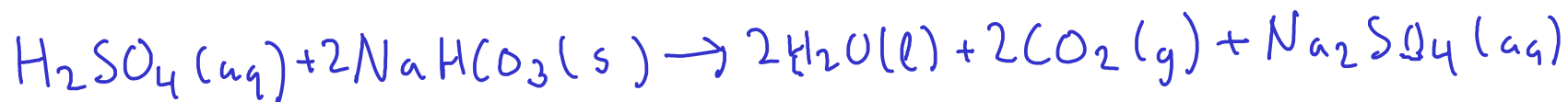


$$FW_{\text{NaHCO}_3} = 84.007 \text{ g/mol}$$



Given 25.0 g of sodium bicarbonate and sufficient sulfuric acid, what volume of carbon dioxide gas would be produced at 25.0 C and 0.950 atm pressure?

- 1- Convert 25.0 grams sodium bicarbonate to moles. Use FORMULA WEIGHT.
- 2 - Convert moles sodium bicarbonate to moles carbon dioxide gas. Use CHEMICAL EQUATION.
- 3 - Convert moles carbon dioxide gas to volume. Use IDEAL GAS EQUATION, $PV=nRT$

$$\textcircled{1} 84.007 \text{ g NaHCO}_3 = \text{mol NaHCO}_3 \quad \textcircled{2} 2 \text{ mol NaHCO}_3 = 2 \text{ mol CO}_2$$

$$25.0 \text{ g NaHCO}_3 \times \frac{\text{mol NaHCO}_3}{84.007 \text{ g NaHCO}_3} \times \frac{2 \text{ mol CO}_2}{2 \text{ mol NaHCO}_3} = 0.2975942481 \text{ mol CO}_2$$

$$\textcircled{3} \begin{array}{l} PV = nRT \\ V = \frac{nRT}{P} \end{array} \quad \begin{array}{l} n = 0.2975942481 \text{ mol CO}_2 \\ R = 0.08206 \frac{\text{L}\cdot\text{atm}}{\text{mol}\cdot\text{K}} \\ T = 25.0^\circ\text{C} = 298.2 \text{ K} \end{array} \quad P = 0.950 \text{ atm}$$

$$V = \frac{(0.2975942481 \text{ mol CO}_2)(0.08206 \frac{\text{L}\cdot\text{atm}}{\text{mol}\cdot\text{K}})(298.2 \text{ K})}{(0.950 \text{ atm})}$$

$$= 7.67 \text{ L of CO}_2 @ 25.0^\circ\text{C}, 0.950 \text{ atm}$$

What volume would the gas in the last example problem have at STP?

STP: "Standard Temperature and Pressure" (0 °C and 1 atm)

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2} \quad \left| \quad \begin{array}{ll} P_1 = 0.950 \text{ atm} & P_2 = 1 \text{ atm} \\ V_1 = 7.67 \text{ L} & V_2 = ? \\ T_1 = 298.2 \text{ K} & T_2 = 0^\circ\text{C} = 273.2 \text{ K} \end{array} \right.$$

$$\frac{(0.950 \text{ atm})(7.67 \text{ L})}{(298.2 \text{ K})} = \frac{(1 \text{ atm})(V_2)}{(273.2 \text{ K})}$$

$$V_2 = \boxed{6.67 \text{ L at STP}}$$

Alternate solution. Since, we already knew the moles of gas, we can use $PV=nRT$...

$$PV = nRT \quad \left| \quad \begin{array}{ll} n = 0.2975942481 \text{ mol } (\text{O}_2) & P = 1 \text{ atm} \end{array} \right.$$

$$V = \frac{nRT}{P} \quad \left| \quad \begin{array}{l} R = 0.08206 \frac{\text{L}\cdot\text{atm}}{\text{mol}\cdot\text{K}} \\ T = 0^\circ\text{C} = 273.2 \text{ K} \end{array} \right.$$

$$V = \frac{(0.2975942481 \text{ mol } (\text{O}_2) (0.08206 \frac{\text{L}\cdot\text{atm}}{\text{mol}\cdot\text{K}}) (273.2 \text{ K})}{(1 \text{ atm})}$$

$$= \boxed{6.67 \text{ L at STP}}$$