EXERCISE-I

Solubility

1. The solubility of a gas in water depends on
(A) Nature of the gas (B) Temperature
(C) Pressure of the gas (D) All of the above

2. Which of the following is not correct for D_2O
(A) Boiling point is higher than H_2O
(B) D_2O reacts slowly than H_2O
(C) Viscosity is higher than H_2O at 25^o
(D) Solubility of *NaCl* in it is more than H_2O

3. The statement " The mass of a gas dissolved in a given mass of a solvent at any temperature is proportional to the pressure of the gas above the solvent" is
(A) Dalton's Law of Partial Pressures
(B) Law of Mass Action
(C) Henry's Law
(D) None of these

4. Which is correct about Henry's law
(A) The gas in contact with the liquid should behave as an ideal gas
(B) There should not be any chemical interaction between the gas and liquid
(C) The pressure applied should be high
(D) All of these

5. The statement "If 0.003 moles of a gas are dissolved in 900 *g* of water under a pressure of 1 atmosphere, 0.006 *moles* will be dissolved under a pressure of 2 atmospheres", illustrates
(A) Dalton's law of partial pressure
(B) Graham's law
(C) Raoult's law
(D) Henry's law

Method of expressing concentration of solution

6. 5 *ml* of *N HCl*, 20 *ml* of *N*/2 H_2SO_4 and 30 *ml* of *N*/3 HNO_3 are mixed together and volume made to one litre. The normally of the resulting solution is
(A) $\frac{N}{5}$ (B) $\frac{N}{10}$
(C) $\frac{N}{20}$ (D) $\frac{N}{40}$

7. The amount of $K_2Cr_2O_7$ (*eq.* wt. 49.04) required to prepare 100 *ml* of its 0.05 *N* solution is
(A) 2.9424 *g* (B) 0.4904 *g*
(C) 1.4712 *g* (D) 0.2452 *g*

8. With increase of temperature, which of these changes
(A) Molality
(B) Weight fraction of solute
(C) Fraction of solute present in water
(D) Mole fraction

9. 25*ml* of a solution of barium hydroxide on titration with a 0.1molar solution of hydrochloric acid gave a *litre* value of 35 *ml*. The molarity of barium hydroxide solution was
(A) 0.07 (B) 0.14
(C) 0.28 (D) 0.35

10. 2.0 molar solution is obtained , when 0.5 *mole* solute is dissolved in
(A) 250 *ml* solvent (B) 250 *g* solvent
(C) 250 *ml* solution (D) 1000 *ml* solvent

11. How many *gram* of *HCl* will be present in 150 *ml* of its 0.52 *M* solution
(A) 2.84 *gm* (B) 5.70 *gm*
(C) 8.50 *gm* (D) 3.65 *gm*

12. The number of moles present in 2 *litre* of 0.5 *M NaOH* is
(A) 0.5 (B) 0.1
(C) 1 (D) 2

13. 36*g* water and 828*g* ethyl alcohol form an ideal solution. The mole fraction of water in it, is
(A) 1.0 (B) 0.7
(C) 0.4 (D) 0.1

14. What will be the normality of a solution containing 4.9 *g*. H_3PO_4 dissolved in 500 *ml* water
(A) 0.3 (B) 1.0
(C) 3.0 (D) 0.1

15. 3.0 molal *NaOH* solution has a density of 1.110 *g*/*ml*. The molarity of the solution is
(A) 3.0504 (B) 3.64
(C) 3.05 (D) 2.9732

16. The number of moles of solute per kg of a solvent is called its
(A) Molarity (B) Normality
(C) Molar fraction (D) Molality

17. 1.0 *gm* of pure calcium carbonate was found to require 50 *ml* of dilute *HCl* for complete reaction. The strength of the *HCl* solution is given by
(A) 4 *N* (B) 2 *N*
(C) 0.4 *N* (D) 0.2 *N*

18. Molecular weight of glucose is 180. A solution of glucose which contains 18 gms per litre is
(A) 2 molal (B) 1 molal
(C) 0.1 molal (D) 18 molal

