SECTION – A

51. At a given temperature, total vapour pressure in torr of a mixture of volatile components A and B is given by

$P = 120 - 75\ X_B$

hence, vapour pressure of pure A and B respectively (in torr) are:

(1) 120, 75 (2) 120, 195

(3) 120, 45 (4) 75, 45

52. Relative lowering in vapour pressure of a solution containing 1 mole K_2SO_4 in 54 g H_2O is:

(K_2SO_4 is 100% ionised)

(1) $\frac{1}{55}$ (2) $\frac{3}{55}$

(3) $\frac{3}{4}$ (4) $\frac{1}{2}$

53. A 0.2 molar aqueous solution of a weak acid (HX) is 20% ionised. The freezing point of the solution is:

(K_f of H_2O = 1.86 kg mol^{-1} K)

(1) – 0.45°C (2) 0.90°C

(3) – 0.31°C (4) – 0.53°C

54. Which one of the following pairs of solution can we expect to be isotonic at the same temperature?

(1) 0.1 M – urea and 0.1 M – NaCl

(2) 0.1 M – urea and 0.1 M – $MgCl_2$

(3) 0.1 M – Na_2SO_4 and 0.1 M – NaCl

(4) 0.1 M – Na_2SO_4 and 0.1 M – $Ca(NO_3)_2$

55. Which pair from the following will not form an ideal solution:

(1) $CCl_4 + SiCl_4$ (2) $H_2O + C_4H_9OH$

(3) $C_2H_5Br + C_2H_5I$ (4) $C_6H_{14} + C_7H_{16}$

56. The osmotic pressure of decimolar solution of urea at 27°C is:

(1) 3.40 atm (2) 1.25 atm

(3) 2.46 atm (4) 5.0 atm

57. Which of the following solution will have least vapour pressure?

(1) 0.1 M $BaCl_2$

(2) 0.1 M urea

(3) 0.1 M Na_2SO_4

(4) 0.1 M Na_3PO_4

58. The molarity of H_2SO_4 solution, which has a density 1.84 g/cc at 35°C and contains 98% by weight is:

(1) 1.84 M (2) 18.4 M

(3) 20.6 M (4) 24.5 M

59. Significant figures in 0.00051 are

(1) 5 (2) 3

(3) 2 (4) 4

60. If an element Z exist in two isotopic form Z^{50} and Z^{52}. The average atomic mass of Z is 51.7. Calculate the abundance of each isotopic forms

(1) Z^{50} (15%), Z^{52} (85%)

(2) Z^{50} (85%), Z^{52} (15%)

(3) Z^{50} (5%), Z^{52} (95%)

(4) Z^{50} (95%), Z^{52} (5%)

61. The number of oxygen atoms in 24.9 g of $CuSO_4.5H_2O$ is (molar mass of Cu = 63 g mol^{-1})

(1) 2.41×10^{24} (2) 3.01×10^{24}

(3) 5.42×10^{23} (4) 5.42×10^{24}

62. What percentage of oxygen is present in the compound $CaCO_3.3Ca_3(PO_4)_2$?

(1) 23.3% (2) 45.36%

(3) 41.94% (4) 17.08%

63. 2g of O_2 at NTP occupies the volume

(1) 1.4 L (2) 2.8 L

(3) 11.4 L (4) 3.2 L

64. The number of electron in 3.1 mg NO_3^- is:-

(1) 32 (2) 1.6×10^{-3}
(3) 9.6×10^{20} (4) 9.6×10^{23}

65. The number of hydrogen atoms presents in 25.6 g of sucrose ($C_{12}H_{22}O_{11}$) which has a molar mass of 342.3 g is:

(1) 22×10^{23} (2) 9.91×10^{23}
(3) 11×10^{23} (4) 44×10^{23}

66. 1 mol of CH_4 contains

(1) 6.02×10^{23} atoms of H
(2) 4 *g* atom of Hydrogen
(3) 1.81×10^{23} molecules of CH_4
(4) 3.0 *g* of carbon

67. Calculate number of neutrons present in 20×10^{25} atoms of oxygen ($_8O^{17}$):
Given : $N_A = 6 \times 10^{23}$

(1) 180×10^{25} (2) 1600
(3) 1800 N_A (4) 3200N_A

68. The mass of oxygen in 3.6 mol of water is

(1) 115.2 g (2) 57.6 g
(3) 28.8 g (4) 18.4 g

69. A compound contains 11.99% N, 13.70% O, 9.25% B and 65.06% F. Its empirical formula (molar mass of B is 10.8 g mol^{-1})

