

## Answer on Question #67767 - Chemistry - General Chemistry

Question:

How many mL of 6.0 M hydrochloric acid, HCl is needed to generate 940 mL of carbon dioxide gas at room temperature and pressure. (Hint: gas law to determine moles carbon dioxide with given variables, moles carbon dioxide to moles HCl, solve for volume of HCl using Molarity and the moles HCl)

**Solution:**

Room temperature:  $T = 15 - 25\text{ }^{\circ}\text{C} = 288 - 298\text{ K}$ ;

Room pressure:  $p = 101325\text{ Pa}$ ;

$V(\text{CO}_2) = 940\text{ mL} = 940\text{ cm}^3 = 0.00094\text{ m}^3$ ;

The equation of state of an ideal gas (sometimes the Mendeleev-Clapeyron equation or the Clapeyron equation):

$$p \cdot V = n \cdot R \cdot T;$$

For carbon dioxide:  $n = \frac{p \cdot V}{R \cdot T}$

$$n = \frac{101325 \cdot 0.00094}{8.314 \cdot 288} = 0.040\text{ mol};$$

$$n' = \frac{101325 \cdot 0.00094}{8.314 \cdot 298} = 0.038\text{ mol};$$

$n(\text{HCl}) = 2n(\text{CO}_2) = 0.080\text{ mol}$  (0.076 mol);

$$V(\text{HCl}) = \frac{n}{c};$$

$$V = \frac{0.080}{6} = 0.0133\text{ L} = 13.3\text{ mL};$$

$$V = \frac{0.076}{6} = 0.0127\text{ L} = 12.7\text{ mL};$$

**Answer:**  $V(\text{HCl}) = 12.7 - 13.3\text{ mL}$ .

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