15. (b) $17\,gm\ NH_3$ = 1 *mole*.

Molecules of $NH_3 = \dfrac{6.02\times10^{23}\times4.25}{17} = 1.5\times10^{23}$

17. (b) $(2.5\times1+3\times0.5) = M_3\times5.5$

or $2.5+1.5 = M_3\times5.5$ or $M_3 = \dfrac{4}{5.5} = 0.73$ *M*.

20. (b) Normality of $2.3\,M\,H_2SO_4 = M\times$ Valency

$= 2.3\times2 = 4.6N$

21. (c) $N_1V_1 = N_2V_2$, $36\times50 = N_2\times100$

$N_2 = \dfrac{36\times50}{100} = 18$; $18N\ H_2SO_4 = 9M\,H_2SO_4$.

22. (c) Molarity $= \dfrac{w}{m.wt.\times \text{volume in litre}} = \dfrac{171}{342\times1} = 0.5M$.

23. (c) $N_1V_1 + N_2V_2 = NV$

$4x + 10(1-x) = 6\times1$; $-6x = -4$; $x = 0.66$

24. (b) $[H_3O^+] = 2\times0.02 = 0.04M$

$\therefore$ 2 *litre* solution contains 0.08 mole of H_3O^+.

25. (c) $\because$ 10 *litre* of urea solution contains 240 *gm* of urea

$\therefore$ Active mass $= \dfrac{240}{60\times10} = 0.4$.

26. (d) $NV = N_1V_1 + N_2V_2 + N_3V_3$

or, $1000N = 1\times5 + \dfrac{1}{2}\times20 + \dfrac{1}{3}\times30$ or $N = \dfrac{1}{40}$.

27. (d) $W = \dfrac{N\times eq.wt.\times V(ml)}{1000} = \dfrac{0.05\times49.04\times100}{1000} = 0.2452.$

29. (a) For *HCl* $M = N = 0.1$

$N_1V_1 = N_2V_2$; $25\times N_1 = 0.1\times35$

$N_1 = \dfrac{0.1\times35}{25}$; $\therefore M = \dfrac{0.1\times35}{25\times2} = 0.07$.

30. (c) We know that

Molarity $= \dfrac{\text{Number of moles of solute}}{\text{Volume of solution in } litre}$

$\therefore 2.0 = \dfrac{0.5}{\text{Volume of solution in } litre}$

$\therefore$ Volume of solution in *litre*

$= \dfrac{0.5}{2.0} = 0.250\,litre = 250\,ml.$

31. (a) $M = \dfrac{w}{m\times V(l)}$; $0.52 = \dfrac{w}{36.5\times0.15}$; $w = 2.84\,gm$

32. (c) $M = \dfrac{n}{V(l)}$; $0.5 = \dfrac{n}{2}$; $n = 1$

33. (d) $N = \dfrac{W}{M} = \dfrac{828}{46} = 18, n = \dfrac{w}{m} = \dfrac{36}{18} = 2$

$x_{H_2O} = \dfrac{n}{n+N} = \dfrac{2}{2+18} = \dfrac{2}{20} = 0.1$

34. (a) $N = \dfrac{w\times1000}{E\times \text{volume in } ml.}$, $E = \dfrac{98}{3} = 32.6$

$N = \dfrac{4.9\times1000}{32.6\times500} = 0.3N$.

39. (b) Mole fraction of solute $= \dfrac{20}{80} = 0.25$.

40. (c) $N = \dfrac{w\times1000}{m.wt.\times \text{Volume in}\,ml} = \dfrac{4\times1000}{40\times100} = 1.0\,N$.

41. (c) $M_1V_1 + M_2V_2 = M_3V_3$;

$1.5\times480 + 1.2\times520 = M\times1000$

$M = \dfrac{720+624}{1000} = 1.344\,M$.

44. (c) $m = \dfrac{18\times1000}{180\times500} = 0.2\,m$

45. (a) Molarity $= \dfrac{\%\times10\times d}{GMM} = \dfrac{22\times10\times1.253}{342} = 0.805M$.

Normality $= \dfrac{\%\times10\times d}{GEM} = \dfrac{22\times10\times1.253}{342/6} = 4.83N$

Molality $= \dfrac{22\times1000}{342(100-22)} = 0.825m$

46. (a) 100 *ml.* of 0.30*M* $= \dfrac{100\times0.3}{1000} = 0.03$ mole of *NaCl*

100 *ml* of 0.40*M* $= \dfrac{100\times0.4}{1000} = 0.04$ mole of *NaCl*

Moles of *NaCl* to be added $= 0.04 - 0.03 = 0.01$ mole

= 0.585 *gm*

47. (c) $N = \dfrac{6\times1000}{40\times100} = 1.5\,N$

It is show highest normality than others.

48. (b) $M = \dfrac{n}{V(l)} \Rightarrow 0.8 = \dfrac{0.1}{V(l)} \Rightarrow V = 125\,ml$.

50. (c) Strength of $H_2SO_4 = 98\times19.8\,g/litre$

$S = eq.wt.\times N$; $N = \dfrac{S}{eq.wt.} = \dfrac{98\times19.8}{49} = 39.6$

51. (c) $W = 1000\,gm\ \ (H_2O)$; $n = 1$ *mole*

$N = \dfrac{W}{M} = \dfrac{1000}{18} = 55.55$

$x_{\text{Solute}} = \dfrac{n}{n+N} = \dfrac{1}{1+55.55}$ = 0.018.

53. (d) Normality of acid = molarity × basicity

i.e., 0.2=molarity × 2

$\therefore$ Molarity = 0.2/2 = 0.1

55. (b) Mole fraction of $H_2O = \dfrac{\dfrac{80}{18}}{\dfrac{80}{18}+\dfrac{20}{34}} = \dfrac{68}{77}$.

59. (d) Volume strength $= \dfrac{1.5\times100}{17} = 8.82.$

60. (a) $n = \dfrac{w}{m}; w = n\times m = 0.25\times98 = 24.5gm$

61. (d) Molar concentration $[H_2] = \dfrac{Mole}{V\,\text{in}\,litre} = \dfrac{20/2}{5} = 2$.

62. (a) Amount of $AgNO_3$ added in 60 *ml* of solution $= 60\times 0.03 = 1.8\ g$

63. (a) $N = \frac{w}{E\times V(l)} \Rightarrow 0.1 = \frac{w}{100\times 0.1} \Rightarrow w = 1gm$

64. (b) $N = \frac{w}{E\times V(l)} \Rightarrow 0.1 = \frac{w}{40\times 0.25} \Rightarrow w = 1\,gm$

65. (a) $20\times 0.4 = 40\times N$ or $N = 0.2$ or $M = \frac{0.2}{2} = 0.1M$.

