Please show your work for all calculations, and report answers to the proper number of significant digits to receive full credit. For calculations, circle your final answer.

1. Answer the following questions.
   a. How many sulfur atoms are there in 1.5 mol of S₈ (the form that sulfur takes in nature)?

   \[
   1.5 \text{ mol } S₈ \left( \frac{8 \text{ mol } S}{1 \text{ mol } S₈} \right) = 12 \text{ mol } S \left( \frac{6.022 \times 10^{23} \text{ atoms } S}{1 \text{ mol } S} \right) = 7.2 \times 10^{24} \text{ S atoms}
   \]

   b. What is the mass, in grams, of 1.5 mol S₈?

   \[
   1.5 \text{ mol } S₈ \left( \frac{257.319 \text{ g } S₈}{1 \text{ mol } S₈} \right) = 385.979 \text{ g } S₈ \rightarrow 3.9 \times 10^2 \text{ g } S₈
   \]

   c. What is the mass, in milligrams, of 0.00452 mol S₈?

   \[
   0.00462 \text{ mol } S₈ \left( \frac{83.2069 \text{ g } S₈}{1 \text{ mol } S₈} \right) \left( \frac{1 \text{ mg } S₈}{1 \times 10^{-3} \text{ g } S₈} \right) = 1783 \text{ mg } S₈ \rightarrow 1.78 \times 10^3 \text{ mg } S₈
   \]

2. a. What is the mass, in amu, of one molecule of NH₂CHCO₂H?

   \[
   1 \text{ molecule } \text{NH₂CHCO₂H} : 14.01 \text{ amu} + 4(1.01 \text{ amu}) + 2(12.01 \text{ amu}) + 2(16.00 \text{ amu}) = 74.07 \text{ amu}
   \]

   b. What is the mass, in grams, of one mole of NH₂CHCO₂H?

   \[
   74.07 \text{ amu is equivalent to a molar mass of } 74.07 \text{ g}.
   \]

   c. How many moles of H atoms are in 0.051 g of NH₂CHCO₂H?

   \[
   \frac{0.051 \text{ g NH₂CHCO₂H}}{74.07 \text{ g NH₂CHCO₂H}} = 0.0028 \text{ mol H}
   \]

   d. Determine the mass percent of hydrogen in NH₂CHCO₂H.

   \[
   \frac{4 \left( 1.008 \text{ amu} \right)}{74.07 \text{ amu} \times 100\%} = 5.44\% \text{ H}
   \]

Continued on reverse.
3. In your own words, explain why chemical equations must be balanced, and state the physical law that is responsible for equations needing to be balanced.

Chemical equations must be balanced so that there are equal numbers of atoms of each element in the reactants and products. This is necessary because atoms can neither be created nor destroyed in a reaction. This fact is a statement of the Law of Conservation of Matter.

4. a. Write a balanced equation for the combustion of naphthalene (C_{10}H_{8}), the main ingredient in moth balls.

\[ C_{10}H_8(s) + 12 O_2(g) \rightarrow 10 CO_2(g) + 4 H_2O(l) \]

b. You start the reaction in part a with 1.008 g C_{10}H_8 and 5.021 g O_2. Determine which reactant is the limiting reagent.

\[ \text{1.008 g C}_{10}\text{H}_8 \times \frac{1 \text{ mol C}_{10}\text{H}_8}{128.18 \text{ g}} \times \frac{4 \text{ mol H}_2\text{O}}{1 \text{ mol C}_{10}\text{H}_8} = 0.03146 \text{ mol H}_2\text{O} \]

\[ \text{5.021 g O}_2 \times \frac{1 \text{ mol O}_2}{32 \text{ g}} \times \frac{4 \text{ mol H}_2\text{O}}{12 \text{ mol O}_2} = 0.05230 \text{ mol H}_2\text{O} \]

C_{10}H_8 is the L. R. because it gives less product.

c. Using amounts from part b, calculate the theoretical yield (in grams) of water in this reaction.

\[ 0.03146 \text{ mol H}_2\text{O} \times \frac{18.02 \text{ g H}_2\text{O}}{1 \text{ mol H}_2\text{O}} = 0.5669 \text{ g H}_2\text{O} \]

d. If 0.49 mL of water is obtained in the actual reaction, what is the percent yield for this reaction? (Hint: the density of water is 1.00 g/mL.)

\[ 0.49 \text{ mL H}_2\text{O} \times \frac{1 \text{ mol H}_2\text{O}}{18.02 \text{ g H}_2\text{O}} = 0.0271 \text{ mol H}_2\text{O} \]

\[ \% \text{ yield} = \frac{\text{actual}}{\text{theoretical}} \times 100\% = \frac{0.49 \text{ g}}{0.5669 \text{ g}} \times 100\% = 86\% \text{ yield} \]