PHYSICAL CHEMISTRY

SINGLE CHOICE QUESTIONS

1. 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^o 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

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

3. 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

4. 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}

5. The following facts are available: $2A^- + B_2 \longrightarrow 2B^- + A_2$; $2C^- + B_2 \longrightarrow$ No reaction; $2D^- + A_2 \longrightarrow 2A^- + D_2$. Which of the following statement is correct?
(A) $E^0_{C^-/C_2} > E^0_{B^-/B_2} > E^0_{A^-/A_2} > E^0_{D^-/D_2}$ (B) $E^0_{C^-/C_2} < E^0_{B^-/B_2} < E^0_{A^-/A_2} < E^0_{D^-/D_2}$
(C) $E^0_{C^-/C_2} < E^0_{B^-/B_2} > E^0_{A^-/A_2} > E^0_{D^-/D_2}$ (D) $E^0_{C^-/C_2} > E^0_{B^-/B_2} < E^0_{A^-/A_2} < E^0_{D^-/D_2}$

6. Standard electrode potential data are useful for understanding the suitability of an oxidant in a redox titration. Some half cell reactions and their standard potentials are given below:

$MnO_4^-(aq) + 8H^+(aq) + 5e^- \longrightarrow Mn^{2+}(aq) + 4H_2O(l)$ E° = 1.51 V

$Cr_2O_7^{2-}(aq) + 14H^+(aq) + 6e^- \longrightarrow 2Cr^{3+}(aq) + 7H_2O(l)$ E° = 1.38 V

$Fe^{3+}(aq) + e \longrightarrow Fe^{2+}(aq)$ E° = 0.77 V

$Cl_{2(g)} + 2e^- \longrightarrow 2Cl^-(aq)$ E° = 1.40 V

Identify the only incorrect statement regarding the quantitative estimation of aqueous $Fe(NO_3)_2$

(A) MnO_4^- can be used in aqueous HCl (B) $Cr_2O_7^{2-}$ can be used in aqueous HCl

(C) can be used in aqueous H_2SO_4 (D) $Cr_2O_7^{2-}$ can be used in aqueous H_2SO_4

7. A hydrogen electrode placed in buffer solution of CH_3COONa and acetic acid in the ratio of x/y and y/x has electrode potential values E_1 volts and E_2 volts respectively at 25°C. The pK_a value of acetic acid is : (E_1 and E_2 are oxidation potential):

(A) $\frac{E_1 + E_2}{0.118}$ (B) $\frac{E_2 - E_2}{0.118}$ (C) $\frac{-(E_1 + E_2)}{0.118}$ (D) $\frac{E_1 - E_2}{0.118}$

8. Which will increase the voltage of the cell

$Sn(s) + 2Ag^+(aq) \rightarrow Sn^{2+}(aq) + 2Ag(s)$

(A) increase in size of the silver rod (B) increase in concentration of Sn^{2+} ions

(C) increase in the concentration of Ag^+ ions (D) none

9. Which represents a concentration cell :

(A) $PtH_2 | HCl || HCl | PtH_2$ (B) $PtH_2 | HCl | Cl_2Pt$

(C) $Zn | Zn^{2+} || Cu^{2+} | Cu$ (D) $Fe | Fe^{2+} || Cu^{2+} | Cu$

10. The standard reduction potential of Cu^{2+}/Cu and Cu^{2+}/Cu^+ are 0.33 and 0.153 V respectively. The standard electrode potential of Cu^+/Cu half cell is

(A) 0.184 V (B) 0.827 V (C) 0.507 V (D) 0.490 V

11. 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

12. Vapour pressure (in torr) of an ideal solution of two liquids A and B is given by : $P = 52 X_A + 114$ where X_A is the mole fraction of A in the mixture. The vapour pressure (in torr) of mixture containing A and B in mole ratio of 1 : 3 is–

(A) 166 (B) 153 (C) 140 (D) 280

13. 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) $X'_A + X_A = 1$

14. 4.00 g of substance A, dissolved in 100 g H_2O depressed the f. pt. of water by 0.1°C. While 4 g of another substance B which is a binary electrolyte depressed the f. pt. by 0.2 °C. What is the relation between molecular weights of the two substance -

(A) $M_A = 4M_B$ (B) $M_A = M_B$ (C) $M_A = 0.5M_B$ (D) $M_A = 2M_B$

15. The amount of ice that will separate out from a solution containing 25 g of ethylene glycol in 100 g of water and is cooled to –10°C, will be [Given : K_f for H_2O = 1.86 K mol^{-1} kg]

(A) 50.0 g (B) 25.0 g (C) 12.5 gm (D) 30.0 gm

16. 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

17. Two solutions each in 200 mL having 4 g glucose and 10 g sucrose respectively. How much urea should be added to one of them in order to make them isotonic ?
(A) 0.4218 g urea in glucose solution (B) 0.77 g urea in glucose solution
(C) 0.72 g urea in sucrose solution (D) 0.421 g urea in sucrose solution

18. An electrolyte A gives 3 ions and B is a non-electrolyte. If 0.1 M solution of B produces an osmotic pressure P, then 0.1 M solution of A will produce an osmotic pressure, assuming that the electrolyte is completely ionised.
(A) 1.5 P (B) 3P (C) 0.5 P (D) 0.75 P

19. 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}

20. 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%

21. A solid formed from A and B has the following arrangements of atoms
(i) Atoms A are arranged in c.c.p. array
(ii) Atoms B occupy all the octahedral voids and the tetrahedral voids.
What is the formula of the compound ?
(A) A_2B (B) AB_3 (C) AB_2 (D) AB_4

22. In a compound XY_2O_4, oxide ions are arranged in CCP and cations X are present in octahedral voids. Cations Y are equally distributed among octahedral and tetrahedral voids. The fraction of the octahedral voids occupied is :
(A) 1/2 (B) 1/4 (C) 1/8 (D) 1/6

23. A solid has a structure in which W atoms are located at the corners of the cubic lattice, O-atoms at the centre of the edges and Na atom at the centre of the cube. The formula of the compound is :
(A) $NaWO_2$ (B) Na_2WO_3 (C) $NaWO_3$ (D) $NaWO_4$

24. A mineral is composed of Ca, Ti and oxygen. With Ca^{+2} at cube corners, Ti ions in the centre and oxide ions in the face centre of the unit cell. The formula of the mineral and the oxidation state of Ti are :
(A) $CaTi_2O_3$; +2 (B) $CaTiO_3$; +4 (C) $CaTi_3O_4$; +2 (D) $CaTiO_2$; +2

25. 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

26. 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) $\frac{1}{2}(\sqrt{2}a)$

27. In CsBr crystal structure edge length of unit cell is 4.3 Å. The shortest interionic distance between Cs^+ and Br^- ions is

(A) 3.72 Å (B) 1.86 Å (C) 7.44 Å (D) 4.3 Å

28. The chromium metal exists as a bcc lattice with cell edge 2.88 Å. Its density is 7.20 g/cc. How many atoms does 55 g of chromium contain?

(A) $\frac{55}{51.7}N_0$ (B) $\frac{51.77}{55}N_0$ (C) $\frac{55}{32.60}N_0$ (D) $\frac{32.60}{55}N_0$

29. The presence of F-centres in a crystal makes it

(A) Conducting (B) Coloured (C) Non-conducting (D) Colourless

30. An element (density 6.8 g cm^{-3}) occurs in bcc structure with cell edge of 290 pm. What will be the number of atoms present in 200 g of element

(A) 24.09×10^{23} atoms (B) 24.09×10^{20} atoms (C) 24.09×10^{15} atoms (D) 24.09×10^{10} atoms

31. The amount of $(NH_4)_2SO_4$ having degree of dissociation 75% which should be dissolved in 1500 ml of 1 M NH_4OH to decrease its degree of dissociation by 200 times, is -
[k_b of $NH_4OH = 1.8 \times 10^{-5}$]

(A) 112. 1 gm (B) 224.2 gm (C) 56.0 gm (D) 65.4 gm

32. A solution contains 0.09 M HCl, 0.09 M CCl_2HCOOH, and 0.1 M CH_3COOH. If total $[H^+] = 0.1$ and K_a for $CH_3COOH = 10^{-5}$, K_a for CCl_2HCOOH is

(A) 1.35×10^{-4} (B) 0.18×10^{-2} (C) 0.18×10^{-5} (D) 1.25×10^{-3}

33. If 0.1 M CH_3COOH is mixed with 0.1 M $CH_2ClCOOH$, Find out total $[H^+]$
[Given:K_a $CH_3COOH = 1.8 \times 10^{-5}$, K_a $CH_2ClCOOH = 1.8 \times 10^{-4}$]

(A) 0.404×10^{-2} (B) 1.44×10^{-3} (C) 4.44×10^{-3} (D) 8.44×10^{-4}

34. The amount of H_2SO_4 solution, which should be mixed with 500 ml of 0.1 M H_2S solution to obtain concentration of sulphide ion equal to 10^{-20} moles/litre, is -
[Given : K_a for H_2S is 1.3×10^{-21}]

(A) 5.38 gm (B) 12.79 gm (C) 1.27gm (D) 2.79 gm

35. If degree of dissociation of water at 90 ºC is 1.28×10^{-8} then the ionization constant of water at 90°C is :

(A) 1.28×10^{-14} M (B) 12.81×10^{-15} M (C) 9.07×10^{-15} M (D) 7.52×10^{-12} M

36. 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

37. How much water must be evaporated from 5 litre of 10^{-3} M HCl to change its pH by 2 units

(A) 1.5 litre (B) 0.5 litre (C) 2.54 litre (D) 4.95 litre

38. 100 ml of 0.1 M CH_3COOH is mixed with 50 ml of 0.1 M NaOH solution and pH of the resulting solution is 5. The change in pH if 100 ml of 0.05 M NaOH is added in the above solution is-

(A) 1.30 (B) 4.74 (C) 5 (D) 3.8

39. It is found that 0.1 M solution of three sodium salts NaX, NaY and NaZ gave pH 7.0, 9.0 and 11.0 respectively. The correct order of increasing strength of acid HX, HY, HX is

(A) HX < HY < HZ (B) HY < HZ < HX (C) HZ < HY < HX (D) HZ > HY < HX

40. Solubility of $Mg(OH)_2$ having K_{sp} equal to 8.9×10^{-13}, in a solution containing 500 ml of 0.2 M NH_4OH and 500 ml of 0.4 M $Ca(OH)_2$ is –

(A) 3.4×10^{-19} (B) 55.63×10^{-13} (C) 2.34×10^{-9} (D) 8.34×10^{-13}

41. The equilibrium : $NH_4HS_{(s)} \rightleftharpoons NH_{3(g)} + H_2S_{(g)}$, is followed to set up at 127°C in a closed vessel. The total pressure at equilibrium was 20 atm. The K_C for the reaction is

(A) 0.85 M^2 (B) 3.045 M^2 (C) 0.092 M^2 (D) none of these.

