Juddo Abaker

calculations to determine the theoretical yield of Cu(s) from one of the reactions, and then compare the actual yield to determine the percent yield.

Procedure

1. Label two 250-mL beakers "1" and "2," respectively. Record the mass of beaker 1.
2. Measure out the following amounts of $CuCl_2 \cdot 2H_2O$, add to the beakers, and record the actual masses:
   - 0.50 g $CuCl_2 \cdot 2H_2O$ into beaker 1
   - 0.70 g $CuCl_2 \cdot 2H_2O$ into beaker 2
3. Add 50 mL deionized H_2O to each of the beakers; gently mix the solutions until the copper salt is completely dissolved.
4. Measure out the following amounts of aluminum foil and add to the beakers in small pieces; record the actual masses:
   - 0.25 g Al(*s*) into beaker 1
   - 0.05 g Al(*s*) into beaker 2
5. Inspect the contents of each beaker and record all observations (e.g., colors, smell, bubbling, heat formation, etc.).
6. Stir the contents of each beaker periodically with a glass stirring rod and record any changes you observe.
7. Once the reactions are complete (how do you know this?), record the colors of the beaker contents and any other observations.
8. In beaker 1, if excess aluminum foil is still observed, then in a hood, add 6 *M* HCl in small portions until the foil is completely reacted.
9. After allowing the solid copper product to settle, decant the solution, being careful to not lose any of the copper.
10. Wash the copper solid with 15 mL of deionized water, let solid settle, and decant; repeat once.
11. Wash the copper solid with 10 mL of methanol, let solid settle, and decant.
12. In the hood, heat beaker 1 containing the copper solid on a hot plate at a low setting until dry. *Note:* Avoid heating at high temperatures for longer periods of time, which may cause the unwanted oxidation of the copper product.
13. After cooling, record the mass of beaker 1 and its contents.
14. Now, take a third 250-mL beaker and add 0.70 g $CuCl_2 \cdot 2H_2O$ (record actual mass) and 50 mL deionized H_2O.
15. Determine how much Al(*s*) is needed (i.e., the stoichiometric amount) in order to completely react all of the $CuCl_2$. Measure this amount out (record mass) and add it to beaker in small pieces.
16. Record your observations initially, during the reaction, and at the conclusion of the reaction.
17. Dispose of the contents of the beakers as indicated by your instructor.

Data Collection

1. Mass of beaker 1: #1 111.92 g CuCl₂·H₂O   CuCl·H₂O 101.12 g #2

2. Mass of $CuCl_2 \cdot 2H_2O$:
   - Beaker 1: 50 mL CuCl2
   - Beaker 2: 50 mL CuCl2

3. Mass of Al(*s*):
   - Beaker 1: .19 g
   - Beaker 2: .6 g

4. Observations for reactions:

	Beaker 1	Beaker 2
Initial (immediately after being mixed)	bubblig All pie	bubbling All piece
Changes during reaction	gaining brown Spot	gaining brown Spot
After reaction is complete	No Reaction	No Reaction

5. Mass of beaker 1 + contents: 112.01 g
6. Mass of $CuCl_2{\bullet}2H_2O$: Beaker 3: ____
7. Mass of Al(*s*): Beaker 3: ____
8. Observations for reaction:

	Beaker 3
Initial (immediately after being mixed)	
Changes during reaction	
After reaction is complete	

Analysis

9. Beaker 1 calculations:

Moles of $CuCl_2{\bullet}2H_2O$: 2.5 mol

Moles of Al(*s*): .19 ÷ 27 = 0.0070 mol Cu

Moles of Cu(*s*) produced (theoretical): .00105 mol Cu

Mass of Cu(*s*) produced (theoretical): .0672 g Cu

Mass of Cu(*s*) produced (actual) = (#5) − (#1): 112.01 − 111.92 = 0.09 g Cu

Percent yield of Cu(*s*): 133.9 %

.007 mol | 3 mol / 2 mol = .00105 mol

$\frac{0.099}{0.0672} \times 100 = 133.9\%$

.00105 mol | 64 g / 1 mol = .0672

Cu = 64
2Cl = 70
2H = 4
2O = 32
170

10. Beaker 2 calculations: 50g CuCl2·2H2O | 1mol / 170g CuCl2·2H2O = .294117

Moles of $CuCl_2$•$2H_2O$: .294 mol

Moles of Al(*s*): .19g Al | 1mol / 27g A — 0.007 mol

Moles of Cu(*s*) produced (theoretical): .00105 mol Cu

Moles of $AlCl_3$ produced (theoretical): .222 mol

.6 / 27 =

~~11.~~ Beaker 3 calculations:

Moles of $CuCl_2$•$2H_2O$: __________

Moles of Al(*s*): __________

Moles of Cu(*s*) produced (theoretical): __________

Moles of $AlCl_3$ produced (theoretical): __________

Reflection Questions

1. For the reactions in beakers 1 and 2, each had a total mass of reactants of ~0.75 g.
   (a) Which combination of reactants (beaker 1 or 2) will produce the largest total number of moles of products? Explain. Beaker 2 will produce more product.

   (b) Which combination of reactants (beaker 1 or 2) will produce the largest total number of grams of products? Explain. Beaker 2. beaker 2 has more grams than product in beaker 1.

2. For each reaction, what observation(s) indicated that the reaction was complete? Also, why did each reaction stop—be specific?
   (a) Beaker 1: the bubbling stop. because the total amount of Al consum.

   (b) Beaker 2:

   ~~(c)~~ Beaker 3:

3. For each reaction, based on your calculations, which reactant was the limiting reactant? How did your observations for each reaction reinforce your answer?
   (a) Beaker 1: Al.

   (b) Beaker 2: Al.

   ~~(c)~~ Beaker 3:

4. Is it true that there is a limiting reactant present in *any* reaction that is run? Explain. yes. because of one reactan determine how far they go.

5. For the reaction in beaker 2, what experimental errors could have possibly contributed to your percent yield? if you heat the cupper too much to dry out. You may oxidize the copper the finnal weight greater thant what you weigh first.

6. If all water was removed from beakers 1 through 3, list the chemical species that would be left in the beakers:
   (a) Beaker 1: stop bubbling and going dry.

   (b) Beaker 2: stop bubbling and going dry.

   ~~(c)~~ Beaker 3:

Connection

Based on your experience in this lab, draw a connection to something in your everyday life or the world around you (something not mentioned in the background section):

On observation reaction will be visualize limiting and excess reactants.