LESSON 54 CLASSROOM

Sorry, Charlie
Charles's Law

Name _____

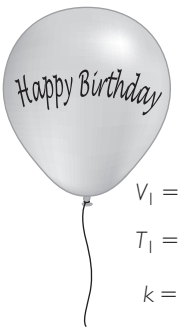
Date _____ Period _____

Purpose

To calculate changes in the volume of a gas as they relate to temperature changes.

Questions

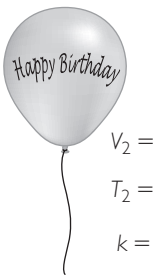
1. A Happy Birthday balloon is filled with three breaths of air. It has an initial volume, V_1, of 400 mL at the initial temperature, T_1, of 285 K. The air in the balloon is cooled to 265 K and the volume decreases. Next, the air in the balloon is heated to 300 K and the volume increases. Calculate the missing values for the birthday balloon.



$V_1 = 400$ mL

$T_1 = 285$ K

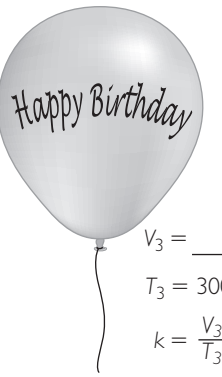
$k = \frac{V_1}{T_1} =$ _____



$V_2 =$ _____

$T_2 = 265$ K

$k = \frac{V_2}{T_2} = 1.4°$ mL/K



$V_3 =$ _____

$T_3 = 300$ K

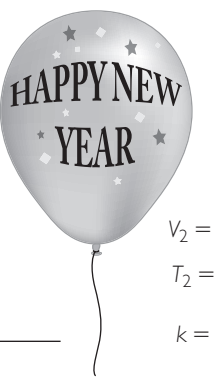
$k = \frac{V_3}{T_3} = 1.4°$ mL/K

2. A New Year's balloon is inflated with five breaths of air. It has an initial volume of 600 mL at 285 K. It is heated to a temperature that changes the volume of air in the balloon to 630 mL. Next the air in the balloon is cooled to 265 K. Calculate the missing values for the New Year's balloon.

$V_1 = 600$ mL

$T_1 = 285$ K

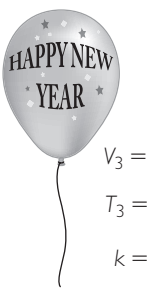
$k = \frac{V_1}{T_1} =$ _____



$V_2 = 630$ mL

$T_2 =$ _____

$k = \frac{V_2}{T_2} =$ _____



$V_3 =$ _____

$T_3 = 265$ K

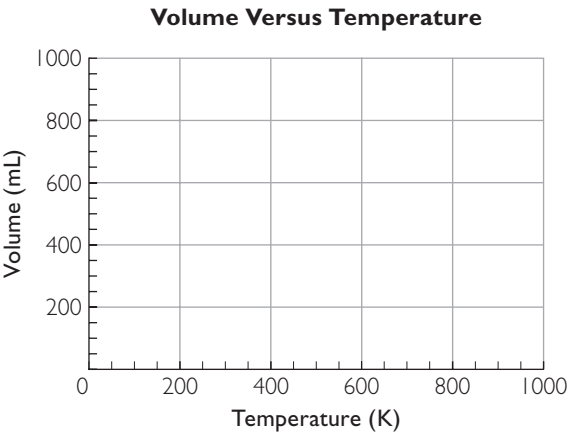
$k = \frac{V_3}{T_3} =$ _____

3. The volume of a sample of gas is proportional to its temperature in kelvins but the volume is *not* proportional to its temperature in degrees Celsius. Use data from Question 1 to provide evidence to support this assertion.

$T_1 =$ $T_2 =$ $T_3 =$

$k = V_1/T_1 =$ $k = V_2/T_2 =$ $k = V_3/T_3 =$

4. Plot volume versus temperature in kelvins for the Happy Birthday balloon and the New Year's balloon on the graph. Label each line.



5. Use the graph to find the approximate volume of the Happy Birthday balloon and the New Year's balloon at a temperature of 400 K.

6. Why do you suppose the Happy Birthday balloon has a different proportionality constant, *k*, than the New Year's balloon?

Problem Solving

(Remember to *always* convert temperatures to the Kelvin scale.)

1. The beginning volume of a gas is 500 mL at 20 °C. The temperature is raised to 35 °C. What is the new volume of the gas?

2. **Making Sense** Suppose you have a Valentine's Day balloon with a volume of 300 mL at 300 K.
   - **a.** Is the proportionality constant larger or smaller than that for the birthday balloon?
   - **b.** At the same temperature, which balloon is smaller, the Valentine's Day balloon or the New Year's balloon?

3. **If You Finish Early** On the graph of volume versus temperature for a gas, what does the slope of the line relate to?