

# Melting Points of Antifreeze

## Colligative Properties

- Colligative properties are properties of a solution which depend on the concentration of solute dissolved in the solvent.
- The freezing point of a solution is LOWER than the freezing point of the pure solvent.
- The amount that the freezing pt lowers can be determined in the equation below. Where  $K_f$  is the freezing point depression constant of the solvent, and molality is the concentration expressed as (moles of solute/kg of solvent).

$$\Delta T_f = K_f \times \text{molality} \quad (\text{Eq. 1})$$

- The freezing point is defined as the temperature at which the solid and solution are both present. The melting point is defined as the temperature at which the solid and solution are both present.



The freezing point and melting point are the SAME. Sometimes it is easier to observe the solid melting than the liquid solidifying.

## ***Experiment***

- Be careful with the liquid Nitrogen. Its boiling point is 77 K or  $-195^{\circ}\text{C}$  !!
- Prepare the solutions as outlined in Table 1.
- Slowly and carefully freeze the ethylene glycol/water solutions.

Then allow them to warm up to determine their melting points.

Remember, the melting point is the same as the freezing point.

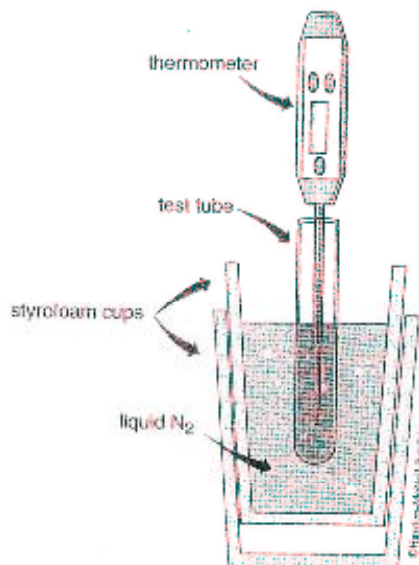


Figure 10-1

- Plot the melting pt temperature (y-axis) vs. the molality of ethylene glycol (x-axis).  
(Be sure that your y-axis starts at  $0^{\circ}\text{C}$  at the top and becomes increasingly negative  $^{\circ}\text{C}$  towards the bottom.)

Note: Equation (1) is for ideal solutions. However, ethylene glycol dissolved in water has a tremendous amount of hydrogen bonding (nonideal solution).

Look at your graph. Does this nonideal behavior affect the relationship between molality and freezing point?