CHAPTER 12
SAMPLE QUESTIONS

K_{fp} of water is 1.86 ºC/m; the K_{bp} is 0.512 ºC/m; and R is 0.082 l atm/mol K

1. Liquid **Q** is a polar solvent and liquid **R** is a nonpolar solvent. On the basis of this information you would expect

(A)   both liquids to be miscible with a third liquid **T**.   (B)   liquid **Q** and H_2O to be miscible.
(C)   liquid **Q** to be miscible with liquid **R**.   (D)   NaCl to be soluble in both **Q** and **R**.
(E) CCl_4 to be immiscible with both **Q** and **R**.

2. Which of the following would you expect to be the most soluble in hexane $[C_6H_{12}]$?

(A)   NaCl   (B)   ethanol   (C) CH_2Cl_2 (D) C_6H_6 (E)   water

3. Which substance is most soluble in water?

(A) C_6H_6 (B) $CaCO_3$ (C) C_2H_5OH (D) CO_2

4. When two pure substances are mixed to form a solution, which of the following is always true?

(A)   heat is released   (B)   heat is absorbed
(C)   there is an increase in entropy   (D)   there is a decrease in entropy

5. The solubility of potassium permanganate ($KMnO_4$) is 7.1 g per 100.0 g of water at 25 °C. What is the mole fraction of potassium permanganate in such a solution?

(A)   0.00803   (B)   0.00863   (C)   0.449   (D)   0.474   (E)   7.1

6. What is the mole fraction of water in 200. g of 95% (by mass) ethanol, C_2H_5OH?

(A)   0.050   (B)   0.12   (C)   0.56   (D)   0.88

7. If 100 g of NaCl is dissolved in 1000 g of water, what is the mole fraction of NaCl?

(A)   0.031   (B)   0.31   (C)   1.71   (D)   0.095   (E)   0.17

8. What mass of water is needed to dissolve 292.5 g of NaCl to produce a 0.25 m solution?

(A)   20 kg   (B)   5.0 kg   (C)   0.80 kg   (D)   0.050 kg

9. If 0.400 g of a substance **R** (molar mass = 80 g/mol) is dissolved in 100 g of liquid **Q**, what is the molality of the solution?

(A) $4.00 \times 10^{-3}\ m$ (B) $5.00 \times 10^{-2}\ m$ (C) $5.00 \times 10^{-3}\ m$ (D) $4.00 \times 10^{-1}\ m$

10. Cadmium bromide is used in photography. Calculate the molality of a solution prepared by dissolving 45.38 g of $CdBr_2$ in 375.0 mL of water (Hint: density of water = 1 g/mL)

(A) 0.0304 m   (B) 0.016 m   (C) 0.1210 m   (D) 0.0004445 m   (E)   0.445 m

11. Potassium fluoride is used for frosting glass. Calculate the molarity of a solution prepared by dissolving 78.6 g KF in enough water to produce 225 mL of solution.

(A) 0.304 M   (B) 0.349 M   (C) 3.29 M   (D) 0.00601 M   (E)   6.01 M

12. Calculate the molarity of a 9.5% by mass solution of potassium nitrate that has a density of 1.055 g/mol.

(A)   0.095 M   (B)   10.0 M   (C)   0.992 M   (D)   0.891 M

13. When sugar is dissolved in water, the resulting solution compared to pure water

(A)   has a higher boiling point   (B)   has a higher freezing point
(C)   has a higher vapor pressure   (D)   has a lower osmotic pressure

14. The addition of a non-volatile solute to water will always

(A)   increase the boiling point.   (B)   increase the freezing point.
(C)   increase the temperature of the solution.
(D)   increase the vapor pressure at a specific temperature.
(E)   increase the total volume relative to the sum of the volumes of the components.

15. Which of the following aqueous solutions would have the lowest total vapor pressure at 25 °C?

(A)   3 M NaOH   (B)   3 M NH_3 (C)   3 M $CaCl_2$ (D)   3 M ethanol

16. A 0.1 M aqueous solution is made of each of the substances listed. Which would have the lowest freezing point?

(A) K_2SO_4 (B) Na_3PO_4 (C) $CaCl_2$ (D)   NaCl

17. Which aqueous solution has the *smallest* freezing point depression?

(A)   0.2 *m* $Ca(NO_3)_2$ (C)   0.2 *m* $MgSO_4$
(B)   0.2 *m* CH_3OH (D)   0.2 *m* K_3PO_4

18. Which of the following aqueous solutions will have the lowest freezing point?

(A)   0.75 M $(NH_4)_3PO_4$ (B)   1.0 M $CaSO_4$ (C)   1.0 M $LiClO_4$
(D)   1.5 M CH_3OH (E)   1.25 M NaCl

19. Which of the following compounds would give the lowest melting point for a one molal solution in water?

(A) $AlCl_3$ (B) $CaCl_2$ (C) NaCl   (D) $Al_2(SO_4)_3$ (E)   glucose

20.   If we have three different solutions, **A**, **B**, and **C**, each containing 100 g of water, plus respectively 34.2 g of sucrose ($C_{12}H_{22}O_{11}$), 4.6 g of ethanol (C_2H_5OH), and 4.0 g of sodium hydroxide, which statement is true?