69. (a) $M = \frac{w\times 1000}{m.wt.\times \text{Volume in } ml.} = \frac{10.6\times 1000}{106\times 500} = 0.2M$.

72. (c) M.eq. of *HCl* = M.eq. of $CaCO_3$

$N\times 50 = \frac{1}{50}\times 1000$; $N = \frac{1\times 1000}{50\times 50} = 0.4N$

73. (c) molality$= \frac{18}{180} = 0.1\,molal$.

74. (b) Molarity of $H_2SO_4 = 0.5$

Normality of $H_2SO_4\ (N_1) = 0.5\times 2 = 1$

$N_1V_1 = N_2V_2$

$1\times 1 = N_2\times 10$ or $N_2 = \frac{1}{10} = 0.1N$.

76. (c) The density of solution $= 1.8\,gm/ml$

Weight of one litre of solution $= 1800\,gm$

$\therefore$ Weight of H_2SO_4 in the solution $= \frac{1800\times 90}{100} = 1620gm$

$\therefore$ Weight of solvent $= 1800 - 1620 = 180\,gm$

$\therefore$ Molality $= \frac{1620}{98}\times\frac{100}{180} = 9.18$

77. (a) Suppose the total volume of water = *x*

$\therefore 100cm^3\times 0.5N = x\times 0.1N$

$\therefore x = \frac{100\times 0.5}{0.1} = 500cm^3$

Therefore the volume of water added

$= \text{Total volume} - 100\text{cm}^3 = 500 - 100 = 400cm^3$.

78. (b) $M_1V_1 = M_2V_2$, $M_2 = \frac{0.25\times 25}{500} = 0.0125$.

79. (c) % by $wt. = \frac{wt.\text{ of the solute}(g)}{wt.\text{ of the solution} g}\times 100$

$= \frac{10}{90+10}\times 100 = 10$

80. (b) Molality $= \frac{w}{m\times W}\times 1000 = \frac{18\times 1000}{180\times 250} = 0.4\ m$

81. (d) Molality $(m) = \frac{w\times 1000}{mW} = 14.05$.

82. (b) $N_1V_1 = N_2V_2$

$10\times 10 = 0.1(10+V)$

$V = \frac{10\times 10}{0.1} - 10 = 1000 - 10 = 990ml.$

83. (b) Sum of mole fraction is always 1.

84. (b) An increases in temperature increase the volume of the solution and thus decreases its molarity.

85. (d) 10^3 parts of $CaCO_3$ has number of parts = 10

10^6 parts of $CaCO_3$ has number of parts

$= \frac{10}{10^3}\times 10^6 = 10{,}000\,ppm$.

86. (d) $X = \frac{n}{n+N}$

$n = \frac{w}{m} = \frac{3.65}{36.5} = 0.1,\quad N = \frac{W}{M} = \frac{16.2}{18} = 0.9$

$X = \frac{0.1}{0.1+0.9} = 0.1$.

87. (d) 10% glucose solution means $10\,g = \frac{10}{180}\,mole$ in 100 *cc*. *i.e.*, 0.1 *litre*

Hence 1 *mole* will be present in $\frac{0.1\times 180}{10}$ =1.8 *litre*.

88. (e) For methyl alcohol *N* = *M*.

89. (b) Mole fraction of glucose = $\frac{n}{n+N}$

$= \frac{0.01}{0.01+5} = 0.00199$

90. (b) Mole of urea $= \frac{6.02\times 10^{20}}{6.02\times 10^{23}} = 10^{-3}$ moles

Conc. of solution (in molarity) $= \frac{10^{-3}}{100}\times 1000 = 0.01M$.

91. (a) Gram molecule of SO_2Cl_2 = 135

$n = \frac{w}{m} = \frac{13.5}{135} = 0.1$.

92. (d) 1000 *ml* of 1 *N* oxalic solution = 63 *g*

500 *ml* of 0.2 *N* oxalic acid solution

$= \frac{63}{1000}\times 500\times 0.2 = 6.3\ g$.

93. (a) Mole fraction at $C_6H_6 = \frac{\frac{7.8}{78}}{\frac{7.8}{78}+\frac{46}{92}} = \frac{1}{6}$.

94. (c) $X_{H_2O} = \frac{n_{H_2O}}{n_{H_2O} + n_{C_2H_5OH} + n_{CH_3COOH}}$

95. (a) $M_1V_1 = M_2V_2$

i.e. $5\times 1 = M_2\times 10 \Rightarrow M_2 = 0.5$

Normality of the solution $= \frac{0.5}{2} = 0.25$.

96. (a) $M = \frac{w\times 1000}{m\times \text{Volume in } ml.} = \frac{1\times 1000}{40\times 250} = 0.1M$.

98. (d) $N = \frac{w\times 1000}{eq.wt.\times \text{volume in } ml.} = 0.33N$.

99. (b) Mole of $HCl = \frac{1.2046\times 10^{24}}{6.023\times 10^{23}} = 2mole$

Normality = molarity × basidity or acicity $= 2\times 1 = 2N$

100. (d) $10\,N$ = Deca - normal , $\frac{1}{10}N$ = Deci-normal.

101. (c) Molarity $= \frac{w\times 1000}{ml\text{ wt.}\times\text{Volume } ml.} = \frac{7.1\times 1000}{142\times 100} = 0.5\,M$.

102. (d) $M = \frac{4\times 10}{40} = 1\,M$.

103. (d) Mole fraction $X = \frac{n}{n+N} = \frac{\frac{6}{60}}{\frac{6}{60}+\frac{180}{18}} = \frac{0.1}{10.1}$.

104. (c) $N = \frac{w\times 1000}{Eq.wt.\times\text{Volume}} = \frac{10\times 1000}{60\times 100} = 1.66\,N$.

106. (b) $N = M\times$bosicity ; $N = 2\times 2 = 4$.

108. (b) Concentration $= \frac{5\times 10^6}{10^6}$ = 5 *ppm.*

110. (a) H_3PO_3 is a dibasic acid

N_1V_1 (acid) $= N_2V_2$ (base)

$0.1\times 2\times 20 = 0.1\times 1\times V_2$

$\therefore V_2 = \frac{0.1\times 2\times 20}{0.1\times 1} = 40\,ml$

111. (d) $H_3PO_4 \rightleftharpoons H^+ + H_2PO_4^-$

$H_2PO_4^- \rightleftharpoons H^+ + HPO_4^{2-}$

$HPO_4^{2-} \rightleftharpoons H^+ + PO_4^{3-}$

Phosphoric acid does not give 1*N* strength.

