

Experiment 9

Data and Calculations: Molar Mass of a Volatile Liquid

	Trial 1	Trial 2
Unknown no.	<u>18</u>	
Mass of flask and stopper	<u>63.1660</u> g	<u>44.6685</u> g
Mass of flask, stopper, and condensed vapor	<u>63.6070</u> g	<u>45.1259</u> g
Mass of flask, stopper, and water (see directions)	<u>269.80</u> g	<u>260.40</u> g
Temperature of boiling water bath	<u>104</u> °C	<u>104</u> °C
Barometric pressure	<u>742.0</u> mm Hg	<u>742.0</u> mm Hg

Calculations and Results

Pressure of vapor, P ^{atm = $\frac{742.0 \text{ mmHg}}{760 \text{ Torr}}$} 0.9763 atm ✓ 0.9763 atm ✓

Volume of flask (volume of vapor), V 0.2070 L ✓ 0.2161 L ✓

Temperature of vapor, T 377 K ✓ 377 K ✓

Mass of vapor, g 0.4410 g ✓ 0.4574 g ✓

Number of moles of vapor, n 0.00653 M ✓ 0.00682 M ✓

$$n = \frac{PV}{RT} = \frac{0.9763 \text{ atm} \cdot 0.2070 \text{ L}}{0.08206 \frac{\text{L} \cdot \text{atm}}{\text{mol} \cdot \text{K}} \cdot 377 \text{ K}}$$

$$n = \frac{PV}{RT} = \frac{0.9763 \text{ atm} \cdot 0.2161 \text{ L}}{0.08206 \frac{\text{L} \cdot \text{atm}}{\text{mol} \cdot \text{K}} \cdot 377 \text{ K}}$$

Molar mass of unknown, as found by substitution into Equation 2

$$M_m = \frac{mRT}{PV} = \frac{0.4410 \text{ g} \cdot (0.08206 \frac{\text{L} \cdot \text{atm}}{\text{mol} \cdot \text{K}}) \cdot 377 \text{ K}}{0.9763 \text{ atm} \cdot 0.2070 \text{ L}} = 77.5 \frac{\text{g}}{\text{mol}}$$

vs. actual

$$M_m = \frac{g}{n} = \frac{0.4574 \text{ g}}{0.00682 \text{ mol}} = 72.1 \frac{\text{g}}{\text{mol}}$$

(2-butanone) ✓