Gas Law Lab Name:_____P___

You will perform three separate experiments to learn about Boyle's, Charles', and Gay-Lussac's Laws. A variable will be changed to measure or observe how it affects the other variable in the Gas Laws.

Marshmallow

1. Place 2 small marshmallows into an empty syringe.
2. Insert the plunger of the syringe to about the 15 mL mark.
3. Cover the tip of the syringe with your finger and pull the plunger. Make sure not to pull the plunger out all the way.
4. Observe what is occurring to the marshmallows.
5. Return plunger to original location and release finger on the tip of syringe.
6. Pull syringe to the 60ml mark.
7. Cover the tip, and push down on plunger to about the 30ml mark.
8. Observe what is occurring to the marshmallows.
9. Return plunger to original location and release finger on the tip of syringe.
10. Throw the marshmallows in to the trash.

Soda Can

1. Fill your tub two–thirds full with cold water.
2. Set up your hot plate.
3. Pour 5-10ml of water into the empty soda can.
4. Set the can on the hot plate and allow the water to boil. You will know it's boiling when you see steam coming out of the top. Allow it to boil for 1 more minute.
5. Now, with tongs in your hand and your palm face up, grab the can at the bottom with the tongs, and in one swift motion, lift the can from the burner and turn it upside down into the tub of cold water.
6. Observe what happens.

Test Tube

1. Fill a medium sized test tube to the top with tap water.
2. Push the rubber stopper into the top of test tube. Some water may gush out. This is OK. Just dry off the outside of the tube. Check to be sure there are no air bubbles trapped below the stopper. The hole in the rubber stopper needs to also be completely filled with water.
3. Carefully remove the stopper, so that the water in the stopper drips into the test tube.
4. Measure the volume of water in the test tube by using a <u>50 ml graduated cylinder</u>. Record the total amount of water your test tube can hold. Total volume of my test tube is _____ml (Use 3 significant figures!)

   This volume is equal to the volume of air the test tube can contain.
5. Dry the empty test tube thoroughly and push the rubber stopper into the test tube.

6. Fill a 100ml or 150 ml beaker with approximately 60 ml of tap water. Place it on the hot plate. Turn on the heat on the hot plate to setting 7 or 8.
7. Bringing the water in the beaker to a boil. Keep the test tube submerged in the beaker. This will serve to heat the air in your empty test tube. You may need to keep the test tube submerged using a test tube holder.
8. After 4 minutes of boiling, place your thermometer in the hot water bath and measure the temperature of the water. Keep your test tube in your water bath while you are recording the temperature. Do not allow the thermometer to touch the sides or bottom of the beaker.
   Record the temperature of the hot water: _____ ^{o}C which is _____ K
9. While your test tube remains in the hot water, fill a plastic pneumatic trough approximately 1/3 full with cool tap water.
   Record the temperature of the cool water: _____ ^{o}C which is _____ K
10. You are now going to transfer your test tube from the hot water into the cool water. To do this, hold your finger over the opening of the test tube. Quickly lift the test tube out of the boiling water. Immerse it completely in the cool water in the pneumatic trough. It works best if you lay the test tube horizontal under the water.
11. Once you have completely immersed the test tube, remove your finger from covering the opening of the test tube. You will see water gush into the test tube. Hold the test tube under the water for two minutes. You may then assume the air in the test tube is at the temperature of the cool water in the trough.
12. Press a finger firmly over the end of the test tube so that no water escapes. Remove the test tube from the water and measure how much water is inside the test tube using a 50 ml graduated cylinder.

    Volume of water inside test tube: _____ ml (Use 3 sig figs)

Questions and Analysis: Just turn this portion in, not the instructions Name:_____P____

Marshmallow:

1. State the Boyle's Law in words

2. As you pushed the plunger in the syringe, the Temperature//Pressure//Volume (circle one) Increased//Decreased. (circle one)
3. Why was it hard to push the plunger when the tip was covered? Why did you feel resistance?

4. Why was it hard to pull the plunger when the tip was covered? Why did you feel resistance?

5. Did the number of gas particles in the syringe change during either experiment? – How do you know?

6. Marshmallows have bubbles of air trapped inside. How was the pressure and volume of the gas in these bubbles of air involved in what you observed happen to the marshmallow?

Soda Can

1. State the Gay-Lussac's Law in words.

2. When the water in the can was heating up, what happened to the temperature inside the can? What about the pressure inside the can, compared to the pressure outside? (hint: the can is open, and not closed...)

3. As the can was submerged in water, what happened to the temperature inside the can? What happened to the pressure inside the can, compared to the pressure of the outside?

4. Using what you know about the difference in pressure, explain what force crushed the can inwards.

Test Tube

1. State the Charles' Law in words, AND an equation.

2. What was the volume of air that was found in the test tube, with the rubber stopper? How were you able to measure this volume?

3. What was the new volume of air found in the test tube as it cooled down? How were you able to measure this volume? (Hint: It involves subtracting the volume of water that was drawn into the test tube)

4. Using the temperature of the hot water and the cool water, set up the Charles law equation to find the theoretical volume of the test tube (V_2). V_1 is from #2, and T_1 is hot water temp, T_2 is the cool water temp. Show work.

5. Find the percent error using the theoretical volume (from question #4) and experimental volume (question #3). $\frac{|Theoretical\ V2 - Experimental\ V2|}{Theoretical\ V2} x\ 100\%$ = Percent Error