

**Chem 112****Solutions**

From the book (10, 12, 16, 18, 22, 24 52, 54, 56, 58, 62, 64, 66, 68, 74, 76, 78, 80, 82, 86, 88, 90, 92, 106 and 116)

1. Which of the following compounds are *nonelectrolytes*?

- A. NaF                      B. HNO<sub>3</sub>              C. CH<sub>3</sub>COOH (acetic acid)      D. C<sub>2</sub>H<sub>6</sub>O (ethanol)  
E. NaOH                      F. C<sub>6</sub>H<sub>12</sub>O<sub>6</sub> (glucose)

2. Which one of the following would be immiscible with water?

- A.  $\begin{array}{c} \text{H}_2\text{C} - \text{CH}_2 \\ / \quad \backslash \\ \text{O} \quad \text{O} \\ \backslash \quad / \\ \text{H}_2\text{C} - \text{CH}_2 \end{array}$                       B. C<sub>2</sub>H<sub>5</sub> - OH
- C.  $\begin{array}{c} \text{O} \\ || \\ \text{CH}_3 - \text{S} - \text{CH}_3 \end{array}$                       D. S = C = S                      E. NH<sub>3</sub>

3. Which response lists all the following pairs that are miscible liquids.

- Pair # 1. octane (C<sub>8</sub>H<sub>18</sub>) and water  
Pair # 2. acetic acid (CH<sub>3</sub>COOH) and water  
Pair # 3. octane (C<sub>8</sub>H<sub>18</sub>) and carbon tetrachloride(CCl<sub>4</sub>)

4. Which of the following liquids would make a good solvent for iodine, I<sub>2</sub>?

- A. HCl              B. H<sub>2</sub>O              C. CH<sub>3</sub>OH              D. NH<sub>3</sub>              E. CS<sub>2</sub>

5. Which of the following compounds should be soluble in CCl<sub>4</sub>?

- A. NaCl              B. H<sub>2</sub>O              C. NaOH              D. C<sub>8</sub>H<sub>18</sub>              E. None of these

6. What mass of K<sub>2</sub>CO<sub>3</sub> is needed to prepare 200. mL of a solution having a potassium ion concentration of 0.150 M?

7. Consider a 0.90 M Al(NO<sub>3</sub>)<sub>3</sub> solution. What is the nitrate ion concentration?

8. What mass of Na<sub>2</sub>SO<sub>4</sub> is needed to prepare 350. mL of a solution having a sodium ion concentration of 0.125 M?

9. What is the approximate Na<sup>+</sup> ion concentration in a 0.75 M Na<sub>2</sub>CO<sub>3</sub> solution?

10. A 50.0 mL sample of 0.436 M  $\text{NH}_4\text{NO}_3$  is diluted with water to a total volume of 250.0 mL. What is the ammonium nitrate concentration in the resulting solution?
11. How many milliliters of 18.4 M  $\text{H}_2\text{SO}_4$  are needed to prepare 600. mL of 0.10 M  $\text{H}_2\text{SO}_4$ ?
12. When 110. mL of 0.125 M HCl is diluted to 250. mL, What is the molarity of the resulting HCl solution is?
13. A 20.00 mL sample of 0.1015 M nitric acid is introduced into a flask, and water is added until the volume of the solution reaches 250. mL. What is the concentration of nitric acid in the final solution?
14. A 3.682 g sample of  $\text{KClO}_3$  is dissolved in enough water to give 375. mL of solution. What is the total ion concentration in this solution?
15. A 4.691 g sample of  $\text{MgCl}_2$  is dissolved in enough water to give 750. mL of solution. What is the total ion concentration in this solution?
16. Plasma is the fluid portion of blood. The concentration of acetylsalicylic acid (aspirin,  $\text{C}_9\text{H}_8\text{O}_4$ , molar mass = 180. g/mol) in your plasma is found to be  $2.99 \times 10^{-4}$  M after you take two tablets of aspirin. If the volume of your plasma is 5.85 L,
- how many grams of aspirin are in your blood?
  - what is the molality,  $m$ , of aspirin in your blood? (Assume density of plasma is 1.00 g/mL.)
17. If 145 grams of potassium nitrate were added to water to make 1,500 mL of solution, what would be the molarity of the resulting solution?
18. How many grams of water are needed to dissolve 27.8 g of ammonium nitrate  $\text{NH}_4\text{NO}_3$  in order to prepare a 0.452 m solution?
19. In how many grams of water should 25.31 g of potassium nitrate ( $\text{KNO}_3$ ) be dissolved to prepare a 0.1982 m solution?
20. Calculate the molality of a solution containing 14.3 g of NaCl in 42.2 g of water.
21. What is the molarity of a 17.0% by mass solution of sodium acetate,  $\text{CH}_3\text{COONa}$  (molar mass = 82.0 g/mol) in water? The density of the solution is 1.09 g/mL.
22. A solution contains 12.0 g of hexane ( $\text{C}_6\text{H}_{14}$ ), 20.0g of octane ( $\text{C}_8\text{H}_{18}$ ) and 98.0 g of benzene ( $\text{C}_6\text{H}_6$ ) what is the mole fraction of benzene in the solution?