(1) $NOBF_2$ (2) $NOBF_4$
(3) N_2OF_2 (4) NO_2F_2

70. Haemoglobin contains 0.33% of iron by weight. The molecular weight of haemoglobin is approximately 67200. The number of iron atoms (at. wt. of Fe = 56) present in one molecule of haemoglobin is

(1) 6 (2) 1
(3) 2 (4) 4

71. 5 mol of VO and 6 mol of Fe_2O_3 are allowed to react completely according to the reaction
$VO + Fe_2O_3 \rightarrow FeO + V_2O_5$
The number of moles of V_2O_5 formed is :

(1) 6 (2) 2
(3) 3 (4) 5

72. Number of Ca^{+2} and Cl^- ion in 111 g of anhydrous $CaCl_2$ are-
[molar mass of: Cl_2 = 71g/mol; Ca = 40g/mol]

(1) N_A, $2N_A$ (2) $2N_A$, N_A
(3) N_A, N_A (4) None

73. Dissolving 120 g of urea (mol. wt. 60) in 1000 g of water gave a solution of density 1.15 g/ml. The molarity of the solution is

(1) 1.78 M (2) 2.00 M
(3) 2.05 M (4) 2.22 M

74. For the reaction
$7A + 13\,B + 15C \rightarrow 17P$
If 15 moles of A , 26 mole of B and 30.5 moles of C are taken initially, then limiting reactant is

(1) A (2) B
(3) C (4) none of these

75. Which of the following is a temperature independent concentration term?

(1) Molality
(2) Mole fraction
(3) Both (1) and (2)
(4) Molarity

76. The weight of lime obtained by heating 200 kg of 95% pure lime stone is:

(1) 98.4 kg (2) 106.4 kg
(3) 112.8 kg (4) 122.6 kg

77. The molality of a solution of urea in acetic acid, if mole fraction of urea in the solution is 0.5, is:

(1) $\frac{100}{3}$ m (2) $\frac{50}{3}$ m
(3) $\frac{40}{3}$ m (4) $\frac{25}{3}$ m

78. The crystalline salt $Na_2SO_4.xH_2O$ on heating loses 55.9% of its weight. The formula of the crystalline salt is

(1) $Na_2SO_4.5H_2O$
(2) $Na_2SO_4.7H_2O$
(3) $Na_2SO_4.2H_2O$
(4) $Na_2SO_4.10H_2O$

79. Calculate the molarity of NaOH in the solution prepared by dissolving its 4 g in enough water to form 500 ml of the solution.

(1) 0.2 M
(2) 0.4 M
(3) 0.02 M
(4) 0.04 M

80. The molarity of aqueous NaCl solution which contains 5.85 g of NaCl in 500 ml solution is:

(1) $\frac{1}{2}$M (2) $\frac{1}{5}$M
(3) $\frac{2}{5}$M (4) $\frac{3}{5}$M

81. Equal volume of N_2 and H_2 react to form ammonia under suitable conditions, then the limiting reagent is:

(1) N_2 (2) H_2
(3) NH_3 (4) Both (1) and (2)

82. The unit of molality is:

(1) mole/ litre (2) g/mol
(3) It is unitless (4) mole/kg

83. 20 g NaOH is dissolved in 400 g of water to prepare a solution. The molality of the solution is:

(1) 1.25×10^{-3} m (2) 2.5×10^{-3} m
(3) 1.25 m (4) 2.5 m

84. Solubility of a substance is its maximum amount that can be dissolved in a specified amount of solvent. It depends upon

(i) nature of solute (ii) nature of solvent
(iii) temperature (iv) pressure

(1) Only (i), (ii) and (iii)
(2) Only (i), (iii) and (iv)
(3) Only (i) and (iv)
(4) (i), (ii), (iii) and (iv)

85. The boiling point of 0.1 m KCl solution in water having ebullioscopic constant (K_b) of 0.51 K kg mol^{-1} is:

(1) 100.102°C (2) 99.49°C
(3) 100.051°C (4) 99.949°C

SECTION-B

86. The value of Henry's law constant for some gases at 293 K is given below. Arrange the gases in the increasing order of their solubility.