42. Consider the following equation in a closed container $N_2O_4(g) \rightleftharpoons 2NO_2(g)$ at a fixed temperature, the volume of the reaction container is halved, for this change, which of the following statement holds true regarding the K_p and degree of dissociation

(A) Neither K_p nor α change (B) Both K_p and α change

(C) K_p change but α does not change (D) K_p does not change but α change

43. The E_a values for forward and backward reactions are 50 kJ/mole and 40 kJ/mole respectively. If K_1 and K_2 be the equilibrium constants of reaction at temperature T_1 and T_2, respectively and $T_2 > T_1$, then

(A) $K_1 < K_2$ (B) $K_2 = K_1$ (C) $K_1 > K_2$ (D) $\frac{K_2}{K_1} = 10$

44. The reaction $A + B \rightleftharpoons C + D$ is studied in a one litre vessel at 250°C. The initial concentration of A was 3n and that of B was n. When equilibrium was attained, equilibrium concentration of C was found to be equal to the equilibrium concentration of B. What is the concentration of D at equilibrium

(A) n/2 (B) (3n –1/2) (C) (n – n/2) (D) n.

45. In terms of mole fraction, equilibrium constant is written as K_X. The relationship between K_C and K_X is

(A) $K_C = K_x\left(\frac{RT}{P}\right)^{\Delta n}$ (B) $K_x = K_c / \left(\frac{P}{RT}\right)^{\Delta n}$

(C) $\frac{K_c}{K_x} = \left(\frac{RT}{P}\right)^{-\Delta n}$ (D) $K_x = K_c\left(\frac{P}{RT}\right)^{-\Delta n}$

46. The vapour density of PCl_5 is 104.25 but when heated to 230°C, its vapour density is reduced to 62. The degree of dissociation of PCl_5 at this temperature will be

(A) 6.8% (B) 68% (C) 46% (D) 64%.

47. In the system, $LaCl_3(s) + H_2O(g) + \text{heat} \rightleftharpoons LaClO(s) + 2HCl(g)$, equilibrium is established. More water vapour is added to establish the equilibrium. The pressure of water vapour is doubled. The factor by which pressure of HCl is changed is

(A) 2 (B) $\sqrt{2}$ (C) $\sqrt{3}$ (D) $\sqrt{5}$

48. Densities of two allotropes 'A' and 'B' are 3.5 and 2.3 gm /c.c. respectively. Increase of pressure on the equilibrium $A(s) \rightleftharpoons B(s)$

(A) favours backward reaction (B) favours forward reaction

(C) has no effect (D) increases the reaction rate.

49. In a reaction : $A(g) + 2B(g) \rightleftharpoons 2C(g)$, 2.0 mole of A, 3.0 mole of B and 2.0 mole of C are placed in a 2.0 L closed flask. If equilibrium concentration of C is 0.5 mol L^{-1}, the equilibrium constant for the dissociation of C is

(A) 0.05 (B) 24.0 (C) 0.073 (D) 0.147

50. 2 mol of SO_2 and 1 mol of O_2 are heated in a closed vessel to reach the equilibrium : $2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3(g)}$. The equilibrium mixture exerted a pressure of 5 atm and required 1/3 mol of $K_2Cr_2O_7$ in acidic medium. K_p for the reaction is

(A) 2 (B) 0.5 (C) 4 (D) none of these

51. The incorrect statement amongst the following is

(A) At 0°C, H_2 and He show positive deviation throughout with increasing pressure indicating thereby that the Boyle's temperatures for these two gas are below 0°C

(B) $N_{2(g)}$ shows ideal behaviour for some range of pressure (0 – 100atm) at 51.1°C indicating that 51.1°C is the Boyle's temperature for $N_2(g)$.

(C) Deviation of real gases from ideal behaviour becomes more pronounced as pressure is increased and temperature is decreased.

(D) A gas above its critical temperature can be liquefied by applying the minimum pressure.

52. A mixture (15ml) of CO and CO_2 is mixed with V ml (excess) of oxygen and electrically sparked. The volume after explosion was (V + 12) ml. what would be the residual volume if 25 ml of the original mixture is exposed to alkali

(A) 7 ml (B) 12 ml (C) 10 ml (D) 9 ml

53. A monoatomic gas 'x' and a diatomic gas 'y', both initially at the same temperature and pressure are compressed adiabatically from a volume V to V/2. The gas which has higher temperature is

(A) x (B) y

(C) both have same temperature (D) none of these

54. A cylinder fitted with a movable and air tight piston contains a few drops of water and nitrogen at a pressure of 760 torr. If the piston is moved forward and volume is reduced to half of its initial volume while keeping temperature constant, the resulting pressure of the system would be: (neglect the volume occupied by water, aqueous tension at the given temperature is 20 torr)

(A) 1520 torr (B) 1480 torr (C) 1500 torr (D) none of these

55. 5 moles of an ideal gas expand isothermally and reversibly from a pressure of 10 atm to 2 atm at 300 K. What is the largest mass which can be lifted through a height of 1 m in this expansion.

(A) 20.46 g (B) 204.6 g (C) 20.46 kg (D) 204.6 kg

56. 20% of N_2O_4 molecules are dissociated in a sample of gas at 27°C and 760 torr. Mixture has density at equilibrium.
(A) 1.48 g/L (B) 1.84 g/L (C) 2.25 g/L (D) 3.12 g/L

57. A flask contains 10g of a gas (relative molecular mass 100) at a pressure of 100 KPa was evacuated to a pressure of 0.01 KPa at constant temperature. Which one of the following is the best estimate of the number of molecules left in the flask?
(A) 6.02×10^{16} (B) 6.02×10^{17} (C) 6.02×10^{18} (D) 6.02×10^{19}

58. A compound exists in the gaseous state both as monomer (A) and dimer (A_2). The atomic weight of the monomer is 48. In an experiment, 96g of the compound was confined in vessel of volume 33.6 L and heated to 273°C. Calculate the pressure developed, if the compound exists as a dimer to extent of 50% by weight under these conditions.
(A) 7.5 atm (B) 2.0 atm (C) 0.9 atm (D) 5.4 atm

59. An ideal gas obeying kinetic gas equation can be liquefied if
(A) its temperature is more than critical temperature
(B) It cannot be liquefied at any value of P and T
(C) its pressure is more than critical pressure
(D) its temperature is more than Boyle's temperature

60. 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

61. Hydrogen atoms are excited to n = 4 state. In the spectrum of emitted radiation, number of lines in the ultraviolet and visible regions are respectively
(A) 3 : 1 (B) 1 : 3 (C) 2 : 3 (D) 3 : 2

62. The average life of an excited state of hydrogen atom is of the order of 10^{-8}s. The number of revolutions made by an electron when it is in state n = 2 and before it suffers a transition to state n = 1, are
(A) 2.28×10^6 (B) 22.8×10^6 (C) 8.23×10^6 (D) 2.82×10^6

63. The energy of an electron in first Bohr orbit of H-atom is – 13.6 eV. The possible energy value of electron in the excited state of Li^{2+} is
(A) – 122.4 eV (B) 30.6 eV (C) – 30.6 eV (D) 13.6 eV

64. An energy of 24.6 eV is required to remove one of the electrons from a helium atom. The energy required to remove both the electrons from helium atom is
(A) 38.2 eV (B) 49.2 eV (C) 51.8 eV (D) 79.0 eV

65. In a photoelectric experiment, the collector plate is at 2.0V with respect to emitter plate made of copper (work function 4.5 eV). The maximum kinetic energy of photo electrons reaching the collector if the emitter is illuminated by a source of monochromatic light of wavelength 200 nm will be

(A) 2.0 eV (B) 2.7 eV (C) 3.2 eV (D) 3.7 eV

66. If the shortest wavelength of H atom in Lyman series is x, then longest wave length in Balmer series of He^+ ion is

(A) 9x/5 (B) 36x/5 (C) x/4 (D) 5x/9

67. What is difference in wavelengths of the 4^{th} and 5^{th} lines of Balmer series in spectrum of hydrogen atom?

(A) 131Å (B) 520Å (C) 390Å (D) 262Å

68. The number of waves made by a Bohr electron in an orbit of maximum magnetic quantum number +2 is

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

69. If the energy of an electron in the first Bohr orbit of H atom is –313.6 Kcal/mol; then energy of electron in the second orbit will be

(A) –34.84 Kcal/mol (B) –12.5 Kcal/mol (C) –78.4 Kcal/mol (D) 313/6 Kcal/mol

70. The relationship between osmotic pressure at 273 K, when 20 gm glucose (P_1), 20 gm urea (P_2) and 20 gm sucrose (P_3) are dissolved in 250 ml of water is

(A) $P_1 > P_2 > P_3$ (B) $P_3 > P_1 > P_2$ (C) $P_2 > P_1 > P_3$ (D) $P_2 > P_3 > P_1$

71. Hardness of water sample is 300 ppm $CaCO_3$. Hence its molarity is :

(A) 0.3 M (B) 0.030 M (C) 0.003 M (D) 0.0015 M

72. Calculate the volume of CO_2 produced by the combustion of 40 ml of acetone vapours in presence of excess of oxygen

(A) 12 ml (B) 1.20 ml (C) 120 ml (D) 11.2 ml

73. 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

74. 1 gram of a carbonate of a metal was dissolved in 25 ml of 1N HCl. The resulting liquid required 5 ml of N NaOH for neutralization. The eq. wt. of metal carbonate is :

(A) 100 (B) 30 (C) 40 (D) 50

75. Sulphuryl chloride SO_2Cl_2 reacts with water to give a mixture of H_2SO_4 and HCl. How many moles of NaOH would be needed to neutralize the solution formed by adding 1 mole of SO_2Cl_2 to excess of water.

