**Charles’ Law**

Lab Question: What are the relationships between changes in volume, temperature and pressure according to the combined gas law?

**Introduction:**

 According to the kinetic-molecular theory, an increase in temperature will cause the molecules of a gas to move faster and exert more pressure, or cause the gas to expand. Conversely, as a gas is cooled, the molecules will move more slowly and the gas will contract, or exert less pressure. In other words, the volume of a gas increases as temperature increases if the pressure remains constant. This relationship between the volume of a gas and its temperature is known as Charles’ Law.

 In this experiment you will study the effects of temperature on gas volume.

Data Table

|  |  |
| --- | --- |
| Initial temperature of air (warm) **T1** |  |
| Final temperature of air (cool) **T2** |  |
| Volume of water in flask (after experiment) |  |
| Total volume of flask **V1** |  |

**Safety:**

* Goggles and aprons are required.
* Be careful with the hot plate as with all electrical equipment.
* Be aware that hot glassware does not look hot.

**Procedure:**

* 1. Using a beaker, tap water and hot plate, set up a hot-water bath but do not plug in the hot plate yet.
* 2. Using a ring stand and clamp, suspend your Erlenmeyer flask into the hot-water bath.
* 3. Using your one-hole rubber stopper with glass tube insert, stopper your Erlenmeyer flask.
* 4. Turn on your hot plate – 6 or 7 setting.
* 5. Using your thermometer, take the temperature of the water after it has begun to fully boil. Record. (This is your **T1**.)
* 6. Let the hot-water bath boil for at least 5 minutes.
* 7. Using tap water, fill your pneumatic trough if not done so already from last period.
* 8. Using a towel to protect your hand, remove the flask from the hot-water bath while holding your finger over the hole of the glass tube insert.
* 9. Submerge your Erlenmeyer flask upside down into your pneumatic trough (bucket o’ water) and once underwater let your finger go.
* 10. Keep the Erlenmeyer flask upside down until water has ceased to enter and the flask is cool.
* 11. Once the flask is cool level the water inside the flask with the water outside the flask and once again put your finger over the hole of the glass tube insert.
* 12. Remove the flask from the pneumatic trough, invert and place on your lab bench. Now you can remove your finger.
* 13. Using your china marker, mark the bottom of the rubber stopper before removing it.
* 14. Using your thermometer, measure the temperature of the water in the flask. Record. (This is your **T2**.)
* 15. Using your graduated cylinder, measure the water in the flask. Record. (This water can now be poured down sink.)
* 16. Now fill the flask with tap water up to the mark you made.
* 17. Using your graduated cylinder, measure the water in the flask. Record. (This is your **V1**.)

**Calculations:**

1. Convert both temperature readings into Kelvin.

Add 273 to the Celsius temperature

*K = C + 273*

1. Final volume of the gas **V2**

Subtract the volume of water in flask (after experiment) from the total volume of flask.

*Total volume of flask – Volume of water in flask (after experiment)*

**Graph:**

Make a temperature vs volume graph.

**Interpolate** *between* the data points with a solid line.

**Extrapolate** *beyond* the data points with a dashed line.

**Extra Credit:**

Answer the Lab Question in a minimum of 100 words in a paragraph or two.