112. (b) $C_6H_5COOH + NaOH \rightarrow C_6H_5COONa + H_2O$

$\frac{w}{40} = \frac{12.2}{122} = 4\,gms.$

113. (c) $(H_2SO_4)\ N_1V_1 = N_2V_2$ (dilute acid)

$N_2 = (10\times 36)/1000 = 0.36\,N$.

114. (c) $H_2O_2 \rightarrow H_2O + \frac{1}{2}O_2$

1 *M* H_2O_2 solution $= 2N = 34\,gm/litre = 11.2$

So Normality $= \frac{2\times 10}{11.2} = 1.75$

115. (b) Weight = molarity × *m.wt.*× *v* = $1\times 132\times 2 = 264\,gm.$

116. (a) Mole fraction $= \frac{n}{n+N} = \frac{\frac{w}{m}}{\frac{w}{m}+\frac{W}{M}} = \frac{\frac{1}{2}}{\frac{1}{2}+\frac{8}{32}} = 0.667$.

118. (c) 98% H_2SO_4 means 98*g* H_2SO_4 in 100*g* solution.

$\frac{100}{1.84}cc = 54.3cc$; $98g\ H_2SO_4 = 1\,mol$

Hence molarity $= \frac{1}{54.3}\times 1000 = 18.4M$

120. (d) $3\,CaCl_2 + 2\,Na_3PO_4 \rightarrow Ca_3(PO_4)_2 + 6NaCl$

$\therefore$ Mole of $Na_3PO_4 = 3$ mole of $CaCl_2 = 1$ *mole* $Ca_3(PO_4)_2$

$\therefore$ 0.2 mole of $Na_3PO_4 = 0.3$ mole of $CaCl_2$ = 0.1 mole of $Ca_3(PO_4)_2$.

121. (b) $\frac{X}{X+\frac{1000}{78}} = 0.2$

122. (c) $C = \frac{6}{60} = 0.1$ *molar.*

123. (b) Molar solution of sulphuric acid is equal to 2*N* because it is show dibasic nature.

124. (a) $N = \frac{w\times 1000}{eq.wt.\times\text{volume in ml}}$ $eq.wt. = \frac{106}{2} = 53$

$w = \frac{0.5\times 53\times 500}{1000} = 13.25$.

125. (c) Molar concentration $= \frac{5.85\times 1000}{58.5\times 200} = 0.5\,Molar.$

126. (c) $M = \frac{w\times 1000}{m.wt.\times V\text{in } ml} = \frac{75.5\times 1000}{56\times 540} = 2.50\,M$

129. (a) $N_1V_1 = N_2V_2$

$10\times 10 = 0.1$ × Volume of new solution

Volume of water = 1000 – 10 = 990 *ml.*

130. (b) $W = \frac{M\times m.wt.\times V}{1000} = \frac{0.1\times 98\times 400}{1000} = 3.92\,g$.

131. (a) Molarity of pure water $= \frac{1000}{18} = 55.6\,M$.

132. (c) $M = \frac{N}{2} = \frac{0.2}{2} = 0.1\,M$

133. (c) Moles of water $= \frac{180}{18} = 10\,mole.$

134. (c) Mole fraction of $CO_2 = \frac{n_{CO_2}}{n_{CO_2}+n_{N_2}} = \frac{\frac{44}{44}}{\frac{44}{44}+\frac{14}{28}} = \frac{2}{3}$.

136. (c) $M = \frac{w}{m\times V(l)} \Rightarrow 0.1 = \frac{w\times 4}{40\times 1} \Rightarrow w = 1gm$

137. (c) $M = \frac{w\times 1\,litre}{m.wt.\times\text{Volume } litre} = \frac{4\times 1}{40\times 0.1} = 1\,M$.

138. (b) Number of moles $= \frac{w_1}{m_1} + \frac{w_2}{m_2} = \frac{90}{18} + \frac{300}{60} = 10$

139. (a) The number of moles of solute dissolved in 1000 *gm* of the solvent is called molal solution.

140. (b) $w = \frac{0.1\times 100\times 392}{1000} = 3.92\,g$

141. (d) $\frac{18}{180\times 1} = \frac{1}{10} = 0.1$ molal.

142. (c) $M = \frac{n}{V(l)} \Rightarrow 3 = \frac{n}{1} \Rightarrow n = 3$ moles.

143. (b) The unit of molality is mole per kilogram.

144. (a) 0.2 water + 0.8 ethanol; X_A = mole fraction of water,

X_B = mole fraction of ethanol

$X_A = \frac{N_1}{N_1+N_2}$, $X_B = \frac{N_2}{N_2+N_1}$

$\therefore$ Mole fraction of water = 0.2 and ethanol = 0.8.

Colligative properties

3. (a) Osmotic pressure is colligative property.

5. (c) Vapour pressure is not colligative property.

Lowering of vapour pressure

1. (a) $\frac{P^0 - Ps}{P^0} = \frac{w \times M}{m\ W} = 143 - \frac{0.5 \times 154}{65 \times 158} \times 143$

$= 143 - 1.03 = 141.97\,mm$.

4. (d) $\frac{P^0 - P_s}{P^0} = \frac{\frac{w}{m}}{\frac{w}{m} + \frac{W}{M}}$ or $0.00713 = \frac{71.5/m}{\frac{71.5}{m} + \frac{1000}{18}}$

$m = 180$

5. (b) HgI_2 although insoluble in water but shows complex formation with *KI* and freezing point is decreases.

6. (a) For solutions containing non-volatile solutes, the Raoult's law may be stated as at a given temperature, the vapour pressure of a solution containing non-volatile solute is directly proportional to the mole fraction of the solvent.

7. (a) Vapour pressure $\propto \frac{1}{\text{Boiling point}}$

When vapour pressure decreases then *b.pt.* increases.

9. (c) Methanol has low boiling point than H_2O

Lower is boiling point of solvent more is vapour pressure.

11. (a) Sucrose will give minimum value of ΔP .

$\Delta P = P^0 - P_s$

$P_s = P^0 - \Delta P$ is maximum.

12. (b) The relative lowering of the vapour pressure of dilute solution is equal to the mole fraction of the solute molecule present in the solution.

13. (b) Acetone solution has vapour pressure less than pure water.

