CHM 102 EXAM III

Show all calculations with proper uses and correct number of significant figures. Write in complete sentences. Turn in the take-home questions with this exam. GOOD LUCK!!!

1. A sealed container with a block of dry ice, solid \( CO_2 \), is allowed to come to equilibrium due to sublimation \([CO_2 (s) \rightarrow CO_2 (g)]\). (15)

   Describe the types of molecular motion that occur in each phase.

   \[
   \begin{align*}
   \text{CO}_2 (s) \\
   \text{CO}_2 (g)
   \end{align*}
   \]

   The mean free path, the distance a molecule travels between collisions, gets shorter as the dry ice sublimes. Why?

   As the dry ice sublimes, does the mass of the container change? Explain.

2. Predict the sign of the enthalpy change and give a brief reason why you selected the sign. (20)

   \[
   \begin{array}{ll}
   \text{Sign} & \text{Reason} \\
   \hline
   2 \text{ F} (g) \rightarrow \text{ F}_2 (g) & \quad \\
   \text{HCN (aq) \rightarrow H}^+ (aq) + \text{CN}^- (aq) & \quad \\
   \text{HCN (g) \rightarrow HCN (l)} & \quad \\
   \text{NaCl (s) \rightarrow NaCl (l)} & \quad \\
   \text{CH}_4 (g) + 2 \text{ O}_2 (g) \rightarrow \text{CO}_2 (g) + 2 \text{ H}_2\text{O} (g) & \quad \\
   \end{array}
   \]
3. Consider the endothermic reaction for the dissolving of silver chloride given below.

\[ \text{AgCl (s)} \rightleftharpoons \text{Ag}^+ (\text{aq}) + \text{Cl}^- (\text{aq}) \]

How will the solubility of AgCl respond (increase, decrease, or no change) when the following stresses are applied? (10)

<table>
<thead>
<tr>
<th>Stress</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>add NaCl (s)</td>
<td></td>
</tr>
<tr>
<td>add NH₃ (g)</td>
<td></td>
</tr>
<tr>
<td>remove AgCl (s)</td>
<td></td>
</tr>
<tr>
<td>add NaNO₃ (s)</td>
<td></td>
</tr>
<tr>
<td>cool the reaction</td>
<td></td>
</tr>
</tbody>
</table>

4. Predict the sign of the entropy change for each. (15)

\[ \text{CuSO}_4 \cdot 5\text{H}_2\text{O (s)} \rightarrow \text{CuSO}_4 (s) + 5\text{H}_2\text{O (g)} \]

\[ \text{Cl}_2 (g) \rightarrow \text{Cl}_2 (\text{aq}) \]

\[ \text{I}_2 (s) \rightarrow \text{I}_2 (g) \]

\[ \text{N}_2\text{O}_4 (g) \rightarrow 2 \text{NO}_2 (g) \]

\[ \text{Mg}^{2+} (\text{aq}) + 2\text{OH}^- (\text{aq}) \rightarrow \text{Mg(OH)}_2 (s) \]

5. Calculate the entropy change for the combustion of ethane. (10)

\[ 2 \text{C}_2\text{H}_6 (g) + 7 \text{O}_2 (g) \rightarrow 4 \text{CO}_2 (g) + 6 \text{H}_2\text{O (g)} \]

\[ S^0: \quad 230 \quad 205 \quad 214 \quad 189 \quad \text{J/K-mole} \]