25. A scientist has two containers of sulfur and knows that she has Avogadro's number of sulfur atoms in each one. One container has only $S_2$ molecules in it and the other has only $S_6$ molecules in it. Answer the following questions and show your work to get full credit.

(a) Are the number of molecules the same in each container? Explain.

(b) Calculate the number of moles of sulfur molecules in each sample. Are the numbers the same? Draw a picture to defend your results.
Consider the following reaction: $\text{K} + \text{H}_2\text{O} \rightarrow \text{KOH} + \text{H}_2$ \text{UNBALANCED}

Balance the equation and describe what is happening as the reaction proceeds using the terms: atom, formula unit, and molecule.

\[ 2 \text{K} + 2 \text{H}_2\text{O} \rightarrow 2 \text{KOH} + 2 \text{H}_2 \]

2 potassium atoms react with 2 water molecules to form 2 potassium hydroxide formula units and 2 hydrogen molecules.

(10 pts) 27. Give the appropriate name or formula for a compound:

(a) ammonium sulfate
(b) iron(II) fluoride
(c) magnesium nitrate
(d) Cu(CH$_3$COO)$_2$
(e) KOH
Water is formed by the direct reaction of hydrogen gas and oxygen gas, according to the reaction:
\[ \text{H}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow \text{H}_2\text{O}(\text{g}) \] UNBALANCED

(2 pts) (a) Balance the equation.

\[ 2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O} \]

(5 pts) (b) Suppose you start the reaction with 3.0 moles of \( \text{O}_2 \) and 2.0 moles of \( \text{H}_2 \).

How many moles of \( \text{H}_2\text{O} \) can you make? \( \frac{2}{3} \) mol

What reactant is left over? How much of it is in excess?

(4 pts) (c) The initial system before the reaction began is represented by the following particle view:

![Initial particle view](image)

where
- \( \text{H} \) is a hydrogen atom
- \( \text{O} \) is an oxygen atom
- \( \text{H}_2\text{O} \) is a water molecule

Draw a picture of the system after the reaction has gone to completion.

![Completed particle view](image)

(4 pts) (d) Briefly explain this reaction and your picture using the concept of limiting reactant.

The reaction went until it ran out of hydrogen because hydrogen was no longer around but still needed for the reaction. It is considered the limiting reactant.