

1. Give an example of each of the following types of solutions:
 - (a) a gas in a liquid
 - (b) a gas in a gas
 - (c) a solid in a solid
2. Indicate the most important types of intermolecular attractions in each of the following solutions:
 - (a) $\text{NO}(l)$ in $\text{CO}(l)$
 - (b) $\text{Cl}_2(g)$ in $\text{Br}_2(l)$
 - (c) $\text{HCl}(aq)$ in benzene $\text{C}_6\text{H}_6(l)$
 - (d) Methanol $\text{CH}_3\text{OH}(l)$ in $\text{H}_2\text{O}(l)$
3. Heat is released when some solutions form; heat is absorbed when other solutions form. Provide a molecular explanation for the difference between these two types of spontaneous processes.
4. Ethylene glycol ($\text{HOCH}_2\text{CH}_2\text{OH}$) is miscible in water in all proportions. Explain why.
5. Methanol not soluble in hexane, but heptanol is soluble. Why? Look up the structures and determine the intermolecular forces for all three molecules. Draw the structures and show how each would interact.)

6. Which of the following pairs is more likely to be soluble in water **and Why?** (list the intermolecular forces involved)
- a) HBr or I₂
 - b) CHCl₃ or NaCl
 - c) (CH₃)₃N or NH₃
 - d) He or Nitrogen (N₂)
7. 125 g of NaCl is dissolved in 750. grams of water. What is the molality, mass percent and mole fraction of NaCl in this solution?
8. Calculate the percent by mass, mole fraction of H₂SO₄ and molality of an 18.0 Molar solution of H₂SO₄(aq) given that the density of the solution is 1.84 g/mL.
9. Commercial Ammonia is 28% NH₃ by mass. It has a density of 0.90 g/ml. Calculate the molarity of this solution.

10. How many grams of NaCl are needed to lower the freezing point of the 500. g of water by 10.00 °C?
11. How many grams of nonvolatile compound B (molar mass= 97.80 g/mol) would need to be added to 250.0 g of water to produce a solution with a vapor pressure of 23.756 torr? The vapor pressure of water at this temperature is 42.362 torr.
12. The freezing point depression of a 0.10 *m* solution of HF(aq) solution is -0.201 °C. Calculate the percent dissociation of HF(aq)..
13. Ethylene glycol (C₂H₆O₂) is used in many anti-freeze mixtures. How many grams of Ethylene glycol must be added to 4.00 L of water so that the resulting solution freezes at -30. °C? (*K_f* for water = 1.86 °C /*m*)

14. Which aqueous solution is likely to have a higher boiling point, 0.50 m KBr or $0.50\text{ m Na}_2\text{SO}_4$? Why?
15. The freezing point of a solution that contains 1.00 g of an unknown compound dissolved in 10.0 g of benzene is found to be $2.07\text{ }^\circ\text{C}$. The freezing point of pure benzene is $5.48\text{ }^\circ\text{C}$. The molal freezing point depression constant of benzene is $5.12\text{ }^\circ\text{C/molal}$. What is the molar mass of the unknown compound?
16. What is the osmotic pressure (at 25°C) of seawater? It contains approximately $35.0\text{ grams of NaCl}$ per liter. (Seawater contains other stuff, but we'll ignore it.)
17. Look up the Osmotic Pressure in your blood and discuss why sea water will kill you if you drink it. (I know that it is more to do with kidneys than blood... but that is too much biology for this worksheet.)