

2019 CHEM2C: Assignment 4

Ram Seshadri (seshadri@mrl.ucsb.edu)

Due date: May 5 2019 (in class). Keep everything brief. Respect significant figures and units.

1. A solution of “sugar water” prepared by adding 185.0 g of glucose $C_6H_{12}O_6$ to 500.0 cm^{-3} of water at $30.00\text{ }^\circ\text{C}$, a temperature at which pure water has a vapor pressure of 31.82 torr. If the resulting sugar solution has a vapor pressure of 30.67 torr, what is the molar mass of glucose. Assume the density of water is 1.000 g cm^{-3} .

Does the value for the molar mass of glucose determined in this experiment agree with the value calculated using the chemical formula given above?

2. If winter temperatures go below the freezing point of water, pure water cannot be used as the coolant in a car’s radiator. “Antifreeze” is a solution of water and ethylene glycol ($C_2H_6O_2$) used in a car’s radiator to keep the coolant from freezing.

(a) Define the colligative property that antifreeze employs to protect car radiators.

(b) What mass of ethylene glycol must be added to 8.00 L of water to produce a solution that freezes at $-12.0\text{ }^\circ\text{C}$? Assume the density of water is exactly 1.00 g cm^{-3} .

3. Osmotic pressure.

(a) Define osmotic pressure. What does it mean to refer to two solutions as isotonic?

(b) Use the concept of hypertonic and hypotonic solutions and their effects on cells to discuss how preservatives extend the shelf life of certain foods.

(c) What concentration of sodium chloride and in water would be required to produce an aqueous solution isotonic with human blood ($\pi=7.70\text{ atm}$ at $25\text{ }^\circ\text{C}$).

4. Surfactants are a special type of molecule with a hydrophilic part, sometimes called the head, and a hydrophobic part, called the tail. Soaps and detergents are important examples of surfactants. Using this information, explain how a mixture of dish soap and water cleans your greasy dishes. Hint: Defining colloids and micelles will help.