15. (d) $P_T = P_p^0 x_p + P_h^0 x_h = 440 \times \frac{1}{5} + 120 \times \frac{4}{5}$

$= 88 + 96 = 184$; $P_p^0 x_p = y_p P_T$; $\frac{88}{184} = y_p$

$y_p = 0.478$

16. (a) $P_B = P_B^o X_B$; $\therefore P_B = \frac{\frac{78}{78}}{\frac{78}{78} + \frac{46}{92}} \times 75$; $\therefore$ P_B = 50 torr

17. (b) Given molecular mass of sucrose = 342

Moles of sucrose $= \frac{100}{342} = 0.292$ *mole*

Moles of water $N = \frac{1000}{18} = 55.5$ *moles* and

Vapour pressure of pure water $P^0 = 23.8$ *mm Hg*

According to Raoult's law

$$\frac{\Delta P}{P^0} = \frac{n}{n+N} \Rightarrow \frac{\Delta P}{23.8} = \frac{0.292}{0.292 + 55.5}$$

$\Delta P = \frac{23.8 \times 0.292}{55.792} = 0.125$ *mm Hg.*

18. (d) According to Raoult's law, the relative lowering in vapour pressure of a dilute solution is equal to mole fraction of the solute present in the solution.

21. (a) When vapour pressure of solvent decreases, then the boiling point of solvent increases.

25. (b) According to Raoult's Law

$\frac{P^0 - P_s}{P^0} = x_B$ (Mole fraction of solute)

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

26. (d) $\frac{P^0 - P_s}{P^0} = \text{molality} \times (1 - \alpha + x\alpha + y\alpha)$ the value of $P^0 - P_s$ is maximum for $BaCl_2$.

27. (a) $\frac{P^0 - Ps}{P^0} = \frac{18 \times 18}{180 \times 90} = 0.02$.

30. (d) $P_T = P_P^0 X_P + P_Q^0 X_Q$; $P_T = 80 \times \frac{3}{5} + 60 \times \frac{2}{5}$

$P_T = 48 + 24 = 72\ torr.$

31. (c) $\frac{P^0 - P_s}{P^0} = \frac{\frac{w}{m}}{\frac{w}{m} + \frac{W}{M}}$ $\because \frac{W}{M} > \frac{w}{m}$ $\Rightarrow \frac{640 - 600}{640}$

$= \frac{w}{m} \times \frac{M}{W} \Rightarrow \frac{40}{640} = \frac{2.175 \times 78}{m \times 39.08}$; $m = \frac{2.175 \times 78}{39.08} \times \frac{640}{40}$

$m = 69.45$.

33. (c) The lower is boiling point more is vapour pressure; boiling point order, $HCl < HBr < HI < HF$

35. (c) $\frac{P^0 - P_s}{P^0} = \frac{n}{N} \Rightarrow \frac{P^0 - P_s}{P^0} = \frac{1}{9.9} \Rightarrow 9.9P^0 - 9.9P_s = P^0$

$8.9P^0 = 9.9P_s \Rightarrow P_s = \frac{8.9}{9.9} P^0 \approx 0.90P^0$

38. (a) 1000 *ml* of CH_3OH requires methanol = 32 *g*.

150 *ml* of 2 *M* CH_3OH requires methanol

$= \frac{32}{1000} \times 150 \times 2 = 9.6\,g$.

39. (b) $\therefore P^0 - P_s = P^0 \times \text{mole fraction solute}$

$10 = P^0 \times 0.2$; $20 = P^0 \times n \Rightarrow n = 0.4 \therefore N = 0.6$.

40. (b) According to the Raoult's law for the non-volatile solute the relative lowering of vapour pressure of a solution containing a non-volatile is equal to the mole fraction of the solute.

43. (d) Relationship between mole fraction of a component in the vapour phase and total vapour pressure of an ideal solution.

$$y_A = \frac{P_A}{P_{total}} = \frac{x_A.P_A^0}{x_A.P_A^0 + x_B.P_B^0}$$

$$= \frac{1 \times 1}{1 \times 1 + 2 \times 2} = \frac{1}{1+4} = \frac{1}{5} = 0.2$$

44. (c) Lowering in weight of solution $\propto$ solution pressure

Lowering in weight of solvent $\propto$ $P^0 - P_s$

($\because$ p^0 = vapour pressure of pure solvent)

$$\frac{p^0 - p_s}{p_s} = \frac{\text{Lowering in weight of solvent}}{\text{Lowering in weight of solution}}$$

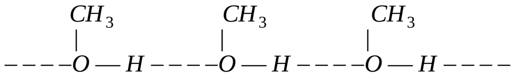
$$\frac{p^0 - p_s}{p_s} = \frac{w \times M}{m \times W}$$

$$\frac{0.05}{2.5} = \frac{10 \times 18}{90 \times m} \Rightarrow m = \frac{2 \times 2.5}{0.05} = \frac{2 \times 250}{5} = 100$$

Ideal and Non-ideal solution

1. (b) In solution showing positive type of deviation the partial pressure of each component of solution is greater than the vapour pressure as expected according to Raoult's law.

In solution of methanol & benzene methanol molecules are held together due to hydrogen bonding as shown below.



$$\overset{\overset{CH_3}{|}}{----O}-H----\overset{\overset{CH_3}{|}}{O}-H----\overset{\overset{CH_3}{|}}{O}-H----$$

On adding benzene, the benzene molecules get in between the molecule of methanol thus breaking the hydrogen bonds. As the resulting solution has weak intermolecular attraction, the escaping tendency of alcohol & benzene molecule from the solution increases. Consequently the vapour pressure of the solution is greater than the vapour pressure as expected from Raoult's law.

3. (b) Chloroform & acetone form a non-ideal solution, in which $A \ldots\ldots B$ type interaction are more than $A \ldots\ldots A$ & $B \ldots\ldots B$ type interaction due to H -bonding. Hence, the solution shows, negative deviation from Raoult's Law *i.e.,*

   $\Delta V_{mix} = -ve$; $\Delta H_{mix} = -ve$

   $\therefore$ total volume of solution = less than (30 + 50 *ml*)

   or $< 80\,ml$

4. (b) H_2O and C_4H_9OH do not form ideal solution because there is hydrogen bonding between H_2O and C_4H_9OH.

6. (a) Aromatic compound generally separated by fractional distillation. *e.g.* Benzene + Toluene.

7. (d) C_2H_5I and C_2H_5OH do not form ideal solution.

19. (a) For the ideal solution ΔH_{mix} and $\Delta V_{\text{mix}} = 0$.

25. (a) For the ideal solution ΔS_{mix} is not equal to zero.

Azeotropic mixture

1. (d) Azeotropic mixture is constant boiling mixture, it is not possible to separate the components of azeotropic mixture by boiling.

3. (d) Azeotropic mixture is a mixture of two liquids which boils at on particular temperature like a pure liquid and distils over in the same composition.

Osmosis and Osmotic pressure of the solution

1. (c) $\pi = CRT = \dfrac{3 \times 1000}{180 \times 60} \times 0.0821 \times 288 = 6.56\,atm$.

