

Answer on Question #78320, Chemistry/ General Chemistry

Calculate the volume of carbon dioxide produced at 0 degrees Celsius and 100.0KPa when 2.5 g sodium carbonate reacts with excess hydrochloric acid.

Solution



Find amount of substance of sodium carbonate:

$$n = m/M$$

$$M(\text{Na}_2\text{CO}_3) = A_r(\text{Na}) \times 2 + A_r(\text{C}) + A_r(\text{O}) \times 3 = 23 \times 2 + 12 + 16 \times 3 = 106$$

$$M_r = M$$

$$M(\text{Na}_2\text{CO}_3) = 106 \text{ g/mol}$$

$$n(\text{Na}_2\text{CO}_3) = 2.5/106 = 0.024 \text{ (mol)}$$

According to equation 1 mole of Na_2CO_3 gives 1 mole of CO_2

We have 0.024 mol of Na_2CO_3 that give x mol of CO_2

$$1/0.024 = 1/x$$

$$x = 0.024$$

$$n(\text{CO}_2) = 0.024 \text{ mol}$$

According to Mendeleev-Clapeyron equation:

$$PV = nRT$$

$$\text{Then } V = nRT/P$$

$$n = 0.024 \text{ mol}$$

$$R = 8.314 \text{ m}^3\text{Pa/Kmol}$$

$$T = 0 + 273.15 = 273.15 \text{ K}$$

$$P = 100.0\text{KPa} = 100000 \text{ Pa}$$

$$V = 0.024 \times 8.314 \times 273.15 / 100000 = 0.000545 \text{ m}^3 = 0.545 \text{ dm}^3 = 545 \text{ cm}^3$$

Answer: 545 cm³