of small amount of electrolytes, the ions carrying opposite charge are adsorbed by sol particles resulting in the neutralization of their charge.When the sol particles either with no charge or reduced charge, come closer due to Browman movement, they coalesce to form bigger particles resulting in their separation from the dispersion medium. This is what is called coagulation or precipitation of the colloidal solution. The coagulating power of the effective ion, which depend on its charge, is expressed in terms of its coagulating value, defined as its minimum concentration (m mol/L) needed to precipitate a given sol.

302. A gelatin sol at pH less then the isoelectric value is subjected to an electric field. The sol particles migrate toward

(A) Anode (B) Cathode

(C) Both anode and cathode (D) Neither anode nor cathode

303. Which of the following ions would have the minimum coagulating value for sol obtained on peptizing $Sn(OH)_4$ by little NaOH solution.

(A) Cl^- (B) SO_4^{2-} (C) K^+ (D) Ba^{2+}

304. How would you obtain a sol of AgI, the particles of which migrate toward cathode under the electric field ?

(A) By adding little excess of KI to $AgNO_3$ solution

(B) By adding little excess of $AgNO_3$ to KI solution

(C) By mixing equal volumes of 0.010 M $AgNO_3$ and 0.010 M KI

(D) None of these

305. When 9.0 ml of arsenius sulphide sol and 1.0 ml of 1.0×10^{-4} M $BaCl_2$ are mixed, turbidity due to precipitation just appears after 2 hours. The effective ion and its coagulating value are respectively

(A) Cl^-, 10 m mol/L (B) Cl^-, 20 m mol/L
(C) Ba^{2+}, 10 m mol/L (D) Ba^{2+} , 20 m mol/L

306. 100 ml each of two sols of AgI, one obtained by adding $AgNO_3$ to slight excess of KI and another obtained by adding KI to slight excess of $AgNO_3$, are mixed together. Then

(A) The two sols will stabilize each other
(B) The sol particles will acquire more electric charge
(C) The sols will coagulate each other mutually
(D) A true solution will be obtained

307. Under the influence of an electric field, the particles in a sol migrate towards cathode. The coagulation of the same sol is studied using NaCl, Na_2SO_4 and Na_3PO_4 solutions. Their coagulating values will be in the order

(A) $NaCl > Na_2SO_4 > Na_3PO_4$ (B) $Na_2SO_4 > Na_3PO_4 > NaCl$
(C) $Na_3PO_4 > Na_2SO_4 > NaCl$ (D) $Na_2SO_4 > NaCl > Na_3PO_4$

COMPREHENSION # 34

Paragraph for Questions Nos. 308 to 311

Ozone is prepared in laboratory by passing silent electric discharge through pure and dry oxygen in an apparatus known as ozoniser. This conversion from oxygen to ozone is a reversible and endothermic reaction. When oxygen is subjected to an ordinary electric discharge, most of the O_3 produced will get decomposed. When any insulating material such as glass, is inserted in the space between the two electrodes and high current density is applied, silent electric discharge passes on between the two electrodes. By this process no spark is produced and much less heat is generated, and as a result the decomposition of the produced ozone is much retarded.

The decomposition of ozone is believed to occur by the following mechanis:

$$O_3 \underset{K_b}{\overset{K_f}{\rightleftharpoons}} O_2 + O \qquad \text{(fast step)}$$

$$O_3 + O \xrightarrow{K_1} 2O_2 \qquad \text{(slow)}$$

308. Order of the reaction is

(A) 1 (B) 2 (C) 3 (D) 0

309. Molecularity of reaction is defined by

(A) slow step (B) reversible step
(C) from overall reaction (D) fast step

310. When the concentration of O_2 is increased, for the same concentration of ozone, its rate

(A) increases (B) decreases
(C) remains the same (D) cannot be answered

311. When the concentration of O_3 is increased, for the same concentration of oxygen, its rate

(A) increases (B) decreases
(C) remains the same (D) cannot be answered

COMPREHENSION # 35

Paragraph for Questions Nos. 312 to 313

Silicon carbide (SiC) and diamond are covalent solids which crystallize in cubic strucures. In SiC, carbon atoms occupy points of the face centred cubic lattice (FCC positions) and silicon atoms occupy half of the tetrahedral voids available. In diamonds, same position of the tetrahedral voids are occupied by other carbon atoms.

Also the density of SiC and diamond are 3.2 and 3.6 g/cc respectively. Answer the following four questions based on the above information: (M : Si = 28)

312. The radius of silicon atom is

(A) 0.76 Å (B) 1.12 Å (C) 3.54 Å (D) 4.75 Å

313. Which of the following will not change the density of SiC solid?

(A) Substitution of some Si atoms by some carbon atoms
(B) Schottky defects
(C) Interchange of some Si atom by some C atom
(D) Decreasing the temperature of solid.

COMPREHENSION # 36
Paragraph for Questions Nos. 314 to 316

Nuclear fission is the process of spliting of a heavy nucleus by bombarding with thermal neutrons in to two approximately equal parts, with simultaneous liberation of a huge amount of energy. If the sample of the fissionable material has a sufficiently large mass called critical mass, the neutrons produced cause additional fission reaction and a chain fission reaction ensues.

314. The missing product in the reaction : ${}^{235}_{92}u + {}^{1}_{0}n \longrightarrow {}^{146}_{57}La + ? + 3\left({}^{1}_{0}n\right)$ is

(A) ${}^{86}_{35}Br$ (B) ${}^{87}_{35}Br$ (C) ${}^{89}_{35}Br$ (D) ${}^{89}_{32}Ge$

315. The pair of elements that are produced in the following nuclear fission is

$${}^{235}_{92}u + {}^{1}_{0}n \longrightarrow {}^{236}_{92}u \longrightarrow products + x\left({}^{1}_{0}n\right)$$

where x is either 2 or 3.

1) ${}^{144}_{56}Ba$ 2) ${}^{90}_{36}Kr$ 3) ${}^{144}_{54}Xe$ 4) ${}^{144}_{55}Cs$

(A) 3, 4 (B) 2, 3 (C) 1, 2 (D) 1, 4

316. Which one is correct for a nuclear fission reaction.

(A) the n/p ratio is low for the product elements
(B) in general β - emission is observed after the product elements are formed
(C) in general α - emission is observed after the product elements are formed
(D) the product elements are not radioactive in nature.

COMPREHENSION # 37
Paragraph for Questions Nos. 317 to 318

Copper reduces NO_3^- into NO and NO_2 depending upon conc. of HNO_3 in solution. Assuming $[Cu^{2+}]$ = 0.1 M, and $P_{NO} = P_{NO_2} = 10^{-3}$ atm and using given data answer the following questions:

$E^o_{Cu^{2+}/Cu}$ = + 0.34 volt

$E^o_{NO_3^-/NO}$ = + 0.96 volt

$E^o_{NO_3^-/NO_2}$ = + 0.79 volt

at 298 K $\frac{RT}{F}(2.303) = 0.06$ volt

317. E_{Cell} for reduction of $NO_3^- \longrightarrow$ NO by Cu(s), when $[HNO_3]$ = 1M is [At T = 298]

(A) ~ 0.61 (B) ~ 0.71 (C) ~ 0.51 (D) ~ 0.81

318. At what HNO_3 concentration thermodynamic tendency for reduction of NO_3^- into NO and NO_2 by copper is same?

(A) $10^{1.23}$ M (B) $10^{0.56}$ M (C) $10^{0.66}$ M (D) $10^{0.12}$ M

COMPREHENSION # 38
Paragraph for Questions Nos. 319 to 321

The potential associated with each electrode is known as electrode potential. If the concentration of each species taking part in the electrode reaction is unit (if any gas appears in the electrode reaction, it is confined to 1 atmospheric pressure) and further the reaction is carried out at 298 K, then the potential of each electrode is said to be the standard electrode potential. By convention, the standard electrode potential of hydrogen electrode is 0.0 volt. The electrode potential value for each electrode process is a measure of relative tendency of the active species in the process to remain in the oxidised/reduced form. A negative E° means that the redox couple is a stronger reducing agent than the H^+/H_2 couple. A positive E° means that the redox couple is a weaker reducing agent than the H^+/H_2 couple. The metal with greater positive value of standard reducion potential forms the oxide of greater thermal stability.

319. Calculate the minimum mass of NaOH required to be added in R.H.S. to consume all the H^+ present in R.H.S. of the cell of emf + 0.701 volt at 25°C before its use.

$$\mathrm{Zn}\,|\,\underset{0.1\mathrm{M}}{\mathrm{Zn}^{2+}}\,||\,\underset{1\,\text{litre.}}{\mathrm{HCl}}\,|\,\underset{1\mathrm{atm}}{\mathrm{Pt(H_2 g)}} \qquad E^0_{\mathrm{Zn/Zn^{2+}}} = 0.760\ \mathrm{V}$$

(A) 1.264 g (B) 4 g (C) 3.2 g (D) 2.258

320. The emf of the cell , $\mathrm{Ag}\,|\,\mathrm{AgI\ in}\ \underset{0.05\mathrm{M}}{\mathrm{KI}}\,|\,\underset{\text{Sol.}}{\mathrm{NH_4NO_3}}\,|\,\underset{0.05\mathrm{M}}{\mathrm{AgNO_3}}\,|\,\mathrm{Ag}$

is 0.788 volt at 25 °C . The degree of dissociation of KI and silver nitrate in the above solution is 0.90 each . Calculate the solubility product of AgI

(A) 9.472×10^{-17} (B) 4×10^{-17} (C) 11×10^{-17} (D) 2.105×10^{-17}

321. The standard reduction potential at 25°C of the reaction $2H_2O + 2e^- \longrightarrow H_2 + 2OH^-$ is – 0.8277 volt. Calculate the equilibrium constant for the reaction in which water is forming from its ions at 25°C.

(A) 10^{-14} (B) 10^{-7} (C) 10^{14} (D) 10^{7}

COMPREHENSION # 39
Paragraph for Questions Nos. 322 to 324

Kohlrausch Law of independent migration of ions relates the ionic conductivities and molar conductivities of the electrolyte. Mobility of ion is not just the speed but, speed under a potential gradient. Moreover mobility of an ion is directly proportional to current carried by it. The fraction of total current carried by an ion is the transport number.

Given ionic mobilities of NH_4^+, H^+, ClO_4^-, Na^+ are 6.6 x 10^{-4}, 3.62 x 10^{-3}, 5.7 x 10^{-4}, 5.2 x 10^{-4}, $cm^2\ Volt^{-1}\ Sec^{-1}$ respectively at infinite dilution.

322. The equivalent conductance of $NaClO_4$ in S cm^2 eq^{-1} is

(A) 105.18 (B) 118.7 (C) 404.3 (D) 356.8

323. Which of the following incorrect with respect to kohlrausch law

(A) $\Lambda^0 Al_2(SO_4)_3 = 3\lambda^0(Al^{+3}) + 2\lambda^0(SO_4^{-2})$ (B) $\Lambda^0 MgCl_2 = \lambda^0(Mg^{+2}) + 2\lambda^0(Cl^-)$

(C) $\Lambda^0 NH_4NO_3 = \lambda^0(NH_4^+) + \lambda^0(NO_3^-)$ (D) $\Lambda^0 FeCl_3 = \lambda^0(Fe^{+3}) + 3\lambda^0(Cl^-)$

324. The ionic mobility of Na^+ if a potential of 15 Volt is applied across the electrodes 5cm apart.

(A) 5.2×10^{-4} (B) 15.6×10^{4} (C) 10.4×10^{-4} (D) 20.8×10^{-4}

COMPREHENSION # 40
Paragraph for Questions Nos. 325 to 327

An aqueous solution of NaCl on electrolysis gives $H_2(g)$, $Cl_2(g)$ and NaOH according to reaction

$$2Cl^-(aq) + 2H_2O \longrightarrow 2OH^-(aq) + H_2(g) + Cl_2(g)$$

A direct current of 25 ampere with a current efficiency of 62% is passed through 20 litre of NaCl solution (20% by weight)

Answer the following questions based on above passage.