2. (b) Isotonic solution = $\dfrac{w_1}{m_1 V_1} = \dfrac{w_2}{m_2 V_2}$

   $= \dfrac{w_1}{342 \times 1} = \dfrac{6}{60 \times 1} = \dfrac{342 \times 6}{60} = 34.2$.

3. (c) $\pi = CRT$, $C = \dfrac{\pi}{RT} = \dfrac{0.0821}{0.821 \times 300} = 0.33 \times 10^{-2}$.

4. (a) $\pi = \dfrac{w}{m} \times RT = \dfrac{0.1}{1} \times 0.0821 \times 273$

5. (b) $\pi = \dfrac{n}{V} RT \Rightarrow M_P = \left(\dfrac{m}{V}\right) \dfrac{RT}{\pi}$

6. (b) $C = \dfrac{5}{342} \times \dfrac{1}{100} \times 1000 = \dfrac{50}{342}$ *mol/l*

   $\pi = \dfrac{50}{342} \times 0.082 \times 423 = 5.07\,atm$

7. (c) $P = \dfrac{w}{mv} R.T$ since *wvT* are constant thus $P \propto \dfrac{1}{m}$

   $P_2 > P_1 > P_3$.

8. (b) In the osmosis solvent molecule move from lower concentration to higher concentration.

10. (a) Osmosis occur from dilute solution to concentrate solution. Therefore solution *A* is less concentrated than *B*.

11. (c) Molar concentration of cane sugar $= \dfrac{5}{342} \times \dfrac{1000}{100} = \dfrac{50}{342}$

    Molar concentration of *X* = $\dfrac{1}{m} \times \dfrac{1000}{100} = \dfrac{10}{m}$

    $\dfrac{10}{m} = \dfrac{50}{342}$ or $m = 68.4$.

12. (d) Osmotic pressure method is especially suitable for the determination of molecular masses of macromolecules such as protein & polymer because for these substances the value of other colligative properties such as elevation in boiling point or depression in freezing point are too small to be measured on the other hand osmotic pressure of such substances are measurable.

13. (b) $\pi = CRT$; $C = \dfrac{\pi}{RT} = \dfrac{7.8}{\cdot 082 \times 310} = 0 \cdot 31\,mol/litre$

14. (b) $\pi = CRT$

    $\pi = \dfrac{w \times R \times T}{mV} = \dfrac{68.4 \times 0.0821 \times 273}{342}$ = 4.92 *atm*

16. (b) $\pi = \dfrac{n}{V} RT = \dfrac{m/MRT}{V}$

    $\dfrac{600}{760} = \dfrac{20 \times 0.0821 \times 288 \times 1000}{500 \times M}$; $M = 1200$

17. (c) $\pi = \dfrac{1.66 + 2.46}{2} = 2.06\,atm$

19. (d) Copper ferrocyanide *ppt.* acts as a semipermeable membrane.

20. (b) Osmotic pressure = *CRT* where *C* = 1 *m*

    $\pi = CRT = 1 \times 0.0821 \times 300 = 24.6\,atm$

23. (d) $P = CRT$ or $\dfrac{\text{P}}{C} = RT$

24. (d) $\pi = CRT$ or $\pi = \left(\dfrac{P^0 - P_s}{P^0}\right) \times \dfrac{dRT}{M}$

31. (a) Isotonic solutions are those which have same concentration.

32. (c) $\pi = CRT = 0.2 \times 0.0821 \times 293 = 4.81$ *atm.*

35. (b) Equal osmotic pressure only applicable of non-electrolytes solution at low concentration.

38. (c) As soon as the solute molecules increases the osmotic pressure of solution increase.

41. (c) Living cells shrinks in hypertonic solution (plasmolysis) while bursts in hypotonic solution (endosmosis). There is no. effect when living cells are kept in isotonic solution.

43. (c) $\pi V = nRT$

    $\pi = \dfrac{w}{m} \dfrac{RT}{V} = \dfrac{10}{342} \times \dfrac{0.821 \times (273 + 69)}{0.1}$ = 8.21 *atm.*

45. (c) KNO_3 dissociates completely while CH_3COOH dissociates to a small extent. Hence, $P_1 > P_2$.

47. (b) $\pi V = nRT$

    $\dfrac{500 V_1}{105.3 V_2} = \dfrac{nR \times 283}{nR \times 298}$; $\dfrac{V_1}{V_2} = \dfrac{1}{5}$ so $V_2 = 5V_1$

48. (a) There is no net movement of the solvent through the semipermeable membrane between two solution of equal concentration.

50. (b) $\pi V = \frac{w}{m} RT$

$\therefore\ 6\times10^{-4}\times1 = \frac{4}{m}\times0.0821\times300$; $m = 1.64\times10^{5}$.

52. (d) According to the dialysis process molecular weight increases but sensitivity decreases.

55. (d) $\pi \propto T$; if T is doubled π is also doubled.

56. (b) Osmosis reaction are takes place in increases the volume.

58. (a) For two non-electrolytic solution if isotonic, $C_1 = C_2$

$\therefore\ \frac{8.6}{60\times1} = \frac{5\times1000}{m.wt.\times100}$ $\therefore\ m = 348.9$

59. (b) Both urea and glucose are non-electrolytes but *NaCl* being electrolyte ionises.

Elevation of boiling point of the solvent

1. (a) $K_b = \frac{M_1RT_0^2}{1000\ \Delta H_V} = \frac{18\times1.987\times(373)^2}{1000\times9700} = 0.513^oC$

2. (b) $\Delta T_b = imk_b = 0.52\times1\times2 = 1.04$.

$\therefore\ T_b = 100 + 1.04 = 101.04^oC$.

3. (c) $K_b = \frac{\Delta T_b}{m} = \frac{0.1\times100}{\frac{1.8}{180}\times1000} = 1K/m$.

4. (d) $m = \frac{K_b\times w\times1000}{\Delta T_b\times W} = \frac{2.16\times0.15\times1000}{0.216\times15} = 100$.

5. (b) Due to higher pressure inside the boiling point elevated.

6. (b) Dissolution of a non-volatile solute raises the boiling pt. of a liquid.

7. (b) As we know that

Boiling point $\propto \frac{1}{\text{vapour pressure of liquid}}$

Hence, on decreasing vapour pressure, boiling point will increase.

8. (b) $\Delta T_b = \frac{100\times K_b\times w}{m\times W}$ $\therefore\ 0.52 = \frac{100\times5.2\times6}{m\times100}$

$m = \frac{100\times5.2\times6}{0.52\times100} = 60$.

10. (b) Elevation in a boiling point is a colligative property as it depends upon the number of particles.

