Classification of Matter and Chemical Changes

Background

Quantitative:

In Part A of this experiment you will observe a material and classify it as a pure substance, a homogeneous mixture, or a heterogeneous mixture. You will then perform a series of experiments on an unknown and classify the components as a pure substance, a homogeneous mixture, or a heterogeneous mixture while analyzing the unknown quantitatively.

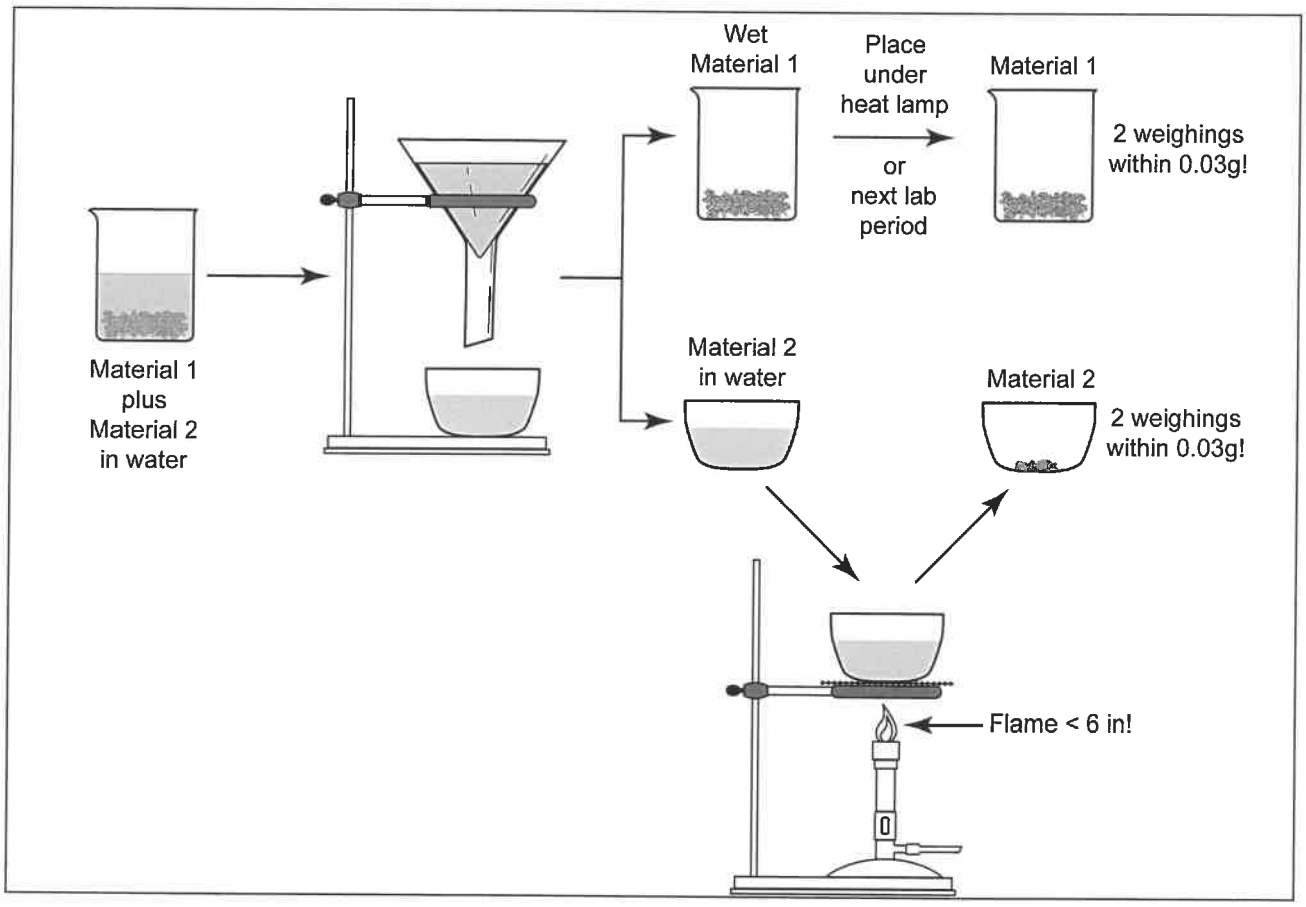


Figure 1–Overview of Part A

Qualitative:

In Part B of this experiment you will observe a pure substance and classify it as an element or a compound.

In Part C, you will use paper chromatography, a method of separation of mixtures based on the different solubilities of substances in the solvent (water in this case). You will be attempting to separate, then classify two different inks.