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

76. 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

77. One gram of a mixture of Na_2CO_3 and $NaHCO_3$ consumes y gram equivalents of HCl for complete neutralisation. One gram of the mixture is strongly heated, then cooled and the residue treated with HCl. How many gram equivalents of HCl would be required for complete neutralisation :

(A) 2y gram equivalent (B) y gram equivalents
(C) 3y/4 gram equivalents (D) 3y/2 gram equivalents

78. One mole of a mixture of CO and CO_2 requires exactly 20 gram of NaOH in solution for complete conversion of all the CO_2 into Na_2CO_3. How many grams more of NaOH would it require for conversion into Na_2CO_3 if the mixture (one mole) is completely oxidized to CO_2.

(A) 60 grams (B) 80 grams (C) 40 grams (D) 20 grams

79. A solution contains Na_2CO_3 and $NaHCO_3$. 10 ml of the solution required 2.5 ml of 0.1 M H_2SO_4 for neutralisation using phenolphthalein as indicator. Methyl orange is then added when a further 2.5 ml of 0.2 M H_2SO_4 was required. The amount of Na_2CO_3 and $NaHCO_3$ in 1 litre of the solution is :

(A) 5.3 g & 4.2 g (B) 3.3 g & 6.2 g (C) 4.2 g & 5.3 g (D) 6.2 g & 3.3 g

80. 0.7 g of a sample of Na_2CO_3. 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

81. The reaction $2NO + Br_2 \longrightarrow 2NOBr$, Obey's the following mechanism:

$NO + Br_2 \overset{\text{fast}}{\rightleftharpoons} NOBr_2$; $NOBr_2 + NO \xrightarrow{\text{slow}} 2NOBr$

The rate expression of the above reaction can be written as:

(A) $r = k [NO]^2 [Br_2]$ (B) $r = k [NO] [Br_2]$ (C) $r = k][NO] [Br_2]^2$ (D) $r = k [NOBr_2]$

82. The chemical reaction, $2O_3 \longrightarrow 3O_2$ proceeds as follows :

$O_3 \rightleftharpoons O_2 + O$ ..... (fast)
$O + O_3 \longrightarrow 2O_2$ ..... (slow)

The rate law expression should be:

(A) $r = K [O_3]^2$ (B) $r = K[O_3]^2 [O_2]^{-1}$
(C) $r = K [O_3][O_2]$ (D)Unpredictable

83. 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

84. 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

85. 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

86. Two radioactive elements X and Y have half lives of 50 and 100 minute respectively. Initial sample of both the elements have same no. of atoms. The ratio of the remaining number of atoms of X and Y after 200 minute is:
(A) 2 (B) 1/2 (C) 4 (D) 1/4

87. Two radioisotopes P and Q of atomic weight 10 and 20 respectively are mixed in equal amount by weight. After 20 day, their weight ratio is found to be 1 : 4. Isotope P has a half life of 10 day. The half life of isotope Q is:
(A) Zero (B) 5 day (C) 20 day (D) infinite

88. 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}

89. One mole of A present in a closed vessel undergoes decay as ${}_{z}A^{m} \longrightarrow {}_{z-4}B^{m-8} + 2\ {}_{2}He^{4}$. The volume of He collected at NTP after 20 days is ($t_{1/2}$ = 10 day):
(A) 11.2 litre (B) 22.4 litre (C) 33.6 litre (D) 67.2 litre

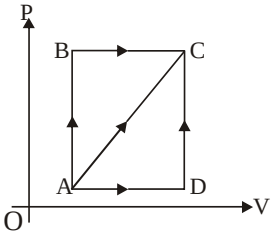
90. The number of β-particle emitted during the change ${}_{a}X^{c} \longrightarrow {}_{d}Y^{b}$ is:
(A) $\frac{a-b}{4}$ (B) $d + \left[\frac{a-b}{2}\right] + c$ (C) $d + \left[\frac{c-b}{2}\right] - a$ (D) $d + \left[\frac{a-b}{2}\right] - c$

91. The maximum work done in expanding 16 g oxygen at 300 K and occupying a volume of 5 dm^3 isothermally until the volume becomes 25 dm^3 is :
(A) -2.01×10^3 J (B) $+2.81 \times 10^3$ J (C) -2.01×10^{-3} J (D) $+2.01 \times 10^{-6}$ J

92. 1 mole of gas occupying 3 litre volume is expanded against a constant external pressure of 1 atm to a volume of 15 litre. The work done by the system is :
(A) -1.215×10^3 J (B) -12.15×10^3 J (C) -121.5×10^3 J (D) none

93. One mole of an ideal gas at 300 K is expanded isothermally from an initial volume of 1 litre to 10 litre. The ΔE for this process is : [R = 2 cal K^{-1} mol^{-1}]
(A) 163.7 cal (B) 1381.1 cal (C) 9 litre–atm (D) zero

94. 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

95. 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

96. Give standard enthalpy of formation of CO (–110 kJ mol^{-1}) and CO_2(–394 kJ mol^{-1}). The heat of combustion when one mole of graphite burns is :
(A) –110 kJ (B) –284 kJ (C) –394 kJ (D) –504 kJ

97. If, $S + O_2 \longrightarrow SO_2$; $\Delta H = -298.2$ kJ ..... (i)

$SO_2 + \frac{1}{2} O_2 \longrightarrow SO_3$; $\Delta H = -98.7$kJ ..... (ii)

$SO_3 + H_2O \longrightarrow H_2SO_4$; $\Delta H = -130.2$ kJ ..... (iii)

$H_2 + \frac{1}{2} O_2 \longrightarrow H_2O$; $\Delta H = -227.3$ kJ ..... (iv)

The enthalpy of formation of H_2SO_4 at 298 K will be :
(A) –754.4 kJ (B) +320.5 kJ (C) –650.3 kJ (D) –433.7kJ

98. ΔH^o_f for the reaction, $Ag^+(aq) + Cl^-(aq) \longrightarrow AgCl(s)$
at 25°C. Given ΔH^o_f (Ag^+, aq) = 105.58 kJ mol^{-1}, ΔH^o_f (Cl^-, aq) = –167.16 kJ mol^{-1} and ΔH^o_f (AgCl, s) = –127.07 kJ mol^{-1}.
(A) –65.49 kJ mol^{-1} (B) 65.49 kJ mol^{-1}
(C) 188.65 kJ mol^{-1} (D) –188.65 kJ mol^{-1}

99. The enthalpy change for a given reaction at 298 K is -x cal/mol. If the reaction occurs spontaneously at 298 K, the entropy change at that temperature -
(A) can be negative but numerically larger than x/298 cal K^{-1}
(B) can be negative, but numerically smaller than x/298 cal K^{-1}
(C) cannot be negative
(D) cannot be positive

100. For the reaction, $2Cl(g) \longrightarrow Cl_2(g)$. The sign of ΔH and ΔS respectively are :
(A) + and – (B) + and + (C) – and – (D) – and +

101. 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 centres but not washed away
(D) cleansing action is not related to micelles

102. $[AgI]I^-$ colloidal sol can be coagulated by the addition of a suitable cation. 1 mol of $[AgI]I^-$ requires mol of $AgNO_3$, $Pb(NO_3)_2$ and $Fe(NO_3)_3$ as :

(A) 1, 1, 1 (B) 1, 2, 3 (C) $1, \frac{1}{2}, \frac{1}{3}$ (D) 6, 3, 2

103. Hydrolysis of ester (RCOOR′) is slow initally but becomes fast as reaction proceeds. It is due to formation of..... which catalyses the reaction.

