CONCEPT: FREEZING POINT DEPRESSION

- The phenomenon when adding a solute to a pure solvent results in ____ of the freezing point of the solvent.
  - □ **Normal Freezing Point** (_____): The freezing point of the solvent _____ the addition of the solute.
  - □ **Freezing Point of Solution** (_____): The freezing point of the solvent _____ the addition of the solute.

Freezing Point Depression

A Freezing Point Depression Formula

ΔT_f = _____ • _____ • _____

B Freezing Point of Solution

FP_____ = FP_____ — _____

C Variables

- □ ΔT_f = Change in Freezing Point
- □ ____ = van't Hoff Factor
- □ ____ = Freezing Point Constant of Solvent in _____.
- □ ____ = molality of solution in _____.

D Constants

Solvent	Normal FP (°C)	k_f (°C/m)
Water	0.0	1.86
Benzene, C_6H_6	5.5	5.12
Chloroform, $CHCl_3$	- 63.5	0.68
Ethanol, C_2H_5OH	- 114.6	0.99

EXAMPLE: Calculate the freezing point of a solution containing 110.7 g glucose, $C_6H_{12}O_6$, dissolved in 302.6 g water.

PRACTICE: How many moles of ethylene glycol, $C_2H_6O_2$, must be added to 1,000 g of water to form a solution that has a freezing point of – 10°C?

a) 334 moles b) 5.4 moles c) 3.2 moles d) 200 moles

CONCEPT: FREEZING POINT DEPRESSION

PRACTICE: An ethylene glycol solution contains 28.3 g of ethylene glycol, $C_2H_6O_2$ in 97.2 mL of water. Calculate the freezing point of the solution. The density of water 1.00 g/mL.

a) -8.72 ºC b) -0.848 ºC c) -0.541 ºC d) -17.4 ºC

PRACTICE: When 825 g of an unknown is dissolved in 3.45 L of water, the freezing point of the solution is decreased by 2.89ºC. Assuming that the unknown compound is a non-electrolyte, calculate its molar mass.

a) 154 g/mol b) 42.4 g/mol c) 44.5 g/mol d) 159 g/mol