In Part D you will combine materials and determine if a chemical change (or reaction) occurs. Chemical changes are frequently characterized by one or more of the following observations:

Change in color
Heat produced or absorbed
Gas produced
Solid formed when two liquids are mixed

Procedure

Part A–Pure Substances, Homogeneous Mixtures, and Heterogeneous Mixtures

1. Obtain a plastic vial containing the unknown. Record the Unknown Number on the plastic vial on the report form. Remember to record all masses on the report form in the balance room. Do not try to remember the numbers or write on scratch paper. Weigh the plastic vial and its contents. Clean, dry, and weigh a 250 mL beaker. Transfer the unknown to the 250 mL beaker. Weigh the empty plastic vial. Observe the unknown and classify it as a pure substance, homogeneous mixture, or heterogeneous mixture.
2. Add 20 mL of deionized water to the beaker and mix with a stirring rod. If you don't have a stirring rod, make one.
3. Weigh and record the mass of a piece of filter paper. Clean, dry, weigh, and record the masses of a watch glass and evaporating dish separately.. Make sure you have an evaporating dish and watch glass that fit together so that the watch glass can be used as a cover for the evaporating dish (if not go to the stockroom and trade).
4. Filter the contents of the beaker as shown in Figures 2 and 3 below. You will need to rinse the solid in the beaker with deionized water squirted from your wash bottle. **Try to minimize the amount of water used. It is not necessary to get all of the solid onto the filter paper, but the solid should be rinsed well.** Collect the filtrate (the liquid that passes through the filter paper) in the evaporating dish. If the volume of filtrate is too much for your evaporating dish, collect the filtrate in another beaker.* You need to have a little space between the liquid in the evaporating dish and the watch glass cover while boiling in step 9.

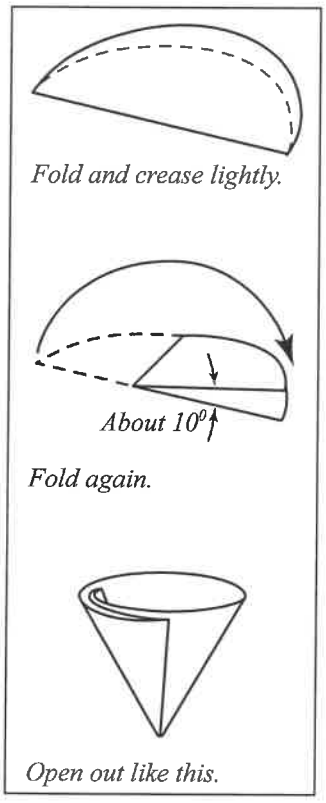


Figure 2–Folding filter paper for a snug fit in the funnel.

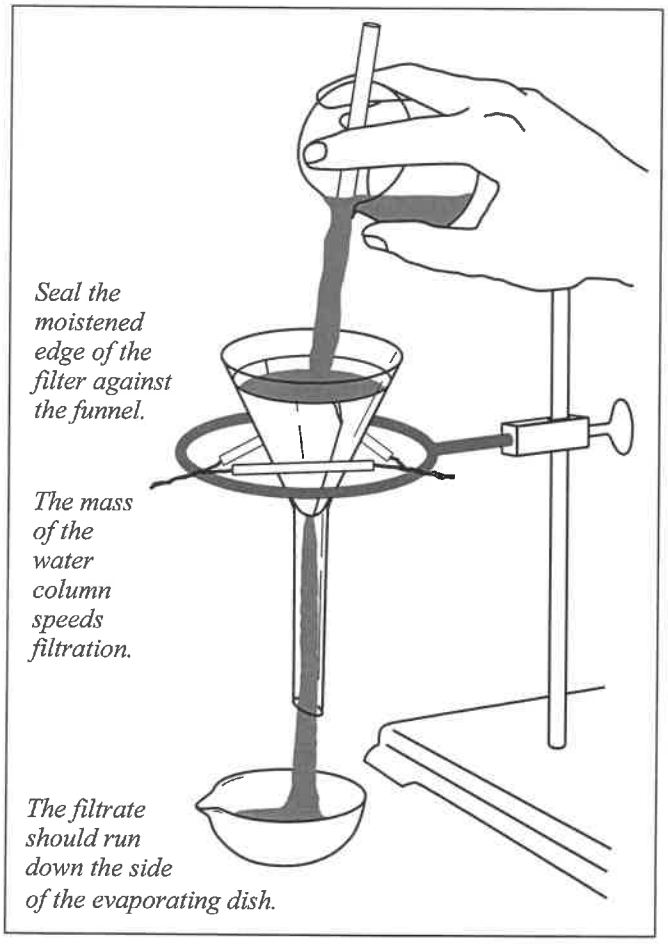


Figure 3–Filtering liquid.

