LESSON
59
CLASSWORK

Egg in a Bottle
Gay-Lussac's Law

Name ____________________

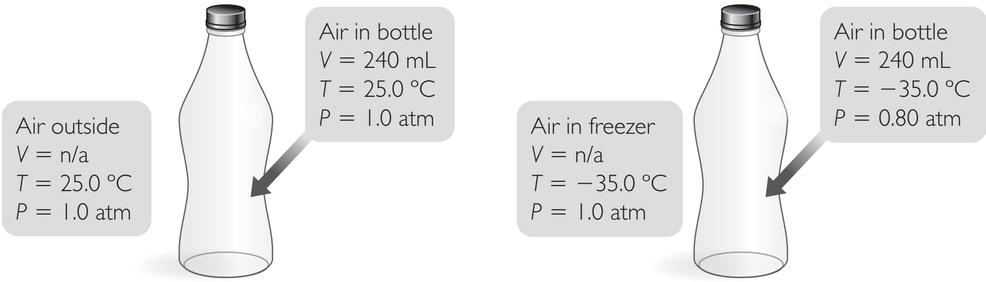
Date __________ Period ______

Purpose

To examine how gas pressure changes in flexible and rigid containers.

Part 1: Glass Bottle (Rigid Container)

The air trapped inside a 240 mL glass bottle has a pressure of 1.0 atm and a temperature of 25.0 °C. You put the glass bottle into a freezer. After several hours, the air trapped inside the bottle has a temperature of −35.0 °C and a pressure of 0.80 atm.



1. When the glass bottle is put into the freezer, how does the air trapped inside the bottle change? How is it the same?

2. Determine the value of *k* for the air trapped inside the glass bottle before and after cooling to show that *P* equals *kT*.

3. The table shows data for the glass bottle in four locations. The atmospheric pressure stays unchanged at 1.0 atm, but the temperature is different at each location.

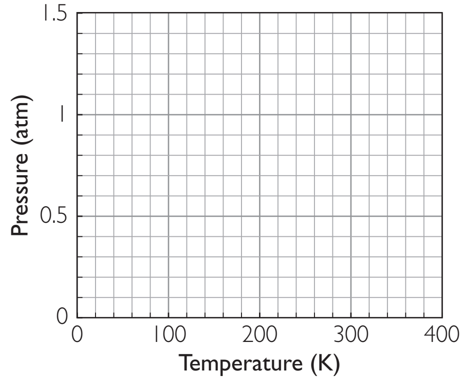
a. Complete the table.

Air outside the bottle			Air inside the bottle			
V (mL)	**T (K)**	**P (atm)**	**V (mL)**	**T (K)**	**P (atm)**	**P/T**
N/A	200 K	1.0 atm	240 mL	200 K	0.67 atm	

Air outside the bottle			Air inside the bottle			
V **(mL)**	***T*** **(K)**	***P*** **(atm)**	***V*** **(mL)**	***T*** **(K)**	***P*** **(atm)**	***P/T***
N/A	238 K	1.0 atm	240 mL	238 K	0.80 atm	
N/A	298 K	1.0 atm	240 mL	298 K	1.0 atm	
N/A	400 K	1.0 atm	240 mL	400 K	1.34 atm	

b. Plot pressure versus temperature for the air inside the glass bottle at each location. Draw the best-fit line through the data points to determine the pressure inside the glass bottle if the temperature is 350 K.

Pressure Versus Temperature
Gas Inside a Glass Bottle



4. A sample of chilled air from a freezer is sealed up inside a glass bottle with a volume of 240 mL. This bottle is then allowed to warm to room temperature. What is the air pressure inside the bottle at 25 °C? Show your work.

Air in the bottle in the freezer

P_1	1.0 atm
T_1	−35 °C
V_1	240 mL

Air in the bottle in the room

P_2	—?—
T_2	25 °C
V_2	240 mL

Part 2: Car Air Bag (Flexible Container)

Identical air bags inflate in two different cars. One car is at sea level, and the second car is in the mountains. The temperature, pressure, and volume of the air outside the air bag and of the gas inside the air bag are given in the table.

	Air at sea level	Gas in airbag at sea level	Air on mountain	Gas in airbag on mountain
V	–	60.0 L	–	86.0 L
T	25.0 °C	25.0 °C	25.0 °C	25.0 °C
P	1.0 atm	1.0 atm	0.70 atm	0.70 atm

1. Consider the gas trapped inside the air bag. How do the volume, pressure, and temperature of the gas change as you go from sea level to the mountaintop?

2. Why is the volume of the air bag different in the two locations?

3. Show that the pressure of the gas in the air bag is inversely proportional to the volume of the gas in the air bag (Boyle's law).

4. A different car has an air bag that inflates to 60 L on the mountaintop, where the air pressure is 0.70 atm and the temperature is 25 °C. What volume will this air bag have at sea level?

Mountaintop

P_1	0.70 atm
T_1	25 °C
V_1	60.0 L

Sea level

P_2	1.0 atm
T_2	25 °C
V_2	—?—

5. Making Sense Compare a rigid container, such as a glass bottle, with a flexible container, such as an air bag. Describe how the type of container affects how the pressure of the gas inside the container can vary.