Ms. Randall
Regents Chemistry
Lab Activity: Gas Laws

Background: In a gas, particles are spread far apart; therefore a gas takes up more volume than a solid or a liquid. For example, water in the form of steam takes up about 2000 times the volume that the same amount of water does in liquid form. There are many formulas to describe the behavior of a gas under certain conditions. Boyle's law ($P_1V_1=P_2V_2$) states that the pressure is inversely proportional to the volume. Charles law ($V_1/T_1=V_2/T_2$), states that volume is directly proportional to temperature. Gay-Lussac's Law ($P_1/T_1 =P_2/T_2$) states that pressure is directly proportional to temperature. Applying these laws together gives us the combined gas law:

$$\frac{P_1V_1}{T_1}=\frac{P_2V_2}{T_2}$$

Objective: To observe gas laws in action!

Safety: Goggles

Materials: syringe, soda can, Bunsen burner(hot plate), iron ring, wire gauze, matches, large beaker(600mL), ice, mini marshmallows, shaving cream, vacuum pump, pen, tongs, medium size balloon, 250 ml flask, small balloon filled with air.

Pre-Lab:

1. A cylinder with a movable piston contains a sample of gas having a volume of 6.0 liters at 293 K and 1.0 atmosphere. What is the volume of the sample after the gas is heated to 303 K, while the pressure is held at 1.0 atmosphere?

Part I. Soda Can Crush

Procedure:
1. Obtain a large beaker (600 mL) and fill it ¾ full with COLD tap water.
2. Obtain an aluminum can and add 7-10mLs of water.
3. Place the can on a heating set up (hot plate or wire gauze/ring stand) and heat until a steady stream of steam flows out of the can.
4. Using beaker tongs grab the aluminum can near the bottom of the can and quickly turn it upside down into the beaker of water.
5. Observe. Lift can out of beaker of water. Observe.

Analysis:

1. What happened to the can?

2. What did you observe when you removed the can from the beaker?

3. Fill in:

When the can was heated, the water turned to _____, which takes up _____(more/less) volume than liquid water. When the can was inverted into the water in the beaker, this created a closed system. The temperature inside the can _____(increased/decreased), causing the steam to change from gas state to _____state. A partial vacuum was created causing the pressure inside the can to be _____(greater/less) than the pressure outside the can. Therefore, the can filled with water from the beaker.

Part II: A Happy Marshmallow

Procedure

1. Take a mini marshmallow and draw a smiley face on one side with the felt tip pen provided.
2. Take the syringe and remove the plunger using a twisting motion.
3. Insert the mini marshmallow and put the plunger back but DO NOT squish the marshmallow!!!
4. Push the plunger down until it almost touches the marshmallow. Put your index finger on the pointy opening of the syringe so that it is airtight. With your other hand, pull the plunger out (slowly) and observe the smiley face.
5. Release your index finger. Note what happens to the marshmallow.
6. Pull the plunger out to near the top of the syringe. Again, put your index finger over the pointy end opening to make it airtight and use your other hand to slowly push the plunger in toward the marshmallow. Observe the smiley face.
7. Release the pressure by removing your index finger. Observe what happens to the marshmallow.

Analysis:

1. What is the relationship you observed between volume and pressure?

2. In terms of the kinetic molecular theory, what is happening to the particles as the pressure varies?

Part III: Pump it!

Procedure:

1. Using the vacuum pump, investigate the effects of pressure changes on a small balloon and shaving cream.

Observations:

	Balloon	**Shaving cream**
After removing air		
After allowing air back in		

Analysis:

1. Describe the relationship observed between pressure and volume.

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Lab conclusion: Gas Laws

1. **Write a paragraph summarizing what you have learned about the scientific concept of the lab from doing the lab. Back up your statement with details from your lab experience.**

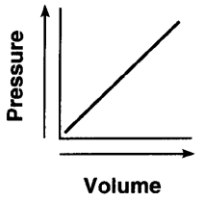
2. **When a sample of a gas is heated at constant pressure, the average kinetic energy of its molecules**

   A) decreases, and the volume of the gas increases
   B) decreases, and the volume of the gas decreases
   C) increases, and the volume of the gas increases
   D) increases, and the volume of the gas decreases

3. **Under which conditions of temperature and pressure does oxygen gas behave least like an ideal gas?**

   A) low temperature and low pressure
   B) low temperature and high pressure
   C) high temperature and low pressure
   D) high temperature and high pressure

4. **Which graph represents the relationship between pressure and volume for a sample of an ideal gas at constant temperature?**

a.


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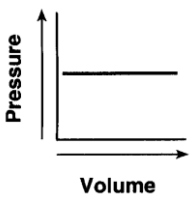

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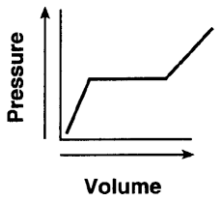

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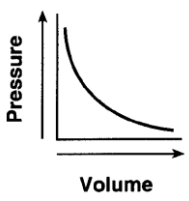
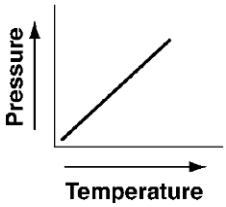


5. **Which graph shows the pressure-temperature relationship expected for an ideal gas?**

a.


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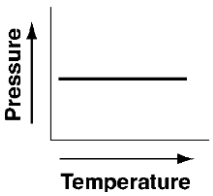

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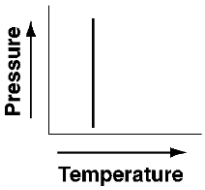

d.