

## Under Pressure – Sample Data & ANSWER KEY

**Data Table**

GAS VOLUME IN THE SODA POP BOTTLE	
Brand of Soda Pop Used	<b>Canada Dry Ginger Ale</b>
Maximum volume of bottle	<b>387.0 mL</b>
Volume of liquid in bottle before opening	<b>364.0 mL</b>
Volume of liquid in bottle after opening	<b>185.0 mL</b>
Initial volume of gas in bottle, $V_1$	<b>23.0 mL</b>
Final volume of gas in bottle, $V_2$	<b>202.0 mL</b>

### Calculations

- Using the data in the data table, determine to the nearest 0.5 mL the initial volume of gas above the liquid. This is the volume of gas at high pressure.

$$387.0 \text{ mL} - 364.0 \text{ mL} = 23.0 \text{ mL}$$

- Determine the final volume of the gas above the liquid after the bottle was opened. This is the volume of gas at atmospheric pressure.

$$387.0 \text{ mL} - 185.0 \text{ mL} = 202.0 \text{ mL}$$

- Assume that atmospheric pressure is 1.0 atm. Calculate the pressure of the unopened bottle using Boyle's Law.

$$\text{Barometric Pressure} = P_2 = 100.45 \text{ kPa} \quad P_1 = \frac{(100.45 \text{ kPa})(202.0 \text{ mL})}{(23.0 \text{ mL})} = \mathbf{882 \text{ kPa}}$$

(Atmospheric)

$$\text{Boyle's Law: } P_1 V_1 = P_2 V_2 \rightarrow P_1 = \frac{P_2 V_2}{V_1}$$

### Questions

- Using the internet, determine what gas is used in the bottling of soft drinks.

*The gas in the bottle is carbon dioxide ( $\text{CO}_2$ ).*

- Why are pressures higher than atmospheric pressure used in bottling soft drinks?

*The pressure inside a soft drink bottle is much higher than the pressure outside the bottle. This helps keep the soda carbonated. That is, the additional pressure at the surface of the liquid inside the bottle forces the bubbles to stay dissolved within the soda.*

- Compare and contrast pressure determined for the different brands of soda used in this experiment.

*The order of highest pressure to lowest pressure was Ginger Ale (882 kPa), Root Beer (610 kPa), Coke (600 kPa), 7-Up (790 kPa), Coke Zero (560 kPa) and Sunkist (220 kPa).*

- Use an advanced chemistry textbook, or the internet to find a statement of Henry's Law. Does the gas in the bottling of soda pop obey this law? Explain.

*Carbonated beverages are an example of Henry's law in everyday life. The dissolved carbon dioxide stays in solution in a closed pop bottle or can where the partial pressure of carbon dioxide was set at a high value during bottling. When the can or bottle is opened the partial pressure of  $\text{CO}_2$  is much lower and the dissolved carbon dioxide will gradually escape from the pop. When the new low partial pressure equilibrium is established the soda will be "flat". This loss of dissolved carbon dioxide will happen faster for warm soda than for cold.*