23. What is the mole fraction of nitrous oxide ( $\text{N}_2\text{O}$ ) in an aqueous 0.020 molal solution?
24. A water solution of sodium hypochlorite ( $\text{NaOCl}$ ) is used as a laundry bleach. The concentration of sodium hypochlorite is 0.75 m. Express this concentration as mole fraction.
25. What is the molarity of a solution of 10% by mass cadmium sulfate,  $\text{CdSO}_4$  (molar mass = 208.46 g/mol) by mass? The density of the solution is 1.10 g/mL.
26. Calculate the molality of a 20.0% by mass ammonium sulfate ( $(\text{NH}_4)_2\text{SO}_4$ ) solution. The density of the solution is 1.117 g/mL.
27. Calculate the molality of 6.0 M  $\text{H}_2\text{SO}_4$  solution. The density of the solution is 1.34 g/mL.
28. What is the percent  $\text{CdSO}_4$  by mass in a 1.0 molal aqueous  $\text{CdSO}_4$  solution?
29. Given a 0.711 M  $\text{CsCl}$  solution that has a density of 1.091 g/mL? What is the
- A. Mole Fraction \_\_\_\_\_
  - B. Molality \_\_\_\_\_
  - C. Mass Percent \_\_\_\_\_
30. Given 45.0 g  $\text{KNO}_3$  and 295 g of water. The density of the solution is 0.997 g/mL. What is the
- A. Mole Fraction \_\_\_\_\_
  - B. Mass Percent \_\_\_\_\_
  - C. Molarity \_\_\_\_\_
  - D. Molality \_\_\_\_\_
31. The density of a 20.3 M  $\text{CH}_3\text{OH}$  (methanol) solution in water is 0.858 g/mL. What is the
- A. Mole Fraction \_\_\_\_\_
  - B. Mass Percent \_\_\_\_\_
  - C. Molality \_\_\_\_\_
32. Given a 15.0% by mass solution of  $\text{MgCl}_2$  in  $\text{H}_2\text{O}$  with a density of 1.127 g/mL. What is the
- A. Mole Fraction \_\_\_\_\_
  - B. Molality \_\_\_\_\_
  - C. Molarity \_\_\_\_\_

33. The solubility of nitrogen gas at 25°C and a nitrogen pressure of 522 mmHg is  $4.7 \times 10^{-4}$  mol/L. What is the value of the Henry's Law constant in mol/L-atm?
34. The solubility of oxygen in lakes high in the Rocky Mountains is affected by the altitude. If the solubility of O<sub>2</sub> from the air is  $2.67 \times 10^{-4}$  M at sea level and 25°C, what is the solubility of O<sub>2</sub> at an elevation of 12,000 ft where the atmospheric pressure is 0.657 atm? Assume the temperature is 25°C, and that the mole fraction of O<sub>2</sub> in air is 0.209 at both 12,000 ft and at sea level.
35. At 10°C one volume of water dissolves 3.10 volumes of chlorine gas at 1.00 atm pressure. What is the Henry's Law constant in mol/L-atm?
36. According to Raoult's law, which statement is *false*?
- A. The vapor pressure of a solvent over a solution decreases as its mole fraction increases.
  - B. The solubility of a gas increases as the temperature decreases.
  - C. The vapor pressure of a solvent over a solution is less than that of pure solvent.
  - D. The greater the pressure of a gas over a solution the greater its solubility.
  - E. Ionic solutes dissociate in solution causing an enhancement of all colligative properties.
37. The vapor pressure of water at 20°C is 17.5 mmHg. What is the vapor pressure of water over a solution prepared from  $2.00 \times 10^2$  g of sucrose (C<sub>12</sub>H<sub>22</sub>O<sub>11</sub>) and  $3.50 \times 10^2$  g water?
38. Dissolving a solute such as KOH in a solvent such as water results in
- A. an increase in the melting point of the liquid.
  - B. a decrease in the boiling point of the liquid.
  - C. a decrease in the vapor pressure of the liquid.
  - D. no change in the boiling point of the liquid.
39. What is the freezing point of a solution that contains 10.0 g of glucose (C<sub>6</sub>H<sub>12</sub>O<sub>6</sub>) in 100. g of H<sub>2</sub>O? K<sub>f</sub> for water is 1.86°C/m.
40. Calculate the freezing point of a solution made from 22.0 g of octane (C<sub>8</sub>H<sub>18</sub>) dissolved in 148.0 g of benzene. Benzene freezes at 5.50°C and its K<sub>f</sub> value is 5.12°C/m.
41. Which of the following aqueous solutions has the highest boiling point? K<sub>b</sub> for water is 0.52°C/m.
- A. 0.2 m KCl
  - B. 0.2 m Na<sub>2</sub>SO<sub>4</sub>
  - C. 0.2 m Ca(NO<sub>3</sub>)<sub>2</sub>
42. Which of the following aqueous solutions has the highest osmotic pressure at 25°C?
- A. 0.2 M KBr
  - B. 0.2 M ethanol
  - C. 0.2 M Na<sub>2</sub>SO<sub>4</sub>
  - D. 0.2 M KCl