(A) H_2O (B) RCOOH (C) R′OH (D) $RCOO^-$

104. On adding $AgNO_3$ solution into KI solution, a negatively charged colloidal sol is obtained when they are in :

(A) 100 mL of 0.1 M $AgNO_3$ + 100 mL of 0.1 M KI
(B) 100 mL of 0.1 M $AgNO_3$ + 100 mL of 0.2 M KI
(C) 100 mL of 0.2 M $AgNO_3$ + 100 mL of 0.1 M KI
(D) 100 mL of 0.15 $AgNO_3$ + 100 mL of 0.15 M KI

105. Micelles are :

(A) ideal solution (B) associated colloids (C) adsorbed surfaces (D) adsorbent solutes

106. Which one of the following statements is correct :

(A) Brownian movement is more pronounced for smaller particles than for the bigger ones
(B) Sols of metal sulphides are lyophilic
(C) Schulze-Hardy law states, the bigger the size of the ion, the greater is its coagulating power
(D) One would expect charcoal to adsorb chlorine more strongly than hydrogen sulphide

107. Reactions in zeolite catalyst depend on :

(A) pores (B) apertures (C) size of cavities (D) all of these

108. Colloidal solutions of gold prepared by different methods are of different colours because of:

(A) different diameters of colloidal gold particles
(B) variable valency of gold
(C) different concentration of gold particles
(D) impurities produced by different methods

109. When NaCl solution is added to $Fe(OH)_3$ sol :

(A) $[Fe(OH)_3]Fe^{3+}$ is formed (B) $[Fe(OH)_3]Cl^-$ is formed
(C) $[Fe(OH)_3]Na^+$ is formed (D) $Fe(OH)_3$ is coagulated

110. Chlorine atoms catalyse the decomposition of ozone in the ozone layer of the earth's atmosphere and thus causing global heating. This Cl comes from

(A) teflon (B) freon (C) chloroform (D) pyrene

MULTIPLE CHOICE QUESTIONS

111. 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	$a = 2\, r$

112. If two solution are isotonic then : [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

113. Which of the following gases deviate fairly largely form ideal behaviour :
(A) CO_2 (B) SO_2 (C) C_2H_6 (D) None

114. 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}

115. 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 takesplace in 100 min. for the case when rate constant is .0693 min^{-1}

116. 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

117. 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) $CH_3CO_2C_2H_5 + H_2O \xrightarrow{OH^{\Theta}} CH_3CO_2H + C_2H_5OH$

118. 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

119. 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) $C(s) + H_2O(g) \rightleftharpoons CO(g) + H_2(g)$

120. 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) $(\Delta S)_{U, V} \geq 0$

121. 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

122. 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

123. 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

124. A concentration cell is a galvanic cell in which

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

(B) only the concentration of the two solutions differ

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

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

125. 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

126. 1 mol benzene ($P^o_{benzene}$ = 42 mm) and 2 mol toluene ($P^o_{toluene}$ = 30 mm) will have
(A) total pressure 34 mm
(B) mol fraction of vapours of benzene above liquid mixture is 7/17
(C) positive deviation from Raoult's law
(D) negative deviation from Raoult's law

127. 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

128. 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

129. 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

130. 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

131. 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

132. 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

133. 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) $I_2(g) \rightleftharpoons 2I(g)$

134. Which of the following are redox reactions ?

(A) $NaIO_3 + NaHSO_3 \longrightarrow NaHSO_4 + Na_2SO_4 + I_2 + H_2O$

(B) $FeCl_3 + K_4[Fe(CN)_6] \longrightarrow KCl + Fe_4[(Fe(CN)_6]_3$

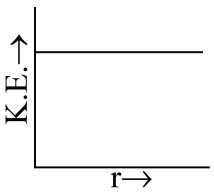
(C) $AgCl + Na_2S_2O_3 \longrightarrow Na_3[Ag(S_2O_3)_2] + NaCl$

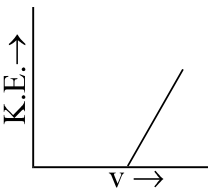
(D) $NaBiO_3 + MnSO_4 + HNO_3 \longrightarrow HMnO_4 + Bi(NO_3)_3 + NaNO_3 + Na_2SO_4 + H_2O$

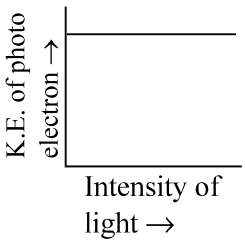
135. The oxidation number of Cr = +6 in

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

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

(A) 

(B) 

(C) 

(D) None of these

137. Heisenberg uncertainty principle is not valid for

(A) moving electrons (B) motor car

(C) stationary particles (D) all

138. A radioactive element is present in VIII gp of the periodic table. If it emits one α-particle, the new position of the nuclide will be

(A) VI B (B) VIII (C) VII B (D) I B

139. 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

140. 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

141. 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

142. 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

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

144. 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

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

146. If x and y are arbitary intensive variables, then
(A) xy is an intensive variable (B) x/y is an intensive variable
(C) (x + y) is an intensive property (D) dx/dy is an extensive property

147. $\Delta E = 0$ for which process
(A) cyclic process (B) isothermal expansion
(C) isochoric process (D) adiabatic process

148. Two reaction A $\rightarrow$ products and B $\rightarrow$ 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 $k_B > k_A$

149. 1.66 g KI reacts with excess of KIO_3 to produce I_2, which converts $Na_2S_2O_3$ into SO_4^{2-}. If the hypo solution was decimolar, then the volume required to reach equivalent point will be
(A) 0.015 litre (B) 15 ml (C) 0.02 litre (D) 20 ml

150. A solution of $Na_2S_2O_3$ is iodometrically titrated against 0.25050 g of $KBrO_3$. This process requires 90 ml of $Na_2S_2O_3$ solution the strength of the $Na_2S_2O_3$ is
(A) 0.2 M (B) 0.1 M (C) 0.05 N (D) 0.1 N

151. The iodide content of a solution was determined by titration with cerium (IV) sulphate in the presence of HCl, in which I^- is converted to ICl. A 250 ml sample of the solution required 20 ml of 0.05 N Ce^{4+} solution. What is the iodide concentration in the original solution.
(A) 0.254 g/litre (B) 2×10^{-3} moles (C) 0.508 g/litre (D) 2.54×10^{-2} moles

152. 3.16 g of $KMnO_4$ is dissolved in water and the solution is made upto 1 litre. An unknown salt containing 6.88g Fe^{2+} ion was dissolved in water and solution was made upto 100 ml. It was found that 20 ml of salt solution decolourised 27.25 ml of the above permanganate solution. Which of the following statements are correct?

(A) Normality of ferrous ion = 0.15 N
(B) Actual strength of ferrous ion 68.8 g $litre^{-1}$
(C) Percentage of ferrous ion is 10.58
(D) Normality of ferrous ion is 0.13 N

153. During the titration of a mixture of NaOH, Na_2CO_3 and inert substances against HCl.

(A) Phenolpthalein is used to detect the end point when half equivalent of Na_2CO_3 and full equivalent NaOH is consumed
(B) Phenolpthalein is used to detect the second end point
(C) Methyl orange is used to detect the final end point
(D) Methyl orange is used to detect the first end point

154. Which of the following is/are correct

(A)The energy of an electron depends only on the principal quantum numbers not on the other quantum numbers
(B) The energy of an electron depends only on the principal quantum number in case of hydrogen and hydrogen like atoms.
(C) The difference in potential energies of any two energy level is always more than the difference in kinetic energies of these two levels.
(D) An electron in an excited state can always emit a photon or two but can not absorb a photon

155. Which of the following statements are false:

(A) The uncertainty in position and momentum in Heisenberg's principle due to electron wave.
(B) The energy level order 4s < 3d < 4p < 5s may not hold good for all elements
(C) The quantum nature of light radiation is manifested in photoemission of electrons
(D) According to Bohr's theory the energy decreases as n increases.

156. The factor which measure the deviation from ideal behavior of a gas are

(A) collision frequency
(B) collision diameter
(C) compressibility factor
(D) vander Waal constant 'a'

157. The basic theory of Arrhenius equation is that:

(A) The number of effective collisions is proportional to the no. 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-exponential factors are always temperature independent.

158. 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 times the half-life for 1^{st} order reaction.
(C) Time required for 75% completion of a 1^{st} order reaction is double the half-life of the reaction.
(D) Time required for 99.9% completion of a reaction is 100 times the half-life period.

159. Two reaction A $\rightarrow$ Products and B $\rightarrow$ products
have rate constants 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 reaction is same then
(A) at lower temperature $K_A > K_B$
(B) At higher temperatures $K_B > K_A$
(C) as temperature rises K_A and K_B will be close to each other in magnitude.
(D) per degree rise in temperature K_B will increase to a greater extent than K_A.

160. Ammonia under a pressure of 20 atm. at 127^0C is heated to 327^0C in a closed vessel. Under these conditions, ammonia is partially decomposed to N_2 and H_2 according to the reaction

$2NH_3(g) \rightleftharpoons N_2(g) + 3H_2(g)$

After decomposition at constant volume in the vessel, the pressure, increases to 50 atm. which of the following statements are correct ?
(A) The degree of dissociation of NH_3 is 2/3.
(B) The K_p of the reaction at 327^0C is 2.7×10^3 atm^2.
(C) The pressure of N_2 and NH_3 gas at equilibrium is 10 atm. each
(D) The pressure of NH_3 at equilibrium is less that that of N_2.

161. One liter of solution was prepared containing 0.005 mol of silver in the +1 oxidation state and 1 mol of NH_3. K_1 for complexation of one NH_3 with Ag^+ is 2.0×10^3 and K_d for $Ag(NH_3)_2^+$ is 6.0×10^{-8}. Which of the following statements are correct?
(A) The concentration of Ag^+ in solution is 3.0×10^{-10}.
(B) The K_2 for the complexation is 8.3×10^3.
(C) The formation constant for the complex is 1.67×10^7.
(D) The K_2 for complexation is 1.2×10^{-4}.

162. Titration of 664 mg of a pure organic carboxylic acid, H_2A, showed a rapid change in pH at 40 ml and at 80 ml of 0.1 M NaOH titrant. When 40 ml of NaOH was added, the pH was 5.85, and at 80 ml of NaOH the pH was 8.08. Which of the following statements are correct?

