

Name:
College ID:
Thomas Edison State University
General Chemistry II with Labs (CHE-122)
Section no.:
Semester and year:

Written Assignment 2: Physical Properties of Solutions

Answer all assigned questions and problems, and show all work.

1. Arrange the following compounds in order of increasing solubility in water: O_2 , $LiCl$, Br_2 , CH_3OH (methanol) (4 points)

(Reference: Chang 12.11)

2. Calculate the percent by mass of the solute in each of the following aqueous solutions:
(12 points)

- a. 5.50 g of $NaBr$ in 78.2 g of solution
- b. 31.0 g of KCl in 152 g of water
- c. 4.5 g of toluene in 29 g of benzene

(Reference: Chang 12.15)

3. Calculate the molality of each of the following solutions: (8 points)

 - a. 14.3 g of sucrose ($C_{12}H_{22}O_{11}$) in 676 g of water
 - b. 7.20 moles of ethylene glycol ($C_2H_6O_2$) in 3546 g of water

(Reference: Chang 12.17)

4. Calculate the molalities of the following aqueous solutions: (12 points)

 - a. 1.22 M sugar ($C_{12}H_{22}O_{11}$) solution (density of solution = 1.12 g/mL)
 - b. 0.87 M $NaOH$ solution (density of solution = 1.04 g/mL)

c. 5.24 M NaHCO_3 solution (density of solution = 1.19 g/mL)

(Reference: Chang 12.19)

5. The alcohol content of hard liquor is normally given in terms of the “proof,” which is defined as twice the percentage by volume of ethanol (CH_3OH) present. Calculate the number of grams of alcohol present in 1.00 L of 75-proof gin. The density of ethanol is 0.798 g/mL. (4 points)

(Reference: Chang 12.21)

6. Calculate the molarity and the molality of an NH_3 solution made up of 30.0 g of NH_3 in 70.0 g of water. The density of the solution is 0.982 g/mL. (8 points)

(Reference: Chang 12.23)

7. Concentrated nitric acid (HNO_3) has a density of 1.42 g/mL and is 70.0% nitric acid. Calculate the molarity of the acid if 30.0 mL of the concentrated acid is mixed with 255 mL of water. (5 points)

8. A 3.20 g sample of a salt dissolves in 9.10 g of water to give a saturated solution at 25°C.

- What is the solubility (in g salt/100 g of water) of the salt? (2 points)
- How much water would it take to dissolve 25 g of this salt? (2 points)
- If 10.0 g of this salt is mixed with 15.0 g of water, what percentage of the salt dissolves? (2 points)

(Reference: Chang 12.27)

9. A man bought a goldfish in a pet shop. Upon returning home, he put the goldfish in a bowl of recently boiled water that had been cooled quickly. A few minutes later the fish was found dead. Explain what happened to the fish. (3 points)

(Reference: Chang 12.34)

10. What are the boiling point and freezing point of a 2.47 *m* solution of naphthalene in benzene? (The boiling point and freezing point of benzene are 80.1°C and 5.5°C, respectively.) $K_b = 2.53\text{ }^{\circ}\text{C}/m$; $K_f = 5.12\text{ }^{\circ}\text{C}/m$ (6 points)

(Reference: Chang 12.55)

11. Pheromones are compounds secreted by the females of many insect species to attract males. One of these compounds contains 80.78 percent carbon, 13.56 percent hydrogen, and 5.66 percent oxygen. A solution of 1.00 g of this pheromone in 8.50 g of benzene freezes at 3.37°C. What are the molecular formula and molar mass of the compound? (The normal freezing point of pure benzene is 5.50°C.) $K_f = 5.12\text{ }^{\circ}\text{C}/m$ (10 points)

(Reference: Chang 12.57)

12. How many liters of the antifreeze ethylene glycol [$\text{CH}_2(\text{OH})\text{CH}_2(\text{OH})$] would you add to a car radiator containing 6.50 L of water if the coldest winter temperature in your area is -20°C ? Calculate the boiling point of this water-ethylene glycol mixture. (The density of ethylene glycol is 1.11 g/mL.) $K_f = 1.86\text{ }^{\circ}\text{C}/m$ (8 points)

(Reference: Chang 12.59)

13. What is the osmotic pressure (in atm) of a 1.36 M aqueous solution of urea [$(\text{NH}_2)_2\text{CO}$] at 22.0°C? (3 points)

(Reference: Chang 12.63)

14. A quantity of 7.480 g of an organic compound is dissolved in water to make 300.0 mL of solution. The solution has an osmotic pressure of 1.43 atm at 27°C. The analysis of this compound shows that it contains 41.8 percent C, 4.7 percent H, 37.3 percent O, and 16.3 percent N. Calculate the molecular formula of the compound. (6 points)

(Reference: Chang 12.65)

15. Arrange the following solutions in order of decreasing freezing point: 0.10 *m* Na₃PO₄, 0.35 *m* NaCl, 0.20 *m* MgCl₂, 0.15 *m* C₆H₁₂O₆, 0.15 *m* CH₃COOH. (5 points)

(Reference: Chang 12.71)