325. Reaction taking place at cathode and at anode respectively are:

(A) $2e^- + 2H_2O \longrightarrow 2OH^- + H_2$; $2Cl^- \longrightarrow Cl_2 + 2e^-$

(B) $Na^+ + e^- \longrightarrow Na$; $2OH^- \longrightarrow H_2O + \frac{1}{2}O_2 + 2e^-$

(C) $2e^- + H_2 \longrightarrow 2H^-$; $H_2 \longrightarrow 2H^+ + 2e^-$

(D) $4e– + O_2 \longrightarrow 2O^{-2}$; $H_2 + 2OH^- \longrightarrow 2H_2O + 2e^-$

326. Time required to produce 1 kg of Cl_2 is –

(A) 30.2 hr (B) 15.1 hr (C) 24.35 hr (D) 48.71 hr

327. Molarity of solution with respect to OH^- ions is –

(A) 2.8 (B) 0.35 (C) 1.4 (D) 0.7

COMPREHENSION # 41
Paragraph for Questions Nos. 328 to 330

Concentration cell is one in which anode and cathode of a voltaic cell is made of same electrode

Ex. $A\,|\,\underset{c_1}{A^{n+}}\,||\,\underset{c_2}{A^{n+}}\,|\,A$

c_1 should not be equal to c_2 to have some emf in the cell. Now consider the cell

$(Pt)\ \underset{P_1}{Cl_2}\ |\ \underset{c}{NaCl}\ ||\ \underset{(sat)}{AgCl}\ |\ \underset{P_2}{Cl_2}\ (Pt)$

K_{sp} of AgCl is 10^{-12}

328. If $P_1 = P_2$, required condition so that the above cell has positive emf

(A) $c > 10^{-6}$ M (B) $c < 10^{-6}$ M

(C) $P_1 = P_2 = 1$ atm

(D) Emf of the cell cannot be found as it is not a concentration cell

329. If $c = 10^{-6}$ which of the following conditions will give positive emf

(A) $P_1 > P_2$ (B) $P_1 < P_2$ (C) $P_1 = P_2$ (D) None

330. Which one of the statements is correct about the cell $(Pt)\ \underset{1\ atm}{H_2}\ |\ \underset{c}{HCl}\ ||\ \underset{c}{NaOH}\ |\ \underset{1\ atm}{H_2}\ (Pt)$

(A) It is not a concentration cell

(B) It has a positive emf

(C) It has a negative emf

(D) cannot say anything about emf without knowing the value of c

COMPREHENSION # 42

Paragraph for Questions Nos. 331 to 333

Colligative properties i.e., the [properties of solution which depends upon the number of particles present in solution are osmotic pressure. Depression in freezing point, elevation in boiling point and lowering in vapour pressure. Experimental values of colligative properties for electrolytes are always higher than those obtained theoretically because electrolytes dissociates to furnish more ions in solution. On the other hand experimentally obtained values of colligative properties for associating nature of solute are lower than those obtained theoretically. The ratio of experimental colligative properties to theoretical colligative properties is called as Vant Hoff factor (*i*).

331. Vant Hoff factor (i) for tetramerisation of a substance A in water, assuming 80% degree of association is:

(A) 0.6 (B) 0.4 (C) 1.6 (D) 1.4

332. Value of α for the reaction , $A \longrightarrow \frac{1}{5} A_5$ is given by the relation

(A) $\alpha = \frac{5}{4}(i - 1)$ (B) $\alpha = \frac{5}{4}(1 - i)$ (C) $\alpha = \frac{4}{5}(1 - i)$ (D) $\alpha = \frac{4}{5}(i - 1)$

333. The maximum depression in freezing point is noticed in:

(A) 1 *M* NaCl (B) 1*M* Na_2SO_4 (C) 1 *M* Na_3PO_4 (D) 1 *M* $Na_4Fe(CN)_6$

COMPREHENSION # 43

Paragraph for Questions Nos. 334 to 336

At any fixed temperature, the vapour phase is always richer in more volatile component as compared to the solution phase. In other words, mole fraction of more volatile component is always greater in vapour phase than in solution phase. We can also say that vapour phase is relatively richer in the component whose addition to liquid mixture results in an increase in total vapour pressure.

334. If 2 moles of A and 3 moles of B are mixed to form an ideal solution, vapour pressures of A and B are 120 and 180 mm of Hg respectively. The total vapour pressure of solution will be :

(A) 48 mm Hg (B) 108 mm Hg (C) 156 mm Hg (D) 15.6 mm Hg

335. From the statement in question number **202**, the composition of A and B in the vapour phase when the first traces of vapours are formed is :

(A) A = 0.407 ; B = 0.592 (B) A = 0.8 ; B = 0.1

(C) A = 0.109 ; B = 0.791 (D) A = 0.307 ; B = 0.693

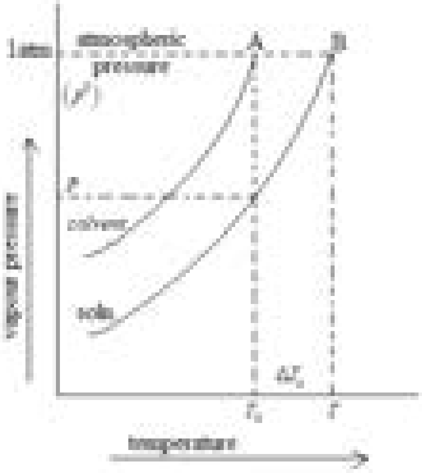
336. From the statement in question number **202** , at what pressure will the last traces of liquid disappear

(A) 100 mm Hg (B) 130 mm Hg (C) 140 mm Hg (D) 150 mm Hg

COMPREHENSION # 44

Paragraph for Questions Nos. 337 to 339

Figure explains elevation in boiling point when a non-volatile solute is added to a solvent



337. Elevation in boiling point of an aqueous urea solution is 0.52^0 (K_b of water is 0.52 $K\ Kg\ mol^{-1}$). Hence mole fraction of urea in this solution is

(A) 0.982 (B) 0.0567 (C) 0.943 (D) 0.018

338. A complex of iron and cyanide ions is 100% ionized at one molal solution. If the elevation in boiling point is $2.08^0 C$ (K_b for water $0.52 K\ Kg\ mol^{-1}$) then the complex is

(A) $K_3[Fe(CN)_6]$ (B) $Fe(CN)_2$ (C) $K_4[Fe(CN)_6]$ (D) $[Fe(CN)_4]^-$

339. Ratio of $\frac{\Delta T_b}{K_b}$ of 6% AB_2 and 9% A_2B (both are non electrolytes) is one mole/Kg in both the cases. Hence atomic masses of A and B are respectively.

(A) 60, 90 (B) 40, 40 (C) 40, 10 (D) 10, 40

COMPREHENSION # 45

Paragraph for Questions Nos. 340 to 342

When a volatile substance A $\left(P_A^0 = 400\text{mm}\right)$ is added to another volatile substance B $\left(P_B^0 = 500\text{mm}\right)$, the vapour pressure of the resulting solution is 470 mm of Hg. To this solution a third volatile solvent C $\left(P_C^0 = 600\text{m}\right)$ is added and vapour pressure of final solution is 496 mm of Hg.

340. Mole fraction of A in the final solution

(A) 0.20 (B) 0.22 (C) 0.24 (D) 0.26

341. Mole fraction of A in the vapour phase

(A) 0.2 (B) 0.22 (C) 0.24 (D) 0.26

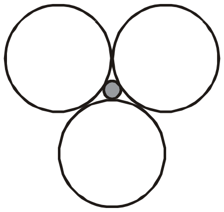
342. Mole fraction of C in the vapour phase

(A) 0.2 (B) 0.22 (C) 0.24 (D) 0.26

COMPREHENSION # 46
Paragraph for Questions Nos. 343 to 345

When atoms are arranged in ABC ABC type of packing or ABAB type of packing, some space is left in between the atom which is known as voids. Depending upon the situation, voids can be classified as triangular, tetrahedral, octahedral or cubic

For example;



void shown in the figure is triangular void because it is formed by touching 3 atoms.

343. If radius of sphere is 200 pm then ideal radius of triangular void is:
(A) 31 pm (B) 45 pm (C) 62 pm (D) 90 pm

344. If for a particular compound AB, radius of A^+ is 80 pm and radius of B^- is 200 pm then location of A^+ ion in the crystal and % occupancy respectively is:
(A) Octahedral void 100% (B) Tetrahedral, 100%
(C) Tetrahedral , 50% (D) Octahedral, 50%

345. Formula of a compound formed by A, B and C in which A is arranged in ccp , B is present in 25% of the tetrahedral voids and C is present in all the remaining voids (tetrahedral as well as octahedral) is :
(A) AB_2C_2 (B) A_2BC_5 (C) ABC_5 (D) A_2B_5C

COMPREHENSION # 47
Paragraph for Questions Nos. 346 to 350

Many lyophilic sols and a few lyophobic sols when coagulated under some special conditions, change into semi rigid mass, enclosing whole amount of liquid within itself, it is called Gel process is called gelation. Gelatin Agar-Agar, gum-Arabic can be converted into gels by cooling them under moderate concentration conditions. Hydrophobic sols like silicic acid, $Al(OH)_3$ are prepared by double decomposition and exchange of solvent method.

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

347. When liquid is dispersed in solid, it is called
(A) Sol (B) Emulsion (C) Gel (D) Aerosols

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

349. The process of imbibing water when elastic gels are placed in water is called
(A) Imbibation (B) Sybneresis (C) Coagulation (D) Thioxotropy

350. Some types of gels like gelatin and silica liquify on shaking thereby changing into sols. The sols on standing change back into gels. This process is known as:
(A) Syneresis (B) Thixotropy
(C) Double decomposition (D) Peptization

COMPREHENSION # 48

Paragraph for Questions Nos. 351 to 353

Dilute solutions show colligative properties. These properties depend on the number of particles of the solute but not on their nature. If solute undergoes dissociation (or) association. The colligative property differ considerably from the calculated value.

351. Which of the following solutions has highest boiling point

(A) 1% (w/v) glucose (B) 1% (w/v) fructose (C) 1% (w/v) sucrose (D) 1% (w/v) urea

352. For a solute undergoing association, the Van't Hoff's factor is

(A) $i > 1$ (B) $i < 1$ (C) $i = 0$ (D) $i = 1$

353. Solutions having same vapour pressure are called

(A) isotonic solutions (B) isopiestic solutions

(C) isochoric solutions (D) isoelectric solutions.

COMPREHENSION # 49

Paragraph for Questions Nos. 354 to 358

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.

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

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

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

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

356. 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

357. Chromatogarphic separations are based on

(A) differential solubility (B) differential adsorption

(C) differential absorption (D) None of these

358. Activated charcoal is prepared by

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

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

(C) adding impurity to charcoal

(D) reacted with conc. HNO_3

COMPREHENSION # 50

Paragraph for Questions Nos. 359 to 362

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.

359. 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

360. Clouds are colloidol solution of

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

361. AgI helps in artificial rain because

(A) It helps in coagulation
(B) It helps in dispersion process
(C) Both
(D) None

362. Electrical chimneys are made on the principle of

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

COMPREHENSION # 51
Paragraph for Questions Nos. 363 to 366

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 aggregated particles. These are known as micelles or associated colloids. Surface active agents like soaps and synthetic detergents 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 is a non-polar medium.
- In concentrated solutions, 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 lyophilic parts which associate together to form micelles.
- Micelles may contain as many as 100 molecules or more.

363. 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) Soap is manufactured by the base catalysed hydrolysis(saponification) of animal fat.

364. Which part of the soap ($RCOO^-$) dissolves 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

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

(A) H-bonding
(B) van der Waals forces
(C) ionic bonding
(D) polar covalent bonding

366. 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 # 52
Paragraph for Questions Nos. 367 to 369

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.

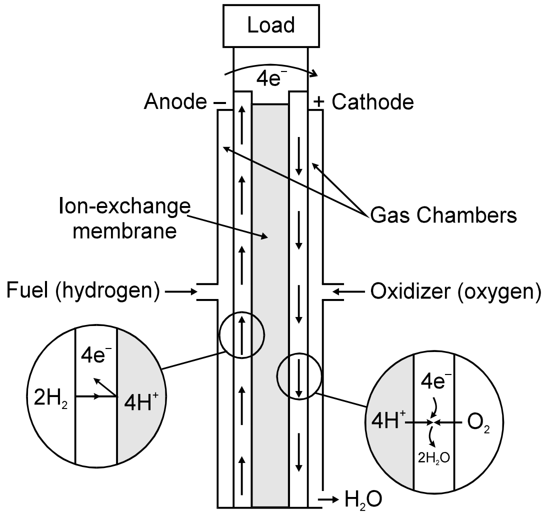
367. On addition of one mL of solution of 10% NaCl to 10 mL of red gold sol in presence of 0.025 g of starch, the coagulation is just prevented. The gold number of starch is
(A) 0.025 (B) 0.25 (C) 2.5 (D) 25

368. 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

369. 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

COMPREHENSION # 53
Paragraph for Questions Nos. 370 to 374

A fuel cell is a cell that is continuously supplied with an oxidant and a reductant so that it can deliver a current indefinitely. Fuel cells offer the possibility of achieving high thermodynamic efficiency in the conversion of Gibbs energy into mechanical work. Internal combustion engines at best convert only the fraction $(T_2 - T_1)/T_2$ of the heat of combustion into mechanical work. While the thermodynamic efficiency of the fuel cell is given by, $\eta = \frac{\Delta G}{\Delta H}$, where ΔG is the Gibbs energy change for the cell reaction and ΔH is the enthalpy change of the cell reaction. This efficiency can be upto 80% - 90% also in contrast to normal heat engine efficincies which are generally about 40%.



