Freezing Point Depression Lab

Data Table

Temperature of Pure Ice-Water Mixture = _____°C

Beaker Number	Additive to Ice-Water Mixture	Mass of Ice + Water (g)	Exact Mass of Additive (g)	Lowest Temperature of Mixture (°C)	Lowest Temperature of Mixture (°C) (Class Average)
1	Sodium chloride $NaCl$				
2	Sucrose $C_{12}H_{22}O_{11}$				
3	Calcium chloride $CaCl_2 \cdot 2H_2O$				
4	Aluminum chloride $AlCl_3 \cdot 6H_2O$				

Name_____

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Freezing Point Depression Lab

Data Analysis Table

Name: _____

Beaker Number	Additive	Formula Weight (g/mol)	ΔT_f (°C)	Moles of Additive	$\frac{\Delta T_f\ (°C)}{mole}$	*n*	*m*	ΔT_f (°C) (theoretical)	% Error
1	NaCl								
2	$C_{12}H_{22}O_{11}$								
3	$CaCl_2 \cdot 2H_2O$								
4	$AlCl_3 \cdot 6H_2O$								

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Post-Lab Questions

Use the results in the Data Analysis Table to answer the following questions. Write your answers on a separate sheet of paper.

1. Make a general statement regarding the effect of additives or impurities on the melting (or freezing) point of a pure substance.
2. Why does an impurity (such as a salt) have the effect of lowering the freezing point of a solvent?
3. Using the same mass of additive (i.e. 30 g), which additive to the ice water lowered the freezing point the most (with the greatest ΔT_f)?
4. Using the same mass of additive (i.e. 30 g), which additive to the ice water lowered the freezing point the least (with the lowest ΔT_f)?
5. Which additive had the greatest freezing point depression per mole? Which had the least? Is this what would be expected? Explain.
6. What should be true about the freezing point depression per particle or ion? Does your data verify this?
7. Percent error was calculated by comparing the freezing point that should have been observed with that actually observed. Think of at least three possible sources for error in the lab procedure. How might each of these have been corrected or prevented?
8. What factors were held constant in this experiment?
9. Why was it important to keep the thermometer off the bottom of the beaker?
10. Why was it necessary to measure the temperature of the pure ice-water mixture, instead of assuming it to be 0.0 °C?
11. Which would be a better de-icer—sodium chloride or potassium chloride? Why?
12. Given the following sample cost data, which de-icing chemical would you recommend a road crew use as the most cost-effective agent at preventing road icing? Why?

Sample cost data:

Additive	*Cost/kg*
Sodium chloride	$ 0.64
Sucrose	$ 0.79
Calcium chloride	$ 0.77
Aluminum chloride	$ 2.76

Extensions

1. Why do road crews salt the streets before a severe snow or ice storm? Is it better to salt before or after the snow (ice) is on the road? Why?
2. Discuss the fact that lakes and rivers freeze, but oceans and seas, which are approximately 0.09% NaCl, do not freeze as readily. Relate this to the main ideas learned in this lab.
3. Using salt on the roads is not accepted by many communities. What are some drawbacks to using salt on the roads?
4. Ethylene glycol, commonly known as antifreeze, is added to cooling systems to lower the freezing point of water. Discuss how antifreeze works as a freezing point depression agent.

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