Name:_____ Date:_____ Hr:_____

Colligative Properties Problems

1. We have now learned how salt can help us in the winter by lowering the freezing point. Are some salts better than others? Compare NaCl vs. $CaCl_2$. Is there a difference?

$CaCl_2$ is better because it is composed of 3 ions instead of 2.

2. Write the mathematical equation for calculating freezing point depression and explain the symbols.

Freezing point depression

$\Delta T = K_f \cdot m \cdot i$

ΔT = change in temperature
K_f = freezing point constant
m = molality
i = # of ions.

3. How is the expression for boiling point elevation similar and how is it different?

everything is the same except K_b instead of K_f

4. What is the boiling point of each solution?

a. 0.50 mol of sugar in 1200 grams of water $\frac{.5 mol}{1.2 Kg} = 0.41667 m$

$\Delta T = \left(.51 \frac{°C}{m}\right)(.41667 m)(1) = 0.2125°C$ → 100.2125°C

b. 150 grams of NaCl in 1000 grams of water $\frac{150 g\ NaCl}{1} \times \frac{1 mol\ NaCl}{58 g\ NaCl} = \frac{2.586 mol\ NaCl}{1 Kg\ H_2O}$

$\Delta T = (2.586 m)\left(.51 \frac{°C}{m}\right)(2) = 2.638°C$ → 102.638°C

5. Determine the freezing point of each solution.

a. 2.0 mol of sugar in 600 grams of water $\frac{2.0 mol}{.6 Kg} = 3.33 m$

$\Delta T = \left(-1.86 \frac{°C}{m}\right)(3.33 m)(1) = 6.2°C$ → −6.2°C

b. 12.0 grams of CCl_4 dissolved in 750 grams of benzene (kf = 5.12, fp = 5.48°C)

$\frac{12.0 g\ CCl_4}{1} \times \frac{1 mol\ CCl_4}{153.8 g\ CCl_4} = \frac{.0780 mol}{.750 Kg} = .104 m$

$\Delta T = \left(5.12 \frac{°C}{m}\right)(.104 m)(1)$

$\Delta T = .533°C$ → fp = 4.947°C

6. How much NaCl would have to be dissolved in 1000 grams of water to raise the boiling point 5.00°C. So, is that why we add salt to water when making pasta?

$\Delta T = (K_b)(m)(i)$

$\frac{5.00°C}{\left(.51 \frac{°C}{m}\right)(2)} = \frac{\left(.51 \frac{°C}{m}\right)(m)(2)}{\left(.51 \frac{°C}{m}\right)(2)}$

$m = \frac{4.902 mol\ NaCl}{1 Kg\ H_2O}$

$\frac{4.902 mol\ NaCl}{1} \times \frac{58 g\ NaCl}{1 mol\ NaCl} =$ 284.3 g NaCl