PRE-LAB FOR STOICHIOMETRY LAB

GOAL/PURPOSE:

to reinforce understanding of the role of limiting reagent in a chemical reaction and to allow students to master laboratory skills

NEEDED PRIOR CONCEPTS

- balanced chemical reaction
- stoichiometry
- mole ratio
- limiting reagent

Note: For advanced classes other concepts that can be incorporated into this experiment include the following:

- reduction/oxidation
- single replacement reaction
- activity series of metals
- transition metal chemistry
- chemical and physical properties of atoms vs ions
- variable oxidation states
- qualitative analysis
- solubility product
- thermodynamics and spontaneity
- heterogeneous reactions
- galvanic vs electrolytic cells

LABORATORY SKILLS TAUGHT:

- use of an analytical balance
- transfer of liquid
- pipetting
- decanting

BACKGROUND:

Depending on the level of the students' knowledge of chemistry this experiment can be approached from different aspects:

> Beginning students can perform this experiment after going through a unit on stoichiometry and limiting reagent and use this to reinforce the theoretical concepts with concrete examples Advanced students can prepare for this experiment by completing a series of questions that tie in various concepts:
>
> - reduction potentials of Cu and Ag+

- prediction of the possible oxidation states of copper ion
- determination of electrochemical potential of the reaction between Cu and Ag+
- prediction of the products for the reaction
- calculation of the Gibbs free energy for the reaction
- definition of a heterogeneous reaction and the role of surface area in the reaction rate
- determination of oxidizing/reducing agents

RELEVANCY:

the importance and variety of reduction/oxidation reactions in nature and industry:

- Nature: aging, spoiling, photosynthesis, vision, rusting
- Industry: purification of metals, photography, metal plating

SAFETY:

- warn students about $AgN0_3$ staining clothes and body --use gloves and wear appropriate clothing for the experiment
- remind students not to dump waste down the drain --use waste container
- acetone is a highly volatile liquid -- be sure to air dry first

PROCEDURE:

Go through the steps with the students and comment on the following numbered steps:

Step #2: show video on rolling Cu wire
#4: show video on use of analytical balance
#7: show video on use of pipette and pipette pump
#8: caution students not to shake to the tube frequently--allow silver to grow on the copper wire to obtain larger precipitate
#9: cross-out the words "pre-weighed" & show video on decanting
#14: warn students to air dry first before placing it in sand bath

STOICHIOMETRY LIMITING REAGENT LABORATORY QUIZ

DIRECTIONS:
PLACE THE LETTER OF THE ANSWER THAT BEST COMPLETES EACH STATEMENT IN THE BLANK TO THE LEFT.

Use the data below for questions 1 -5.

mass of dry screw-cap test tube	22.202 grams
mass of test tube and $AgNO_3$	23.842 grams
mass of copper before reaction with $AgNO_3$	5.030 grams
mass of copper after reaction with $AgNO_3$	4.730 grams
mass of silver produced by the reaction	1.020 grams

1. The mass of AgNO3 reacted is _____.

a. 1.640 grams
b. 87.173 grams
c. 0.300 grams
d. 1.020 grams

2. The moles of AgNO3 (170 grams/mole) reacted is _____.

a. 0.0941 mole
b. 0.513 mole
c. 0.0018 mole
d. 0.00965 mole

3. The mass of copper reacted is _____.

a. l.600 grams
b. 87.170 grams
c. 0.300 grams
d. 1 .200 grams

4. The moles of copper (atomic mass 63.5 grams/mole) reacted is _____.

a. 0.0285 moles Cu
b. 1.373 moles Cu
c. 0.00472 moles Cu
d. 0.0161 moles Cu

5. Based on your answers to questions 1 through 4 and the remaining data, the balanced equation should be _____.

a. $AgNO_3 + Cu \longrightarrow Ag + CuNO_3$
b. $AgNO_3 + 2Cu \longrightarrow Ag + Cu_2NO_3$

c. $2AgNO_3 + 2Cu \longrightarrow 2Ag + 2CuNO_3$

d. $2AgNO_3 + Cu \longrightarrow 2Ag + Cu(NO_3)_2$

Answers

STOICHIOMETRY/LIMITING REAGENT POST LAB

(Group work after lab is turned in to teacher)

1. Explain why acetone is used as the final rinse for both the Cu wire and the Ag crystals.

2. What is the color of the copper nitrate solution ? _____
Observe the tubes of the soluble copper compounds on the counter, $CuCl_2$ & $CuSO_4$.
State a hypothesis about the color of soluble copper compounds

3. You would not have seen a dielectric effect with the silver crystals and glass beaker unless you used rubber gloves. Why?

4. Look up the definition of the dielectric effect in a general science dictionary or physical chemistry book. Please write the definition.

5. Review your chapter on stoichiometry including Dalton's and Proust's laws. Now explain why your answers are ***NO*** in questions # 3 & 4 in the LAB WRITEUP.

6. If you wanted to conduct a theoretically complete reaction with the 10 cm of Cu wire, how much silver nitrate would you actually need? (show balanced formula and dimensional analysis calculations)

7. In the real world of both life and work why is it essential to calculate problems concerning limited reagents?

8. If 80 grams of ammonium phosphide are added to 80 grams of sodium oxalate determine:

a. The balanced equation:
_____

b. The limiting reactant
_____
___

c. The moles of sodium phosphide produced
_____

d. The grams of sodium phosphide produced
_____

e. The moles of ammonium oxalate produced
_____

f. The grams of ammonium oxalate produced
_____

g. Analyzing your data, what is your definition of a limiting reactant?
_____

_____
_____

_____
_____

h. Calculate the moles and then the mass of the excess reactant.

9. Name and describe the four major types of chemical stoichiometry you have or will be covering this quarter.

Make a flow chart for the lab:

Sample of Flow Sheet o