

Molecular Mass from Freezing Points

Object:

Determine the molecular mass of an unknown sample.

Procedure:

1. Add about 6 g of the solvent t-butanol to a test tube.
Note – ($K_f = 9.1^\circ\text{C}/m$)
2. Place the test tube containing the t-butanol in a cold-water bath.
3. Stir the liquid with a thermometer to determine the temperature in which t-butanol freezes. Do this twice using the same sample.
4. Remove the test tube from the cold water bath and add about 0.4 g of the unknown sample to the liquid t-butanol. Make sure the unknown sample dissolves completely.
5. Repeat steps 2 and 3 with the test tube containing t-butanol and the unknown sample.

Data:

Mass of solvent (t-butanol)	<u>4.3</u> g	
Freezing temperature of solvent	<u>24.1</u> °C	_____ °C
Mass of the unknown sample	<u>0.39</u> g	
Freezing temperature of the solution	<u>18.5</u> °C	_____ °C

Results:

Change in freezing temperature (ΔT_f)	<u>5.6</u> °C	_____ °C
Molality (m) of unknown solution	<u>0.615</u> m	_____ m
Molecular mass of unknown sample	<u>147.2</u> g/mole	_____ g/mole

$$\Delta T_f = K_f \cdot m$$

$$5.6 = 9.1 \cdot m$$

$$m = \frac{\text{mol solute}}{\text{kg solvent}}$$

$$0.615 = \frac{\text{mol}}{0.004}$$