Hydrogen-oxygen fuel cell with an ion exchange membrane.

Fuel cells may be classified according to the temperature range in which they operate : low temperature (25 to 100°C), medium temperature (100 to 500°C), high temperature (500 to 1000°C), and very high temperature (above 1000°C).The advantage of using high temperature is that catalysts for the various steps in the process are not so necessary. Polarization of a fuel cell reduces the current. Polarization is the result of slow reactions or processes such as diffusion in the cell

The figure, indicates the construction of a hydrogen-oxygen fuel cell with a solid electrolyte, which is an ion exchange membrane. The membranes is impermeable to the reactant gases, but is permeable to hydrogen ions , which carry the current between the electrodes. To facilitate the operation of the cell at 40 to 60°C, the electrodes are covered with finely divided platinum that function as a catalyst. Water is drained out of the cell during operation. Fuel cells of this general type have been used successfully in the space program and are quite efficient. Their disadvantages for large-scale commercial application are that hydrogen presents storage problems, and platinum is an expensive catalyst. Cheaper catalysts have been found for higher temperature operation of hydrogen-oxygen fuel cells.

Fuel cells that use hydrocarbons and air have been developed, but their power per unit weight is too low to make them practical in ordinary automobiles. Better catalysts are needed.

A hydrogen-oxygen fuel cell may have an acidic or alkaline electrolyte. The half-cell reactions are

$$\frac{1}{2}O_2(g) + 2H^+ + 2e^- = H_2O(\ell) \quad E° = 1.2288\ V$$

$$2H^+ + 2e^- = H_2(g) \quad E° = 0$$

$$H_2(g) + \frac{1}{2}O_2(g) = H_2O(\ell) \quad E° = 1.2288\ V$$

or

$$\frac{1}{2}O_2(g) + H_2O(\ell) + 2e^- = 2OH^- \quad E° = 0.4009\ V$$

$$2H_2O(\ell) + 2e^- = H_2(g) + 2OH^- \quad E° = -0.8279\ V$$

$$H_2(g) + \frac{1}{2}O_2(g) = H_2O(\ell) \quad E° = 1.2288\ V$$

To maximize the power per unit mass of an electrochemical cell, the electronic and electrolytic resistances of the cell must be minimized. Since fused salts have lower electrolytic resistances than aqueous solutions, high-temperature electrochemical cells are of special interest for practical applications.

High temperature also allow the use of liquid metal electrode, which make possible higher current densities than solid electrodes.

370. If 560 mL of H_2 gas at STP is fed into and is consumed by the fuel cell in 10 minutes, then what is the current output of the fuel cell?

(A) 4 A (B) 8 A (C) 16 A (D) 12 A

371. For a Hydrogen - Oxygen fuel cell if $\Delta H_f^0(H_2O,\ell) = -285$ kJ/mole, then what will be its thermodynamic efficiencyunder standard conditions(use data given in the passage if required)

(A) 0.91 (B) 0.41 (C) 0.63 (D) 0.83

372. Why are fuel cells not being used in daily life despite their very high efficiency.

(A) The fuels needed for their operation are rarely found in nature
(B) Their operation always needs very high temperature
(C) The catalyst used in fuel cells at normal temperature are very expensive
(D) The design of fuel cells is so complicated that it is not feasible to construct these for daily life applications.

373. In a H_2-O_2 fuel cell, 6.72 L of hydrogen at NTP reacts in 15 minutes, the average current produced in amperes is

(A) 64.3 amp (B) 643.3 amp (C) 6.43 amp (D) 0.643 amp

374. The reduction and oxidation potentials(approximately) of water respectively are

(A) 1.23 V, – 0.83 V (B) –1.23 V, 0.83 V (C) 0.40 V, – 0.83 V (D) – 0.83 V, 1.23 V

SECTION IV: MATCH THE FOLLOWING

375. **Match the following columns**

	Column I **Structure**		**Column II** **Location of atoms**		**Column III** **Coordination number**
(a)	SCC	(i)	corners as well as face centre	(x)	8
(b)	BCC	(ii)	Only at corners	(y)	12
(c)	FCC	(iii)	Corners as well as body centre	(z)	6

(A) (a)-(i)-(z), (b)-(ii)-(x), (c)-(iii)-(y)
(B) (a)-(ii)-(x), (b)-(i)-(y), (c)-(iii)-(z)
(C) (a)-(iii)-(z), (b)-(i)-(x), (c)-(ii)-(y)
(D) (a)-(ii)-(z), (b)-(iii)-(x), (c)-(i)-(y)

376.

	Name of colloidal solution		**Example**
(a)	Emulsion	(i)	Pumic stone
(b)	Aerosol	(ii)	Rocks salts
(c)	Sol	(iii)	Cheese
(d)	Solid sol	(iv)	Protein
(e)	Foam	(v)	Milk
(f)	Gel	(vi)	Mist
(g)	Solid foam	(vii)	Whipped cream

377. **Match the following columns**

	Column I **Location of ions**		**Column II** **No. of occupied voids**		**Column III** **Void**
(a)	Cs^+ in CsCl structure	(i)	All	(p)	Octahedral
(b)	Na^+ in NaCl structure	(ii)	Alternate	(q)	Tetrahedral
(c)	Zn^{++} in ZnS structure	(iii)	One fourth	(r)	Triangular
(d)	F^- in CaF_2 structure	(iv)	One third	(s)	Cuboidal
(e)	Na^+ in Na_2O structure				

(A) (a)-(i)-(s), (b)-(i)-(q), (c)-(ii)-(q), (d)-(i)-(q), (e)-(i)-(q)

(B) (a)-(ii)-(s), (b)-(i)-(r), (c)-(ii)-(q), (d)-(iii)-(q), (e)-(i)-(q)

(C) (a)-(i)-(s), (b)-(iii)-(r), (c)-(ii)-(r), (d)-(i)-(q), (e)-(i)-(s)

(D) (a)-(ii)-(r), (b)-(i)-(s), (c)-(iii)-(q), (d)-(i)-(q), (e)-(ii)-(q)

378. **Match the following column**

	Column I **Structure**		**Column II** **Packing efficiency**
(a)	atoms are present at corners as well as on edge centre	(i)	$\pi/6$
(b)	atoms are present at corners as well as on face centre	(ii)	$\sqrt{3}\ \pi/8$
(c)	atoms are present at corners as well as on body centre	(iii)	$\pi/12$
(d)	atoms are present only at corners	(iv)	$\sqrt{2}\ \pi/6$

(A) (a)-(iii), (b)-(i), (c)-(iv), (d)-(iii)
(B) (a)-(ii), (b)-(v), (c)-(iv), (d)-(iii)
(C) (a)-(iii), (b)-(iv), (c)-(ii), (d)-(i)
(D) (a)-(v), (b)-(iv), (c)-(i), (d)-(iii)

379.

Column (I)		Column (II)
(A) Gold sol	(P)	Bredig's Arc method
(B) Purification of colloidal solution	(Q)	Negatively charged
(C) As_2S_3 sol	(R)	Ultra centrifugation
(D) Zeta potential	(S)	Electro kinetic potential
(E) Casein	(T)	Double decomposition reaction

380.

	Property		Reason
(a)	Brownian movement	(i)	Due to the scattering of light
(b)	Tyndal effect	(ii)	Due to the presence of charge
(c)	Electrophoresis	(iii)	Due to the neutralization of charge
(d)	Coagulation	(iv)	Due to unequal bombardment by solvent molecules

381.

	Name of colloidal solution		Example
(a)	Emulsion	(i)	Pumic stone
(b)	Aerosol	(ii)	Rocks salts
(c)	Sol	(iii)	Cheese
(d)	Solid sol	(iv)	Protein
(e)	Foam	(v)	Milk
(f)	Gel	(vi)	Mist
(g)	Solid foam	(vii)	Whipped cream

382.

	Property		Application
(a)	Tyndal effect	(i)	Smoke precipitator
(b)	Electrophoresis	(ii)	Ultra microscope
(c)	Coagulation	(iii)	Medicine
(d)	Adsorption	(iv)	Sewage water disposal

383. **Match the following column**

	Column I Structure		Column II Examples
(a)	Spinel structure	(i)	K_2O
(b)	Antifluorite structure	(ii)	$ZnFe_2O_4$
(c)	Wurtzite structure	(iii)	$BaCl_2$
(d)	Fluorite structure	(iv)	ZnS
(e)	Corundum	(v)	Fe_2O_3

(A) (a)-(ii), (b)-(i), (c)-(iv), (d)-(iii), (e)-(v)
(B) (a)-(ii), (b)-(v), (c)-(iv), (d)-(iii), (e)-(ii)
(C) (a)-(iii), (b)-(iv), (c)-(v), (d)-(i), (e)-(ii)
(D) (a)-(v), (b)-(iv), (c)-(i), (d)-(iii), (e)-(ii)

384. **Match the following column**

	Column I Structure		Column II Crystal defect
(a)	Density of crystal decreases	(i)	Schottky defect
(b)	dielectric constant increases	(ii)	Frenkel defect
(c)	equal no. of cations & anions are missing from the lattice	(iii)	F-centres
(d)	Anion vacancies having unpaired electrons		
(e)	Cation is missing from its site and occupies void		

(A) (a)-(ii), (b)-(i), (c)-(iv), (d)-(iii), (e)-(v)
(B) (a)-(i), (b)-(ii), (c)-(i), (d)-(iii), (e)-(ii)
(C) (a)-(iii), (b)-(iv), (c)-(v), (d)-(i), (e)-(ii)
(D) (a)-(v), (b)-(iv), (c)-(i), (d)-(iii), (e)-(ii)

385. **Match the following :**

	Column I		**Column II**
(a)	if the activation energy is 65 kJ then how much time faster a reaction proceed at 25°C than at 0°C	(i)	5
(b)	Rate constant of a first - order reaction is 0.0693 min^{-1}. If we start with 20 mol L^{-1}, it is reduced to 2.5 mol L^{-1} in how many minutes	(ii)	11
(c)	Half - lives of first - order and zeroth order reactions are same. Ratio of rates at the start of reaction is how many times of 0.693	(iii)	30
(d)	the half-life periods are given , $[A]_0$ (M) 0.0677 0.136 0.272 $t_{1/2}$ (sec) 240 480 960 order of the reaction is	(iv)	$\frac{1}{2}$
(e)	Rate of formation of SO_3 in the following reaction $2SO_2 + O_2 \rightarrow 2SO_3$ is 100 g min^{-1}. Rate of disappearance of O_2 in g min^{-1}	(v)	2
		(vi)	1
		(vii)	zero
		(viii)	40
		(ix)	50

386. Match the following

	Column A		**Column B**
(i)	Zero order reaction	(a)	$\frac{k_{t+10}}{k_t}$
(ii)	First order reation	(b)	$\frac{dx}{dt}$
(iii)	Second order reaction	(c)	$-\frac{dx}{dt} = k[A]^2[B]$
(iv)	Instantaneous rate	(d)	$H_2 + Cl_2 \xrightarrow{h\nu} 2HCl$
(v)	Temperature coefficient	(e)	$CH_3COOCH_3 + NaOH \rightarrow CH_3COONa + CH_3OH$
(vi)	Rate equation for third order reaction	(f)	$2H_2O_2 \rightarrow H_2O + O_2$
(vii)	Acidic hydrolysis of ester	(g)	Pseudo-unimolecular reaction

(A) i-e, ii-f, iii-g, iv-c, v-a, vi-d, vii-b
(B) i-d, ii-f, iii-e, iv-b, v-a, vi-c, vii-g
(C) i-e, ii-g, iii-f, iv-d, v-a, vi-c, vii-b
(D) i-b, ii-c, iii-a, iv-d, v-f, vi-g, vii-e

387. Match the following

Column I **order**		**Column II** **Rate reaction**	
(i)	Zero	(a)	$k_2 = \frac{x}{at(a-x)}$
(ii)	One	(b)	$k_0 = \frac{x}{t}$
(iii)	Two	(c)	$k_3 = \frac{x(2a-x)}{t.2a^2(a-x)^2}$
(iv)	Three	(d)	$k_1 = \frac{2.303}{t} \log \frac{a}{a-x}$