43. During osmosis
- pure solvent diffuses through a membrane but solutes do not.
  - pure solutes diffuse through a membrane but solvent does not.
  - pure solvent and a solution both diffuse at the same time through a membrane.
  - gases diffuse through a membrane into a solution and build up pressure.
44. Calculate the approximate freezing point of a solution made from 21.0 g NaCl and  $1.00 \times 10^2$  g of  $H_2O$ .  $K_f$  of water is  $1.86^\circ C/m$ .
45. A solution that contains 55.0 g of ascorbic acid (Vitamin C) in 250. g of water freezes at  $-2.34^\circ C$ . Calculate the molar mass (in units of g/mol) of the solute.  $K_f$  of water is  $1.86^\circ C/m$ .
46. What is the osmotic pressure of a solution that contains 13.7 g of propyl alcohol ( $C_3H_7OH$ ) dissolved in enough water to make 500. mL of solution at  $27^\circ C$ ?
47. What is the osmotic pressure of a solution prepared from 13.7 g of the electrolyte HCl and enough water to make 0.500 L of solution at  $18^\circ C$ ?
48. Which of the following aqueous solutions has the lowest freezing point? .
- A. 0.18 m KCl      B. 0.15 m  $Na_2SO_4$       C. 0.12 m  $Ca(NO_3)_2$       D. pure water  
 E. 0.20 m  $C_2H_6O_2$  (ethylene glycol)

Answers:

- |  |                             |                          |
|--|-----------------------------|--------------------------|
| 1. D and F                                     | 2. D                        | 3. Pairs 2 and 3         |
| 4. E   | 5. D                        | 6. 2.07 g                |
| 7. 2.7 M                                       | 8. 3.11 g                   | 9. 1.50 M                |
| 10. $8.72 \times 10^{-2}$ M                    | 11. 3.3 mL                  | 12. 0.055 M              |
| 13. $8.12 \times 10^{-3}$ M                    | 14. 0.160 M                 | 15. 0.197 M              |
| 16. a. 0.315 g      b. $2.99 \times 10^{-4}$ m |                             | 17. 0.956 M              |
| 18. 769 g                                      | 19. 1,263 g                 | 20. 5.80 m               |
| 21. 2.26 M                                     | 22. 0.800                   | 23. $3.6 \times 10^{-4}$ |
| 24. 0.0130                                     | 25. 0.528 M                 | 26. 1.89 m               |
| 27. 7.98 m                                     | 28. 17.2 %                  | 29. A 0.0130             |
| B. 0.732 m                                     | C. 11.0 %                   | 30. A. 0.266             |
| B. 13.2 %                                      | C. 1.51 m                   | D. 1.30 M                |
| 31. A. 0.668                                   | B. 75.7%                    | C. 112 m                 |
| 32. 0.0322                                     | B. 1.85 m                   | C. 1.77 M                |
| 33. $6.8 \times 10^{-4}$ mol/L·atm             | 34. $1.75 \times 10^{-4}$ M | 35. 0.13 mol/L·atm       |
| 36. A  | 37. 17.0 mmHg               | 38. C                    |
| 39. $-1.03^\circ C$                            | 40. $-1.16^\circ C$         | 41. B and C              |
| 42. C  | 43. C                       | 44. $-13.4^\circ C$      |
| 45. 175 g/ mol                                 | 46. 11.2 atm                | 47. 35.9 atm             |
| 48. B  |                             |                          |