He **:** 144.97 kbar, H_2 : 69.16 kbar,

N_2 : 76.48 kbar, O_2 : 34.86 kbar

(1) He < N_2 < H_2 < O_2
(2) O_2 < H_2 < N_2 < He
(3) H_2 < N_2 < O_2 < He
(4) He < O_2 < N_2 < H_2

87. Mole fraction of $C_3H_5(OH)_3$ in a solution of 36 g of water and 46 g of glycerine is:

(1) 0.46 (2) 0.36
(3) 0.20 (4) 0.40

88. A complex containing K^+ Pt (IV) and Cl^- is 100% ionised giving i = 3. Thus, complex is

(1) $K_2[PtCl_4]$
(2) $K_2[PtCl_6]$
(3) $K_3[PtCl_5]$
(4) $K[PtCl_3]$

89. The vapour pressure of water depends upon:

(1) Surface area of container
(2) Volume of container
(3) Temperature
(4) All of these

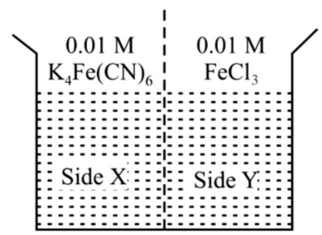
90. Which of the following is less than zero for ideal solutions?

(1) ΔH_{mix} (2) ΔV_{mix}
(3) ΔG_{mix} (4) ΔS_{mix}

91. For each of the following dilute solutions, van't Hoff factor is equal of 3, except:

(1) Na_2SO_4 (2) CaF_2
(3) K_3PO_4 (4) $(NH_4)_2CO_3$

92. $FeCl_3$ on reaction with $K_4[Fe(CN)_6]$ in aqueous solution gives blue colour. These are separated by a semipermeable membrane AB as shown. Due to osmosis there is:



(1) Blue colour formation in side X.
(2) Blue colour formation in side Y.
(3) Blue colour formation in both of the sides X and Y
(4) No blue colour formation.

93. Elevation in boiling point for 1 molal solution of glucose is 2K. The depression in the freezing point for 2 molal solution of glucose in the same solvent is 2K. The relation between K_b and K_f is;

(1) $K_b = 1.5 K_f$
(2) $K_b = K_f$
(3) $K_b = 0.5 K_f$
(4) $K_b = 2K_f$

94. Two open beakers one containing a solvent and the other containing a mixture of that solvent with a non-volatile solute are together sealed in a container. Over time:

(1) the volume of the solution decreases and the volume of the solvent increases
(2) the volume of the solution and the solvent does not change
(3) the volume of the solution increases and the volume of the solvent decreases
(4) the volume of the solution does not change and the volume of the solvent decreases

95. 1 g of non-volatile non-electrolyte solute is dissolved in 100 g of two different solvents A and B whose ebullioscopic constants are in the ratio of 1 : 5. The ratio of the elevation in their boiling points, $\frac{\Delta T_b(A)}{\Delta T_b(B)}$ is:

(1) 5 : 1 (2) 10 : 1
(3) 1 : 5 (4) 1 : 0.2

96. Which of the following colligative properties is not associated with molality?

(1) Lowering of vapour pressure
(2) Osmotic pressure
(3) Depression in freezing point
(4) Elevation in boiling point

97. When mercuric iodide is added to the aqueous solution of potassium iodide:

(1) the boiling point does not change
(2) freezing point is raised
(3) the freezing point is lowered
(4) freezing point does not change

98. Which of the following solutions will have highest boiling point?

(1) 0.1 M $FeCl_3$
(2) 0.1 M $BaCl_2$
(3) 0.1 M NaCl
(4) 0.1 M urea (NH_2 $CONH_2$)

99. Which one of the following is correct for an ideal solution?

(1) It must obey Raoult's law
(2) $\Delta S_{mix} = 0$
(3) $\Delta H = \Delta V \neq 0$
(4) ΔG is always positive

100. The solubility of a solid in a liquid is significantly affected by temperature changes.

Solute + Solvent $\rightleftharpoons$ Solution.

The system being in a dynamic equilibrium must follow Le-chatelier's principle. Considering the Le-chatelier's principle which of the following is correct?

