Gases and Stoichiometry Part 2

1. Consider the following reaction:

$2\ KClO_3\ (s) \rightarrow 3\ O_2\ (g) + 2\ KCl\ (s)$

What volume of oxygen, in L, at 28.0°C and 1.00 atm is produced if 6.85 g of $KClO_3$ decomposes?

$M_m\ KClO_3 = 122.55\ g/mol$ $\qquad 28.0°C + 273.15 = 301.15\ K$

$$6.85\ g\ KClO_3 \times \frac{1\ mol\ KClO_3}{122.66\ g} \times \frac{3\ mol\ O_2}{2\ mol\ KClO_3} = 0.0838\ mol\ O_2$$

$$PV = nRT \text{ and } V = \frac{nRT}{P} = \frac{0.0838\ mol \times 0.0821\frac{L \cdot atm}{mol \cdot K} \times 301.15\ K}{1.00\ atm} = \mathbf{2.07\ L}$$

2. Consider the following chemical equation:

$CaC_2\ (s) + 2\ H_2O\ (l) \rightarrow Ca(OH)_2\ (s) + C_2H_2\ (g)$

What volume of C_2H_2 is produced if 1.523 g of CaC_2 is reacted. The pressure is 731.9 torr at a temperature of 23.0 °C.

$M_m\ CaC2 = 64.009\ g/mol$ $\qquad 23.0°C + 273.15 = 296.15\ K$

$$1.523\ g\ CaC_2 \times \frac{1\ mol\ CaC_2}{64.009\ g} \times \frac{1\ mol\ C_2H_2}{1\ mol\ CaC_2} = 0.0238\ mol\ C_2H_2$$

$$PV = nRT \text{ and } V = \frac{nRT}{P} = \frac{0.0238\ mol \times 0.0821\frac{L \cdot atm}{mol \cdot K} \times 296.15\ K}{731.9\ torr \times \frac{1.00\ atm}{760\ torr}} = \mathbf{0.959\ L}$$

3. An airbag has a volume of 60.0 L at a temperature of 22.0 °C. Nitrogen gas, N_2, is formed from solid sodium azide, NaN_3 according to the following chemical equation.

$2\ NaN_3\ (s) \rightarrow 2\ Na(s) + 3\ N_2\ (g)$

How many grams of NaN_3 is required if the pressure inside the airbag, once it inflates, is 826 mmHg?

826 mmHg = 1.09 atm, 22°C = 295 K, $M_m\ NaN_3 = 65.009\ g/mol$

$$n = \frac{PV}{RT} = \frac{1.09\ atm \times 60.0\ L}{0.0821\frac{L \cdot atm}{mol \cdot K} \times 295\ K} = 2.70\ mol\ N_2$$

$$2.70\ mol\ N_2 \times \frac{2\ mol\ NaN_3}{3\ mol\ N_2} \times \frac{65.009\ g\ NaN_3}{1\ mol\ NaN_3} = \mathbf{117\ g\ NaN_3}$$