# "Laboratory" Assignment 8-Freezing Point Depression Worksheet

Chemistry 122 - Department of Chemistry, Oregon State University

The purpose of this exercise is to determine the molecular mass of an unknown by freezing point depression.

Data can be collected to determine the freezing point of a solvent. Data can be collected to determine the freezing point of that solvent which contains a small amount of an unknown. The molar mass of the unknown can be determined from difference of these freezing points ($\Delta T_f = imk_f$).

The temperature of a sample cooling and freezing can be plotted as a function of temperature (Figure 1 on the right). The freezing point of the sample can be determined by extrapolation.
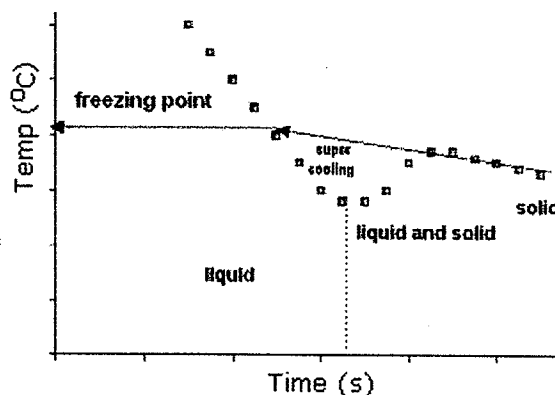
A student heats 8.46 g of benzophenone, $(C_6H_5)_2CO$, $k_f = -9.8°C/m$, above the freezing point. The sample is then cooled and the temperature of the sample is plotted as a function of time (Figure 2). Show your extrapolation work (the lines and labels) on Figure 2 and record the freezing point below.

The extrapolated freezing point of pure benzophenone is: about 48°C   (see next page)

The student adds 1.85 g of an unknown molecule (i = 1) to the sample of benzophenone. The sample is heated above the freezing point then cooled and the temperature of the sample is plotted as a function of time (Figure 3). Show your extrapolation work (the lines and labels) on Figure 3 and record the freezing point below.

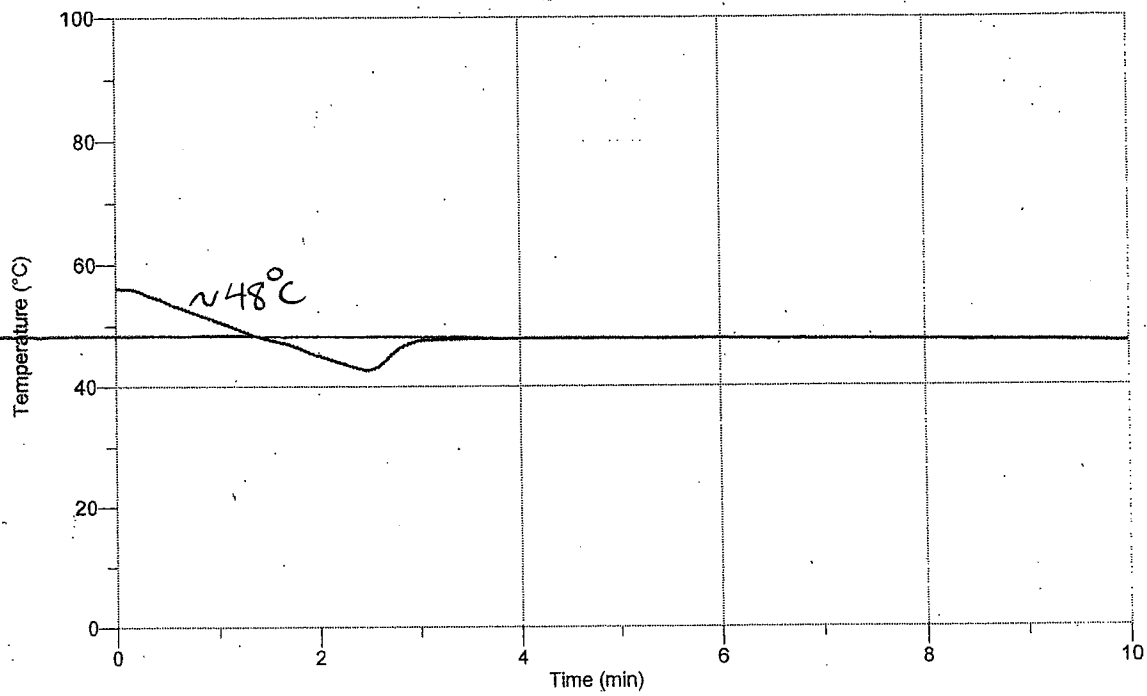| The extrapolated freezing point of the benzophenone/unknown mixture is: about 42°C (see next page) |
| --- |