(A) The molecular weight of acid is 166 (B) The P_{Ka_1} of acid is 3.7

(C) The P_{Ka_2} of acid is 8.08 (D) The P_{Ka_1} is 5.85 and is 8.08

163. To a 100 ml solution having 0.2 M HA (weak acid, $K_a = 1.0 \times 10^{-5}$) and 0.2 M NaA, 200 ml. of 0.1 M NaOH has been added. Furthermore, diluted to 1L. Which of the following statement is correct ?
(A) Initially, the solution have pH equal to 5
(B) After the addition of NaOH, the pH of solution increases by four unit
(C) In the final solution, the concentration of $[OH^-]$ is 10^{-9} M.
(D) After the addition of base, the solution losses buffering action and restores after the addition of acid

164. $M(OH)_2$ is a sparingly soluble substance. Its K_{sp} value is 4×10^{-12}, which of the following statement is/are correct?
(A) Its saturated solution has pH is equal to 10.3
(B) Its solubility has been decreased in a buffered medium having pH at 9
(C) Its solubility has been increased in a buffered medium at pH at 1
(D) The solubility is unaffected by pH of the medium

165. A solution contains $Cl^-_{(aq)}$, $Br^-_{(aq)}$ and $I^-_{(aq)}$ each having concentration 1 M. solid $AgNO_3$ is slowly added into the solution. Which of the following statements is/are correct ?
(A) At first yellow ppt. is formed, followed by light yellow ppt. and the white ppt.
(B) At first white ppt. is formed, followed by light yellow and then yellow ppt.
(C) When the pptation of AgBr starts, almost I^- is completely ppted.
(D) When the pptation of AgBr starts, almost Cl^- is completely ppted.

166. Four elements W, X, Y and Z can form diatomic molecules and monoatomic anions with –1 charge. Consider the following reactions about these
$2X^- + Y_2 \longrightarrow 2Y^- + X_2$; $X_2 + 2Z^- \longrightarrow 2X^- + Z_2$; $2W^- + Y_2 \longrightarrow$ No reaction
Select correct statements about these
(A) W_2 is strongest oxidizing agent while Z is strongest reducing agent
(B) Z_2 is strongest oxidizing agent while W is strongest reducing agent
(C) $E^\circ_{W_2/W^-}$ is the highest
(D) Y_2 will oxidize X^- and also Z^- to form X_2 and Z_{-2}

167. Electrode potential data are given below :
$Fe^{3+}(aq) + e^- \rightarrow Fe^{2+}(aq)$; $E° = +0.77$ V
$Al^{3+}(aq) + 3e^- \rightarrow Al(s)$; $E° = -1.66$ V
$Br_2(aq) + 2e^- \rightarrow 2\,Br^-(aq)$; $E° = +1.08$ V
Based on the given data which statement/s is/are true ?
(A) Fe^{2+} is stronger reducing agent than Br^- (B) Fe^{2+} is stronger reducing agent than Al
(C) Al is stronger reducing agent than Fe^{2+} (D) Br^- is stronger reducing agent than Al

168. The standard emf of the cell, $Cd(s) \mid \underset{0.1M}{CdCl_2(aq)} \parallel AgCl(s) \mid Ag(s)$ in which the cell reaction is 0.6195 V at 0°C and 0.6753 V at 25° C. The value of ΔH of the reaction at 25°C is
(A) 167.26 kJ/mol (B) –167.26 kJ/mol (C) 40 K/mol (D) –40 Kcal/mol

169. The standard electrode potentials, $E^\circ_{I_2/I^-}$, $E^\circ_{Br^-/Br_2}$ and $E^\circ_{Fe/Fe^{2+}}$ are respectively + 0.54 V, – 1.09 V and 0.44V as the basis of given data which of following is/are spontaneous
(A) $Br_2 + 2I^- \rightarrow 2Br^- + I_2$ (B) $Fe + Br_2 \rightarrow Fe^{2+} + 2Br^-$
(C) $Fe + I_2 \rightarrow Fe^{2+} + 2I^-$ (D) $I_2 + 2Br^- \rightarrow]2I^- + Br_2$

170. Sea water is found to contain 5.85% KCl and 9.5% $CaCl_2$ by weight of solution. Assuming 80% ionization of KCl and 50% ionization of $CaCl_2$ ($K_b = 0.5$ 1kg mol^{-1} K^{-1}). Which of the following statements are correct
(A) $\Delta T_b = 1.68$ (B) Boiling point of solution = 101.68°C
(C) $\Delta T_b = 4.29$ (D) Boiling point of solution = 104.29°C

171. An aqueous solution containing 288 g of a non-electrolyte compound having the stoichiometric composition $C_nH_{2n}O_n$ in 90 g water boils at 101.24°C at 1 atm pressure.
$K_b = 0.512$ K mol^{-1} Kg. Which of the following statements are correct
(i) Molecular mass of $C_nH_{2n}O_n = 1321.2$ g
(ii) Molecular formula of $C_nH_{2n}O_n = C_{44}H_{88}O_{44}$
(iii) Molecular mass of $C_nH_{2n}O_n = 104.2$ g
(iv) Empirical formula of $C_nH_{2n}O_n$ is CH_2O
(A) (i) and (iv) (B) (ii) and (iv) (C) (i) and (ii) (D) (iv) and (ii)

172. Titanium monoxide has a rock salt structure. X-ray diffraction data show that the length of one edge of the cubic unit cell for TiO, where in the ratio of Ti to O is 1 : 1 is 4.18×10^{-8} cm and the density determined by volume and mass measurements is 4.91 g cm^{-3} which of the following defects are found
(A) Schottky defects with cation and anion pair vacancy.
(B) Schottky defects with equal numbers of vacancies on the cation and anion sites.
(C) Frenkel defects with cation and anion pair interstitial defects.
(D) Frenkel defects with equal numbers of intertitals on the cation and anion sites.

173. In antifluorite structure
(A) oxide ions are face centred
(B) cations are present in all the tetrahedral voids
(C) $r_{Li} + r_{O^{2-}} = \frac{\sqrt{3}a}{4}$
(D) cations are face centred and anions are present in all the tetrahedral voids

174. Which of the following statements are correct?
(A) Halides of all alkali metals and alkaline earth metals have rock salt structure
(B) Cesium halides and beryllium oxides have rock salt structure
(C) In zinc blende structure, sulphide ions are face centered and zinc is present in alternate tetrahedral voids
(D) In FCC unit cell, void percentage = 26%

175. In face centered cubic unit cell
(A) Rank of unit cell is 3
(B) Face diagonal of the cube which is $\sqrt{2}a$ is equal to 4r
(C) 8 tetrahedral voids per unit cell of FCC
(D) Effective no. of atoms is 4 in FCC

176. If we assume 'M' (atomic weight = 28) crystallizes in a fcc unit cell and tetrahedral voids are also occupied by 'M' atoms. If the edge length of the unit cell is 0.55 nm and the density of 'M' is 2.23 g/cc, which of the following statements are correct
(A) 40% of the tetrahedral voids are occupied by 'M'-atoms in this lattice
(B) 50% of the tetrahedral voids are occupied by 'M'-atoms in this lattice
(C) M-M bond length is equal to the sum of radii of 2 'M' -atoms which is equal to 0.24 nm
(D) 20% of tetrahedral voids are occupied by 'M' –atoms in this lattice

177. The heat evolved during the combustion of 46 gm of ethanol in a bomb calorimeter was determined to be 670.5 Kcal/mol at 25°C. The value of ΔU of the reaction at the same temperature is
(A) –335.25 Kcal (B) –660.3 Kcal (C) –670.5 Kcal (D) –2802.6 KJ

178. xy, x_2 and y_2 are diatomic molecules if ΔH_{x-x}, ΔH_{y-y} and ΔH_{xy} are in the ratio of 2 : 1 : 2 and enthalpy of formation of x – y form x_2 and y_2 is – 100 kJ/mol. The value of ΔH_{x-x} is
(A) 47.85 Kcal/mol (B) 23.92 Kcal/mol (C) 100 KJ/mol (D) 200 KJ/mol

179. Which of the following expression is correct for an adiabatic process ?

(A) $\left(\frac{T_2}{T_1}\right) = \left(\frac{V_1}{V_2}\right)^{\gamma-1}$ (B) $\frac{P_2}{P_1} = \left(\frac{T_1}{T_2}\right)^{\gamma-1/r}$ (C) $P_2V_2^{\gamma} = P_1V_1^{\gamma}$ (D) $P_1V_1^{\gamma-1} = P_2V_2^{\gamma-1}$

180. Which of the following is/are characteristics of hydrophilic solutions?
(A) High concentration of dispersed phase can be easily attained.
(B) Coagulation is reversible
(C) Viscosity and surface tension are nearly same as that of water
(D) The charge of the particle depends on the pH value of the medium; it may be positive, negative or neutral.

COMPREHENSION TYPE QUESTIONS

✍ **Write-up I**

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*).

181. 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

182. 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) $\alpha = \frac{4}{5}(i-1)$

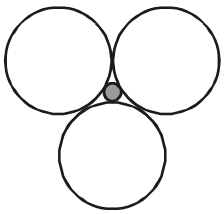
183. The maximum depression in freezing point is noticed in:

(A) 1 *M* NaCl (B) 1*M* Na_2SO_4 (C) 1 *M* Na_3PO_4 (D) 1 *M* $Na_4Fe(CN)_6$

✍ **Write-up II**

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.

