LESSON 61 CLASSWORK

What Goes Up
Combined Gas Law

Name _____

Date _____ Period _____

Purpose

To explore what happens when the temperature, pressure, and volume of a gas all change at the same time.

Tracking the Volume of a Weather Balloon

A weather balloon is filled to a volume of 12,500 L at sea level. The air pressure is 1.0 atm and the temperature is 290 K. These starting values are listed in the bottom row of the table.

Altitude (ft)	Temperature (°C)	Temperature (K)	Pressure (atm)	Volume (L)
40,000 ft	−57 °C		0.20 atm	
30,000 ft	−45 °C	228 K	0.30 atm	33,000 L
25,000 ft	−35 °C		0.40 atm	
10,000 ft	−5 °C		0.70 atm	
5,000 ft	5 °C		0.80 atm	
0 ft	17 °C	290 K	1.0 atm	12,500 L

1. What is the value of *PV/T* at these beginning conditions?

2. **Example:** The balloon is released and travels to an altitude of 5,000 ft. Here is how the value of *PV/T* can be used to calculate the volume of the balloon under these new conditions:

$$k = \frac{P_1 V_1}{T_1} = \frac{(1.0\ \text{atm})(12{,}500\ \text{L})}{290\ \text{K}} = 43\ \frac{\text{atm} \cdot \text{L}}{\text{K}}$$

$$k = \frac{P_2 V_2}{T_2}$$

$$43\ \frac{\text{atm} \cdot \text{L}}{\text{K}} = \frac{(0.80\ \text{atm})(V_2)}{278\ \text{K}}$$

$$V_2 = 15{,}000\ \text{L}$$

Write this new volume in the table.

3. Did the volume of the balloon increase or decrease when it rose to 5,000 ft? Explain why.

4. Calculate the rest of the values that are missing in the table. Fill in the table with your answers.
5. What is the value of *PV/T* at sea level? at 25,000 ft? Explain why this number is useful in your calculations.

6. Suppose a second weather balloon is filled with 25,000 L of helium at 290 K and 1.0 atm. What is the value of the proportionality constant for this balloon?

7. **Making Sense** What happened to the volume of the balloon as it rose? What explanation can you offer for this?

8. **If You Finish Early** Suppose a weather balloon is designed to burst when the volume expands to 40,000 L.
   a. For a balloon filled at sea level with 12,500 L of helium, use the table to estimate the altitude at which the balloon will burst.

   b. If this same balloon is filled at sea level with 25,000 L of helium, will it burst at the same altitude, a higher altitude, or a lower altitude than if it started with 12,500 L of helium? Support your answer with a calculation.