19. 0.5 *M* of H_2SO_4 is diluted from 1 litre to 10 litre, normality of resulting solution is
(A) 1 *N* (B) 0.1 *N*
(C) 10 *N* (D) 11 *N*

20. If one mole of a substance is present in 1*kg* of solvent, then
(A) It shows molar concentration
(B) It shows molal concentration
(C) It shows normality
(D) It shows strength *gm* / *gm*

21. The molality of 90% H_2SO_4 solution is [density=1.8 *gm/ml*]
(A) 1.8 (B) 48.4
(C) 9.18 (D) 94.6

22. The volume of water to be added to 100cm^3 of 0.5 *N* H_2SO_4 to get decinormal concentration is
(A) 400 cm^3 (B) 500 cm^3
(C) 450 cm^3 (D) 100 cm^3

23. If 25 *ml* of 0.25 *M NaCl* solution is diluted with water to a volume of 500*ml* the new concentration of the solution is
(A) 0.167 *M* (B) 0.0125 *M*
(C) 0.833 *M* (D) 0.0167 *M*

24. 10 grams of a solute is dissolved in 90 grams of a solvent. Its mass percent in solution is
(A) 0.01 (B) 11.1
(C) 10 (D) 9

25. What is the molality of a solution which contains 18 *g* of glucose ($C_6H_{12}O_6$) in 250 *g* of water
(A) 4.0 *m* (B) 0.4 *m*
(C) 4.2 *m* (D) 0.8 *m*

26. On dissolving 1 mole of each of the following acids in 1 litre water, the acid which does not give a solution of strength 1*N* is
(A) *HCl* (B) Perchloric acid
(C) HNO_3 (D) Phosphoric acid

27. How many grams of *NaOH* will be required to neutralize 12.2 grams of benzoic acid
(A) 40 *gms* (B) 4*gms*
(C) 16*gms* (D) 12.2 *gms*

28. 10*ml* of conc. H_2SO_4 (18 molar) is diluted to 1 litre. The approximate strength of dilute acid could be
(A) 0.18 *N* (B) 0.09 *N*
(C) 0.36 *N* (D) 1800 *N*

29. The normality of 10 *lit.* volume hydrogen peroxide is
(A) 0.176 (B) 3.52
(C) 1.78 (D) 0.88

30. Essential quantity of ammonium sulphate taken for preparation of 1 molar solution in 2 litres is
(A) 132 *gm* (B) 264 *gm*
(C) 198 *gm* (D) 212 *gm*

Colligative properties

31. Which of the following is not a colligative property
(A) Optical activity
(B) Elevation in boiling point
(C) Osmotic pressure
(D) Lowering of vapour pressure

32. Colligative properties of a solution depends upon
(A) Nature of both solvent and solute
(B) The relative number of solute and solvent particles
(C) Nature of solute only
(D) Nature of solvent only

33. Which is not a colligative property
(A) Refractive index
(B) Lowering of vapour pressure
(C) Depression of freezing point
(D) Elevation of boiling point

34. Which of the following is a colligative property
(A) Surface tension (B) Viscosity
(C) Osmotic pressure (D) Optical rotation

35. Colligative properties are used for the determination of
(A) Molar Mass
(B) Equivalent weight
(C) Arrangement of molecules
(D) Melting point and boiling point

Lowering of vapour pressure

36. Lowering of vapour pressure is highest for
(A) Urea (B) $0.1M$ glucose
(C) $0.1M\ MgSO_4$ (D) $0.1M\ BaCl_2$

37. An aqueous solution of glucose was prepared by dissolving 18 g of glucose in 90 g of water. The relative lowering in vapour pressure is
(A) 0.02 (B) 1
(C) 20 (D) 180

38. "Relative lowering in vapour pressure of solution containing non-volatile solute is directly proportional to mole fraction of solute". Above statement is
(A) Henry law
(B) Dulong and Petit law
(C) Raoult's law
(D) Le-Chatelier's principle