$\Delta T_b \propto n$

For sucrose, $n = 1$, $\Delta T_b = 0.1^\circ C$

For *NaCl*, $n = 2$, $\Delta T_b = 0.2^\circ C$

11. (b) $\Delta T_b = K_b\times m$ or $K_b = \Delta T_b / m$

12. (c) $\Delta T_b = K_b\times m = 0.513\times\left(\frac{0.1}{200}\times1000\right)$

$= 0.2565\ ^oC$, $T_b = 100.256^oC$

15. (a) $\Delta T_b = i.K_b.m$

$CuCl_2 \longrightarrow Cu^{2+} + 2Cl^-$

1 0 0

$(1-\alpha)$ α 2α

$i = 1 + 2\alpha$

Assuming 100% ionization

So, $i = 3$

$\Delta T_b = 3\times0.52\times0.1 = 0.156 \approx 0.16$

16. (d) $\Delta T_b = \frac{K_b\times w\times1000}{m\times W}$

$m = \frac{K_b\times w\times1000}{\Delta T_b\times W} = \frac{2.53\times10\times1000}{1\times100} = 253g$.

18. (b) Common salt is non-volatile and rises the b.pt.

19. (b) In the process of evaporation, high energy molecules leave the surface of liquid, hence average kinetic energy and consequently the temperature of liquid falls.

20. (a) The boiling occurs at lowers temperature if atmospheric pressure is lower than 76*cm Hg*.

23. (b) $BaCl_2$ furnishes more ions than KCl and thus shows higher boiling point $T_1 > T_2$.

Depression of freezing point of the solvent

1. (c) $\Delta T_f = K_f\times\text{molality} = 1.86\times0.05 = 0.093\ ^\circ C$

Thus freezing point = 0 – 0.093 = -0.093^oC .

2. (c) $\Delta T_f = \frac{100\times K\times w}{m\times W}$ $\therefore 0.186 = \frac{100\times18.6\times w}{60\times500}$

$w = 3g$

3. (a) Camphor has the maximum value of $K_f (= 39.7)$.

4. (d) The extent of depression in freezing point varies with the number of solute particles for a fixed solvent only and it is a characteristics feature of the nature of solvent also. So for two different solvents the extent of depression may vary even if number of solute particles be dissolved.

6. (a) Molar mass $= \frac{K_f\times1000\times w}{\Delta T_f\times W} = \frac{1.86\times1000\times1.25}{20\times1.1}$

$= 105.68 = 105.7$.

7. (b) $HBr \rightleftharpoons H^+ + Br^-$

$(1-\alpha)$ α α

Total = 1 + α $\therefore\ i = 1+\alpha = 1+0.9 = 1.9$

$\Delta T_f = iK_f\times m = 1.9\times1.86\times\frac{8.1}{81}\times\frac{1000}{100} = 3.53^oC$

$T_f = -3.53^oC$.

8. (b) $\Delta T_f = K_f\times m = 1.86\times0.1 = 0.186$.

9. (b) Freezing point is lowered on addition of solute in it..

10. (d) $\Delta T_b = 0.18$; $\Delta T_b = mK_b$

$\frac{0.18}{\Delta T_f} = \frac{mK_b}{m\,K_f}$; $\frac{0.18\times1.86}{0.512} = \Delta T_f$; $\Delta T_f = 0.653$

$T^0 - T_s = 0.653$; $T^0 - T_s = 0.653$; $T_s = 0 - 0.653^oC$.

11. (a) $\Delta T_f = 1.86\times\left(\frac{342}{342}\right) = 1.86^o$; $\therefore\ T_f = -1.86^oC$.

12. (b) $\Delta T_b = K_b\times m$ *i.e.* $0.52 = 0.52\times m$

$\Delta T_f = K_f\times m = 1.86\times1 = 1.86$; $T_f = -1.86^oC$.

13. (b) For $NaCl$ $i = 2$

$\Delta T_f = 2K_fm = 2\times1.86\times1 = 3.72$

$T_s = T - \Delta T_f = 0 - 3.72 = -3.72°C$

15. (b) $\Delta T_f = K_f \times m \Rightarrow 0.186 = 1.86 \times m$

So $m = 0.1$, Put the value of m in $\Delta T_b = K_b \times m$

$\Delta T_b = 0.521 \times (0.1) = 0.0521$

17. (a) Dissolution of a non-volatile solute lowers the freezing pt. of the solution H_2O.

20. (a) By using, $m = \dfrac{K_f \times 1000 \times w}{\Delta T_f \times W_{\text{Solvent}}\,(gm)} = \dfrac{5.12 \times 1000 \times 1}{0.40 \times 50}$

$= 256\, gm/mol$

Hence, molecular mass of the solute $= 256\, gm\, mol^{-1}$

21. (a) $m = \dfrac{K_f \times w \times 1000}{\Delta T_f \times W} = \dfrac{5.12 \times 0.440 \times 1000}{0.567 \times 22.2} = 178.9$

22. (a) $KBr = K^+ + Br^- = 2$ ions

$BaCl_2 = Ba^{2+} + 2Cl^- = 3$ inos

$Al_2(SO_4)_3 = 2Al^{3+} + 3SO_4^{2-} = 5$ ions

$\therefore$ urea is not ionise hence it is shows highest freezing point.

23. (d) $NaCl \rightarrow Na^+ + Cl^- = 2$ ions

$K_2SO_4 \rightarrow 2K^+ + SO_4^{2-} = 3$ ions

K_2SO_4 give maximum ion in solution so it shows maximum depression in freezing point.

24. (c) $\Delta T_f = \dfrac{K_f \times 1000 \times w}{m \times W} = -0.216^o C$

25. (a) $\Delta T_f = \dfrac{1000 \times 1.86 \times 17}{46 \times 1000} = 0.69^o C$

$T_f = 0 - 0.69 = -0.69^o C$

26. (ad) The depression of freezing point is less than that of pure solvent and only solvent molecules solidify at the freezing point.

27. (b) $K_f = \dfrac{RT_f^2}{1000 \times L_f}$, $R = 8.314 JK^{-1}mol^{-1}$

$T_f = 273 + 16.6 = 289.6K$; $L_f = 180.75\, Jg^{-1}$

$K_f = \dfrac{8.314 \times 289.6 \times 289.6}{1000 \times 180.75}$

Colligative properties of electrolyte

1. (c) $(NH_4)_3PO_4$ gives maximum ion. Hence, its osmotic pressure is maximum.

2. (b) $BaCl_2$ gives maximum ion hence it is shows lowest vapour pressure.

3. (d) Na_3PO_4 consist of maximum ions hence it show lowest vapour pressure.

$Na_3PO_4 \rightarrow 3Na^+ + PO_4^{3-} = 4$ ion.