(1) $\Delta H_{sol} > 0$; solubility $\uparrow$; temperature $\downarrow$
(2) $\Delta H_{sol} < 0$; solubility $\downarrow$; temperature $\uparrow$
(3) $\Delta H_{sol} > 0$; solubility $\downarrow$; temperature $\uparrow$
(4) $\Delta H_{sol} < 0$; solubility $\uparrow$; temperature $\uparrow$

Solution

51. (3)

From Raoult's law;

$P_{total} = P_A + P_B$

$= P_A^o \chi_A + P_B^o \chi_B$

$= P_A^o (1-\chi_B) + P_B^o \chi_B$

$= P_A^o - P_A^o\chi_B + P_B^o \chi_B$

$= P_A^o + P_B^o \chi_B - P_A^o\chi_B$

$P_{total} = P_A^o + \chi_B(P_B^o - P_A^o)$

or $P_{total} = P_A^o - (P_A^o - P_B^o)\chi_B$ ....(ii)

$P = 120 - 75\chi_B$ ....(i) [given]

Comparing equation (i) and (ii)

$P_A^o = 120$ torr

and $P_A^o - P_B^o = 75$ torr

$\therefore -P_B^o = 75 \text{ torr} - P_A^o$

$-P_B^o = 75 \text{ torr} - 120 \text{ torr}$

$-P_B^o = -45$ torr

$P_B^o = 45$ torr

52. (4)

$$\frac{P^o - P_s}{P^o} = i \times \chi_{solute}$$

$$= \frac{i\, n_{solute}}{i\, n_{solute} + n_{solvent}}$$

$$= \frac{3\times1}{3\times1+3} = \frac{3}{6} = \frac{1}{2}.$$

53. (1)

For dissociation;

$$\alpha = \frac{i-1}{n-1}$$

$$\therefore\ 0.2 = \frac{i-1}{2-1}$$

$0.2 = i - 1$

$i = 1.2$

Hence, $\Delta T_f = i\, K_f\, m$

$= 1.2 \times 1.86 \times 0.2$

$= 0.4464^oC = 0.45^oC$

Thus,

Freezing point $= 0^oC - (\Delta T_f)$

$= 0^oC - (0.45^oC) = -0.45^oC.$

54. (4)

For isotonic solutions, $\pi_1 = \pi_2$

$\pi \propto i \times C$

For Na_2SO_4 and $Ca(NO_3)_2$ van't Hoff factor (i) = 3.

55. (2)

$H_2O + C_4H_9OH$

56. (3)

$\pi = i\,C\,R\,T$

$$= 1 \times \frac{1}{10} \times 0.0821 \times 300$$

$= 2.46$ atm.

57. (4)

$$\text{Vapour pressure} \propto \frac{1}{i \times C}$$

	Solute		$i \times C$
(1)	0.1 M $BaCl_2$	:	0.3
(2)	0.1 M urea	:	0.1
(3)	0.1 M Na_2SO_4	:	0.3
(4)	0.1 M Na_3PO_4	:	0.4

58. (2)

When %w/w is given then:

$$\text{Molarity} = \frac{\%w/w \times 10 \times d}{GMM}$$

$$= \frac{98 \times 10 \times 1.84}{98} M = 18.4 M.$$

59. (3)

Only 2 significant figures.

60. (1)

$$\text{Average atomic mass} = \frac{x \cdot a + y \cdot b}{100}$$

61. (3)

$$\text{Mole} = \frac{24.9}{249} = 0.1$$

Number of oxygen atom = $0.1 \times 9 \times 6.02 \times 10^{23}$

62. (3)

$$\%\text{ of O} = \frac{16\times27}{(100+3\times310)} \times 100 = 41.94\%$$

63. (1)

$$\text{Mole} = \frac{2}{32} = \frac{1}{16}$$

At N.T.P.

$$\text{Mole} = \frac{V(lt)}{22.4}$$

$$\frac{1}{16} = \frac{V(lt)}{22.4}$$

$V(lt) = 1.4$ L

64. (3)

$$\text{Moles of } NO_3^- = \frac{3.1\times10^{-3}}{62\times10} = 0.05\times10^{-3}$$

$$\text{Numbers of molecule} = 0.05\times10^{-3}\times6\times10^{23}$$

$= 3\times10^{19}$

Numbers of e^- = Numbers of molecule

$\times e^-$ in NO_3^- Ion

$= 3 \times 10^{19} \times 32$

$= 96 \times 10^{19} = 9.6 \times 10^{20}$

65. **(2)**

Number of moles of sucrose $= \dfrac{\text{Mass}}{\text{Molar mass}}$

$= \dfrac{25.6}{342.3}$

Number of moles of hydrogen atom $= 0.075\times22$

Number of atoms of hydrogen

$= 0.075\times22\times6.023\times10^{23} = 9.9\times10^{23}$

66. **(2)**

1 mole of methane contains 1 mole of C, 2 mole of H_2.