(A)   **A**, **B**, and **C** will all have the same freezing points.
(B)   **A** and **C** have the same boiling point, but **B** has a lower one.
(C)   **C** has the lowest freezing point in the group.
(D)   **A**, **B**, and **C** all have different freezing points.
(E)   The boiling point of **C** is lower than that of **A** or **B**.

21.   Of two solutions of nonelectrolytes, one containing 100 g of methanol (CH_3OH) in 1000 g of water and the other 100 g of glycerine ($C_3H_5(OH)_3$) in 1000 g of water, which will have the lower freezing point?

(A)   the methanol solution   (B)   the glycerine solution
(C)   Both will freeze at the same temperature, which is below 0 °C.
(D)   It is impossible to predict.
(E)   Both will freeze at 0 °C because only ionic solutes affect the freezing point.

22.   800 g of ethanol (C_2H_5OH) was added to 8000 g of water. How much would this lower the freezing point?

(A)   3.2 °C   (B)   4.1 °C   (C)   8.2 °C   (D)   16 °C   (E)   32 °C

23.   The freezing point of ethanol is –114.6 °C and the K_{fp} value is 2.00 m/°C. What is the freezing point (in °C) of a solution prepared by dissolving 50.0 g of glycerine ($C_3H_8O_3$) in 200 g of ethanol?

(A)   -115   (B)   -5.4   (C)   -132   (D)   -120   (E)   -114.6

24.   Carbon tetrachloride (CCl_4) has a boiling point of 76.7 °C and a K_{bp} of 5.05 °C/m. Calculate the boiling point of a solution prepared by dissolving 375 g of sulfur (S_8) in 1250 g of CCl_4.

(A) 70.8 °C   (B)   72.3 °C   (C)   78.2 °C   (D)   82.6 °C   (E)   76.7 °C

25.   A 3.0% solution of a non-electrolyte in water freezes at –2.20 °C. What is the molality of the solution?

(A)   1.18 m (B)   3.55 m (C)   0.85 m
(D)   can't be calculated without knowing what the solute is

26.   A solution is prepared by dissolving 65.0 g of an unknown solute in 375 g of ethanol. The solution boils at 80.3 °C. Calculate the molar mass (in g/mol) of the unknown given that ethanol boils at 78.5 °C and has a K_{bp} of 1.22 °C/m.

(A)   44.1   (B)   65/8   (C)   117   (D)   553   (E)   0.553

27.   A 2.00 g sample of a non-electrolyte is dissolved in 100 g H_2O. If the resulting solution freezes at –0.186 °C, what is the molar mass of the compound in g/mol?

(A)   18.6   (B)   20.0   (C)   186   (D)   200

28.   A cellophane bag, which acts as a membrane permeable only to water, contains a 2 M sugar solution. The bag is immersed in a 1 M sugar solution. What will happen?

(A)   The bag will soon contain more solution that will be are concentrated than 2 M.
(B)   The bag will soon contain more solution that will be less concentrated than 2 M.
(C)   The bag will lose sugar and the solution in it will become less concentrated.
(D)   The bag will lose water and the solution in it will become more concentrated.
(E)   There will be no change.

29.   Human blood has a concentration of solutes of 0.30 M. What is the osmotic pressure of blood at 25 °C?

(A)   0.012 atm   (B)   0.62 atm   (C)   6.8 torr   (D)   6.8 atm   (E) 7.3 atm

30.   Lysine is an amino acid. 8.60 g of lysine was dissolved in enough water to produce 750 mL of solution. If this solution has an osmotic pressure of 1.918 atm at 25 °C, what is the molar mass of lysine in g/mol?

(A)   0.146   (B)   110   (C)   146   (D)   1340   (E)   1780

31.   A solution is prepared by dissolving 6.00 g of a nonelectrolyte in enough water to make 1.0 L of solution. The osmotic pressure of the solution is 570 torr at 25.0 deg C. What is the molecular weight of the solute?

(A)   16.4   (B)   196   (C)   110   (D)   30.6

32.   A solution is prepared by dissolving 0.600 g of nicotine in enough water to make 12 mL of solution. The osmotic pressure of the solution is 7.55 atm at 25.0 deg C. What is the molecular weight of nicotine?

(A)   28   (B)   43   (C)   50   (D)   160

ANSWERS: B D C C A | B A A B E | E C A A C | B B A D C | A B D D A | C D B E C | B D