4. (c) Vapour pressure of a solvent is lowered by the presence of solute in it. Lowering in vapour pressure is a colligative property *i.e.,* it depends on the no. of particles present in the solution. $Cu(NO_3)_2$ give the maximum no. of ions. (*i.e.,* 3) so it causes the greatest lowering in vapour pressure of water.

5. (c) Na_2SO_4 have more osmotic pressure than $NaCl$ solution because Na_2SO_4 gives 3 ions.

6. (a) *NaCl* gives maximum ion hence it will show highest osmotic pressure.

8. (c) $BaCl_2 \Rightarrow Ba^{2+} + 2Cl^- = 3$ ion

$NaCl \Rightarrow Na^+ + Cl^- = 2$ ion

Glucose $\Rightarrow$ No ionisation

$\therefore BaCl_2 > NaCl >$ Glucose

9. (a) $Al_2(SO_4)_3$ gives maximum osmotic pressure because it is gives 5 ion.

10. (a) Highest osmotic pressure is given by solution which produce maximum number of ions i.e. $CaCl_2$.

11. (c) $BaCl_2$ gives maximum ion. Hence, its shows highest boiling point.

12. (c) $BaCl_2$ gives maximum ion. Hence, its boiling point is maximum.

13. (d) $CaCl_2$ gives maximum ion hence it shows highest boiling point.

14. (c) Elevation in boiling point is a colligative property which depends upon the number of solute particles. Greater the number of solute particle in a solution higher the extent of elevation in boiling point.

$Na_2SO_4 \rightarrow 2Na^+ + SO_4^{2-}$

15. (a) $NaCl$ contain highest boiling point than other's compound.

16. (d) $\underset{\text{Boiling point decreasing order} \rightarrow}{KCl > C_6H_5OH > C_6H_{12}O_6}$

Potassium chloride is ionic compound and phenol is formed phenoxide ion hence it is shows greater boiling point then glucose.

17. (c) $Al_2(SO_4)_3$ gives maximum ion hence it will show highest boiling point.

18. (b) *NaCl* is a more ionic compare to $BaCl_2$, glucose and urea solution.

19. (c) Urea = 1 ; Common salt = 1 ; $Na_2SO_4 = 3$

Ratio = 1 : 2 : 3

20. (c) $CaCl_2$ gives maximum ion hence it has minimum freezing point.

21. (b) *NaCl* gives maximum ion hence it shows lowest freezing point

23. (b) Lesser the number of particles in solution. Lesser the depression in freezing point, *i.e.* higher the freezing point.

24. (c) $BaCl_2$ gives maximum ion hence it shows maximum depression in freezing point.

26. (d) We know that lowering of freezing point is a colligative property which is directly proportional to the number of particles formed by one mole of compound therefore 0.1*M* $Al_2(SO_4)_3$ solution will have minimum freezing point.

27. (a) $Al_2(SO_4)_3$ gives maximum ion hence its gives lowest freezing point.

28. (b) Colligative property in decreasing order

$Na_3PO_4 > Na_2SO_4 > NaCl$

$Na_3PO_4 \rightarrow 3Na^+ + PO_4^{3-} = 4$

$Na_2SO_4 \rightarrow 2Na^+ + SO_4^{2-} = 3$

$NaCl \rightarrow Na^+ + Cl^- = 2$

29. (d) $K_4[Fe(CN)_6]$ gives maximum ion. Hence it have lowest vapour pressure.

Abnormal Molecular Mass

1. (c) Na_3PO_4 gives maximum four ion it is show highest Vant's haff factor.

2. (a) $K_4[Fe(CN)_6]$ dissociates as $4K^+ + [Fe(CN)_6]^{4-}$, thus 1 molecule dissociates into five particles in the similar way $Al_2(SO_4)_3$ also gives five particles per molecule.

3. (a) Benzoic acid in benzene undergoes association through intermolecular hydrogen bonding.

4. (c) vont's Hoff factor $(i) = \dfrac{\text{experiment al C.P.}}{\text{Calculated C.P.}}$

$= 1 - \alpha + x\alpha + y\alpha$, for KCl it is = 2 and for sugar it is equal to 1.

5. (c) $Ca(NO_3)_2 \to Ca^{2+} + 2NO_3^-$ it gives three ions hence the Van't Hoff factor = 3.

6. (a) $m = \dfrac{5 \times 18 \times 2.5}{0.04 \times 80} = 70.31$

8. (c)

	Na_2SO_4	$\rightleftharpoons$	$2Na^+$	+	SO_4^{2-}
Mol. before diss.	1		0		0
Mol. after diss	$1-\alpha$		2α		1α

$i = \dfrac{\text{Exp.C.P.}}{\text{Normal C.P.}} = 1 - \alpha + 2\alpha + \alpha = 1 + 2\alpha$

10. (d) $MgSO_4$ dissociates to give 2 ions.

11. (d) Urea does not give ion in the solution.

13. (b) Molecular weight of $CH_3COOH = 60$

Hence the molecular weight of acetic acid in benzene $= 2 \times 60 = 120$.

17. (b) $AlCl_3$ furnishes more ions than $CaCl_2$ and thus shows higher boiling point *i.e.* $t_1 > t_2$.

18. (d) $Na_3PO_4 = 3Na^+ + PO_3^{3-}$.

19. (b) Benzoic acid dimerises due to strong hydrogen bonding.

Critical Thinking Questions

1. (a) $\dfrac{P^o - P_s}{P^o} = \dfrac{n}{n+N}$; $P^o = 0.80,\ P_s = 0.60$

$\therefore \dfrac{n}{n+N} = \dfrac{0.2}{0.8} = 0.25$.

2. (c) We have,

$\dfrac{p^0 - 21.85}{21.85} = \dfrac{30 \times 18}{90 \times m}$, for I case .....(i)

wt. of solvent $= 90 + 18 = 108gm$

$\dfrac{p^0 - 22.15}{22.15} = \dfrac{30 \times 18}{108 \times m}$, for II case .....(ii)

By eq. (1) $p_m^0 - 21.85m = 21.85 \times 6 = 131.1$

By eq. (2) $p_m^0 - 22.15m = 22.15 \times 5 = 110.75$

$0.30m = 20.35$

$m = \dfrac{20.35}{0.30} = 67.83$

3. (c) $\dfrac{P^o - P_s}{P^o} = \dfrac{\dfrac{W_2}{M_2}}{\dfrac{W_1}{M_1}} = \dfrac{3000 - 2985}{3000} = \dfrac{\dfrac{5}{M_2}}{\dfrac{100}{18}}$ or $M_2 = 180$

4. (d) It is known that azeotropic mixture of HCl and water 20.2% HCl.

5. (a) $\pi = CRT = \dfrac{n}{V}RT = \dfrac{\dfrac{1.75}{342}}{\dfrac{150}{1000}} \times 0.0821 \times 290$

$= 0.8095 \approx 0.81\,atm$.