39. An ideal solution was obtained by mixing methanol and ethanol. If the partial vapour pressure of methanol and ethanol are $2.619\,kPa$ and $4.556\,kPa$ respectively, the composition of the vapour (in terms of mole fraction) will be
(A) 0.635 methanol, 0.365 ethanol
(B) 0.365 methanol, 0.635 ethanol
(C) 0.574 methanol, 0.326 ethanol
(D) 0.173 methanol, 0.827 ethanol

40. The vapour pressure of two liquids P and Q are 80 and 600 torr, respectively. The total vapour pressure of solution obtained by mixing 3 *mole* of P and 2 *mole* of Q would be
(A) 140 torr (B) 20 torr
(C) 68 torr (D) 72 torr

41. The vapour pressure of benzene at a certain temperature is $640\,mm$ of Hg. A non-volatile and non-electrolyte solid weighing $2.175g$ is added to $39.08g$ of benzene. The vapour pressure of the solution is $600mm$ of Hg. What is the molecular weight of solid substance
(A) 49.50 (B) 59.6
(C) 69.5 (D) 79.8

42. Which one of the following is the expression of Raoult's law

(A) $\frac{p-p_s}{p}=\frac{n}{n+N}$ (B) $\frac{p_s-p}{p}=\frac{N}{N+n}$

(C) $\frac{p-p_s}{p_s}=\frac{N}{N-n}$ (D) $\frac{p_s-p}{p_s}=\frac{N-n}{N}$

$p=$ vapour pressure of pure solvent

$p_s=$ vapour pressure of the solution

$n=$ number of moles of the solute

$N=$ number of moles of the solvent

43. Which has maximum vapour pressure
(A) *HI* (B) *HBr*
(C) *HCl* (D) *HF*

44. When a non-volatile solute is dissolved in a solvent, the relative lowering of vapour pressure is equal to
(A) Mole fraction of solute
(B) Mole fraction of solvent
(C) Concentration of the solute in grams per litre
(D) Concentration of the solute in grams 100 *ml*

45. 60 *gm* of Urea (*Mol. wt* 60) was dissolved in 9.9 *moles*, of water. If the vapour pressure of pure water is P_o, the vapour pressure of solution is
(A) 0.10 P_o (B) 1.10 P_o
(C) 0.90 P_o (D) 0.99 P_o

Ideal and Non-ideal solution

46. In which case Raoult's law is not applicable
(A) 1*M NaCl* (B) 1 M urea
(C) 1 M glucose (D) 1 M sucrose

47. A solution that obeys Raoult's law is
(A) Normal (B) Molar
(C) Ideal (D) Saturated

48. An example of near ideal solution is
(A) *n*-heptane and *n*-hexane
(B) $CH_3COOH + C_5H_5N$
(C) $CHCl_3 + (C_2H_5)_2O$
(D) $H_2O + HNO_3$

49. A mixture of liquid showing positive deviation in Raoult's law is
(A) $(CH_3)_2CO + C_2H_5OH$
(B) $(CH_3)_2CO + CHCl_3$
(C) $(C_2H_5)_2O + CHCl_3$
(D) $(CH_3)_2CO + C_6H_5NH_2$

50. All form ideal solution except
(A) C_2H_5Br and C_2H_5I
(B) C_2H_5Cl and C_6H_5Br
(C) $C_6H_6[0,1]$ and $C_6H_5CH_3$
(D) C_2H_5I and C_2H_5OH

51. Formation of a solution from two components can be considered as
(i) Pure solvent $\rightarrow$ separated solvent molecules ΔH_1
(ii) Pure solute $\rightarrow$ separated solute molecules ΔH_2
(iii) Separated solvent and solute molecules $\rightarrow$ solution ΔH_3
Solution so formed will be ideal if
(A) $\Delta H_{soln} = \Delta H_3 - \Delta H_1 - \Delta H_2$
(B) $\Delta H_{soln} = \Delta H_1 + \Delta H_2 + \Delta H_3$
(C) $\Delta H_{soln} = \Delta H_1 + \Delta H_2 - \Delta H_3$
(D) $\Delta H_{soln} = \Delta H_1 - \Delta H_2 - \Delta H_3$

