WKS ***Name*_____**

Colligative Properties of Solutions ***Period*_____**

(FP depression and BP elevation)

Freezing point depression:

It's a FACT: When a solute (a solid, liquid or gas) is dissolved into water, the freezing point of the solution will be lower than pure water. For example, when NaCl (s) is dissolved into water, the freezing point of the saltwater solution is lower than 0^0C. *(Thus, it is harder to freeze a solution of water than pure water.)*

Boiling Point Elevation:

It's a FACT: When a solute (a solid, liquid or gas) is dissolved into water, the boiling point of the solution will be higher than that of pure water. For example, if ethylene glycol (antifreeze) is dissolved into water, the boiling point of the antifreeze solution is greater than 100^0C. *(Thus, it is harder to boil a solution of water than pure water.)*

How Concentration of Solute affects Boiling points and Freezing points: M↑ Fp↓ and M ↑ Bp ↑

The greater the amount of solute molecules/ions dissolved in the water, the more the boiling point is elevated and the more the freezing point is lowered.

*Ex: Freezing point of a 2 M NaCl solution is **lower** than a 1M NaCl solution.*

*Ex: Boiling point of 2 M NaCl solution is **higher** than a 1 M NaCl solution.*

PRACTICE:

1) Arrange the following solutions from lowest to highest boiling point.

2 grams of NaCl / 10 mL of water; 1 gram of NaCl / 10 mL of water; 3 grams of NaCl / 10 mL of water.

Lowest BP _____ _____ _____ highest BP

2) Arrange the following solutions from lowest to highest freezing point.

2 mL alcohol / 20 mL water; 4 mL alcohol / 20 ml water; 3 ml alcohol l/ 20 mL water

Lowest FP _____ _____ _____ highest FP

3) Arrange the following from lowest to highest boiling point.

1 M CO_2 (aq); 3 M CO_2 (aq); 4 M CO_2 (aq); 2 M CO_2 (aq); 5 M CO_2 (aq)

Lowest BP _____ _____ _____ _____ _____ highest BP

4) Arrange the following from lowest to highest freezing point

1 M $CaCl_2$ (aq); 3 M $CaCl_2$ (aq); 2 M $CaCl_2$ (aq); 4 M $CaCl_2$ (aq)

Lowest FP _____ _____ _____ _____ highest FP

Now, we know the facts, but WHY????

Boiling point elevation: Why does the boiling point get higher when a solute is added?

5) Describe the interaction between the solvent and solute molecules that increases the boiling point.

Freezing point depression: *Why does the freezing point get lower when a solute is added?*

6) A drop of food coloring was stirred into a glass of water. Then, the glass was put into the freezer overnight. Describe what the glass of ice looks like now.

7) When put in the freezer, the outside of the glass got colder first.
Thus, what froze first? pure water or colored water _____
Thus, is it easier to freeze pure water or colored water? _____
Thus, is it harder to freeze pure water or colored water? _____ *(A lower temp is needed.)*

8) Now, explain why a lower temperature is needed to freeze water when a solute is dissolved in it.
(You must discuss the structure of ice in your answer.)

ANALYSIS of Club Soda demo: Explain as thoroughly as possible. Use concepts discussed above.

9) **Unopened bottle of club soda:** It is placed in –8°C ice/salt bath. It does not freeze. Why not?

10) **Bottle is opened:** While the club soda is still at –8°C, the bottle is opened. Now it freezes. Why?