12 g of C (1 mole = 12 g)

4 g of H_2 (2 moles)

4 gm of Hydrogen atom is the answer.

67. **(1)**

Atomic number = P = 8

Atomic mass = N + P = 17

N = 9

Total number of neutron = $9 \times 20 \times 10^{25}$

$= 180 \times 10^{25}$

68. **(2)**

1 mole = Grame mol. mass.

mol. mass = 1 × 2 + 16 = 18 g

1 mole = 18 g

1 mole = 16 g

3.6 moles = 3.6 × 16 = 56.7

69. **(2)**

$NOBF_4$

70. **(4)**

Fe present in 67200 u = $\dfrac{0.33}{100}\times67200$

$= 222u = \dfrac{222}{56} = 4$ atoms

71. **(2)**

$\underset{5\,\text{mole}}{2VO} + \underset{6\,\text{mole}}{3Fe_2O_3} \rightarrow 6FeO + V_2O_5$

$Fe_2O_3 \rightarrow L.R$

By unitary method

3 mole Fe_2O_3 – 1 mole V_2O_5

6 mole Fe_2O_3 – $\dfrac{1\times6}{3}$ mole of V_2O_5 formed

= 2 mole V_2O_5 formed.

72. **(1)**

$CaCl_2$ molar mass

$\Rightarrow\ 40 + (35.5)\times2$

$\Rightarrow\ 40 + 71 = 111\,g$

Moles of $CaCl_2$ = $\dfrac{111\,g}{111\,g} = 1$ mole

1 $CaCl_2$	Ca^{+2}	Cl^-
mole × NA	1	2
'N_A' atoms	N_A	$2N_A$

73. **(3)**

Molarity $= \dfrac{\frac{120}{60}}{\frac{1120\times10^{-3}}{1.15}} = 2.05$

74. **(2)**

B is limiting reactant as ratio of given moles to stoichiometric coefficient is lowest for B.

75. **(3)**

Molality and mole fraction do not involve volume term hence they are temperature independent concentration term.

76. **(2)**

$\because$ 100 kg impure sample has pure

$CaCO_3 = 95$ kg

$\therefore$ 200 kg impure sample has pure $CaCO_3$

$= (95\times200/100) = 190$ kg.

$CaCO_3 \rightarrow CaO + CO_2$

$\because$ 100 kg $CaCO_3$ gives CaO = 56 kg

$\therefore$ 190 kg $CaCO_3$ gives CaO = $(56\times190/100)$

$= 106.4$ kg.

77. **(2)**

Molality = $\dfrac{\chi_{solute}}{\chi_{solvent}}\times\dfrac{1000}{\text{Molar mass of solvent}}$

$= \dfrac{0.5}{0.5}\times\dfrac{1000}{60} = \dfrac{50}{3}$ m

78. **(4)**

$\%\text{ of } H_2O = \dfrac{\text{No. of } H_2O\times(\text{M.wt of } H_2O)\times100}{\text{M.wt of } (Na_2SO_4.xH_2O)}$

79. **(1)**

Molarity = $\dfrac{n_{solute}}{V_L\ \text{solution}}$

$= \dfrac{4/40}{500/1000} = \dfrac{4}{40}\times\dfrac{1000}{500}$

$= \dfrac{1}{10}\times2 = 0.2$ M

80. (2)

$$\text{Molarity} = \frac{n_{solute}}{V_L \text{ solution}}$$

$$= \frac{5.85/58.5}{500/1000} = \frac{5.85}{58.5} \times \frac{1000}{500}$$

$$= 0.1 \times 2 = 0.2 \text{ M} = \frac{1}{5} \text{ M}$$

81. (2)

Balanced reaction is:

	N_2	+	$3H_2$	$\rightarrow$	$2NH_3$
From equation :	1 V		3 V		2 V
Given (suppose) :	1 V		1 V		?

1 V of N_2 reacts with 3 V of H_2 but available volume of H_2 is only 1 V, hence, it will be consumed totally.

Thus, limiting reagent is H_2.

