Day 3.3 Warm-Up

1. 26 g of propane, C_3H_8 reacts with excess O_2 to produce CO_2 and H_2O according to the balanced equation below. Calculate the volume of CO_2 produced at 25°C and 1.3 atm.

$$C_3H_8 + 5\ O_2 \rightarrow 3\ CO_2 + 4\ H_2O$$

2. A balloon of helium gas occupies a volume of 2.5 L at a temperature of 30°C. Calculate the temperature at which the balloon will occupy a volume of 4.6 L at constant pressure.

$$NH_4NO_3\ (s) \rightarrow N_2O\ (g) + 2\ H_2O\ (g)$$

3. A 0.03 mol sample of $NH_4NO_3(s)$ is placed in a 1 L evacuated flask, which is then sealed and heated. The $NH_4NO_3(s)$ decomposes completely according to the balanced equation above. Calculate the total pressure in the flask measured at 400 K.

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26 g

V = ? L

T = 25 °C

P = 1.3 atm

$$\frac{26\ g\ C_3H_8}{1} \left| \frac{1\ mol\ C_3H_8}{44.11\ g\ C_3H_8} \right| \frac{3\ mol\ CO_2}{1\ mol\ C_3H_8} = 1.8\ mol\ CO_2$$

$PV = nRT$

$$(1.3\ atm)V = (1.8\ mol)\left(0.0821 \frac{L \cdot atm}{mol \cdot K}\right)(298\ K)$$

$V = 33\ L$

2. A balloon of helium gas occupies a volume of 2.5 L at a temperature of 30°C. Calculate the temperature at which the balloon will occupy a volume of 4.6 L at constant pressure.

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$\frac{2.5\,L}{303\,K} = \frac{4.6\,L}{T_2}$$

$$T_2 = 557\,K$$

$$T_2 = 560\,K = 287\,^{\circ}C$$

$$NH_4NO_3\,(s) \rightarrow N_2O\,(g) + 2\,H_2O\,(g)$$

0.03 mol

3. A 0.03 mol sample of $NH_4NO_3(s)$ is placed in a 1 L evacuated flask, which is then sealed and heated. The $NH_4NO_3(s)$ decomposes completely according to the balanced equation above. Calculate the total pressure in the flask measured at 400 K.

V

T

$$\frac{0.03\,mol\,NH_4NO_3 \,/\, 1\,mol\,N_2O}{1\,mol\,NH_4NO_3} = 0.03\,mol\,N_2O$$

$$PV = nRT$$

$$P_{N_2O}(1\,L) = (0.03\,mol)\left(0.0821\,\frac{L \cdot atm}{mol \cdot K}\right)(400\,K)$$

$$P_{N_2O} = .9852\,atm$$

$$\frac{0.03\ \text{mol}\ NH_4NO_3 \,/\, 2\ \text{mol}\ H_2O}{1\ \text{mol}\ NH_4NO_3} = 0.06\ \text{mol}\ H_2O$$

$$P_{H_2O}(1L) = 0.06\ \text{mol}\ H_2O \left(0.0821 \frac{L \cdot atm}{mol \cdot K}\right)(408K)$$

$$P_{H_2O} = 1.9704\ atm$$

$$\therefore P_T = P_{N_2O} + P_{H_2O} = .9852\ atm + 1.9704\ atm$$

$$P_T = 3\ atm$$

$$n_T = n_{N_2O} + n_{H_2O} = 0.03\ mol + 0.06\ mol$$

$$n_T = 0.09\ mol$$

$$P_T(1L) = (0.09\ mol)\left(0.0821 \frac{L \cdot atm}{mol \cdot K}\right)(408K)$$

$$P_T = 3\ atm$$