~48°C

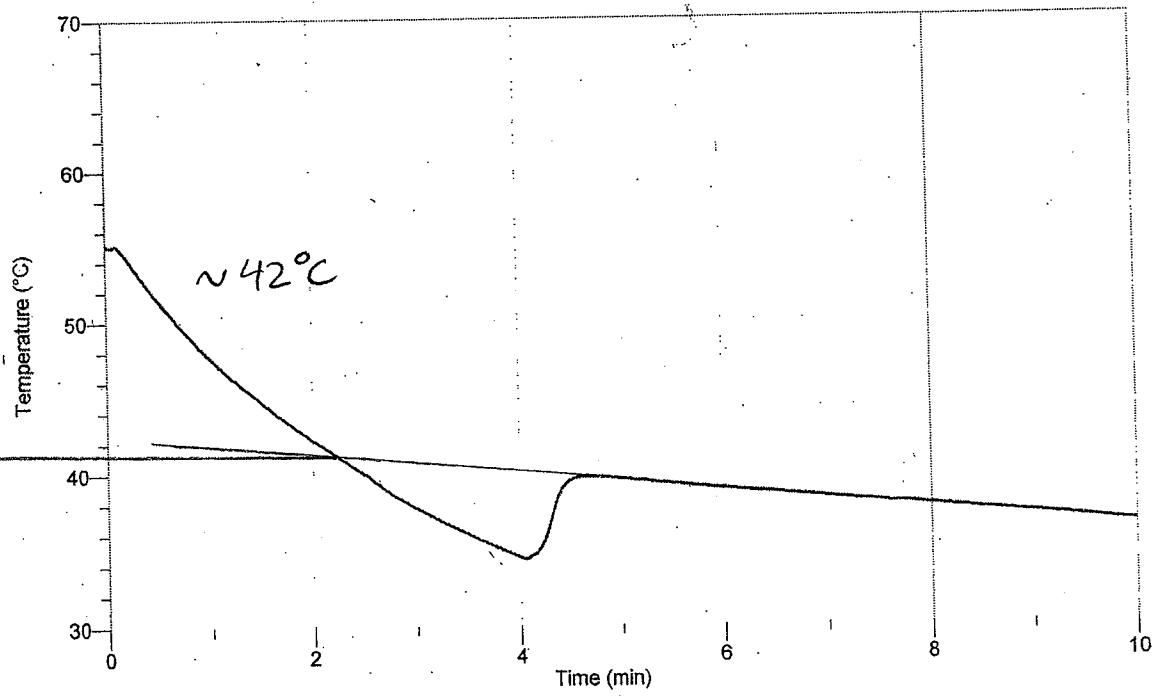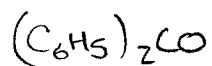Fig 2 - Benzophenone

~42°C

Fig 3 - Benzophenone/unknown

What is the molar mass of benzophenone?	Draw the structure of benzophenone below
$(C_6H_5)_2CO$ 182.2 $^g/mol$	
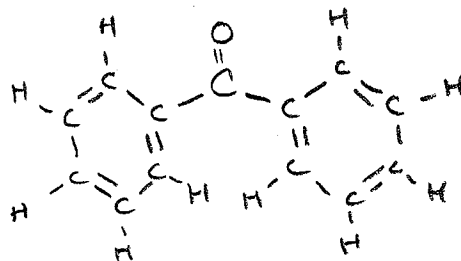
Showing your work below, determine the molar mass of the unknown and record it at the bottom of this box.

$$\Delta T_f = i\, m\, k_f$$

$$(42°C - 48°C) = (1)(m)\left(-9.8 \frac{°C}{m}\right)$$

$$-6°C = \left(-9.8 \frac{°C}{m}\right)(m)$$

$$m = 0.612 \; m \quad or \quad \frac{moles\; solute}{kg\; solvent}$$

$$moles\; solute = (0.612\, m)(8.46 \times 10^{-3}\, kg\; benzophenone) =$$

$$0.0052 \; mol \; solute$$

$$Molar\; Mass\; solute = \frac{1.85\, g}{0.0052\, mol} = 357\, ^g/mol$$

Molar Mass of the unknown _____357_____ g/mol