52. Identify the mixture that shows positive deviation from Raoult's law
(A) $CHCl_3 + (CH_3)_2CO$
(B) $(CH_3)_2CO + C_6H_5NH_2$
(C) $CHCl_3 + C_6H_6$
(D) $(CH_3)_2CO + CS_2$

53. When acetone is added to chloroform, then hydrogen bond is formed between them.These liquids show
(A) Positive deviation from Raoult's law
(B) Negative deviation from Raoult's law
(C) No deviation from Raoult's law
(D) Volume is slightly increased

54. Which of the following is true when components forming an ideal solution are mixed
(A) $\Delta H_m = \Delta V_m = 0$ (B) $\Delta H_m > \Delta V_m$
(C) $\Delta H_m < \Delta V_m$ (D) $\Delta H_m = \Delta V_m = 1$

55. The liquid pair benzene-toluene shows
(A) Irregular deviation from Raoult's law
(B) Negative deviation from Raoult's law
(C) Positive deviation from Raoult's law
(D) Practically no deviation from Raoult's law

Azeotropic mixture

56. The azeotropic mixture of water $(b.p.100^oC)$ and $HCl\,(b.p.85^oC)$ boils at 108.5^oC. When this mixture is distilled it is possible to obtain
(A) Pure HCl
(B) Pure water
(C) Pure water as well as pure HCl
(D) Neither HCl nor H_2O in their pure states

57. An azeotropic solution of two liquids has boiling point lower than either when it
(A) Shows a negative deviation from Raoult's law
(B) Shows no deviation from Raoult's law
(C) Shows positive deviation from Raoult's law
(D) Is saturated

58. A liquid mixture boils without changing constituent is called
(A) Stable structure complex
(B) Binary liquid mixture
(C) Zeotropic liquid mixture
(D) Azeotropic liquid mixture

59. Azeotropic mixture are
(A) Constant temperature boiling mixtures
(B) Those which boils at different temperatures
(C) Mixture of two solids
(D) None of the above

60. A mixture of two completely miscible non-ideal liquids which distil as such without change in its composition at a constant temperature as though it were a pure liquid. This mixture is known as
(A) Binary liquid mixture
(B) Azeotropic mixture
(C) Eutectic mixture
(D) Ideal mixture

Osmosis and Osmotic pressure of the solution

61. If 20 g of a solute was dissolved in 500 ml of water and osmotic pressure of the solution was found to be 600 mm of Hg at 15^oC, then molecular weight of the solute is
(A) 1000 (B) 1200
(C) 1400 (D) 1800

62. The osmotic pressure of 0.4% urea solution is 1.66 atm and. that of a solution of suger of 3.42 % is 2.46 atm. When both the solution are mixed then the osmotic pressure of the resultant solution will be
(A) 1.64 atm (B) 2.46 atm
(C) 2.06 atm (D) 0.82 atm

63. Blood is isotonic with
(A) 0.16 M $NaCl$ (B) Conc. $NaCl$
(C) 50 % $NaCl$ (D) 30 % $NaCl$

64. Which inorganic precipitate acts as semipermeable membrane **or** The chemical composition of semipermeable membrane is
(A) Calcium sulphate
(B) Barium oxalate
(C) Nickel phosphate
(D) Copper ferrocyanide

65. The osmotic pressure of $1m$ solution at 27^oC is
(A) 2.46 atm (B) 24.6 atm
(C) 1.21 atm (D) 12.1 atm

66. Osmotic pressure of a solution can be measured quickly and accurately by
(A) Berkeley and Hartley's method
(B) Morse's method
(C) Pfeffer's method
(D) De Vries method

67. The solution in which the blood cells retain their normal form are with regard to the blood
(A) Isotonic (B) Isomotic
(C) Hypertonic (D) Equinormal

