

Introduction:

The **limiting reactant** in a chemical reaction is the reactant that will be consumed completely. Once there is no more of that reactant, the reaction cannot proceed. Therefore, it limits the reaction from continuing. The **excess reactant** is the reactant that could keep reacting if the other had not been consumed. There will be some excess reactant left over even after the reaction is complete.

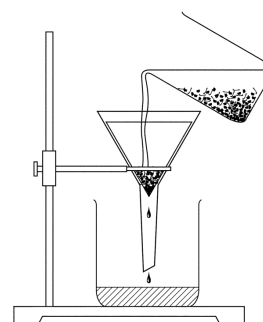
Objectives:

1. To observe the reaction between aluminum metal and a solution of copper (II) chloride; to observe a reaction between magnesium metal and a solution of hydrochloric acid (HCl)
2. To determine the limiting and excess reactants in both observed reactions
3. To complete stoichiometric calculations based on both observed reactions

Part I: Aluminum-Copper Replacement Reaction

Procedure:

1. Obtain a piece of aluminum foil and weigh the aluminum foil and record the mass in the data table provided.
2. Calculate the mass of copper (II) chloride needed to completely react the aluminum foil. Record this value. **Show your teacher for confirmation.**
3. To this calculated amount, add an extra 10%. (ex. If you need 1.0 g, add 1.1g) Record this value.
4. Put on safety goggles.
5. Obtain a clean, dry medium beaker.
6. Measure copper (II) chloride crystals in the empty beaker until you reach your predicted mass. **CuCl₂ is poisonous - wash any spills with plenty of water**
7. Carefully add water to the beaker containing the crystals until all the crystals are dissolved. *(the less water you add, the more concentrated your solution will be, the more reactive your reaction will be!)*
8. Loosely roll the aluminum foil into a tube and place the tube into the solution in the beaker.
9. Make and record qualitative observations.
10. Stir the mixture regularly with a stir rod to ensure that all the aluminum reacts.
11. Wait for the solid and liquid to visibly separate. *(What is the solid? What is the liquid?)*
12. Pour out the liquid into a separate beaker, being careful to leave the solid behind. The liquid may be discarded
13. To the beaker containing the solid, add water and rinse the solid until the water runs clear
14. Set up a filter apparatus *(see photo to the right)*
15. Weigh and record the mass of your clean, dry filter paper.
16. Pour the contents into the filter funnel and use a wash bottle to rinse all particles of copper from the beaker.
17. Place your product in the drying area designated by your teacher
18. THE NEXT DAY: Record the mass of the filter paper and residue. Contents may be discarded in the garbage.



Part II: Gas Production

Procedure:

1. Take the piece of provided magnesium metal – weigh and record mass on data table. Make sure that the mass is between 0.01 – 0.05g
2. Place the magnesium in the wire that is attached to the rubber stopper. Make sure it is secure by bending the wire or bending the magnesium metal.
3. Pour out a small portion (at least 10 mL) of 6.0M HCl acid into a small beaker.
4. Using a dropper pipette and graduated cylinder, measure 10.0 mL of the acid.
5. Discard any unused HCl down the sink with lots of water.
6. Add a few drops of food colouring to the acid in the graduated cylinder.
7. Over the sink, carefully transfer the acid from the graduated cylinder into the eudiometer.
8. Rinse out the graduated cylinder.
9. Fill a medium size beaker with water.
10. Over the sink, tip the eudiometer at an angle and slowly pour water from the beaker into the eudiometer until it is completely full.
11. Over the sink, place the rubber stopper into the mouth of the eudiometer so that the magnesium is in the solution.
12. Ensure that the rubber stopper is secure.
13. Slowly invert the eudiometer and place it in a medium beaker partially filled with water.
14. Rest the eudiometer in the ring stand.
15. As the reaction proceeds, note down qualitative observations.
16. Continue to observe the reaction until the amount of gas produced remains constant.
17. Record the mL (to 2 decimal places) of gas produced in the data table provided.
18. Remove the rubber stopper and carefully pour the contents of the eudiometer down the sink.
19. Wash your hands with soap and water, then give your partner(s) a high five