184. 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

185. 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%

186. 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

✍ **Write-up III**

For the reaction, A + B ⟶ product

Following initial rate data is given:

Exp. No.	**$[A]_0$ (m/*l*)**	**$[B]_0$ (m / *l*)**	**Initial rate (m / *l* / s)**
1	1.5	4.5	3×10^{-3}
2.	3	4.5	6×10^{-3}
3.	1.5	9	3×10^{-3}

187. Order of reaction with respect to A and B is:

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

188. Rate constant of reaction is:

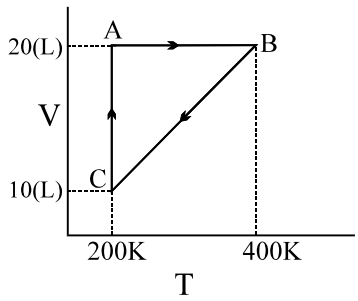
(A) 2×10^{-3} sec^{-1} (B) 10^{-3} sec^{-1} (C) $\frac{1}{2} \times 10^{-3}$ sec^{-1} (D) 2.25×10^{-3} sec^{-1}

189. Time required to decrease concentration of A from 16 M to 1M is:

(A) 346.5 sec (B) 639 sec (C) 1386 sec (D) 6930 sec

✍ **Write-up IV**

For 1 mole of an ideal gas following V-T graph is given



Answer the following questions from the graph

190. The pressure at A and B in atmosphere are respectively :

(A) 0.821 & 1.642 (B) 1.642 & 0.821 (C) 1 & 2 (D) 0.082 & 0.164

191. The pressure at C is :

(A) 3.284 atm (B) 1.642 atm (C) 0.0821 atm (D) 0.821 atm

192. The process which occurs in going from B ⟶ C is :

(A) isothermal (B) adiabatic (C) isobaric (D) isochoric

193. The work done in going form C to A is :

(A) zero (B) –1.15 kJ (C) –2.3 kJ (D) unpredictable

194. The process A ⟶ B refer to :

(A) isoentropic process (B) reversible process

(C) isochoric process (D) isobaric process

✍ **Write-up V**

When 36.5 μ gm of HCl is dissolved in 1 litre of water, the solution will be acidic in nature due to increase in concentration of H^+ ion, then find out-

195. Concentration of H^+ ion in the above solution if we neglect H^+ due to water is -
(A) 10^{-5} (B) 10^{-7} (C) 10^{-6} (D) 10^{-8}

196. Concentration of H^+ ion in the above solution if we consider H^+ due to water is -
(A) 1.0099×10^{-6} (B) 10.099×10^{-6} (C) 1×10^{-5} (D) 1.02×10^{-7}

197. % error in the above two questions will be -
(A) 0.99 % (B) 9.9% (C) 99% (D) no error

✍ **Write-up VI**

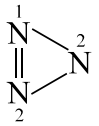
A weak acid (HA) is titrated with a strong base (NaOH) pH of the solution at 1/4th neutralisation of the acid is 4.52. Enough strong acid (HCl) 25 meq is now added in the above solution to completely convert the salt and total volume of the solution is 1 ℓ.

198. K_a of the acid is
(A) 10^{-6} (B) 10^{-4} (C) 10^{-3} (D) 10^{-5}

199. Final pH of the solution will be -
(A) 3 (B) 4.74 (C) 3.74 (D) 4.52

✍ **Write-up VII**

Redox reaction are those in which oxidation and reduction takes place simultaneously. Oxidising agent can gain electron whereas reducing agent can lose electron easily. The oxidation state of any element can never be in fraction. If oxidation number of any element comes out be in fraction, it is average oxidation number of that element which is present in different oxidation state.

200. 

, In this compound HN_3 (hydrazoic acid) oxidation state of N_1 N_2 and N_3 are
(A) 0, 0, 3 (B) 0, 0, –1 (C) 1, 1, –3 (D) –3, –3, –3

201. Equivalent weight of chlorine molecule in equation,
$3\ Br_2 + 6\ NaOH \longrightarrow 5\ NaBr + NaBrO_3 + 3\ H_2O$
(A) 96 (B) 80 (C) 20 (D) 16

202. Which of the following can be both oxidising as well as reducing agent.
(A) H_2 (B) I_2 (C) H_2O_2 (D) all of these

✍ **Write-up VIII**

The branch of science which deals with dual behaviour of matter is said to be quantum mechanics. The fundamental equation of quantum mechanics is Schrodinger wave equation. The important features of quantum mechanics are

(i) the energy of electron is quantized as a result of wave like properties of electrons.

(ii) the position and momentum of an electron cannot be determined simultaneously. The path of electron cannot be determined. We can only talk of probability of finding electron.

(iii) An atomic orbital is represented by wave function 'ψ' for an electron. 'R' is radial wave function whose values varies with distance from the nucleus ψ^2 determines total probability (angular and radial) whereas R^2 is called radial probability. All information about electron in an atom is stored in orbital wave function ψ. 'R' is a radial wave function.

(iv) R can be +ve and –ve but R^2 is always +ve. Similarly, ψ can be +ve and –ve but ψ^2 is always +ve. ψ^2 can be equal to zero.

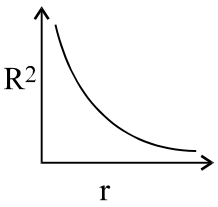
203. The regions or space where $\psi^2 = 0$ are called

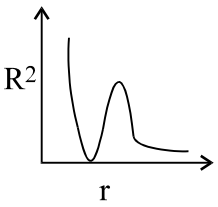
(A) nodes (B) antinodes (C) orbitals (D) energy level

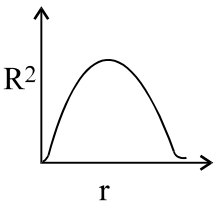
204. The quantum number which is not derived from schrodinger wave equation is

(A) n (B) l (C) m_l (D) m_s

205. Which of the following probability distribution curve represents 2s orbital for H-atom.

(A) 

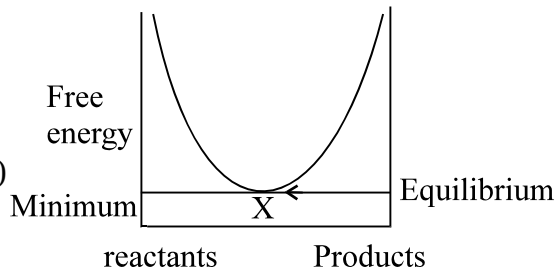
(B) 

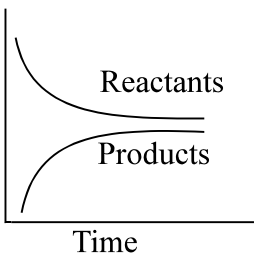
(C) 

(D) None of these

✍ **Write-up IX**

The following two graphs (A) and (B) and answer the questions

(A) 

(B) conc. 

206. Which of the following option are correct?
(A) It can be said that graph A is common for all types of reactions which are irreversible
(B) for all chemical reactions, graph A can be observed
(C) It can be said that graph A is observed for only reversible reactions.
(D) Graph A has no significance.

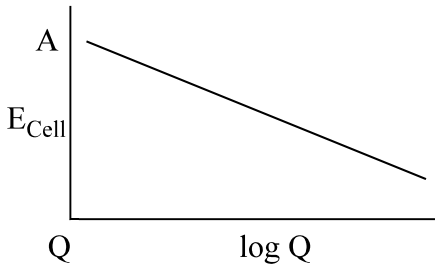
207. From graph A it can be interpreted that
(A) Equilibrium is achieved at point X (B) Equilibrium is not achieved at all
(C) At X, free energy = 0 (D) All of these

208. Graph B tells that the reaction is
(A) a dissociation reaction
(B) a combination reaction
(C) as time increases, reactant conc. decreases but product conc. increases
(D) All of these

✍ **Write-up X**

For the reaction $Zn(s) + Cu^{2+}(aq) \rightleftharpoons Cu(s) + Zn^{2+}(aq)$

Reaction quotient = $\frac{[Zn^{2+}]}{[Cu^{2+}]}$ variation of E_{cell} with Q is given by (where Q = concentration quotient) and OA = 1.1 Volt.



209. When E_{cell} is 1.1591 volts. It implies,

(A) $\frac{[Cu^{2+}]}{[Zn^{2+}]} = 0.1$ (B) $\frac{[Zn^{2+}]}{[Cu^{2+}]} = 0.01$ (C) $\frac{[Zn^{2+}]}{[Cu^{2+}]} = 0.1$ (D) $\frac{[Zn^{2+}]}{[Cu^{2+}]} = 1$

210. The ΔG for the process will be –ve if :

(A) $\frac{[Cu^{2+}]}{[Zn^{2+}]} = 102$ (B) $\frac{[Zn^{2+}]}{[Cu^{2+}]} = 10^3$ (C) $\frac{[Zn^{2+}]}{[Cu^{2+}]} = 10$ (D) $\frac{[Zn^{2+}]}{[Cu^{2+}]} = 10^5$

211. When E_{cell} is 1.1591 and concentration is, $\frac{[Zn^{2+}]}{[Cu^{2+}]} = 10^{-2}$ it implies.

(A) T = 273°C (B) T = 298°C (C) T = 298 K (D) T= 300 K

✍ **Write-up XI**

100 ml of FeC_2O_4 solution is treated with 40 ml of 0.3 molar $KMnO_4$ in acidic medium for complete oxidation. CO_2 gas so formed was treated with 0.2 M excess NaOH forming Na_2CO_3. The solution then needed 5 M 24 ml HCl in presence of phenolphthalene to reach end point.

