Results #1—Moles Name _____

Lab section: M T W Th F

- ***Put your answers in the blanks provided.***
- ***Show your work in the space provided.***

I. Moles calculations: (The equations that you need can be found in the *Background* section of the online lab manual.)

In this experiment, you have reacted some of the iron from the nail at the same time as you have produced some copper. In order to find the moles of each of these substances, you will need to divide the mass of the iron used or the copper produced by the molar mass. You can also determine the moles of copper (II) sulfate that you started with by dividing the mass of the copper (II) sulfate by the molar mass. By multiplying by Avogadro's number, you will be able to determine the total number of atoms involved in the reaction. Finally, you will determine the ratio of moles of iron used to moles of copper produced. The ratio should agree with the stoichiometry predicted by one of your balanced chemical equations.

1. Revisit your observations and describe the qualitative data (no numbers, just description) showing that a reaction has occurred.

2. Calculate the **moles of Cu^{2+} available at the beginning of the reaction** by multiplying the volume of solution by its molarity (concentration).
    a. Amount of $CuSO_4$ solution used initially: _____ mL
    b. Amount of $CuSO_4$ solution in liters: _____ L

    c. Molarity (M = mol/L) of solution used: _____ mol/L
    d. Initial moles of copper used: _____ moles

3. In order to find the **moles of copper solid produced**, you will need to divide the mass of the copper produced by its molar mass.
    a. Record the molar mass of copper _____ g/mole.
    b. Consider the mass of copper solid produced in the reaction:

       _____ grams
    c. Calculate the moles of copper produced in the reaction: _____ moles

    d. Using Avogadro's number calculate how many $Cu_{(s)}$ atoms were produced?
       _____ atoms

4. Compare the initial moles of Cu^{2+} to the number of moles of $Cu_{(s)}$ produced by calculating the percent yield after 2 hours:
    a. Moles of $Cu_{(s)}$ produced in the reaction: _____ moles
    b. Moles of Cu^{+2} used initially: _____ moles
    c. Percent yield = (moles produced) / (moles available initially) x 100% =

       _____

    d. Make a hypothesis of what would happen if the reaction were allowed to proceed for 5 hours instead of only 2 hours. Would more copper solid be produced? _____ Why or Why not?

5. In order to find the **moles of iron consumed**, you will need to divide the mass of the iron used by the molar mass.
    a. Record the molar mass of iron: _____ g/mole.
    b. Consider the mass of iron consumed in the reaction: _____ grams
    c. Then calculate the moles of iron consumed in the reaction: _____ moles

    d. Using Avogadro's number calculate how many $Fe_{(s)}$ atoms were consumed in the reaction: _____ atoms

    e. If one nail weighs 2.76 grams, how many nails would represent one mole of iron? _____ nails

6. **Which iron ion is produced, Fe^{+2} or Fe^{+3}?** Your lab manual has a section titled "Understanding the Reaction" which discusses the fact that we could produce either $Fe^{+2}_{(aq)}$ or $Fe^{+3}_{(aq)}$ ions. Below are the possible reactions:

$$Cu^{2+}_{(aq)} + Fe_{(s)} \rightarrow Cu_{(s)} + Fe^{2+}_{(aq)} \quad \textit{or}$$

$$3\ Cu^{2+}_{(aq)} + 2\ Fe_{(s)} \rightarrow 3\ Cu_{(s)} + 2\ Fe^{3+}_{(aq)}$$

    a. Reexamine your calculations in questions 3c and 5c and use those answers to determine the ratio of moles of copper solid produced (_____ moles) to moles of iron solid consumed (_____ moles). _____ moles Cu/ moles Fe.
    b. Does your data agree with the stoichiometry shown in one of the overall chemical reactions you balanced earlier? Which one? Is Fe^{2+} or Fe^{3+} formed? _____

c. Calculate the % error in your molar ratio:

% error = [(experimental ratio) – (expected ratio)] / (expected ratio)

% error = _____

7. List at least two some sources of error in this experiment (i.e. reasons why your percent yield is not 100% and your percent error is not 0%). Do not include human error (e.g. "I might have made a mistake.").

III. Workshop take-home question:

8. A Nobel-Prize-worthy compound…

   a. Consider 100g of the substance. What is the mass of each element, in grams, in that 100g sample?

      C _____

      H _____

      Fe _____

   b. How many moles of C, H, and Fe are there in this arbitrary 100g sample? Show work.

      C _____

      H _____

      Fe _____

   c. What is the chemical formula of the Nobel-Prize-worth compound?

      _____