6. (c) Vant hoff factor of $NaCl$ about 1.95 because it will be ionise into two ions.

$NaCl \rightleftharpoons Na^+ + Cl^-$

7. (b) $m = \dfrac{wRT}{PV} = \dfrac{0.6 \times 0.082 \times 300}{1.23 \times 0.1} = 120$

8. (b) $m = \dfrac{K_b \times w \times 1000}{\Delta T_b \times W} = 143.18$

9. (c) Here: $\Delta T_b = 0.323K$

$w = 0.5143g$ weight of Anthracene.

$W = 35g$ weight of chloroform

$K_b =$ Molal elevation constant $(3.9\ K - Kg/mol)$

$m = \dfrac{K_b \times w \times 1000}{W \times \Delta T_b} = \dfrac{3.9 \times 0.5143 \times 1000}{0.323 \times 35}$

$= 177.42g/mol$

10. (c) First boiling point of water = $100^o C$

Final boiling point of water = 100.52^o

$w = 3g$, $W = 200\,g$, $K_b = 0.6\,kg^{-1}$

$\Delta T_b = 100.52 - 100 = 0.52^o C$

$m = \dfrac{K_b \times w \times 1000}{\Delta T_b \times W}$

$= \dfrac{0.6 \times 3 \times 1000}{0.52 \times 200} = \dfrac{1800}{104} = 17.3gmol^{-1}$.

11. (b) Applying clausius clapeytron equation

$\log\dfrac{P_2}{P_1} = \dfrac{\Delta H_V}{2.303R}\left[\dfrac{T_2 - T_1}{T_1 \times T_2}\right]$

$\log\dfrac{760}{23} = \dfrac{40656}{2.303 \times 8.314}\left[\dfrac{373 - T_1}{373T}\right]$

This gives $T_1 = 294.4K$.

12. (b) $\Delta T_f = \text{molality} \times K_f \times (1 + \alpha)$

$\alpha = 0.2$, Molality = 0.2, $K_f = 1.86$

$\Delta T_f = 0.2 \times 1.2 \times 1.86 = 0.4464^o$

Freezing point = $-0.45^o C$.

13. (b) $\Delta T_f = imk_f$; $0.0054 = i \times 1.8 \times 0.001$

$i = 3$ so it is $[Pt(NH_3)_4Cl]Cl_2$.

14. (d) $m = \dfrac{K_f \times w \times 1000}{\Delta T_f \times W} = 60\,g/mole$.

15. (a) $\Delta T = K_f \times \text{Molality} = 4.9 \times 0.001 = 0.0049K$

16. (c) $\underset{}{Na_2CO_3} + \underset{98\,gm\,(2mole)}{H_2SO_4} \to \underset{1mole}{Na_2SO_4} + \underset{1mole}{CO_2}HO$

$0.02 = \dfrac{0.02 \times 22.4}{2} = 0.224$.

17. (a) We know that in the first solution number of the moles of urea $= \dfrac{\text{Mass of urea}}{m.wt.\text{ of urea}} \times \dfrac{1}{\text{V}}$ $= \dfrac{12}{60} \times \dfrac{1}{1} = 0.2$ and

In second solution the number of moles of cane sugar $= \dfrac{\text{Mass of cane sugar}}{m.wt.\text{ of cane sugar}}$ $= \dfrac{68.4}{342} \times \dfrac{1}{1} = 0.2$.

Assertion & Reason

1. (a) Molecular weight of urea (NH_2CONH_2)

$$= 14 + 2 + 12 + 16 + 14 + 2 = 60$$

Number of moles $= \dfrac{\text{Weight}}{\text{molecular weight}} = \dfrac{60}{60} = 1$

2. (e) If 100 *cc* of $0.1\,N\,HCl$ is mixed with 100 *cc* of $0.2N\,HCl$, the normality of the final solution will be 0.15.

$N_1V_1 + N_2V_2 = N_3V_3$ *i.e.,* $0.1 \times 100 + 0.2 \times 100$

$= N_3 \times 200$ or $N_3 = \dfrac{0.3 \times 100}{200} = 0.15$

3. (c) Both the solute and solvent will form the vapour but vapour phase will become richer in the more volatile component.

4. (b) Non-ideal solutions with positive deviation i.e., having more vapour pressure than expected, boil at lower temperature while those with negative deviation boil at higher temperature than those of the components.

5. (c) The polymer solutions possess very little elevation in boiling point or depression in freezing point.

6. (a) Depression in freezing point is a colligative property which depends upon the number of particles. The number of particles are different in case of benzene and water that is why molecular weight of acetic acid determined by depression in freezing point method is also different.

7. (d) Sodium ion, Na^+ and potassium ion, K^+ are responsible for maintaining proper osmotic pressure balance inside and outside of the cells of organisms.

8. (a) If a pressure larger than the osmotic pressure is applied to the solution side, the pure solvent flows out of the solution through semi-permeable membrane and this phenomenon is called as reverse osmosis.

9. (c) Camphor has high molal depression constant.

10. (b) Elevation in boiling point and depression in freezing point are colligative properties because both depend only on the number of particles (ions or molecules) of the solute in a definite amount of the solvent but not on the nature of the solute.

12. (a) The boiling point and melting point are higher due to presence of the intermolecular hydrogen bonding.

14. (d) If a non-volatile solute is added to water its vapour pressure always decreases. Therefore, both assertion and reason are false.

15. (b) We know that heat of vaporisation of water at 100^oC is $40.6kJ$ and that of benzene is $31kJ$ at 80^oC. The amount of heat required to vaporise one mole of liquid at constant temperautre is known as heat of vapourisation therefore, both assertion and reason are true but reason is nat the correct explanation of assertion.

16. (d) See melts slowly at high altitude because melting is favoured at a high pressure at high altitude the atmospheric pressure is low and so ice melts slowly.

17. (a) Colligative properties are the properties of solutions containing non volatile solute. It is correct that malecular mass of benzoic acid when determined by colligative properties is found abnormally high. This is because dimerisation of benzoic takes place in solution resulting high molecular mass. Therefore, assertion and reason are true and reason is correct explanation.

18. (a) It is fact that use of pressure cooker reduces cooking time because at higher pressure over the liquid due to cooker lid, the liquid boils at higher temperature and cooking occurs faster.

19. (c) The assertion that CCl_4 & H_2O are immiscible is true because CCl_4 is non-polar liquid while water is polar hence assertion is true and reason is false.

20. (b) It is true that isotonic solution doesn't show the phenomenon of osmosis. Isotonic solution are those solution which have same osmotic pressure. Here both assertion and reason are true but reason is not correct explanation.