Practice for Gases KEY

1. Nitrogen gas reacts with hydrogen gas to produce ammonia (NH_3). Write a balanced equation for the reaction. How many grams of ammonia can be produced from the reaction of an excess of hydrogen with 2.3 L of nitrogen at 20.0 °C and 750 mmHg?

~~Hint: First find the volume of the nitrogen at STP, then use that volume and the molar volume factor to convert liters of nitrogen to grams of ammonia in a stoichiometry problem.~~

$$N_2 + 3H_2 \rightarrow 2NH_3$$

2.3 L → ? g

$V = 2.3\,L$

$T = 293\,K$

$P = 750\,mmHg = .987\,atm$

$PV = nRT$

$n = \frac{PV}{RT}$

$= \frac{(.987\,atm)(2.3\,L)}{(.0821\,\frac{L\,atm}{mol\,K})(293\,K)}$

$= .094\,moles\,N_2$

$$\frac{.094\,mol\,N_2}{1} \left| \frac{2\,mol\,NH_3}{1\,mol\,N_2} \right| \frac{17.04\,g\,NH_3}{1\,mol\,NH_3} = 3.2\,g\,NH_3$$

2. 0.145 L of a hydrogen gas is collected at 23°C and an atmospheric pressure of 98 kPa.
   A. How many moles of hydrogen were collected?

$V = .145\,L$

$T = 296\,K$

$P = \frac{98\,kPa}{1} \left| \frac{1\,atm}{101.3\,kPa} \right. = .97\,atm$

$n = ?$

$PV = nRT$

$n = \frac{PV}{RT} = \frac{(.97\,atm)(.145\,L)}{(.0821\,\frac{L\,atm}{mol\,K})(296\,K)} = .0058\,moles\,H_2$

   B. What is the volume of the hydrogen at STP?

$$\frac{.0058\,mol\,H_2}{1} \left| \frac{22.4\,L}{1\,mol\,H_2} \right. = .1299$$

$.13\,L\,H_2$

3. A sample of oxygen diffuses 2.3 times faster than another gas. What is the molar mass of the other gas?

$$\frac{r_1}{r_2} = \sqrt{\frac{M_2}{M_1}}$$

$$\frac{2.3}{1} = \sqrt{\frac{X}{32.00}}$$

$$\left(\frac{2.3}{1}\right)^2 = \frac{X}{32.00}$$

$$\frac{5.29}{1} = \frac{X}{32.00}$$

$X = 169.28\,g/mol$

4. When a container is filled with 2.6 moles of nitrogen gas and 5.8 moles of carbon dioxide, the total pressure in the container is 955 mmHg. What is the partial pressure of the carbon dioxide?

2.6 mol N_2
5.8 mol CO_2

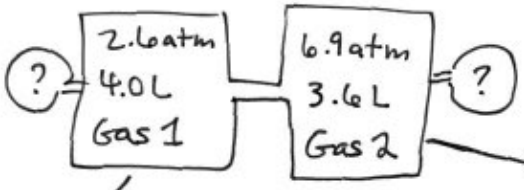
2.6 mol
5.8 mol
8.4 mol

$$\frac{n_1}{n_2} = \frac{P_1}{P_2} \Rightarrow \frac{n_{CO_2}}{n_{Total}} = \frac{P_{CO_2}}{P_T}$$

$$\frac{5.8\ mol}{8.4\ mol} = \frac{P_{CO_2}}{955\ mmHg}$$

$P_{CO_2} = \boxed{659\ mmHg}$

5. Two gases are in two separate containers connected by a closed valve. The pressure and volume of Gas 1 are 2.6 atm and 4.0 L respectively. The pressure and volume of Gas 2 are 6.9 atm and 3.6 L respectively. If the valve is opened and we wait for several hours, what will be the pressure reading on the pressure gauges that are attached to each container?



$P_1V_1 = P_2V_2$

$(2.6\ atm)(4.0\ L) = P_2(7.6\ L)$

$P_2 = 1.4\ atm$

$P_1V_1 = P_2V_2$

$(6.9\ atm)(3.6\ L) = P_2(7.6\ L)$

$P_2 = 3.3\ atm$

$P_T = 1.4\ atm + 3.3\ atm$

$= \boxed{4.7\ atm}$