SCH 3U

**MICROSCALE GAS CHEMISTRY**

Purpose: To investigate several properties of gases.

Materials: safety glasses clear plastic cup plastic weighing boat

 60 mL syringe syringe cap vial cap

 500 mL Erlenmeyer flask 10 mL graduated cylinder candle

 stir rod latex tubing

 vinegar NaHCO3 limewater

 Universal indicator

Procedure:

1. Move the syringe plunger up and down a dozen times to make sure it is moving easily, more if it is new.
2. Weigh out 0.22 g NaHCO3 in the vial cap.
3. Remove the plunger of the syringe, put your finger over the opening where the needle would be, and fill the syringe barrel with water. Float the vial cap on the water’s surface, and remove your finger to release the water and lower the vial cap into the syringe barrel. For this to be successful, the cap should rest upright on the bottom of the syringe with all of the reagent still in the cap. Keep the syringe in this vertical position. If you need to set it down, put it into an Erlenmeyer flask.
4. Install the plunger while maintaining the syringe in a vertical position. The plunger should fit snugly against the rim of the vial cap. Use a graduated cylinder to pour about 5 mL of vinegar into the weighing boat. Draw the vinegar into the syringe while the syringe stays vertical. The vial cap should float on the solution.
5. Push the latex syringe cap over the hole in the syringe. Place the syringe in the plastic cup which serves as a splash shield. Hold the syringe and cup together with the same hand and shake the device up and down in order to mix the reagents. Gas generation will commence and the syringe plunger should rise. It may be necessary to gently help the plunger move up the barrel.
6. After the plunger has reached 50 mL (or before this if the reaction has ceased), tip the syringe so that the plunger points downwards and the syringe cap is up. Carefully remove the syringe cap, then quickly turn the syringe opening downward into the plastic cup and discharge the excess liquid into the cup without letting the gas escape. **Caution: Never remove the syringe cap with the cap end of the syringe directed downward – the reagents will spray out of the syringe.** Immediately cap the syringe to prevent loss of gas. Repeat steps 1-6 as needed to make more carbon dioxide.
7. ***Reaction with limewater***: Remove the syringe cap and attach a 15 cm length of latex tubing to the syringe. Pour a few mL of limewater (Ca(OH)2) into a plastic cup or beaker. Bubble some of the CO2 into the limewater. Record your observations. Recall that this is the test for whether a gas is CO2.
8. ***Flame –out!***: Tape a small birthday candle to a glass stirring rod as shown. Hold the syringe with the plunger pointing up and remove the plunger, but not the syringe cap. Ignite the candle and lower it into the syringe barrel. Record your observations.
9. ***pH of CO2***: Fill a plastic cup to within 1 cm of the top with distilled water. Add several mL of Universal indicator solution. DO NOT STIR. Set the cup near a bottle of strong ammonia solution, remove its cap and cup your hand over the bottle opening. Because ammonia is less dense than air, your cupped hand will fill with gaseous ammonia. Carefully move your cupped hand over to the filled plastic cup, and make very close, but not direct contact with the water. Look at the layers of colour from the side of the cup. The ammonia (a base) readily dissolves in water. What do you observe to confirm this? Carbon dioxide is more dense than air. Remove the syringe cap and SLOWLY discharge some CO2 directly onto surface of the dilute NH3 solution. Look at the layers of colour from the side of the cup. What do you observe?
10. Dispose of all solutions down the drain. Wash out and return all equipment, including the plastic cups and weighing boats.

Discussion:

1. Why do you think that 0.22 g of NaHCO3 was used to generate the CO2?
2. Write the balanced reaction equation for the generation of CO2 gas.
3. Write the balanced reaction equation for carbon dioxide and limewater.
4. Why did the candle flame go out in step 8? What property of carbon dioxide does this demonstrate?
5. What property does carbon dioxide have when dissolved in water?