212. Volume of NaOH added to CO_2 was

(A) 400 ml (B) 800 ml (C) 1200 ml (D) 600 ml

213. Volume of HCl reacted with Na_2CO_3 is

(A) 8 ml (B) 12 ml (C) 16 ml (D) 24 ml

214. Volume of NaOH reacted with CO_2 was

(A) 400 ml (B) 800 ml (C) 1200 ml (D) 600 ml

✍ **Write-up XII**

$2A \longrightarrow 4B + C$; optically active A, decomposes into B and C, which are also optically active specific rotation of A is 10°, B is 30° and C is –40°. After 10 sec the rotation of mixture was 25° and at infinite time was 30°.

215. Rate constant of reaction is

(A) $\frac{1}{10}\ell n\frac{9}{2}$ (B) $\frac{1}{10}\ell n\frac{3}{2}$ (C) $\frac{1}{10}\ell n\frac{4}{9}$ (D) $\frac{1}{10}\ell n\frac{2}{9}$

216. Degree of dissociation at 10 sec is

(A) $\alpha = \frac{7}{9}$ (B) $\alpha = \frac{3}{4}$ (C) $\alpha = \frac{7}{12}$ (D) $\alpha = \frac{12}{9}$

217. Degree of dissociation at 20 sec is

(A) $\alpha = \frac{77}{81}$ (B) $\alpha = \frac{81}{77}$ (C) $\alpha = \frac{3}{4}$ (D) $\alpha = \frac{6}{13}$

✍ **Write-up XIII**

The density of the vapours of a gas at 0.5 atm pressure and 600 K temp.is 3.92 kg/m^3. The vapours of the gas effuse $\frac{2}{7}$ times than O_2 at identical pressure condition.

218. Molar mass of gas is

(A) 386 (B) 392 (C) 400 (D) 382

219. Molar volume of gas is

(A) 100 litre (B) 200 litre (C) 150 litre (D) 300 litre

220. Compressibility factor 'Z' of vapours is

(A) Z > 1 (B) Z < 1 (C) Z = 0 (D) Z = 1

✍ **Write-up XIV.**

S. No.	Atoms	Electron in outermost shell	Value of Electronegativity on Pauling scale
1	**X**	2	0.56
2	**Y**	3	0.89
3	**Z**	5	2.1
4	**V**	6	2.7
5	**W**	7	3.8

221. Type of bond between X and W is primarily a
(A) Covalent Bond (B)Electrovalent Bond
(C) Cordinate Bond (D) None of these

222. The Hybridisation of ZVW_3 is
(A) SP^3 (B) SP^3d (C) SP^2 (D) SP

223. $Y_2(ZV_4)_3$ has what types of bond
(A) Only Electrovalent (B) Electrovalent & Covalent
(C) Cordinate & Covalent (D) Cordinate,Covalent & Electrovalent

✍ **Write-up XV**

A solution contains 0.01 M conc. each of Zn^{2+}, Mg^{2+}, Cu^{2+} and Mn^{2+} ions, they are to be precipitated as their sulphide by passing H_2S gas (0.1 M) into the solution.

$K_{sp(ZnS)} = 10^{-18}$, $K_{sp(MnS)} = 10^{-22}$, $K_{sp\,(MgS)} = 10^{-12}$, $K_{sp\,(CuS)} = 10^{-13}$, $K_{a(H_2S)} = 10^{-21}$.

224. The pH range with in which only ZnS precipitated is
(A) 1 to 3 (B) 3 to 5.5 (C) pH > 6 (D) 5.5 to 6

225 . In pH range (1 to 5.5), which ions get precipitated
(A) Mn^{2+}, Zn^{2+} (B) Zn^{2+}, Cu^{2+} (C) Mg^{2+}, Zn^{2+} (D) Mg^{2+}, Cu^{2+}

226. MgS gets precipitated with pH range
(A) pH > 6 (B) 3 to 5.5 (C) 1 to 3 (D) 5.5 to 6

✍ **Write-up XVI**

$2A + 3B \rightarrow$ Product

Mechanism $A + B \underset{K_{b_1}}{\overset{K_{f_1}}{\rightleftharpoons}} AB_2 \quad E_{a_1 f} \mid E_{b_1}$

$AB_2 + B \underset{K_{b_2}}{\overset{K_{f_2}}{\rightleftharpoons}} AB_2$ (slow step) $E_{af_2} \mid E_{bf_2}$

$AB_2 + A \underset{K_{b_3}}{\overset{K_{f_3}}{\rightleftharpoons}} A_2B_2$

$A_2B_2 + B \underset{K_{b_4}}{\overset{K_{f_4}}{\rightleftharpoons}}$ Product

227. Rate law of reaction is

(A) $r = K [A]^2 [B]^2$ (B) $r = K [A] [B]^2$ (C) $r = K [A] [B]^3$ (D) $r = K [A^2] [B]^2$

228. Rate constant of reaction is

(A) $K = \frac{K_{f_1}}{K_{b_1}} \times K_{b_2}$ (B) $K = \frac{K_{f_1}}{K_{b_1}} \times \frac{K_{b_3}}{K_{b_3}}$ (C) $K = \frac{K_{f_1}}{K_{b_1}} \times K_{f_2}$ (D) $K = \frac{K_{f_1}}{K_{b_1}} \times \frac{K_{f_2}}{K_{b_2}}$

229. Molecularity of the reaction is

(A) 5 (B) 2 (C) 4 (D) none of these

✍ **Write-up XVII**

Following two equilibrium are simultaneously established on mixing two gases $NO_{2\,(g)}$ and $Cl_{2\,(g)}$.

(i) $3NO_{2\,(g)} = N_3O_{6\,(g)}$ $K_p = 3.2$

(ii) $NO_{2\,(g)} + Cl_{2\,(g)} = NO_2Cl_{2\,(g)}$

If NO_2 and Cl_2 are mixed in 2 : 1 molar ratio & total pressure at equilibrium 1.8 atm and partial pressure of $N_3O_{6\,(g)}$ is 0.4 atm at equilibrium.

230. The equilibrium pressure of $NO_{2\,(g)}$ is

(A) 0.5 atm (B) 0.2 atm (C) 0.6 atm (D) none of these

231. K_p of reaction (ii) is

(A) 0.5 (B) 0.25 (C) 0.75 (D) 1.00

232. The equilibrium pressure of $Cl_{2\,(g)}$ is

(A) 0.1 (B) 0.2 (C) 0.3 (D) 0.4

MATCH THE FOLLOWING

233. Match the following column

Column I	**Column II**
(A) $IO_4^- + I^- \longrightarrow I_2$	(P) 7 $OH^{\ominus}$
(B) $S \longrightarrow S^{2-} + S_2O_3^{2-}$	(Q) 8 H^+
(C) $Zn + NO_3^- \longrightarrow ZnO_2^{2-} + NH_3$	(R) 64 H^+
(D) $CuS + NO_3^- \longrightarrow Cu^{+2} + S_8 + NO$	(S) 6 $OH^{\ominus}$

234. Match the following column

Column I	**Column II**
(A) $^{96}_{42}Mo$ (....., n) $^{97}_{43}Tc$	(P) $^{209}_{83}Bi$
(B) ..... (α, 2n) $^{211}_{85}At$	(Q) $^{2}_{1}H$
(C) ..... (....., n) $^{210}_{84}Po$	(R) $^{4}_{2}He$
(D) $^{23}_{11}Na$ (....., p).....	(S) $^{26}_{12}Mg$

235. Match the following column

Column I	**Column II**
(A) $CHCl_3 + CH_3CH_2COCH_3$	(P) Ideal solution
(B) $HCl + H_2O$	(Q) Non-ideal solution
(C) $C_2H_5OH + H_2O$	(R) Positive deviation
(D) $C_2H_4Br_2 + C_3H_6Br_2$	(S) Negative deviation

236. Match the following column

Column I (Structure)	**Column II (Packing efficiency)**
(A) atoms are present at corners as well as on edge centre	(P) 52.33%
(B) atoms are present at corners as well as on face centre	(Q) 67.98%
(C) atoms are present at corners as well as on body centre	(R) 26.17%
(D) atoms are present only at corners	(S) 73.99%

237. Match the following column

Column I	**Column II**
(A) Cell constant	(P) S m^2 eq^{-1}
(B) λ_m	(Q) cm^{-1}
(C) λ_{eq}	(R) S cm^{-1}
(D) k	(S) S cm^2 mol^{-1}

238. 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.

Column I	**Column 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) $pK_a - 2\log 3$.

239. Match the following given in column A with relevant ansers given in column B.

Column A	**Column B**
(A) Half life period of zero order reaction	(P) Pseudo-unimolecular reaction
(B) Zero order reaction	(Q) $mole^{-1}$ L $time^{-1}$
(C) Unit of second order k	(R) a/2k
(D) Acidic hydrolysis of ester	(S) $H_2 + Cl_2 \xrightarrow{h\nu} 2\,HCl$

240. Match the following column

Column I	**Column II**
(A) $CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$	(P) Effect of conc., pressure, temperature on a system at equilibrium
(B) $k_P = k_C$	(Q) Heterogeneous reversible reaction
(C) $2\,Mg + O_2 \longrightarrow 2\,MgO$	(R) $2\,HI(g) \rightleftharpoons H_2(g) + I_2(g)$
(D) Le Chatelier's principle	(S) Irreversible reaction

241. Match the following column

Column I	**Column II**
(A) Cyclic process	(P) ΔG is negative
(B) Spontaneous	(Q) $\Delta G = 0$
(C) Endothermic	(R) $\Delta E = 0$, $\Delta H = 0$
(D) A process in equilibrium	(S) ΔH is positive

242. Match the following column

Column I	**Column II**
(A) Balmers series	(P) Neutron
(B) Chadwick	(Q) mvr
(C) Planck's law	(R) Line spectrum in visible region
(D) Angular momentum	(S) Photon

243. Match the following reactions :

Column I	**Column II**
(A) $_4Be^9 + {}_2He^4 \rightarrow {}_6C^{12} + ...$	(P) $_2He^4$
(B) $_6C^{12} + ... \rightarrow {}_5B^{10} + {}_2He^4$	(Q) $_0n^1$
(C) $_7N^{14} + ... \rightarrow {}_8O^{17} + {}_1H^1$	(R) $_1D^2$
(D) $_{20}Ca^{40} + ... \rightarrow {}_{19}K^{37} + {}_2He^4$	(S) $_1H^1$

244. van der waals' equation for :

Column I	**Column II**
(A) High pressure	(P) $PV = RT + pb$
(B) Low pressure	(Q) $PV = RT - a/V$
(C) Force of attraction is negligible	(R) $PV = RT + a/V$
(D) Volume of molecules is negligible	(S) $\left(P + \frac{a}{V^2}\right)(V - b) = RT$

245. For an hydrogen like atom :

Column I	**Column II**
(A) $(E_n \times V_n)^{1/3}$ is proportional to	(P) Z
(B) $E_n \times r_n$ is proportional to	(Q) Z^3 / n^4
(C) $V_n \times w_n$ is proportional to	(R) n
(D) E_n/w_n is proportional to	(S) Z/n

246.