(A) i-b, ii-d, iii-a, iv-c
(B) i-d, ii-b, iii-c, iv-a
(C) i-c, ii-a, iii-b, iv-d
(D) i-a, ii-b, iii-c, iv-d

388. The following data are for the reaction A + B → products:

concn. A (M)	**concn. B (M)**	**Initial Rate (mol L^{-1} s^{-1})**
0.1	0.1	4.0×10^{-4}
0.2	0.2	1.6×10^{-3}
0.5	0.1	2.0×10^{-3}
0.5	0.5	1.0×10^{-2}

Column I		**Column II**	
(a)	the order with respect to A	(i)	2.8×10^{-3} $M \cdot s^{-1}$
(b)	the order with respect to B	(ii)	One
(c)	the rate constant	(iii)	1.8×10^{-3} $M \cdot s^{-1}$
(d)	the reaction rate for A and B are 0.2M and 0.35M, respectively.	(iv)	k[A][B]
(e)	the reaction rate for A and B are 0.3M and 0.15M, respectively.	(v)	$4 \times 10^{-2} M^{-1} s^{-1}$
(f)	rate of reaction	(vi)	$k[A]^2$ [B]

389. Given the following steps in the mechanism for a chemical reaction :

$$A + B \xrightarrow{\text{fast}} C$$
$$B + C \xrightarrow{\text{slow}} D + E$$
$$D + F \xrightarrow{\text{fast}} A + E$$

Column I		**Column II**	
(a)	The stoichiometric equation for the reaction	(i)	Second
(b)	Catalysts in this reaction	(ii)	rate = k [B][C]
(c)	Intermediates in this reaction	(iii)	rate = k'[A][B]
(d)	The rate-determining step	(iv)	B + C → D + E
(e)	The rate law for the rate-determining step	(v)	2 B+F → 2E
(f)	Order of the reaction	(vi)	A
		(vii)	C
		(viii)	D

390.

Column I		**Column II**	
Examples of solution			**Types of solution**
(a)	Acetone + Aniline	(i)	Positive deviation from ideal behaviour
(b)	Water + Methanol	(ii)	Negative deviation from ideal behaviour
(c)	Benzene + Toluene	(iii)	Ideal solution
(d)	n-Hexane + N-heptane		
(e)	Water + HCl		

391.

Column I		**Column II**	
Condition for various solutions		**Type of solutions**	
(a)	$P_A + P_B < P_A^o x_A + P_B^o x_B$	(i)	Positive deviation from ideal behaviour
(b)	A–B attractive forces should be weaker than B–B attractive forces.	(ii)	Negative deviation from ideal behaviour
(c)	$\Delta V_{mix} > 0$ & Endothermic dissolution	(iii)	Ideal solution
(d)	$\Delta H_{mix} < 0$ & volume decreased during dissolution		
(e)	Raoult's law is obeyed at every range of temperatre		

392.

Column I		**Column II**	
Example of electrolyte			**Value of Van't Hoff factor.**
(a)	$K_3[Fe(CN)_3]$	(i)	2
(b)	Benzoic acid in benzene	(ii)	1
(c)	NaCl	(iii)	$1 + \propto$
(d)	CH_3COOH	(iv)	$1 - \left(1-\frac{1}{n}\right) \propto$
(e)	Urea	(v)	$1 + 3\propto$

393.

Column I		**Column II**	
Colligative properties.		**Their formula**	
(a)	π	(i)	$P_0 x_B$
(b)	$P_0 - P_s$	(ii)	$\frac{nRT}{V}$
(c)	ΔT_f	(iii)	$K_b.m$
(d)	ΔT_b	(iv)	$\frac{1000\,K_f W_A}{m_A W_B}$

394.

	Column I **Properties**		**Column II** **Formula**
(a)	Molal depression constant (K_f)	(i)	$\frac{1000 \times K_f \times W}{W \times \Delta T_f}$
(b)	degree of dissociation	(ii)	$\frac{i-1}{\frac{1}{n}-1}$
(c)	degree of association	(iii)	$\frac{M_{solute}\,(normal)}{M_{solute}\,(observed)}$
(d)	Van't Hoff factor	(iv)	$\frac{i-1}{n-1}$
(e)	M_{solute} (observed)	(v)	$\frac{R\,T_f{}^2}{1000 \times L_f}$

395. Match the following :

	Column I		**Column II**
(i)	Cell constant	(a)	Ω cm
(ii)	λ_m	(b)	cm^{-1}
(iii)	λ_{eq}	(c)	$S\ cm^{-1}$
(iv)	k	(d)	$S\ cm^2\ mol^{-1}$
(v)	ρ	(e)	$S\ m^2\ eq^{-1}$

(A) i-b, ii-d, iii-e, iv-c, v-a

(B) i-a, ii-d, iii-c, iv-e, v-b

(C) i-d, ii-b, iii-a, iv-c, v-e

(D) i-b, ii-d, iii-a, iv-e, v-c

396. Match the following:

Column I				**Column II**		
	Electrolyte	Anode	Cathode	Product at cathode at anode		
(i)	Aq $CuCl_2$	Pt	Pt	(a)	Cu(s)	Cu^{++}
(ii)	Aq $CuCl_2$	Cu	Cu	(b)	Cu(s)	$Cl_2(g)$
(iii)	Aq $CuCl_2$	Cu	Ag	(c)	Cu(s)	Cu^{++}
(iv)	Aq $CuCl_2$	Ag	Cu	(d)	Cu(s)	Ag^{++}

(A) i-b, ii-d, iii-a, iv-a

(B) i-a, ii-b, iii-a, iv-d

(C) i-a, ii-b, iii-a, iv-d

(D) i-b, ii-a, iii-a, iv-d

397. Match the following :

	Column I **Electrode**		**Column II** **Type**
(i)	Pt, H_2(1 atm) | H^+ (1M)	(a)	Secondary refrence electrode
(ii)	Zn(s) | Zn^{2+} || Cu^{2+} | Cu(s)	(b)	Primary reference electrode
(iii)	Calomel electrode	(c)	NHE
(iv)	Ag | AgCl | Cl^- (1M)	(d)	Denial cell

(A) i-bc, ii-d, iii-a, iv-a

(B) i-bc, ii-a, iii-d, iv-a

(C) i-ac, ii-d, iii-b, iv-a

(D) i-bc, ii-d, iii-a, iv-b

398. Match the following :

	Column I		Column II
(i)	Salt bridge	(a)	+ ΔG
(ii)	nFE	(b)	Diffusion in ions
(iii)	Corrosion	(c)	$-\Delta G$
(iv)	$Cu(s) \mid Cu^{++} \parallel Zn^{++} \mid Zn(s)$	(d)	$Fe_2O_3\ x\ .H_2O$

(A) i-d, ii-c, iii-b, iv-a (B) i-c, ii-b, iii-a, iv-d

(C) i-b, ii-c, iii-d, iv-a (D) i-a, ii-c, iii-d, iv-b

399. Match the following :

	Column I		Column II
(i)	Loss of electron	(a)	Cathode to anode
(ii)	Gain of electron	(b)	Anode to cathode
(iii)	Flow of current	(c)	Cathode
(iv)	Flow of electron	(d)	Anode

(A) i-c, ii-c, iii-a, iv-d (B) i-a, ii-c, iii-d, iv-c

(C) i-d, ii-c, iii-a, iv-c (D) i-c, ii-a, iii-d, iv-c

SECTION V: INTEGER TYPE

400. What will be the initial rate of a reaction if its rate constant is 10^{-3} min^{-1} and the concentration of reactant is 0.2 mol dm^{-3} ? How much of reactant will be converted into products in 200 minute ?

401. Same quantity of electricity is being used to liberate iodine (at anode) and a metal x (at cathode). The mass of x deposited is 0.617g and the iodine is completely reduced by 46.3 cc of 0.124M sodium thiosulphate. Find the equivalent mass of x to the nearest integer.

402. One litre water in a bucket is placed in a closed dry air room having dimensions $4 \times 2 \times 1.5\ m^3$ at 300 K . If the vapour pressure of water at 300 K is 27.0 mm and density of water at 300 K is 0.990 g cm^{-3}, calculate the amount of water left in liquid state .

403. The composition of a sample of wurtzite is $Fe_{0.93}O_{1.00}$. What percentage of iron is present in the form of Fe(III) ?

404. We have taken a saturated solution of AgBr.K_{sp} of AgBr is 12×10^{-14}. If 10^{-7} mole of $AgNO_3$ are added to 1 litre of this solution find conductivity (specific conductance) of this solution in terms of 10^{-7} S m^{-1} mol^{-1}.

Given : $\lambda^0_{(Ag^+)} = 6 \times 10^{-3}$ S m^2 mol^{-1} ; $\lambda^0_{(Br^-)} = 8 \times 10^{-3}$ S m^2 mol^{-1} ; $\lambda^0_{(NO_3^-)} = 7 \times 10^{-3}$ S m^2 mol^{-1}

405. From the following data, estimate the activation energy (in kcal/mol) for the reaction,

$$H_2 + I_2 \longrightarrow 2HI$$

T, K	1/T, K^{-1}	log k
769	1.3×10^{-3}	2.9
667	1.5×10^{-3}	1.1

406. A radioactive isotope of P^{32} ($t_{1/2}$ = 14.3 day) used in biotracer studies of phosphorus metabolism accumulates in waste material having activity 1 millicurie . If it is unsafe to dispose off this waste material until the activity falls to 0.01 microcurie , how long must we store the waste in lead container before it is safe to dispose it ?

407. To reduce nitrobenzene to aniline , 20 g of $C_6H_5NO_2$, 30 mL of an alcohol , 250 mL of water , 11 g of HCl and 1 g of $SnCl_2 . 2\ H_2O$ were placed in the cathode space . After passing a current of 26.5 ampere hour through the lead cathodic electrolytic cell , 12.76 g of aniline was produced . Determine the current efficiency .

408. Copper sulphate solution (250 mL) was electrolysed using a platinum anode and a copper cathode. A constant current of 2 mA was passed for 16 mintue. It was found that after electrolysis, the absorbance (concentration) of the solution was reduced to 50% of its original value. If the calculated concentration of copper sulphate in the solution to begin with comes out to be abc × 10^{-d} M. (Give the value of 4 digit integer no. 'abcd')

409. During the discharge of a lead storage battery the density of sulphuric acid fell from 1.294 to 1.139 $g.ml^{-1}$. H_2SO_4 of density 1.294 g mL^{-1} is 39% and that of density 1.139 g mL^{-1} is 20% by weight. The battery holds 3.5L of acid and the volume practically remains constant during the discharge. Calculate the number of ampere hours for which the battery must have been used. The discharging reactions are:

$Pb + SO_4^{2-} \rightarrow PbSO_4 + 2e^-$ (anode)

$PbO_2 + 4H^+ + SO_4^{2-} + 2e^- \rightarrow PbSO_4 + 2H_2O$ (cathode)

410. Calculate the numbers of α and β particles emitted in the conversion of ${}_{92}U^{238}$ to ${}_{82}Pb^{206}$.

(Suppose the no. of α and β particles is x and y respectively then give your answer as two digit integer 'xy')

411. A binary compound AB (formula weight 6.023 Y amu , where Y is some arbitrary number) AB exists in rock salt structure (1 : 1) . The shortest cation-anion distance is $Y^{1/3}$ nm .

Calculate :

(i) The density

(ii) If observed density is 20 kg/m^3 then find which point defect is present ?

412. A small amount of solution containing Na^{24} radio nucleide with activity A = 2 × 10^3 dps was administered into blood of a patient in a hospital. After 5 hour, a sample of the blood drawn out from the patient showed an activity of 16 dpm per c.c. $t_{1/2}$ for Na^{24} = 15 hr. Find –

(a) volume of the blood in patient

(b) Activity of blood sample drawn after a further time of 5 hr.

413. The vapour pressures of ethanol and methanol are 44.5 and 88.7 mm of Hg respectively. An ideal solution is formed at the same temperature by mixing 60 g of ethanol and 40 g of methanol. Calculate the total vapour pressure of solution and mole fraction of methanol in vapour phase.

414. The coagulation of 100 ml of a colloidal sol of gold is completely prevented by addition of 0.25 g of starch to it before adding 1 ml of 10 % NaCl solution. Find out the gold number of starch.

415. The vapour pressure of liquids A and B at 100 °C are 300 and 100 mm of Hg respectively . A mixture of two liquids forming ideal solution at 100 °C exerts a vapour pressure in gaseous phase in which A and B are one mole each in vapour phase . Calculate the vapour pressure of mixture and the mole fraction of liquid mixture in which two liquids are mixed .

