1. (3 points) Rank the following aqueous solutions from lowest to highest boiling point. 

\[
\begin{align*}
\text{(a) 0.10 M sodium chloride} & \quad \text{(b) 0.10 M methanol} & \quad \text{(c) 0.10M potassium sulfate} \\
\text{NaCl} & \quad \text{CH}_3\text{OH} & \quad \text{K}_2\text{SO}_4
\end{align*}
\]

\[
\begin{align*}
0.10 \text{m} & < a < c \\
0.20 \text{m} & < b < c \\
0.30 \text{m} & \quad \text{K}_2\text{SO}_4
\end{align*}
\]

2. (3 points) The calculate vapor pressure of a 0.10 M KCl solution was found to be 5% greater than the measured vapor pressure while a 0.00010 M KCl solution was only 0.1% greater. Explain why there is a difference.

As conc. dec, the soln becomes more ionic, therefore, less error.

Calc. conc \equiv \text{true conc. for dilute soln.}

3. (4 points) 0.356 g of an unknown molecular substance was added to 20.0 g of cyclohexane. The solution was found to have a freezing point of 5.37°C. Determine the molar mass of the unknown compound given that the freezing point for pure cyclohexane is 6.5°C and \( K_f = 20.0 \text{°C} \cdot \text{mol}^{-1} \cdot \text{kg} \).

\[
\begin{align*}
\Delta T &= K_f \cdot m \\
m &= \frac{\Delta T}{K_f} \\
m \times kg \text{ solvent} &= \text{mols solute}
\end{align*}
\]

\[
\begin{align*}
\frac{g \text{ solute}}{mol \text{ solute}} &= \frac{0.356 \text{ g}}{315 \text{ g}} \\
&= \frac{0.356 \text{ g}}{315 \text{ g}} \times \frac{(4.5 - 5.37) \text{°C}}{20.0 \text{°C} \cdot \text{mol}^{-1}} \times \frac{20.0 \text{ g}}{10^3 \text{ g}} \\
&= 315 \text{ g} \\
&= 320 \text{ g} \text{ mol}^{-1}
\end{align*}
\]

4. (3 points) Arrange the following in terms of increasing molecular speed:

\[
\begin{align*}
(a) \text{ nitrogen} & \quad (b) \text{ argon} & \quad (c) \text{ ammonia} & \quad (d) \text{ methane} \\
\text{16} & \quad 40 & \quad 17 & \quad \text{16 at/m} \text{sec}
\end{align*}
\]

\[
\begin{align*}
(d) & < (c) < (a) < (b) \\
(b) & < (a) < (c) < (d) \\
V_{max} &= \sqrt{\frac{3RT}{M_{\text{mol}}}}
\end{align*}
\]