68. The osmotic pressure of a solution is given by the relation

(A) $P = \frac{RT}{C}$ (B) $P = \frac{CT}{R}$

(C) $P = \frac{RC}{T}$ (D) $\frac{P}{C} = RT$

69. The osmotic pressure of a solution is directly proportional to

(A) The molecular concentration of solute

(B) The absolute temperature at a given concentration

(C) The lowering of vapour pressure

(D) All of the above

70. What would happen if a thin slice of sugar beet is placed in a concentrated solution of $NaCl$

(A) Sugar beet will lose water from its cells

(B) Sugar beet will absorb water from solution

(C) Sugar beet will neither absorb nor lose water

(D) Sugar beet will dissolve in solution

Elevation of boiling boint of the solvent

71. The molal elevation constant is the ratio of the elevation in B.P. to

(A) Molarity

(B) Molality

(C) Mole fraction of solute

(D) Mole fraction of solvent

72. The molal boiling point constant for water is $0.513^{o}C\,kg\,mol^{-1}$. When 0.1 mole of sugar is dissolved in $200ml$ of water, the solution boils under a pressure of one atmosphere at

(A) $100.513^{o}C$ (B) $100.0513^{o}C$

(C) $100.256^{o}C$ (D) $101.025^{o}C$

73. Value of gas constant R is

(A) 0.082 *litre atm*

(B) 0.987 $cal\ mol^{-1}K^{-1}$

(C) 8.3 $J\ mol^{-1}K^{-1}$

(D) 83 $erg\ mol^{-1}K^{-1}$

74. The temperature, at which the vapour pressure of a liquid becomes equal to the atmospheric pressure is known as

(A) Freezing point

(B) Boiling point

(C) Absolute temperature

(D) None of these

75. The elevation in boiling point of a solution of $13.44g$ of $CuCl_2$ in $1kg$ of water using the following information will be

(Molecular weight of $CuCl_2$ = 134.4 and K_b = 0.52 $K\,molal^{-1}$)

(A) 0.16 (B) 0.05

(C) 0.1 (D) 0.2

Depression of freezing point of the solvent

76. Given that ΔT_f is the depression in freezing point of the solvent in a solution of a non-volatile solute of molality m, the quantity $\lim_{m\to 0}\left(\frac{\Delta T_f}{m}\right)$ is equal to

(A) Zero (B) One

(C) Three (D) None of the above

77. The freezing point of 1 percent solution of lead nitrate in water will be

(A) Below $0^{o}C$ (B) $0^{o}C$

(C) $1^{o}C$ (D) $2^{o}C$

78. What is the effect of the addition of sugar on the boiling and freezing points of water

(A) Both boiling point and freezing point increases

(B) Both boiling point and freezing point decreases

(C) Boiling point increases and freezing point decreases

(D) Boiling point decreases and freezing point increases

79. During depression of freezing point in a solution the following are in equilibrium
(A) Liquid solvent, solid solvent
(B) Liquid solvent, solid solute
(C) Liquid solute, solid solute
(D) Liquid solute solid solvent

80. 1.00 *gm* of a non-electrolyte solute dissolved in 50 *gm* of benzene lowered the freezing point of benzene by 0.40 *K*. K_f for benzene is 5.12 $kg\ \ mol^{-1}$. Molecular mass of the solute will be
(A) $256\,g\,mol^{-1}$ (B) $2.56\,g\,mol^{-1}$
(C) $512\times10^{3}\,g\,mol^{-1}$ (D) $2.56\times10^{4}\,g\,mol^{-1}$

81. 0.440 *g* of a substance dissolved in 22.2 *g* of benzene lowered the freezing point of benzene by $0.567^{o}C$. The molecular mass of the substance $(K_f = 5.12^{o}C\,mol^{-1})$
(A) 178.9 (B) 177.8
(C) 176.7 (D) 175.6

82. Which of the following aqueous molal solution have highest freezing point
(A) Urea
(B) Barium chloride
(C) Potassium bromide
(D) Aluminium sulphate

83. Which will show maximum depression in freezing point when concentration is 0.1*M*
(A) *NaCl* (B) Urea
(C) Glucose (D) K_2SO_4