Column I	**Column II (n_f)**
(A) $Ba(SCN)_2 \longrightarrow Ba^{2+} + SO_4^{2-} + CN^-$	(P) 2
(B) $2KMnO_4 + 16HCl \longrightarrow 2KCl + 2MnCl_2 + 5Cl_2 + 8H_2O$	(Q) 12
(C) $H_2SO_4 + HCl \longrightarrow Cl_2 + SO_3^{2-}$	(R) $\frac{5}{18}$
(D) $K_4Fe(CN)_6 \longrightarrow K^+ + Fe^{2+} + (CN^-)$	(S) 4

247. H_2CO_3 $\quad K_{a_1} = 10^{-7},\ K_{a_2} = 10^{-10}$

H_3PO_4 $\quad K_{a_1} = 10^{-3}, K_{a_2} = 10^{-8},\ K_{a_3} = 10^{-13}$

Now, match the following :

Column I	**Column II**
(A) $NaHCO_3$ (0.1 M)	(P) pH is independent of initial concentration
(B) 0.1 M HCl + 0.1 M CH_3COOH ($pK_a = 5$)	(Q) $pH = \frac{pK_{a_1} + pK_{a_2}}{2}$
(C) NaH_2PO_4 (0.1 M)	(R) pH = 1
(D) 0.05 M H_2SO_4	(S) $[CH_3COO^-] = 10^{-5}$

248. For CH_3COOH ($K_a = 10^{-5}$)

Match the following :

Column I	**Column II**
(A) 0.1 M 200 ml CH_3COOH +0.1 M 100 ml NaOH	(P) pH = 5 – log 3
(B) 0.1 M 200 ml CH_3COOH +0.1 M 100 ml NaOH +0.1 M 100 ml HCl	(Q) pH = 5 + log 3
(C) 0.1 M 200 ml CH_3COOH +0.1 M 50 ml NaOH	(R) pH = 6
(D) 0.1 M 200 ml CH_3COOH +0.1 M 150 ml NaOH	(S) pH = 5

249. Match the following :

Column I	**Column II**
(A) $A_{(g)} \rightleftharpoons B_{(g)} + C_{(g)}$	(P) $\alpha = \sqrt{\frac{Kp}{K_p + 4p}}$
(B) $D_{(g)} \rightleftharpoons 2E_{(g)}$	(Q) $\alpha = \sqrt{\frac{Kp}{p + Kp}}$
(C) $PCl_{5(g)} \rightleftharpoons PCl_{3(s)} + Cl_{2(s)}$	(R) $M_{mix} = \frac{M_{Reagent}}{1+\alpha}$
(D) $N_2O_4 \rightleftharpoons 2NO_{(g)}$	(S)On decreasing pressure reaction moves in forward direction

250. Match the following :

Column I	**Column II**
(A) ${}_7N^{14} + {}_2He^4 \longrightarrow {}_8O^{17} + ...$	(P) ${}_0n^1$
(B) ${}_2{}_1H^3 \longrightarrow {}_2He^4 + 2.....$	(Q) ${}_1H^1$
(C) ${}_{94}Pu^{239} + {}_2He^4 \longrightarrow {}_{96}Cm^{242} + ...$	(R) ${}_2He^4$
(D) ${}_{29}Cu^{53} \longrightarrow {}_{28}Ni^{53} + ...$	(S) ${}_1e^0$

SUBJECTIVE TYPE QUESTIONS

251. 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.

252. A cylinder containing 5.0 litre O_2 at 25 ºC was leaking. When the leakage was detected and stopped there was a change in the pressure of the gas from 3.0 atm to 2.235 atm. How much oxygen in g has been leaked during this period ?

253. 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.

254. A drug mariguana 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. Determine its molecular weight.

255. 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 $(NH_4)_2SO_4$ component in mixture in milligram.

256. 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

257. When light of frequency ν is thrown on a metal surface with threshold frequency ν_0, Photoelectrons are emitted with maximum kinetic energy = 1.3×10^{-18} J. If the ratio, $\nu : \nu_0 = 3 : 1$, if the threshold frequency $\nu_0 = x \times 10^{14}$ Hz, then calculate the value of x.

258. 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 ?

259. 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 (Answer in nearest integral value).

260. Calculate the emf of the cell at 25 ºC (Report in millivolts)

$$Pb \left| \begin{matrix} PbSO_4 \\ \text{Saturated} \\ \text{Solution} \end{matrix} \right| \left| \left| \begin{matrix} PbI_2 \\ \text{Saturated} \\ \text{Solution} \end{matrix} \right| Pb \right.$$

K_{sp} of $PbSO_4 = 1.6 \times 10^{-8}$ and K_{sp} of $PbI_2 = 8 \times 10^{-9}$.

261. 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? (Answer in nearest integral value)

262. 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 & B are 1 mole each in vapour phase. Find the vapour pressure of mixture.

263. 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 is the value of m + n ?

264. The dissociation pressure of solid ammonium hydro-sulphide at 27 °C 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.

265. The rate of disappearance of A at two temp.rature for the equilibrium $A \rightleftharpoons B$ is given by,

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

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

Calculate heat of the reaction in calories.

266. 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 $litre^{-1}$? [$K_{sp_{AgCl}} = 1.8 \times 10^{-10}$]

267. 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 °C. Calculate the value of X. Assume complete dissociation of NaCl and ideal behaviour of this solution. [R = 0.08 litre atm $mol^{-1}\,K^{-1}$]

268. 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 ($N_0 = 6 \times 10^{23}$)

269. Half life time of ${}^{A}_{Z}X$ is 10 days and it decays to ${}^{A-12}_{Z}X$ by α and β emission. Calculate the volume (in *l*) of the gas collected in a closed container at STP after 40 days if 16 moles of ${}^{A}_{Z}X$ is taken initially in the container.

270. 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, *l*n 3 = 1.1]

271. $Mg + NO_3^- \rightarrow Mg^{2+} + NO_2$

$Ca + NO_3^- \rightarrow Ca^{2+} + NH_4^+$

How much volume of 3 M HNO_3 in ml will be required to react completely with 9.6gm of Mg & 16gm of Calcium.

272. Photochemical dissociation of oxygen results in production of two oxygen atoms, one in the ground state and one in the excited state.

$O_2 \xrightarrow{hv} O + O^*$

The maximum wavelength (λ) needed for this is 174 nm. If the excitation energy $O \rightarrow O^*$ is 3.15×10^{-19} J. How much energy in kJ $mole^{-1}$ is needed for the dissociation of one mole of oxygen into normal atoms in ground state?

273. 12 g of impure cyanogens undergo hydrolysis by two different pathways :

(i) $(CN)_2 + 2H_2O \longrightarrow (NH_4)_2C_2O_4$

(ii) $(CN)_2 + 2H_2O \longrightarrow NH_2CONH_2$

The exact amount of urea was obtained when 11.52 g of pure ammonium carbonate was heated. If 20 ml of 1.6 M acidic $KMnO_4$ solution was required to completely oxidize $(NH_4)_2C_2O_4$. Calculate percentage progress in first reaction.

274. A definite amount of a gaseous hyudrocarbon having less than 5 carbon atoms was burned with sufficient amount of O_2. The volume of all reactants was 600 ml, after the explosion the volume of the products was found to be 700 ml under the similar conditions. What is the volume of hydrocarbon taken?

275. For the reaction $A \square B$; $K_c = \left(10^{\frac{5}{2.303}}\right)$ and $E_{af}/E_{ab} = 5/2$, assuming preexponential factor same for forward and backward reaction. Calculate the value of E_{ab} in calories.

276. Calculate the value of *ln* K_p for the reaction
$N_2(g) + 3H_2(g) = 2NH_3(g)$
at 27°C. The standard enthalpy of formation of $NH_3(g)$ is –48 Kcal and standard entropy of $N_2(g)$, $H_2(g)$ and $NH_3(g)$ are 189, 130 and 192 cal / mol respectively. (R = 2.0 cal/K/mole).

277. Half life period of C^{14} is 5760 years. A piece of wood buried in the earth has 1% C^{14}. Now as charcoal it has only 0.25% C^{14}. How long the piece of wood been buried?

278. Find the pH of 0.1 M $ZnCl_2$, assuming complete hydrolysis of ions involved. $[K_{b[Zn(OH)_2]} = 5 \times 10^{-12}, K_w = 1 \times 10^{-14}]$