416. If an element crystallizes in a cubic structure of edge length 5 Å . If the density and the atomic mass of the element are 2 gm/cc and 75 respectively , then calculate the radius ?

417. The acid catalysed hydrolysis of an organic compound A at 30 °C has half life of 100 minute when carried out in a buffer solution of pH = 5 and 10 minute when carried out at pH = 4 . Both the times the half life are independent of the initial concentration of A . If the rate of reaction is given by , rate = K $[A]^m [H^+]^n$, what are the values of m and n ?

418. 200 g of a non-electrolyte compound (molar mass = 20) are dissolved in 2.0 litre of X M Na_2SO_4 aqueous solution . The osmotic pressure of this solution is found to be 480 atm at 27 ºC. Calculate the value of X. Assume complete dissociation of NaCl and ideal behaviour of this solution .
[R = 0.08 litre atm $mol^{-1} K^{-1}$]

419. How many kinds of space lattices are possible in a crystal ?

420. A metal of atomic weight 80 has density 50 gm/cm^3. If edge length of unit cell is 200 pm then calculate no. of atoms per unit cell ($N_0 = 6 \times 10^{23}$)

421. A wooden lamp excavated recently was found to emit 5 β -particles per minute per gram of carbon. The freshly cut wood is found to emit 14 β -particles per minute per gram of carbon. how old is wooden lamp. Half life period of ^{14}C is 5770 yrs.

422. For the coagulation of 100 ml of arsenious sulphide sol, 5 ml of 1 M NaCl is required. What is the Flocculation value of NaCl?

423. A nuclear reactor produces radioactive phosphorus (P^{32}) with half life of 13.8 days. Initially the activity was 2.0×10^9 nuclei per second. After how much time from the begining of production the activity will reduce to 1×10^9 dps. answer to the nearest integer.

424. The volume of nitrogen gas U_m (measured at STP) required to cover a sample of silica gel with a mono-molecular layer is 129 $cm^3 g^{-1}$ of gel. Calculate the surface area per gram of the gel if each nitrogen molecule occupies 16.2×10^{-20} m^2.

XI

SECTION I: SINGLE OPTION CORRECT

425. The order of increasing thermal stabilities of ,

(I) K_2CO_3 , (II) $MgCO_3$, (III) $CaCO_3$, (IV) $BaCO_3$ is:

(A) II < III < IV < I
(B) IV < II < III < I
(C) IV < II < I < III
(D) II < IV < III < I

426. Iron is harder than sodium because

(A) iron atoms are smaller
(B) iron atoms are more closely packed
(C) metallic bonds are stronger in sodium
(D) metallic bonds are stronger in iron

427. Which of the following is the right order of lattice energy ?

(A) $Na_2O = Al_2O_3$ (B) $Al_2O_3 < Na_2O$ (C) $Na_2O >$ MgO (D) $Na_2O <$ MgO

428. The maximum covalency is equal to –

(A) the number of unpaired p-electrons
(B) the number of paired d-electrons
(C) the number of unpaired s and p-electrons in the outermost shell
(D) the actual number of s and p-electrons in the outermost shell

429. The volatility of HF is low because of

(A) its low polarizability
(B) the weak dispersion interaction between the molecules
(C) its small molecular mass
(D) its strong hydrogen bonding

430. Acetylene does not form hydrogen bond because :

(A) absence of lone pair of electron in higher electronegative carbon atom
(B) absence of more electronegative atom
(C) size of more electronegative atom is large
(D) None of these

431. Anhydrous $AlCl_3$ is covalent but $AlCl_3 . 6 H_2O$ is ionic because :

(A) $AlCl_3$ has a plane triangular structure
(B) the ionization energy of Al is very low
(C) the hydration energy of $AlCl_3$ is very high
(D) the hydration energy of $AlCl_3$ compensates for the high ionization energy of aluminium

432. Which of the following employ(s) the technique of fractional crystallisation?

(A) Parke's process
(B) Pattinson's process
(C) Van–arkel's process
(D) zone refining

433. When a small amount of solid calcium phosphide, Ca_3P_2 , is added to water, what are the most likely products ?

(A) aqueous Ca^{+2} and OH^- ions and PH_3 gas
(B) aqueous Ca^{+2} and OH^- ions and aqueous H_3PO_3
(C) solid CaH_2 and aqueous H_3PO_3
(D) solid CaO and PH_3 gas

434. In Ostwald's Process, _________ is oxidised to NO using _________.

(A) N_2O, O_2 (B) N_2, O_2 (C) NH_3, N_2O (D) NH_3, O_2

435. A metal oxide when heated with water gas at 50^0C under atmospheric pressure, gets converted completely to a gas which is highly toxic and inflammable. The metal could be

(A) Pb (B) Ni (C) Hg (D) Ba

436. Which variety of coal is used for reduction of tinstone in metallurgy of tin?
(A) Peat (B) Lignite (C) Bone char (D) Anthracite

437. In which of the following is highest temperature attainable
(A) kiln (B) induction furnace
(C) blast furnace (D) reverberatory furnace

438. For the confirmatory tests of acid radicals, sodium carbonate extract is prepared because –
(A) all anions react with Na
(B) Na is more reactive
(C) Na_2CO_3 is water soluble
(D) sodium salts of almost all anions are water soluble

439. In a suspected case of poisoning, a forensic expert is analysing a food sample. When the sample is heated with zinc and dil. acid after appropriate treament, a foul-smelling gas is evolved which gives a silver mirror when passed through a heated glass tube. The poisonous element from the sample gives (in its ionic form in the solution) a yellow precipitate when H_2S is passed in its ammonical solution. The poisonous element could be
(A) Hg (B) Sb (C) As (D) Pb

440. The name of the blue product of the reaction between ferrous ion and ferricyanide ion is –
(A) thenard blue (B) turnbull's blue (C) Prussian blue (D) ultramarine blue

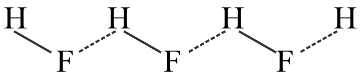
441. The correct lewis acid order for boron halides is -
(A) $BF_3 > BCl_3 > BBr_3 > BI_3$ (B) $BCl_3 > BF_3 > BBr_3 > BI_3$
(C) $BI_3 > BBr_3 > BCl_3 > BF_3$ (D) $BBr_3 > BCl_3 > BI_3 > BF_3$

442. Permutit is
(A) hydrated sodium aluminium silicate (B) sodium hexametaphosphate
(C) sodium silicate (D) sodium metaaluminate

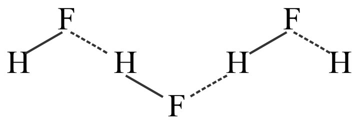
443. The H bonding slip HF can be best represented as –

(A) H – F .. H – F .. H – F

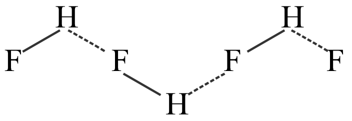
(B)



(C)



(D)



444. Soda extract of the salt is prepared by –
(A) fusing mixture of backing soda and slat and then extracting with water
(B) dissolving $NaHCO_3$ and salt in dil HCl
(C) boiling Na_2CO_3 and salt in dil HCl
(D) boiling Na_2CO_3 and salt in distilled water

445. Ferric ions form a Prussian blue coloured precipitate with $K_4Fe(CN)_6$ due to the formation of –
(A) $K_3[Fe(CN)_6]$ (B) $Fe_4[Fe(CN)_6]_3$ (C) $Fe(OH)_3$ (D) $KFe[Fe(CN)_6]$

446. What is incorrect about $Al_2(SO_4)_3$?
(A) it is a white salt
(B) its aqueous solution gives precipitate of compound Al with $AgNO_3$ solution.
(C) on adding NaOH solution to its aqueous solution, a precipitate is formed which dissolved in excess of NaOH
(D) it will give precipitate with lead acetate solution

447. The main factor responsible for weak acidic nature of B - F bond in BF_3 is ;
(A) Large electronegativity of F
(B) Three centred two electron bond in BF_3
(C) $P\pi$ - $d\pi$ back bonding
(D) $P\pi$ - $P\pi$ back bonding

448. Na_2CO_3 can be manufactured by Solvay process but K_2CO_3 can not be prepared because –
(A) K_2CO_3 is more soluble (B) K_2CO_3 is less soluble
(C) $KHCO_3$ is more soluble than $NaHCO_3$ (D) $KHCO_3$ is less soluble than $NaHCO_3$

449. Which one of the following does not have intermolecular H-bonding
(A) H_2O (B) o-nitrophenol (C) HF (D) CH_3COOH

450. An acid among the following is -
(A) $B(OH)_3$ (B) $Al(OH)_3$ (C) NaOH (D) None

451. Inert pair effect is prominent characteristic of :
(A) s - block (B) d - block (C) p - block (D) f - block

452. For $Be(NO_3)_2$ anhydrous which is correct .
(A) starting material is $Be(NO_3)_2.2H_2O$ with N_2O_4
(B) $Be(NO_3)_2$ (anh.) on heating upto 125° C gives basic beryllium nitrate $[Be_4O(NO_3)_6]$
(C) $Be + HNO_3\ (\text{dil.}) \rightarrow Be(NO_3)_2$ (anh.) + H_2O
(D) all of these are correct

453. CaNH on hydrolysis will give gas (A) which on oxidation by $CaOCl_2$ will convert into (B) . What are (A) and (B) ?
(A) $A = NH_3$, $B = N_2$ (B) $A = N_2$, $B = NH_3$
(C) $A = NH_3$, $B = NH_3$ (D) $A = N_2$, $B = N_3H$

454. The correct order of viscosity of alcohol, ethylene glycol and glycerol is
(A) alcohol > glycol > glycerol (B) glycerol > glycol > alcohol
(C) glycol > glycerol > alcohol (D) alcohol > glycerol > glycol

455. Highly pure dilute solution of sodium in liquid ammonia :
(A) shows blue colour
(B) exhibits electrical conductivity & act as reducing agent
(C) produces sodium amide
(D) All of these

456. Which of the following sets of characteristics leads to the increase in solubility of ionic substances
(A) High dipole moment, strong attraction by an ion and large solvation energy
(B) Low dipole moment, weak attraction by an ion and high solvation energy
(C) High dipole moment, strong attraction by an ion and low solvation energy
(D) High dipole moment, weak attraction by an ion and large solvation energy

457. What is the chemical composition of matte?
(A) $Cu_2O + FeS$ (B) $Cu_2O + Cu_2S$ (C) $FeS + SiO_2$ (D) $Cu_2S + FeS$

458. The second I.P. of Na, third I.P. of Mg and fourth I.P. of Al are very high because
(A) the ion Na^+, Mg^{2+} and Al^{3+} have high ionic potential
(B) these ions are isoelectronic
(C) these ions have outer ns^2np^6 configuration
(D) these ions are of normal elements

459. Which of the following exhibit/s H-bonding?

(A) CH_4 (B) H_2Se (C) N_2H_4 (D) H_2S

460. Correct order of electronegative difference between bonded atom is :

(A) $AlCl_3 < MgCl_2 < NaCl$ (B) $NaCl < AlCl_3 < MgCl_2$

(C) $NaCl < MgCl_2 < AlCl_3$ (C) $MgCl_2 < NaCl < AlCl_3$

SECTION II: MORE THAN ONE OPTION CORRECT

461. Three centre-two electron bonds exist in –

(A) B_2H_6 (B) $Al_2(CH_3)_6$ (C) BeH_2(s) (D) $BeCl_2$ (s)

462. Adding electron to neutral gaseous atom usually leads to

(A) Liberation of energy (B) Formation of ion

(C) Proton/electron ratio decreases (D) Stabilizing the species

463. Sodium nitrate decomposes above ~ 800ºC to give

(A) N_2 (B) O_2 (C) NO_2 (D) Na_2O

464. Select correct statement(s):

(A) Borax is used as a buffer
(B) 1 M borax solution reacts with equal volumes of 2 M HCl solution
(C) Titration of borax can be made using methyl orange as the indicator
(D) Coloured bead obtained in borax-bead test contains metaborate

465. Select correct statement about B_2H_6

(A) Bridging groups are electron-deficient with 12 valence electrons
(B) It has 2c - 2e B–H bonds
(C) It has 3c - 2e B–H–B bonds
(D) All of above are correct statements

466. Which one of the following process(es) will produce temporary hard water?

(A) Addition of Na_2SO_4 to water. (B) Saturation of water with $CaCO_3$

(C) Saturation of water with $MgCO_3$ (D) Saturation of water with $CaSO_4$

467. The reagent(s) that can't be used to determine hardness of water titrimetrically is/are :

(A) oxalic acid (B) disodium salt of EDTA

(C) sodium citrate (D) sodium thiosulphate

468. In context with the industrial preparation of hydrogen from water gas ($CO + H_2$), which of the following is/are the incorrect statement(s)?