84. The freezing point of a 0.01*M* aqueous glucose solution at 1 atmosphere is $-0.18^{o}C$. To it, an addition of equal volume of 0.002 *M* glucose solution will; produce a solution with freezing point of nearly
(A) $-0.036^{o}C$ (B) $-0.108^{o}C$
(C) $-0.216^{o}C$ (D) $-0.422^{o}C$

85. What should be the freezing point of aqueous solution containing 17 *gm* of C_2H_5OH in 1000 *gm* of water (water $K_f = 1.86\ \text{deg}-kg\,mol^{-1}$
(A) $-0.69^{o}C$ (B) $-0.34^{o}C$
(C) $0.0^{o}C$ (D) $0.34^{o}C$

Colligative properties of electrolyte

86. Which of the following will have the highest boiling point at 1 *atm* pressure
(A) 0.1*M NaCl* (B) 0.1*M* sucrose
(C) 0.1*M* $BaCl_2$ (D) 0.1*M* glucose

87. Which one of the following would produce maximum elevation in boiling point
(A) 0.1 M glucose
(B) 0.2 M sucrose
(C) 0.1 M barium chloride
(D) 0.1 M magnesium sulphate

88. Which of the following solutions will have the highest boiling point
(A) 1% glucose (B) 1% sucrose
(C) 1% *NaCl* (D) 1% $CaCl_2$

89. Which one of the following aqueous solutions will exhibit highest boiling point
(A) 0.015 M urea (B) 0.01*M* KNO_3
(C) 0.01*M* Na_2SO_4 (D) 0.015*M* glucose

90. Which of the following aqueous solutions containing 10 gm of solute in each case has highest B.P.
(A) *NaCl* solution (B) *KCl* solution
(C) Sugar solution (D) Glucose solution

91. 0.01 molar solutions of glucose, phenol and potassium chloride were prepared in water. The boiling points of
(A) Glucose solution = Phenol solution = Potassium chloride solution
(B) Potassium chloride solution > Glucose solution > Phenol solution
(C) Phenol solution > Potassium chloride solution > Glucose solution
(D) Potassium chloride solution > Phenol solution > Glucose solution

92. Which one has the highest boiling point
(A) 0.1*N* Na_2SO_4 (B) 0.1*N* $MgSO_4$
(C) 0.1*M* $Al_2(SO_4)_3$ (D) 0.1*M* $BaSO_4$

93. Which of the following solutions boils at the highest temperature

(A) 0.1 *M* glucose (B) 0.1 *M NaCl*

(C) 0.1 *M* $BaCl_2$ (D) 0.1 *M* Urea

94. 0.01*M* solution each of urea, common salt and Na_2SO_4 are taken, the ratio of depression of freezing point is

(A) 1 : 1 : 1 (B) 1 : 2 : 1

(C) 1 : 2 : 3 (D) 2 : 2 : 3

95. Which has the minimum freezing point

(A) One molal *NaCl* solution

(B) One molal *KCl* solution

(C) One molal $CaCl_2$ solution

(D) One molal urea solution

Abnormal molecular mass

96. The Van't Hoff factor i for a 0.2 molal aqueous solution of urea is

(A) 0.2 (B) 0.1

(C) 1.2 (D) 1.0

97. One mole of a solute A is dissolved in a given volume of a solvent. The association of the solute take place according to $nA \rightleftarrows (A)_n$. The Van't Hoff factor i is expressed as

(A) $i = 1 - x$ (B) $i = 1 + \frac{x}{n}$

(C) $i = \frac{1 - x + \frac{x}{n}}{1}$ (D) $i = 1$

98. Acetic acid dissolved in benzene shows a molecular weight of

(A) 60 (B) 120

(C) 180 (D) 240

99. The observed osmotic pressure of a solution of benzoic acid in benzene is less than its expected value because

(A) Benzene is a non-polar solvent

(B) Benzoic acid molecules are associated in benzene

(C) Benzoic acid molecules are dissociated in benzene

(D) Benzoic acid is an organic compound

100. The experimental molecular weight of an electrolyte will always be less than its calculated value because the value of Van't Hoff factor "*i*" is

(A) Less than 1 (B) Greater than 1

(C) Equivalent to one (D) Zero