CHM 110
Gas Laws Practice Set SOLUTIONS

Solve the following problems Write the answer in the answer blank, and show work in the space provided.

1) What volume of CO_2 gas would (given enough carbon and chlorine) be produced at 504 °C and 1.10 atm by the reaction of 45.0 g of TiO_2 in the following reaction?

$$TiO_2(s) + C(s) + 2Cl_2(g) \rightarrow TiCl_4(g) + CO_2(g)$$

Answer: 32.7 L CO_2

79.87 g TiO_2 = mol TiO_2 mol TiO_2 = mol CO_2

$$45.0\,g\,TiO_2 \times \frac{mol\,TiO_2}{79.87\,g\,TiO_2} \times \frac{mol\,CO_2}{mol\,TiO_2} = 0.56341555\ mol\ CO_2$$

$V = \frac{nRT}{P}$ | $n = 0.56341555\ mol\ CO_2$ $T = 504°C = 777\ K$ $R = 0.08206\ \frac{L\cdot atm}{mol\cdot K}$ $P = 1.10\ atm$

$$V = \frac{(0.56341555\ mol\ CO_2)(0.08206\ \frac{L\cdot atm}{mol\cdot K})(777\ K)}{(1.10\ atm)} = 32.657931639\ L$$

2) C_2H_5OH burns in air to form CO_2 and H_2O. What volume of carbon dioxide gas (at 25.0°C and 1.07 atm) can be produced when 55.0 grams of C_2H_5OH burns in sufficient oxygen?

$$C_2H_5OH(l) + 3O_2(g) \rightarrow 2CO_2(g) + 3H_2O(l)$$

Answer: 54.6 L CO_2

46.068 g C_2H_5OH = mol C_2H_5OH 2 mol CO_2 = mol C_2H_5OH

$$55.0\,g\,C_2H_5OH \times \frac{mol\,C_2H_5OH}{46.068\,g\,C_2H_5OH} \times \frac{2\,mol\,CO_2}{mol\,C_2H_5OH} = 2.387774594\ mol\ CO_2$$

$V = \frac{nRT}{P}$ | $n = 2.387774594\ mol\ CO_2$ $R = 0.08206\ \frac{L\cdot atm}{mol\cdot K}$ $T = 25.0°C = 298.2\ K$ $P = 1.07\ atm$

$$V = \frac{(2.387774594\ mol\ CO_2)(0.08206\ \frac{L\cdot atm}{mol\cdot K})(298.2\ K)}{(1.07\ atm)} = 54.607048175\ L$$

3) What mass of magnesium nitride is required to produce 475 L of ammonia gas at STP via the following reaction??

$$Mg_3N_2(s) + 6H_2O(l) \rightarrow 3Mg(OH)_2(s) + 2NH_3(g)$$

Answer: 1070 g Mg_3N_2

$n = \frac{PV}{RT}$ | $P = 1.00$ atm $V = 475$ L $R = 0.08206 \frac{L \cdot atm}{mol \cdot K}$

$T = 0°C = 273.15$ K

$$n_{NH_3} = \frac{(1.00\ atm)(475\ L)}{(0.08206 \frac{L \cdot atm}{mol \cdot K})(273.15\ K)} = 21.191460653\ mol\ NH_3$$

100.95 g Mg_3N_2 = mol Mg_3N_2 2 mol NH_3 = mol Mg_3N_2

$$21.191460653\ mol\ NH_3 \times \frac{mol\ Mg_3N_2}{2\ mol\ NH_3} \times \frac{100.95\ g\ Mg_3N_2}{mol\ Mg_3N_2} = 1069.63897646\ g\ Mg_3N_2$$

4) A 4.50 L flask contains pure nitrogen gas (N_2) at 0.979 atm and 30.0 °C. What is the mass of nitrogen gas inside the flask?

Answer: 4.96 g N_2

$n = \frac{PV}{RT}$ | $P = 0.979$ atm $V = 4.50$ L

$R = 0.08206 \frac{L \cdot atm}{mol \cdot K}$ $T = 30.0°C = 303.2$ K

$$n_{N_2} = \frac{(0.979\ atm)(4.50\ L)}{(0.08206 \frac{L \cdot atm}{mol \cdot K})(303.2\ K)} = 0.177065723\ mol\ N_2$$

28.02 g N_2 = mol N_2

$$0.177065723\ mol\ N_2 \times \frac{28.02\ g\ N_2}{mol\ N_2} = 4.961381546\ g$$