(A) CO is oxidised to CO_2 with steam in the presence of a catalyst followed by absorption of CO_2 in alkali.
(B) CO and H_2 are fractionally separated using differences in their densities.
(C) CO is removed by absorption in aqueous Cu_2Cl_2 solution.
(D) H_2 is removed through occlusion with Pd.

469. Hydrogen peroxide is

(A) A stronger acid than water (B) A weaker acid than water

(C) An oxidising agent (D) A reducing agent

470. Hydrogen can be obtained from water by

(A) Reaction with metal oxides (B) Reaction with non-metal oxides

(C) Reaction with metals (D) Reaction with metal hydrides

471. Which of the following is/are hard water(*s*)

(A) Water containing some potash alum (B) Water containing a few drops of *HCl*

(C) Water containing common salt (D) Water containing calcium nitrate

472. Pick the incorrect statement(s):

(A) Sodium borohydride reacts very slowly with cold water

(B) Sodium borohydride reacts very violently with cold water to produce H_2

(C) Solubility of sodium borohydride in water at 25°*C* is 10.05 *g*/*mL*

(D) Melting point of sodium borohydride is 500°*C*

473. Hydrogen can be obtained from water, by the action of water on

(A) Calcium carbide (B) Calcium hydride (C) Calcium oxide (D) Calcium

474. What is true about ice

(A) Its density is more than water (B) It is a good conductor of heat

(C) It is a thermal insulator (D) Its density is less than water

475. Which of the following order is wrong:

(A) $NH_3 < PH_3 < AsH_3$ – Acidic (B) Li < Be < B < C – IE_1

(C) $Al_2O_3 < MgO < Na_2O < K_2O$ – Basic (D) $Li^+ < Na^+ < K^+ < Cs^+$ – Ionic radius

476. True statement(s) for periodic classification of elements is

(A) The properties of the elements are periodic function of their atomic numbers

(B) No. of nonmetallic elements is less than the no. of metallic elements

(C) First ionization energy of elements does not change continuously with increasing of atomic no. in a period .

(D) d-subshell is filled by directional electron with increasing atomic no. of transition elements.

477. Which of the following is / are correct for group 14 elements?

(A) The stability of dihalides are in the order $CX_2 < SiX_2 < GeX_2 < SnX_2 < PbX_2$

(B) The ability to form $p\pi$–$p\pi$ multiple bonds among themselves increases down the group

(C) The tendency for catenation decreases down the group

(D) They all form oxides with the formula MO_2.

478. The incorrect statement(s) among the following is/are:

(A) The first ionisatioin potential of Al is less than the first ionisation potential of Mg

(B) The second ionisation potential of Mg is greater than the second ionisation potential of Na

(C) The first ionisation potential of Na is less than the first ionisation potential of Mg

(D) The third ionisation potential of Mg is greater than the third ionisation potential of Al

479. The correct statement(s) related to allotropes of carbon is/are

(A) graphite is the most stable allotropes of carbon and having a two dimensional sheet like structure of hexagonal rings of carbon (sp^2)

(B) diamond is the hardest allotrope of carbon and having a three dimensional network structure of $C(sp^3)$

(C) fullerene (C_{60}) is recently discovered non-crystalline allotrope of carbon having a football-like structure.

(D) Vander Waal's force of attraction acts between the layers of graphite 6.14 Å away from each other

480. The hydrolytic constants are expressed as K_{hydr}. At 25ºC, pK_{hydr} of the following calions are as given:

Cations

	Mg^{2+}	Ca^{2+}	Al^{3+}	Fe^{2+}
pK_{hydr}	*11.4*	*12.6*	*5.1*	*9.5*

(A) Smaller the value of ionisation constant of base, greater is the extent of hydrolysis

(B) Greater the polarisation power of the cation stronger the hydrolysis

(C) pK_{hydr} for Fe^{3+} is expected to be lesser than 9.5

(D) pK_{hydr} for Ba^{2+} is expected to be greater than 12.6

481. When an inorganic compound (X) having 3c-2e as well as 2c-2e bonds reacts with ammonia gas at a certain temperature, gives a compound (Y) iso-structural with benzene. Compound (X) with ammonia at a high temperature, produces a hard substance (Z). Then

(A) (X) is B_2H_6

(B) (Z) is known as inorganic graphite

(C) (Z) having structure similar to graphite

(D) (Z) having structure similar to (X)

482. Which of the following statements is/are correct regarding B_2H_6?

(A) banana bonds are longer but stronger than normal B–H bonds

(B) B_2H_6 is also known as 3c–2e compound

(C) the hybrid state of B in B_2H_6 is sp^3 while that of sp^2 in BH_3

(D) it cannot be prepared by reacting BF_3 with $LiBH_3$ in the presence of dry ether

483. Select correct statements -

(A) $Ca_3(PO_4)_2$ is part of bones and $3Ca_3(PO_4)_2.CaF_2$ is part of enamel in teeth

(B) Ca^{2+} ions are important in blood clotting

(C) BeH_2 and MgH_2 are covalent and polymeric while CaH_2 , SrH_2 and BaH_2 are ionic

(D) BeH_2 contain three-centre two-electron bonds

484. Which of the following cannot be used as primary standard base -

(A) NaOH (B) $Ca(OH)_2$ (C) $Na_2B_4O_7$, $10H_2O$ (D) $Na_2C_2O_4$

485. Which of the following is correct among the following?

(A) Increasing polarising power : $Na^+ < Ca^{+2} < Mg^{+2} < Al^{+3}$

(B) Increasing covalent character : LiF < LiCl < LiBr < LiI

(C) Ionic character: $MCl < MCl_2 < MCl_3$

(D) Increasing polarisibility : $F^- < Cl^- < Br^- < I^-$

486. Which of the following carbides are methanides?

(A) CaC_2 (B) Mg_2C_3 (C) Al_4C_3 (D) Be_2C

487. Which of the following statements about alkaline earth metals are correct ?

(A) Hydration energy of Sr^{2+} is greater than that of Be^{2+}

(B) $CaCO_3$ decomposes at a higher temperature than $BaCO_3$

(C) $Ba(OH)_2$ is stronger base than $Mg(OH)_2$

(D) $SrSO_4$ is less soluble in water than $CaSO_4$

488. Which of the following pairs of elements will give superoxides and peroxides respectively when heated in excess of air

(A) K, Ba (B) Na,Rb (C) K,Rb (D) Na, Ba

489. Which one of the following statement (s) is (are) correct?

(A) The electronic configuration of Cr is [Ar] $3d^5$ $4s^1$.(Atomic No. of Cr = 24)

(B) The magnetic quantum number may have a negative value

(C) In silver atom, 23 electrons have a spin of one type and 24 of the opposite type. (Atomic No. of Ag = 47)

(D) The oxidation state of nitrogen in HN_3 is –3.

490. In Alkali metal family cesium is

(A) Used in photoelectric cells (B) Lightest of all

(C) Less electropositive than francium (D) Soft and has low melting and boiling points.

491. Alkali metals are characterised by

(A) Good conductor of heat and electricity (B) high oxidation potentials

(C) High melting points (D) Solubility in liquid ammonia.

492. Which of the following superoxides are orange coloured

(A) RbO_2 (B) CsO_2 (C) KO_2 (D) None of these

493. All the following substances react with water, in which of the cases same gaseous product is obtained?

(A) Na (B) Na_2O_2 (C) KO_2 (D) NaH

494. Solutions of equal strength of XOH and QOH are prepared. The Ionisation Potential of X and Q are 5.1 and 13.0eV respectively, whereas their Electronegativity are 0.9 and 3.2 respectively. Using the information, spot the correct conclusion(s)

(A) Reaction of XOH and NH_4Cl will produce NH_3

(B) Solution of QOH will give effervescence with $NaHCO_3$

(C) Phenolphthalein will give pink colour with XOH solutions

(D) The pH of QOH solution will be more than 7

495. Which of the following statement/s is/are correct?

(A) The structure of carborundum is as same that of diamond

(B) Carbogen is a mixture of O_2 and CO_2 (5–10%) which is used for artificial respiration in pneumonia patients

(C) $SnCl_2$ is a strong oxidizing agent.

(D) PbO a yellow coloured powder is known as litharge.

SECTION III: COMPRHENSIONS

COMPREHENSION # 54

Paragraph for Questions Nos. 496 to 498

100 ml of hard water sample containing Ca^{2+} as only hardness imparting cation was divided into two equal parts.

To the first part, 1 ml of NH_4Cl-NH_4OH buffer was added and pH adjusted to 11, addition of 4–5 drops of Erichrome black T indicator. The colour of the resulting solution was pink. The solution so obtained was titrated with 10^{-3} (M) disodium salt of EDTA (Na_2EDTA), 40 ml of Na_2EDTA solution was required to change the colour of solution from pink to blue. For the following reaction

$Na_2EDTA + Ca^{2+} \longrightarrow CaEDTA + 2Na^+$

To the second part 10^3 ml of excess $Ca(OH)_2$ solution was added, thoroughly stirred,

6×10^{-4} gm of white ppt of $CaCO_3$ was obtained.

The density of hard water sample was 1gm/ml

496. What was the temporary hardness of given hard water sample? Hardness is expressed in ppm of $CaCO_3$.

(A) 3 ppm (B) 6 ppm (C) 18 ppm (D) 20 ppm

497. What was the permanent hardness of the given hard water sample with respect to ppm of $CaCO_3$?

(A) 80 ppm (B) 74 ppm (C) 64 ppm (D) 84 ppm

498. If the 100 ml of the given water sample is passed through in cation exchange resin only then what should be the pH of effluent water from the resin?

Given log 2 = 0.3 and log 3 = 0.48

(A) 4.8 (B) 2.52 (C) 2.8 (D) 5.8

COMPREHENSION # 55

Paragraph for Questions Nos. 499 to 501

Depletion of resources of fossil fuels will at some future time make hydrogen, either for use directly by combustion and electrochemically in fuel cells or indirectly via hydrogenation of coal, the major alternative to nuclear energy; hence arises the current interest in the so-called hydrogen economy.

A thermochemical cycle for hydrogen production involves at least one element that can exist in two different oxidation states .

$2H_2O \rightarrow 2H_2 + O_2$

499. Production of H_2 from H_2O requires a net input of energy that would come from -

(A) nuclear source (B) solar source (C) both of these (D) none of these

500. In the above thermochemical cycle, $FeCl_2$ is one of the catalyst involved and thus regenerated at the end of the reaction, after formed into -

(A) $FeCl_3$, FeO, Fe_2O_3 (B) $FeCl_3$, Fe_2O_3, Fe_3O_4

(C) $FeCl_3$, FeO (D) $FeCl_3$, Fe_3O_4

501. H_2 is produced in the following thermochemical reaction -

(A) $FeCl_2 + H_2O \rightarrow$ (B) $Fe_3O_4 + Cl_2 + HCl \rightarrow$

(C) $FeO + H_2O \rightarrow$ (D) $FeCl_3 + H_2O \rightarrow$

COMPREHENSION # 56

Paragraph for Questions Nos. 502 to 506

Consider the following flowsheet and answer the questions given after it

$$C_3H_{8(g)} + A \longrightarrow \text{Syngas} \xrightarrow[Fe_2O_3/Cr_2O_3]{x}$$

$$Y + Z \xrightarrow[\text{High pressure}]{\text{Cold water}} Z(g) + \text{Aq. solution of Y.}$$

Z has low chemical reactivity at room temperature but under vigorous suitable conditions it reacts with other elements to form very useful compounds. Z is also being looked upon as prospecitve source of energy for future.

502. The above flowsheet refers to which process -

(A) Lane's process (B) Haber's process (C) Bosch process (D) Mond's process

503. Which two substances are same?

(A) X and Z (B) A and X (C) A and Y (D) A and Z

504. Which of following represents dihydrogen?

(A) Y (B) Z (C) X (D) None of these

505. Components of syngas are -

(A) CO_2, CO (B) CO, H_2O (C) CO, H_2 (D) CO_2, H_2

506. Which compound of Z is called oxidane ?

(A) X (B) Y (C) H_2O_2 (D) N_2H_4

COMPREHENSION # 57

Paragraph for Questions Nos. 507 to 509

The mineral colemanite is fused with sodium carbonate, compound (Z) is obtained along with white ppt. When (Z) reacts with conc. H_2SO_4 gives a compound (A) which on hydrolysis gives monobasic acid (B) which on strong heating gives (C). (C) on reduction with Mg produced (D) and non metal (X). (X) is a II period element and its valency shell have 3 electrons . Treatment of halogen on a mixture of (C) and carbon at high temperature gives a halide (E) which is fuming liquid (b. pt. 13ºC) along with a oxide (F), which is neutral in nature.

