

Answer on Question #40918, Chemistry, Other

Question

Dissolving 3.00 g of an impure sample of calcium carbonate in hydrochloric acid produced 0.656 L of carbon dioxide (measured at 20.0°C and 792 mmHg). Calculate the percent by mass of calcium carbonate in the sample. State any assumptions.

Answer

The assumptions are:

- calcium carbonate was dissolved to the full extent and amount of CO₂ released was proportional to the amount of CaCO₃
- the sample did not contain any other compounds that released CO₂ or reacted with CO₂

$$PV=nRT$$

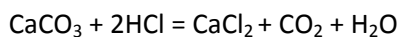
$$n=PV/RT$$

$$P=792 \text{ mmHg} = 792/760 \text{ atm} = 1.04 \text{ atm}$$

$$T = 20 + 273 = 293 \text{ K}$$

$$R = 8.314 \text{ J/(K}\cdot\text{mol)} = 0.082 \text{ (L}\cdot\text{atm)}\cdot\text{(K}\cdot\text{mol)}$$

$$n(\text{CO}_2) = (1.04 \text{ atm} \cdot 0.656 \text{ L}) / (0.082 \text{ (L}\cdot\text{atm)}\cdot\text{(K}\cdot\text{mol)} \cdot 293 \text{ K}) = 0.0284 \text{ mol}$$



$$n(\text{CaCO}_3) = n(\text{CO}_2)$$

$$m(\text{CaCO}_3) = n(\text{CaCO}_3) \cdot M(\text{CaCO}_3) = 0.0284 \text{ mol} \cdot 100 \text{ g/mol} = 2.84 \text{ g}$$

$$w(\text{CaCO}_3) = (2.84 \text{ g} / 3.00 \text{ g}) \cdot 100 \% = 94.7 \%$$

Answer: 94.7 %.