

Colligative Properties with Ionic Compounds

Key

1) What is the freezing point of a solution prepared by adding 239.0 g of copper(II) sulfate to 4.00 liters of water? The freezing point depression constant (K_f) of water is $1.86^\circ\text{C}/m$ and remember the density of water is 1.00 g/mL .

Chemical formula for copper(II) sulfate: CuSO_4

$$239.0\text{g CuSO}_4 \times \frac{1\text{ mol CuSO}_4}{159.62\text{g CuSO}_4} = 1.497\text{ mol}$$

van't Hoff factor (i): 2

$$\Delta T_f = (2)(1.86^\circ\text{C}/m) \left(\frac{1.497\text{ mol}}{4.00\text{ kg H}_2\text{O}} \right) = 1.39^\circ\text{C}$$

$$T_f = -1.39^\circ\text{C}$$

2) What is the new boiling point of a solution prepared by adding 96.0 g of sodium acetate to 383 mL of water? The boiling point constant (K_b) for water is $0.512^\circ\text{C}/m$.

Chemical formula for sodium acetate: $\text{NaC}_2\text{H}_3\text{O}_2$

$$96.0\text{g NaC}_2\text{H}_3\text{O}_2 \times \frac{1\text{ mol}}{82.034\text{g}} =$$

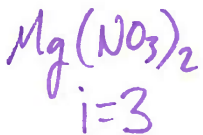
van't Hoff factor (i): 2

$$1.17\text{ mol NaC}_2\text{H}_3\text{O}_2$$

$$\Delta T_b = (2)(0.512^\circ\text{C}/m) \left(\frac{1.17\text{ mol NaC}_2\text{H}_3\text{O}_2}{0.383\text{ kg H}_2\text{O}} \right) = 3.13^\circ\text{C}$$

$$T_b = 103.13^\circ\text{C}$$

3) Assuming 100% dissociation, calculate the freezing point (T_f) and boiling point (T_b) of $1.34\text{ m Mg(NO}_3)_2(\text{aq})$. Useful info: For water, $K_f = 1.86^\circ\text{C}/m$ and $K_b = 0.512^\circ\text{C}/m$



$$\Delta T_f = (3)(1.86^\circ\text{C}/m)(1.34\text{ m}) = 7.48^\circ\text{C}$$

$$T_f = -7.48^\circ\text{C}$$

$$\Delta T_b = (3)(0.512^\circ\text{C}/m)(1.34\text{ m}) = 2.06^\circ\text{C}$$

$$T_b = 102.06^\circ\text{C}$$