Based on the above paragraph answer the following questions .

507. Compound (B) is weak acid in ....(1)......... & strong acid in ....(2)........... What are (1) and (2)?

	(1)	(2)		(1)	(2)
(A)	H_2O	glycol	(C)	glycol	H_2O
	(1)	(2)		(1)	(2)
(C)	glycol	NH_4OH	(D)	glycol	NaOH

508. By heating the non metal (X) in the atmosphere of nitrogen yields a compound (Y). The structure of (Y) is similar to :

(A) diamond (B) graphite (C) silicate (D) carborundum

509. The anhydrous form of (A) is :

(A) H_3BO_3 (B) B_2O_3 (C) $H_2B_4O_7$ (D) B

COMPREHENSION # 58
Paragraph for Questions Nos. 510 to 512

The electronic configuration of the elements show a periodic variation of increasing atomic number. Consequently there are also periodic variations in physical and chemical behaviour of the elements. Before examining the variation in properties, the concept of effective nuclear charge should also be understood as it influences the atomic size and ionization energy. The effective nuclear charge effect is the charge felt by the valence electron $Z_{eff} = z - \sigma$, where z is actual nuclear change and σ is screening constant. Now variation in different type of atomic radii i.e. metallic radius covalent radius and Vander Wall radius can be studied keeping Z_{eff} in consideration. Z_{eff} also plays an important role in variation of ionization energy across the period and group. A large Z_{eff} means a more tightly held outer electron and hence greater first ionization energy.

510. The increasing order of effective nuclear charge in Na, Al, Mg and Si atoms

(A) Na < Mg < Si < Al (B) Na < Mg < Al < Si

(C) Mg < Na < Al < Si (D) Na = Mg = Al = Si

511. Which of the following option is correct? **[State T for true and F for false]**

(i) On moving from left to right in a period screening constant value is increase

(ii) In a s, p, d, f-orbitals the order of screening effect is s > p > d > f in a given shell

(iii) In any period left to right effective nuclear charge increases so electronegativity is also increases

(iv) The effective nuclear charge of Na is 2.85

(A) TTTF (B) FFFT (C) FFTT (D) TTFF

512. Calculate the screening constant for the last electron of Si

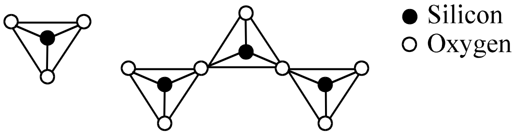
(A) 4.15 (B) 9.85 (C) 8.85 (D) 4.85

COMPREHENSION # 59
Paragraph for Questions Nos. 513 to 515

Read the following short write-up and answer the questions at the end of it

The name **'silica'** covers an entire group of minerals, which have the general formula SiO_2, the most common of which is **quartz**. Quartz is a framework silicate with SiO_4 tetrahedra arranged in spirals. The spirals can turn in a clockwise or anticlockwise direction – a feature that results in there being two mirror images, optically active, varieties of quartz.

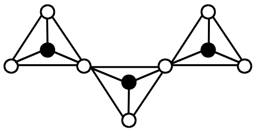
513. The following pictures represent various silicate anions. Their formulae are respectively:

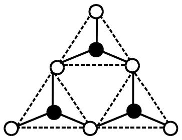


(A) SiO_3^{2-} $Si_3O_7^{2-}$ (B) SiO_4^{4-} $Si_3O_{10}^{8-}$

(C) SiO_4^{2-} $Si_3O_9^{2-}$ (D) SiO_3^{4-} $Si_3O_7^{8-}$

514. $\mathrm{Si_3O_9^{6-}}$ (having three tetrahedral) is represented as:

(A) 

(B) 

(C) both

(D) none

515. The silicate anion in the mineral kinoite is a chain of three SiO_4 tetrahedra that share corners with adjacent tetrahedra. The mineral also contains Ca^{2+} ions, Cu^{2+} ions, and water molecules in a 1:1:1 ratio mineral is represented as:

(A) $CaCuSi_3O_{10}\cdot H_2O$

(B) $CaCuSi_3O_{10}\cdot 2H_2O$

(C) $Ca_2Cu_2Si_3O_{10}\cdot 2H_2O$

(D) none of these

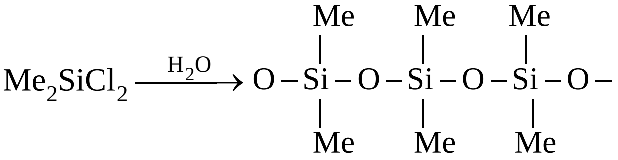
COMPREHENSION # 60

Paragraph for Questions Nos. 516 to 517

Silicons are synthetic polymers containing repreated R_2SiO units. Since, the empirical formula is that of a ketone (R_2CO), the name silicone has been given to these materials. Silicones can be made into oils, rubbery elastomers and resins. They find a variety of applications because of their chemical inertness, water repelling nature, heat-resistance and good electrical insulating property.

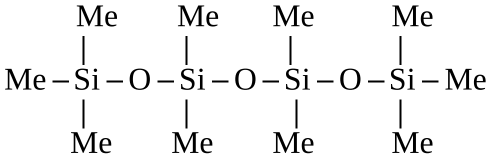
Commercial silicon polymers are usually methyl derivatives and to a lesser extent phenyl derivatives and are synthesised by the hydrolysis of

R_2SiCl_2[R=methyl (Me) or phenyl (ϕ)]

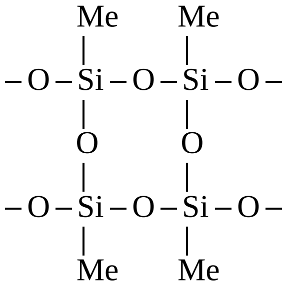


$$\mathrm{Me_2SiCl_2} \xrightarrow{H_2O} \mathrm{O-\underset{Me}{\overset{Me}{Si}}-O-\underset{Me}{\overset{Me}{Si}}-O-\underset{Me}{\overset{Me}{Si}}-O-}$$

516. If we mix Me_3SiCl with Me_2SiCl_2, we get silicones of the type:

(A) 

$$\mathrm{Me-\underset{Me}{\overset{Me}{Si}}-O-\underset{Me}{\overset{Me}{Si}}-O-\underset{Me}{\overset{Me}{Si}}-O-\underset{Me}{\overset{Me}{Si}}-Me}$$

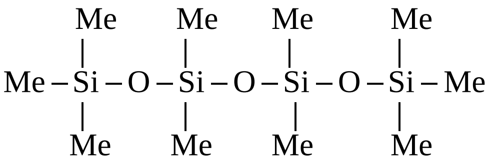
(B) 

$$\begin{array}{c} \mathrm{-O-\overset{Me}{Si}-O-\overset{Me}{Si}-O-} \\ \quad\;\; | \qquad\quad | \\ \quad\;\; \mathrm{O} \qquad\;\; \mathrm{O} \\ \quad\;\; | \qquad\quad | \\ \mathrm{-O-\underset{Me}{Si}-O-\underset{Me}{Si}-O-} \end{array}$$

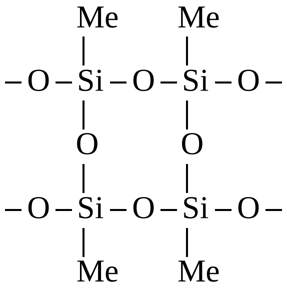
(C) both of the above

(D) none of the above

517. If we start with $MeSiCl_3$ as the starting material, silicones formed is:

(A) 

$$\mathrm{Me-\underset{Me}{\overset{Me}{Si}}-O-\underset{Me}{\overset{Me}{Si}}-O-\underset{Me}{\overset{Me}{Si}}-O-\underset{Me}{\overset{Me}{Si}}-Me}$$

(B) 

(C) both of the above (D) none of the above

COMPREHENSION # 61
Paragraph for Questions Nos. 518 to 520

Lattice enthalpy: The lattice enthalpy of an ionic solid is defined as the energy required to completely separate one mole of a solid ionic compound into gaseous constituent ions. For e.g., the lattice enthalpy of NaCl is 788 kJ mol^{-1}. This means that 788 kJ of energy is required to separate to an infinite distance 1 mole of solid NaCl into 1 mole of $Na^+(g)$ and one mole of $Cl^-(g)$. This process involves both the attractive forces between ions of opposite charges and the repulsive forces between ions of like charge. The solid crystal being three-dimensional; it is not possible to calculate lattice enthalpy directly from the interaction of forces of attraction and repulsion only. Factors associated with the crystal geometry have to be included.

The first theoretical interpretation of lattice enthalpy was given by Born and Lande. They gave a simple equation for the calculation of lattice enthalpy.

$$U_0 = \frac{AN_A |z^+||z^-| e^2}{4\pi\varepsilon_0 r_0} (1 - 1/n)$$

Where U_0 is the lattice enthalpy ; A, the Madelung constant (this take care of interaction with all the other ions besides the nearest neighbours) N_A, the Avogadro constant ; z^+, charge on the positive ion ; z^-, the charge on the negative ion ; e, charge on the electron ; π, constant (3.14159); ε_0 ; vacuum permittivity ; r_0 inter-ionic distance , n is the born exponent in the repulsion terms.

On moving up to down lattice energy decreases in groups. Same for hydration energy also. If lattice energy is less than hydration energy, means that salt will be soluble in water.

518. Which one has highest melting point among the following?

(A) NaCl (B) KCl (C) CsCl (D) RbCl

519. Which of the following order is correct for lattice energy (U) .

(A) $Fe_2O_3 > FeO$ (B) $Fe_2O_3 < FeO$ (C) $Fe_2O_3 = FeO$ (D) none of these

520. $BaSO_4$ is inosluble in water because :

(A) lattice energy is greater than hydration energy

(B) lattice energy is less than hydration energy

(C) lattice energy is almost same its hydration energy

(D) None of these

COMPREHENSION # 62

Paragraph for Questions Nos. 521 to 523

Calcium sulphate is available in nature in two forms, anhydride, $CaSO_4$ and gypsum, $CaSO_4 . 2H_2O$. Gypsum when heated at 120ºC, from the monoclinic form it changes to orthorhombic form and then it loses three fourth of it's water of crystallisation and plaster of paris is produced

521. What will be the product if gypsum is heated at 200ºC?

(A) $CaSO_4 . H_2O$ (B) $2CaSO_4 . H_2O$

(C) $CaSO_4$ (D) CaO, SO_2 and O_2

522. Suspension of gypsum is used for production of nitrogeneous fertilizer as follows –

(A) $CaSO_4 + NH_3 \longrightarrow (NH_4)_2 SO_4 + Ca(OH)_2$

(B) $NH_3 + CaSO_4 + CO_2 \longrightarrow (NH_4)_2SO_4 + CaCO_3$

(C) $CO_2 + CaSO_4 \longrightarrow Ca(OH)_2 + CaCO_3$

(D) $NH_3 + CaSO_4 + CO_2 \longrightarrow CaCO_3 + (NH_4)_2CO_3 + H_2SO_4$

523. Which of the following represent the setting reaction of plaster of paris ?

(A) $2CaSO_4 . H_2O \xrightarrow{\Delta} CaSO_4$

(B) $2CaSO_4 . H_2O \xrightarrow{H_2O} CaSO_4 . 2H_2O$ (orthorhombic)

(C) $2CaSO_4 . H_2O \xrightarrow{H_2O} CaSO_4 . 2H_2O$ (monoclinic)

(D) $2CaSO_4 . H_2O \xrightarrow{H_2O} CaSO_4 . H_2O$ (monoclinic)

COMPREHENSION # 63

Paragraph for Questions Nos. 524 to 529

Boron forms a number of hydrides having the general formulae B_nH_{n+4} and B_nH_{n+6}. These hydrides are called boranes. The simplest hydride of boron is diborance, B_2H_6. Boranes contain special types of bonds known as multicentre bonds. Boranes have high heat of combustion.