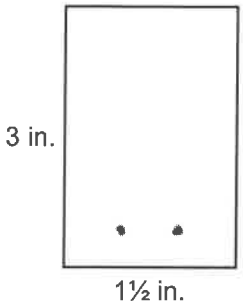
5. Examine and classify the material collected on the filter paper.
6. Transfer the filter paper and the contents (called Material 1) into the weighed 250 mL beaker. Place this beaker under the heat lamp and weigh near the end of the lab period. Record as Mass of beaker, filter paper and Material 1 first weighing.
7. Store the beaker uncovered in your lab drawer until the next lab period. Reweigh at the beginning of the next lab period (second weighing). If the two weighings differ by more than 0.03 g, place the beaker under the heat lamp for an hour. Reweigh and record as third weighing. Repeat heating and weighings until two successive weighings differ by no more than 0.03 g. Use the lower weight for your calculations.
8. After completing your calculations and showing your results to your instructor, dispose of filter paper and Material 1 in the trash.
9. Examine the filtrate and classify it.
10. Using a bunsen burner with ring stand and either clay triangle or wire gauze, **gently** boil the filtrate in the evaporating dish. (*If the volume of filtrate is too much for your evaporating dish, pour all filtrate back into beaker and boil the filtrate in beaker until the filtrate volume will fit into the evaporating dish. Before pouring into the evaporating dish, make sure to dissolve any crystals that have form on the sides of the beaker by stirring to dissolve the crystals with the stirring rod.)
11. Let the evaporating dish and watch glass cool on the ring stand. Never place a hot evaporating dish on the lab counter, as it will break! After the evaporating dish has cooled (so you can touch it), examine and classify the material left in the dish. Weigh the evaporating dish, watch glass, and contents (Material 2). Record as first weighing.
12. Heat for a few more minutes, allow to cool and weigh again (second weighing). If the two weighings differ by more than 0.03 g, repeat the heating, cooling, and weighing until the difference between successive weighings is less than 0.03 g.
13. After completing your calculations and showing them to your instructor, rinse and dispose of Material 2 in the sink.

Part B–Elements or Compounds

Obtain a few crystals (about the size of a raisin) of the substance labeled copper(II) sulfate pentahydrate, $CuSO_4 \cdot 5H_2O$ in a medium test tube (sometimes labeled cupric sulfate pentahydrate). Make observation of the substance. Using a test tube holder, gently heat in the flame of a Bunsen burner for a few minutes. Do not over heat. Allow it to cool and observe again. Thinking about your observation while heating, classify the original crystals as an element or a compound. Dispose of the remaining substance by adding water, stirring and emptying into aqueous metal waste.

Part C–Homogeneous Mixtures and Pure Substances

Cut a piece of filter paper 1 ½ in by 3 in. Obtain two different brands of black marking pens. Make a **small** dot about ¾ in from the bottom of filter paper as shown.



Make a second dot with the second pen. Tape the top of the paper to a stirring rod and suspend across the top of a beaker having enough water in it so that it just covers the bottom edge of the paper. Let the system stand until water has moved at least ¾ of the way up the filter paper. Remove the paper from the beaker and examine it.

Classify the **original** ink in each pen as a homogeneous mixture or a pure substance.

Part D–Observing Chemical Changes

Perform the following and record your observations:

1. Mix a squirt of 6M sodium hydroxide, NaOH, with a squirt of 6M hydrochloric acid, HCl, in a medium test tube. Feel the bottom of the test tube with your hand. Pour the liquid in the test tube into the neutralizing bucket in the hood sink.
2. Mix 10 drops of 6 M NH_3 (aqueous ammonia) with 20 drops of 0.1 M $Co(NO_3)_2$ (cobalt nitrate) in a medium test tube. Observe. Discard in the Aqueous Metal Waste container.
3. Using a scoopula place a small amount of sodium hydrogen carbonate (or sodium bicarbonate) in a test tube. Holding the test tube with a test tube holder, add about 20 drops of 6M hydrochloric acid, HCl, **slowly** to the test tube. Observe. Pour the liquid in the test tube into the neutralizing bucket in the hood sink.
4. Mix 10 drops of 0.1 M barium chloride ($BaCl_2$) and 10 drops of 0.1 M sodium sulfate ((Na_2SO_4)) in a medium test tube. Observe. Discard in the Aqueous Metal Waste container.