82. (4)

$$\text{Molality} = \frac{\text{Number of moles of solute}}{\text{Mass of solvent in kg}}$$

$$= \frac{\text{Mole}}{\text{kg}}$$

Hence unit of molality is mole/kg

83. (3)

$$\text{Molality} = \frac{n_{solute}}{W_{kg} \text{ solvent}}$$

$$= \frac{20/40}{400/1000} = \frac{20}{40} \times \frac{1000}{400} = 1.25 \text{ m}$$

84. (4)

85. (1)

$$\Delta T_b = i\, K_b\, m$$

$$= 2 \times 0.51 \times 0.1 = 0.102^o \text{C}$$

Hence, Boiling Point = $100^oC + \Delta T_b$

$= 100^oC + 0.102^oC$

$= 100.102^oC$

86. (1)

Higher the value of K_H lower is the solubility of gas in liquid.

87. (3)

Molar mass of glycerine, $C_3H_5(OH)_3$ = 92 g/mol

$$\chi_{glycerine} = \frac{n_{glycerine}}{n_{glycerine} + n_{H_2O}}$$

$$= \frac{46/92}{46/92 + 36/18}$$

$$= \frac{\frac{1}{2}}{\frac{1}{2} + 2} = \frac{\frac{1}{2}}{\frac{5}{2}} = \frac{1}{2} \times \frac{2}{5} = 0.2$$

88. (2)

$K_2[PtCl_6] \rightarrow 2K^+ + [PtCl_6]^{2-}$

For $K_2[PtCl_4]$, i = 3 but oxidation number of Pt = +2

89. (3)

Vapour pressure of liquid depends only upon temperature.

Vapour pressure $\propto$ Temperature

90. (3)

For an ideal solution only $\Delta G_{mix} < 0$

i.e. ΔG_{mix} = –ve

91. (3)

Salt	**(i)**
Na_2SO_4	3
CaF_2	3
K_3PO_4	4
$(NH_4)_2CO_3$	3

92. (4)

There is no formation of blue colour because only solvent particles can pass through SPM hence Fe^{3+} and $[Fe(CN)_6]^{4-}$ ions cannot interact with each other.

93. (4)

(I) $\Delta T_b = i\, K_b\, m$

$2 = 1 \times K_b \times 1$

$2 = K_b$

(II) $\Delta T_f = i\, K_f\, m$

$2 = 1 \times K_f \times 2$

$1 = K_f$

$\therefore \quad K_b = 2\, K_f$

94. (3)

The pure solvent will try to maintain higher vapour pressure in the sealed container and in return the solvent vapour molecules will condense in the solution of non-volatile solute as it maintains an equilibrium with lower vapour pressure. (Lowering of vapour pressure is observed when a non-volatile solute is mixed in a volatile solvent).

$$P^o_{solvent} > P_{solution}$$

This will lead to increase in the volume of solution container and decrease in the volume of solvent container.

95. **(3)**

$$\frac{\Delta T_b(A)}{\Delta T_b(B)} = \frac{K_{b(A)} \times m}{K_{b(B)} \times m}$$

$$= \frac{K_{b(A)} \times \dfrac{1\times1000}{m.m._{(solute)}\times100}}{K_{b(B)} \times \dfrac{1\times1000}{m.m._{(solute)}\times100}}$$

$$= \frac{K_{b(A)}}{K_{b(B)}} = \frac{1}{5}$$

96. **(2)**

The formula of osmotic pressure is;

$\pi = i\ C\ R\ T$

Hence, there is no involvement of molality in the osmotic pressure.

97. **(2)**

$2KI + HgI_2 \rightarrow K_2[HgI_4]$

No. of moles of ions in KI solution before the addition of $HgI_2 = 2K^+$ and $2I^- = 4$

No. of moles of ions in the solution after the addition of $HgI_2 = 2K^+$ and $[HgI_4]^- = 3$

$$\text{V.P. and F.Pt.} \propto \frac{1}{\text{No. of moles of ions in the solution}}$$

Since number of moles of ions in the solution decreases hence freezing point is raised.

98. **(1)**

Elevation in boiling point is a colligative property, i.e., depends only on number of particles of ions. 0.1 M $FeCl_3$ gives maximum number of ions, thus has highest boiling point.

99. **(1)**

For an ideal solution, $\Delta H = 0$, $\Delta V = 0$

100. **(2)**

According to Le-chateliers principle, for an exothermic reaction ($\Delta H < 0$) increase in temperature decreases the solubility