524. The type of hybridization of boron in diborane is

(A) sp (B) sp^2 (C) sp^3 (D) dsp^2

525. Three centre two electron bond(3c – 2e) is present in :-

(A) BF_3 (B) B_2H_6 (C) H_3BO_3 (D) None of these

526. Which of the following is electron deficient compound :

(A) C_2H_6 (B) SiH_4 (C) PH_3 (D) B_2H_6

527. Which hydride does not exist :

(A) BH_3 (B) H_2F_2 (C) SbH_3 (D) N_2H_4

528. From B_2H_6, all the following can be prepared except :

(A) H_3BO_3 (B) $B_2(CH_3)_4H_2$ (C) $B_2(CH_3)_6$ (D) $NaBH_4$

529. In B_2H_6 :

(A) There is direct boron-boron bond

(B) The boron atoms are linked through hydrogen bridges

(C) All the B-H bond distances are equal

(D) All the atoms are in one plane

COMPREHENSION # 64

Paragraph for Questions Nos. 530 to 532

Element A has two electrons in its valence shell & its principal quantum number for last electron is 2 & element B has 4 electrons in its valence shell & its principal quantum no. for last electron is 2 & element X has 3 electrons in its valence shell & principal quantum no. for last electron is 3.

530. The nature of the oxide of element X is:

(A) amphoteric (B) acidic (C) neutral (D) basic

531. Which of the following option is correct

(A) The element B and X element show diagonal relationship with each other

(B) The ionization potential value of A & X element is nearly same

(C) The electronegativity of A & X element is nearly same

(D) The ionic potential value (ϕ) of A & X element is nearly same

532. Compound XB and AB on hydrolysis gives

(A) CO_2 (B) CH_4 (C) B_2H_6 (D) SO_2

COMPREHENSION # 65

Paragraph for Questions Nos. 533 to 535

The atoms have an outer electronic configuration of s^2p^1. Monovalency is explained by the s electrons in the outer shell remaining paired, and not participating in bonding. This is called the 'inert pair effect'. If the energy required to unpair them exceeds the energy evolved when they form bonds, then the s electrons will remain paired. The inert pair effect is not the explanation of why monovalency occurs in group 13. It merely describes what happened, i.e. two electrons do not participate in bonding. The reason that they do not take part in bonding is energy. The inert pair effect is not restricted to group 13, but also occurs among the heavier elements in other groups in the p-block

Thus in the s-block, groups 1 and 2 show only the group valency. Groups in the p-block show variable valency, differing in steps of two. Variable valency also occurs with elements in the d-block.

533. Which of the following elements are capable of showing inert pair effect?

(A) Carbon (B) Aluminium (C) Lead (D) All of these

534. The correct order of shielding effect is s, p, d, f orbital

(A) $s > p > d > f$ (B) $s < p > d > f$ (C) $s < p < d < f$ (D) $s > p < d > f$

535. Due the inert pair effect

(A) Heavier p-block element show lower oxidation state as stable oxidation state

(B) Heavier p-block element show higher oxidation state as stable oxidation state

(C) Strong shielding effect by inner-penultimate electrons

(D) The oxidation state is equal to the valence shell electron

SECTION III: MATCH TYPE

536. Match the following columns

	Column I		**Column II**
(a)	NaCl	(P)	Soluble in water
(b)	AgCl	(Q)	Lattice energy > Hydration energy
(c)	$CdCl_2$	(R)	Lattice energy < Hydration energy
(d)	$FeSO_4$	(S)	Cation has Pseudo inert (18 e^- in valence shell) gas configuration

537. Match list I with list II & then select the correct answer from the codes given below

	List - I		**List - II**
(A)	Increasing atomic size	(a)	Cl < O < F
(B)	Decreasing atomic radius	(b)	B > Be > Li
(C)	Increasing electronegativity	(c)	Si < Al < Mg
(D)	Decreasing effective nuclear charge	(d)	N > O > F

538.

	Column- I		**Column-II**
(A)	Permanent hardness	(P)	Na^+ (aq)
(B)	Temporary hardness	(Q)	Ca^{2+} (aq)
(C)	React on heating	(R)	Mg^{2+} (aq)
(D)	Not responsible for hardness	(S)	HCO_3^- (aq)

539.

	Column- I		**Column-II**
(A)	Primary standard base	(P)	$Na_2C_2O_4$
(B)	Equiv. wt =	(Q)	$Na_2B_4O_7$
(C)	Primary standard reducing agent	(R)	Na_2CO_3
(D)	Capable of reducing hardness of water due to the presence of Ca^{2+}	(S)	As_2O_3

540.

	Column-I		**Column-II**
(A)	oxone	(P)	Na_2SO_4
(B)	Aq. Solution is Neutral toward litmus	(Q)	Na_2O_2
(C)	solvay process	(R)	$NaHCO_3$
(D)	Evolve $CO_2 \uparrow$ on heating	(S)	Na_2CO_3

541.

	Column I(Heating effect of oxalate salts)		**Column II(Products of heating effect)**
(A)	$(COONa)_2$	(P)	CO
(B)	$Ba(COO)_2$	(Q)	CO_2
(C)	$Mg(COO)_2$	(R)	Carbonate salts
(D)	$(COOAg)_2$	(S)	Pure metal

542.

	Column-I		**Column-II**
(A)	$[Be(OH)_4]^{2-}$	(P)	Amphoteric
(B)	BeF_2	(Q)	Tetrahedral
(C)	$Be(OH)_2$	(R)	Polymeric
(D)	MgO	(S)	NaCl type structure

543.

	Column-I		**Column-II**
(A)	$KHCO_3$	(P)	Exists in the solid state
(B)	$NaHCO_3$	(Q)	Soluble in water
(C)	$LiHCO_3$	(R)	Hydrogen bonding
(D)	NH_4HCO_3	(S)	Dimeric anion

544.

	Column-I		**Column-II**
(A)	NaO_2	(P)	Paramagnetic
(B)	KO_2	(Q)	Yellow, pyrites structure
(C)	RbO_2	(R)	Orange
(D)	CsO_2	(S)	Brown

545. Match the following columns

	Column I		**Column II**
(a)	Chlorine	(P)	transition element
(b)	Helium	(Q)	highest electron affinity
(c)	Iron	(R)	high ionisation energy
(d)	Lithium	(S)	strongest reducing agent

546. **Match the column**

	Column I		**Column II**
(a)	Ionization energy	(P)	Amount of energy released when an extra electron is added in any neutral gaseous atom.
(b)	Electron affinity	(Q)	The charge or partial charge which comes by transfer or parital shifting of electron in any atom during its compound formation.
(c)	Electronegativity	(R)	Minimum amount of energy required to remove an outermost electron.
(d)	Oxidation number	(S)	Relative tendency to attract shared pair of electron towards itself.

547. Match List I with List II and select the correct answer using the codes given below the lists -

	List I		**List II**
(1)	Heavy water	(A)	Bicarbonates of Mg and Ca in water
(2)	Temporary hard	(B)	lather with soap water
(3)	Soft water	(C)	D_2O
(4)	Permament hard	(D)	Sulphates and water chloride of Mg and Ca

548.

Column (A)	**Column (B)**
(a) $Ca(OH)_2 + Cl_2 \xrightarrow[35°C]{below}$ (slaked lime)	(i) Calcium chloride
(b) $Ca(OH)_2 + Cl_2 \xrightarrow{cold}$ (milk of lime)	(ii) Calcium chloride and cal. chlorate
(c) $2Ca(OH)_2 + 2Cl_2 \xrightarrow{heat}$	(iii) Bleaching powder
(d) $2Ca(OH)_2 + 2Cl_2 \xrightarrow{red\ heat}$ (Slaked lime)	(iv) Calcium chloride and calcium hypochlorite
	(v) Calcium chloride & calcium chlorite

(A) (a – iii) (b – iv) (c – ii) (d – i)
(B) (a – ii) (b – i) (c – iv) (d – iii)
(C) (a – iv) (b – i) (c – iii) (d – i)
(D) (a – ii) (b – iii) (c – iv) (d – i)

549. Match the following:

Column I	**Column II**
(a) Anhydrous $AlCl_3$	(i) Antiseptic
(b) Alum	(ii) Alloy
(c) Ultramarine	(iii) Friedel-Craft’s reaction
(d) Borax	(iv) Complex blue coloured silicate
(e) Magnelium	(v) Tincal

(A) (a–i); (b–iv); (c–iii); (d–v); (e–ii)
(B) (a–iii); (b–i); (c–iv); (d–v); (e–ii)
(C) (a–v); (b–ii); (c–iii); (d–iv); (e–i)
(D) (a–ii); (b–i); (c–v); (d–iv); (e–iii)

550. Match the various sequences with the appropriate orders:

Sequences	**Orders**
(I) Na^+ Mg^{+2} Al^{+3}	(a) increasing size of ion in gaseous state
(II) I^- S^{2-} N^{3-}	(b) decreasing size of ion in gaseous state
(III) O O^- O^{-2}	(c) increasing size of ions aqueous state.
(IV) N F O (IE_2)	(d) decreasing size of ions aqueous state.
	(e) increasing order of IE_2
	(f) decreasing order of electron affinity

551. Match the following:

Column I	**Column II**
(A) $Bi^{3+} \rightarrow (BiO)^+$	(P) Heat
(B) $[AlO_2]^- \rightarrow Al(OH)_3$	(Q) Hydrolysis
(C) $SiO_4^{4-} \rightarrow Si_2O_7^{6-}$	(R) Acidification
(D) $(B_4O_7^{2-}) \rightarrow [B(OH)_3]$	(S) Dilution by water

SECTION V: INTEGER TYPE

552. How much energy in joules must be needed to convert all the atoms of sodium to sodium ions present in 2.3 mg of sodium vapours ? Ionisation energy of sodium is 495 kJ mole^{-1}

553. The nuclei of tritium (H^3) atom would contain neutrons -

554. How many maximum Hydrogen bonds can be made by 1 molecule of water?

555. How many bridging chlorine are present in Al_2Cl_6?

556. Calculate the E.N. of Cl from the bond energy of ClF (61 KCal/mol). Given that bond energies of F_2 and Cl_2 are 38 and 58 KCal/mol respectively.

557. What mass of CaO will be required to remove the hardness of 10^3 litres of water containing 1.62 gm of calcium bicarbonate per litre -

558. Which property will NOT increase for IA group as we go down the group.

(a) Atomic size
(b) Ionic radii
(c) I E
(d) Density
(e) Melting point
(f) Boiling point
(g) E N
(h) At. mass
(i) Valance e$^-$
(j) Metallic ch
(k) Chemical reactivity

559. If there were 10 periods in the periodic table then how many elements would this period can maximum comprise of.

560. Calculate the effective nuclear charge (Z*) for valence shell electrons of bromine atom

561. The electron affinity of chlorine is 3.7 eV. How much energy in kcal is released when 2 g of chlorine is completely converted to Cl^- ion in a gaseous state ?
(1 eV = 23.06 kcal mol^{-1})

562. Find the degree of hardness of a sample of water containing 30 ppm of $MgSO_4$.

563. Certain sample of water was found to contain 68 ppm of $CaSO_4$ and 19 ppm of $MgCl_2$. What will be the total hardness of water ?

564. Calculate the electron affinity of the hydrogen atom using the following enthalpy data

$H_2(g) \longrightarrow 2H(g)$; $\Delta H = +436$ kJ mol^{-1}
$H_2(g) + 2K(s) \longrightarrow 2KH(s)$; $\Delta H = -118$ kJ mol^{-1}
$K(s) \longrightarrow K(g)$; $\Delta H = +83$ kJ mol^{-1}
$K(g) \longrightarrow K^+(g) + e^-$; $\Delta H = +413$ kJ mol^{-1}
$H^-(g) + K^+(g) \longrightarrow KH(s)$; $\Delta H = -742$ kJ mol^{-1}

565. Indicate whether the following process is exothermic or endothermic :
$M(g) + 2X(g)\ M^{2+}(g) + 2X^{-}(g)$
$(I.\ E.)_1$ of $M(g) = 737.7\ kJ\ mol^{-1}$
$(I.\ E.)_2$ of $M(g) = 1451\ kJ\ mol^{-1}$
$(E.\ A.)$ of $X(g) = -328\ kJ\ mol^{-1}$

566. The ionization energy of lithium is 520 kJ mol^{-1}. The amount of energy required to convert 70 mg of lithium atoms in gaseous state into Li^{+} ions is :

567. The n/p ratio for ${}_{1}H^{1}$ is -

568. 5.0 mL solution of H_2O_2 liberates 0.508 g of iodine from an acidified KI solution. Calculate the strength of H_2O_2 in terms of volume strength at STP.

569. A diatomic molecule has a dipole moment of 1.2 d. If the bond distance is 1.0 Å, what fraction of an electronic charge, e, exists on each atom ?

570. The dipole moment of LiH is 1.964×10^{-29} cm and the interatomic distance between Li and H in this molecule is 1.596Å. What is the percent ionic character in LiH.