Dougherty Valley HS Chemistry **Name:**
Charles' Law: The effect of Temperature on Volume **Date:**
Period:

Introduction:
According to the **Kinetic Molecular Theory**, an increase in temperature will cause the molecules of a gas to move faster, exert more pressure, and cause the gas particles to move further apart. Conversely, as a gas is cooled, the molecules will move more slowly, exert less pressure, and take up less space. In other words, the volume of a gas increases as the temperature increases if the pressure remains constant. This relationship between the volume of a gas and its temperature is known as Charles' Law.

Purpose: You will study the effects of temperature on a gas volume and use the Charles' Law equation.

Objectives:
1) Determine the effect of temperature on the volume of a gas when pressure is constant
2) Use your volume and temperature data to calculate a constant, K, showing the relationship between these values.

Background: Answer the following questions in your typed report.
1) Write down the equation for Charles' Law, what each variable means, and the units for each one.
2) What does Charles' Law state? What quantity must be constant for this law to work
3) Explain how you convert temperature in °C to Kelvins

Materials:

250 ml Erlenmeyer flask	Rubber stopper with hole for tubing
600 ml beaker	Graduated cylinder (50 or 100 ml)
Bucket	Glass tubing for stopper
Hot plate	Buret clamp

Procedure:
1. Record the atmospheric pressure.

2. Set up the apparatus as shown in the front of classroom. Obtain a 600 ml beaker and add approximately 250 ml of tap water. Obtain a 250 ml Erlenmeyer flask. Place a one-hole stopper fitted with a glass tube in the flask and place the flask in the beaker as shown in the front of class.

3. Heat the water to boiling. Record this temperature as T_1 in your data table. Continue heating at this temperature for 3-5 minutes. Lower the setting on the hot plate if necessary.

4. Remove the flask from the beaker. Protect your hand with a towel while placing your finger firmly over the end of the glass tubing. **CAUTION**: **Flask in hot**. Submerge the flask in the bucket as directed. (Do not allow air to enter the flask while transferring)

5. Remove your finger from the glass tubing and hold the flask under water (with open end down) until the flask has cooled and the water ceases to enter. Raise the flask (glass tube down), until the water level inside is equal to the water level outside as directed. **Pressure inside the flask is now equal to the atmospheric pressure**.

6. Place your finger over the glass tubing while the outside and inside water levels are equal. Remove the flask and place it in an upright position on your lab table **before** removing your finger. Measure the temperature of the water in the flask and record at T_2. Measure the volume of the water in the flask with a graduated cylinder. Record the volume of water in the flask in your data table.

7. Refill the flask with tap water to the top and put the rubber stopper back on. Remove the stopper and measure the remaining volume of water in a graduated cylinder and record it as the total volume of the flask.

8. Repeat the procedure using different temperature: **Trial 2 (60 °C)** and **Trial 3 (10 °C)**

Analysis:

1. Use the following table to record your experimental data.
2. To convert temperature and pressure to standard units use the following conversions:

K = °C + 273
101.3 kPa = 760 mm Hg

Table 1

	Trial 1	**Trial 2**	**Trial 3**
Initial temperature of air inside the flask (**T_1**)	_____ °C _____ K	_____ °C _____ K	_____ °C _____ K
Final Temperature of air inside flask (**T_2**)	_____ °C _____ K	_____ °C _____ K	_____ °C _____ K
Total volume of flask (**V_1**)			
Volume of water in flask after experiment			
Final Volume of gas (**V_2**)			

3. Create a graph of your data by plotting temperature (K) on the horizontal axis and volume (ml) on the vertical axis for each trial.
    a. Extrapolate to locate the temperature at which the volume would be zero for each trial.
    b. Data from all three trials may be plotted on the same graph.
    c. Distinguish between trials by plotting data from each trial with different colored lines and symbols for the data points (example, Trial 1 = triangles, Trial 2 = squares, Trial 3 = circles).
    d. Be sure to make a key, label your axis, include units and have a title.

Question Set:
You MUST answer in COMPLETE sentences!

1. Look at your graph of temperature vs. volume. In your own words, explain the relationship that exists between the two variables. What is the general equation for this relationship?

2. Explain at least 3 sources of error that took place in the experiment. Support with evidence.

3. How would your data be affected if you did not equalize the pressure in Step 6?

4. Did water enter the flask in all trials? If not, explain the results using Charles' Law.

5. In a detailed description, how did this experiment illustrate Charles' Law?

6. What should you have learned from this experiment regarding Charles' Law?

7. At what temperature (in Kelvins) will the volume of gas be zero?

Your report should be typed/included/stapled in the following order:

1) Grading rubric
2) This lab sheet with your data table filled out
3) Graph
4) Background questions – typed (you may hand write equations only, if you don't know how to type them)
5) Question Set - typed