1. (8 pts) Draw the Lewis dot diagram for the following molecules. Show all valence electrons.

   a. SCl₂
   b. CO₃²⁻

   :Cl—S—Cl:  [O—O—O]²⁻

2. (10 pts) Consider the following equation:

   4HCl + MnO₂ → 2H₂O + MnCl₂ + Cl₂

   a. When 4.00 grams of each reactant is used, how many grams of MnCl₂ will be produced? Which reactant is the limiting reagent?

      3.45 g MnCl₂  5.79 g MnCl₂

      HCl limiting reagent

3. (10 pts) Predict the order of boiling points for the following molecules by placing a 1 in front of the highest boiling point and a 5 in front of the lowest boiling point. Next, write the type of intermolecular force primarily responsible for the molecule's boiling point.

   CH₃OH ____1____, H-bond  CF₄ ____4____, induced dipole

   CCl₄ ____3____, induced dipole  CHCl₃ ____2____, dipole dipole

   CH₄ ____5____, induced dipole
4. (9 pts) Consider the molecule below.

\[
\begin{array}{c}
\text{H} & \text{N} & \text{C} & \text{C} & \text{C} & \text{N} \\
\text{H} & 1 & 2 & \text{C} & \text{H} & \text{H}
\end{array}
\]

Fill in the blanks corresponding to the designated atom.

<table>
<thead>
<tr>
<th>atom</th>
<th>electron pair geometry</th>
<th>molecular geometry</th>
<th>angle</th>
</tr>
</thead>
<tbody>
<tr>
<td>nitrogen 1</td>
<td>tetr.</td>
<td>Pyramidal</td>
<td>&lt;109</td>
</tr>
<tr>
<td>carbon 2</td>
<td>trig. Planar</td>
<td>trig planar</td>
<td>120</td>
</tr>
<tr>
<td>carbon 3</td>
<td>linear</td>
<td>linear</td>
<td>180</td>
</tr>
</tbody>
</table>

5. (6 pts) Name the following compounds or elements.

- a. P₂O₃ **diphosphorous trioxide**
- b. SnBr₄ **tin(IV) bromide**
- c. SCN⁻ **thiocyanate**
- d. Ca(OH)₂ **calcium hydroxide**
- e. SO₃²⁻ **sulfite ion**
- f. HF **hydrofluoric acid**

6. (6 pts) Write the formula or elemental symbol for the following names. Be sure to remember that all elements are reported as they exist in nature.

- a. Iron(III) sulfide \( \text{Fe}_2\text{S}_3 \)
- b. trinitrogen hexoxide \( \text{N}_3\text{O}_6 \)
- b. chromate ion \( \text{CrO}_4^{2-} \)
- d. oxygen \( \text{O}_2 \)
- e. bicarbonate \( \text{HCO}_3^- \)
- f. aluminum oxide \( \text{Al}_2\text{O}_3 \)
7. (8 pts) Balance the following reactions.

a. \( \text{C}_3\text{H}_8 + \_5\_ \text{O}_2 \rightarrow \_3\_ \text{CO}_2 + \_4\_ \text{H}_2\text{O} \)

b. \( \_4\_ \text{Fe} + \_3\_ \text{O}_2 \rightarrow \_2\_ \text{Fe}_2\text{O}_3 \)

c. \( \_3\_ \text{NaBH}_4 + \_4\_ \text{BF}_3 \rightarrow \_3\_ \text{NaBF}_4 + \_2\_ \text{B}_2\text{H}_6 \)

d. \( \_\_ \text{Cu(NO}_3\text{)_2} + \_2\_ \text{NaOH} \rightarrow \_\_ \text{Cu(OH)}_2 + \_\_ \text{NaNO}_3 \)

8. (10 pts) Consider 12.7 g of Ca(OH)\(_2\) to answer the following questions.

a. How many moles of Ca(OH)\(_2\) is this? \(0.171 \text{ mol}\)

b. How many molecules of Ca(OH)\(_2\) is this? \(1.02 \times 10^{23} \text{ molec.}\)

c. How many oxygen atoms are there? \(2.04 \times 10^{23} \text{ O atoms}\)

d. What is the weight of one molecule of Ca(OH)\(_2\) in amu? \(74.08 \text{ amu}\)

e. What is the weight of one molecule of Ca(OH)\(_2\) in grams? \(1.23 \times 10^{-22} \text{ g/molec}\)

9. (10 pts) A compound is composed of 74.0% C, 8.70% H, and 17.3% N. Its molar mass is 162 g/mol. What is the molecular formula?

\[
\text{C}_{10}\text{H}_{14}\text{N}_2
\]
10. (10 pts) Consider the following reaction:

\[ 3\text{H}_2 + \text{N}_2 \rightarrow 2\text{NH}_3 \]

a. If this reaction required 12.3 g of hydrogen, how many grams of ammonia were produced?

\[ 69.7 \text{ g NH}_3 \]

b. According to part a., how many grams of nitrogen were consumed to react with 12.3 g of hydrogen?

\[ 57.4 \text{ g N}_2 \]

11. (10 pts) Iron and carbon dioxide can be generated by reacting iron(III) oxide and carbon monoxide in a blast furnace.

a. Write the balanced equation for this reaction.

\[ \text{Fe}_2\text{O}_3 + 3\text{CO} \rightarrow 2\text{Fe} + 3\text{CO}_2 \]

b. How much carbon monoxide must be used to produce 32.3 g of iron if the percent yield is 87.8%?

\[ 27.7 \text{ g CO} \]

12. (8 pts) Place a P by the polar molecules and a NP by the non-polar molecules.

\begin{align*}
\text{N}_2 & \quad \text{NP} \\
\text{BF}_3 & \quad \text{NP} \\
\text{NH}_3 & \quad \text{P} \\
\text{H}_2\text{O} & \quad \text{P} \\
\text{CH}_2\text{Cl}_2 & \quad \text{P} \\
\text{CCl}_4 & \quad \text{NP} \\
\text{CH}_3\text{Cl} & \quad \text{P} \\
\text{CO}_2 & \quad \text{NP}
\end{align*}