Differentiated Chemistry. Ch. 10 Take-Home Quiz #2 Name: Answer Key

YOU MUST SHOW ALL YOUR WORK FOR CREDIT. NO WORK, NO CREDIT!!!!

1. A liter of methane gas, CH_4, at STP contains more atoms of hydrogen than does a liter of pure hydrogen, at STP. Using Avogadros Law, explain why?

Equal volumes of any gases @ the same temperature and pressure contain the same number of particles, which means the moles of CH_4 is equal to the moles of H_2 @ STP. But one more of CH_4 contains 4 moles of hydrogen atoms and one mole of H_2 contains 2 moles of hydrogen atoms. So 1 Liter of CH_4 @ STP will have twice as many hydrogen atoms as 1 Liter of hydrogen gas @ STP

2. What is the total volume of the $CO_2(g)$ and $H_2O(g)$ at 600°C and 735 torr produced by the combustion of 1.00 L of $C_3H_8(g)$ measured at STP? Assume that the products are the only materials remaining.

$C_3H_8(g) + 5O_2(g) \rightarrow 3CO_2(g) + 4H_2O(g)$

$V = \frac{nRT}{P}$

$1.00\,L\,C_3H_8 \left|\frac{1\,mol}{22.4\,L}\right| \frac{7\,mol\,CO_2 + H_2O}{1\,mol\,C_3H_8} \left|\frac{0.0821\,L\cdot atm}{mol\cdot K}\right| \frac{(600\,^\circ C + 273.15)K}{735\,torr} \left|\frac{760\,torr}{1\,atm}\right| = 23.2\,L\ CO_2(g) + H_2O(g)$

3. What is the partial pressure of CO_2 in the product gases from #2.

① from % volume ⇒ $\frac{3}{7} \cdot 735\,torr = 315\,torr$

② from stoich

$P = \frac{nRT}{V}$

$1.00\,L\,C_3H_8 \left|\frac{1\,mol}{22.4\,L}\right| \frac{3\,mol\,CO_2}{1\,mol\,C_3H_8} \left|\frac{0.0821\,L\cdot atm}{mol\cdot K}\right| \frac{(600+273.15)K}{23.2\,L} \left|\frac{760\,torr}{1\,atm}\right| = 315\,torr$

4. Thin films of amorphous silicon for electronic applications are prepared by decomposing silane gas, SiH_4, on a hot surface at low pressures

$SiH_4(g) \rightarrow Si(s) + 2H_2(g)$

What volume of silane gas at 130 Pa and 800 K is required to produce a 10.0cm x 10.0cm film that is 200 angstroms thick? The density of amorphous silicon is 1.9 g/cm^3.

$V = \frac{nRT}{P}$

$10.0\,cm \left|\frac{10.0\,cm}{}\right| \frac{200\,\text{Å}}{1\times10^{8}\,\text{Å}} \left|\frac{1\,cm}{1\,cm^3}\right| \frac{1.9\,g\,Si}{} \left|\frac{1\,mol\,Si}{28.09\,g\,Si}\right| \frac{1\,mol\,SiH_4}{1\,mol\,Si} \left|\frac{0.0821\,L\cdot atm}{mol\,K}\right| \frac{800\,K}{130\,Pa} \left|\frac{101325\,Pa}{1\,atm}\right| = 0.7\,L\,SiH_4$

$V = nRT/P$

Vol of $Si_{(s)}$ × density × m.m = mol Si; mole:mole

$(0.693\,L\,SiH_4)$

5. Cyclopropane, a gas used with oxygen as a general anesthetic, is composed of 85.7% carbon and 14.3% hydrogen by mass. If 1.56 g of cyclopropane has a volume of 1.00 L at 0.984 atm and 50.0°C, what is the molecular formula of cyclopropane?

E.F. ⇒ $85.7\,g\,C \left|\frac{1\,mol\,C}{12.01\,g\,C}\right| = 7.14\,mol\,C / 7.14 = 1$ CH_2

$14.3\,g\,H \left|\frac{1\,mol\,H}{1.01\,g\,H}\right| = 14.2\,mol\,H / 7.14 = 2$

m.m ⇒ $\frac{g}{n} = \frac{g \cdot RT}{PV}$ $1.56\,g\,C_xH_y \left|\frac{0.0821\,L\cdot atm}{mol\cdot K}\right| \frac{(50.0+273.15)K}{0.984\,atm} \left|\frac{}{1.00\,L}\right| = 42.1\,g/mol$

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

$M.F. = E.F \times \frac{m.m}{E.F.m} = CH_2 \cdot \left(\frac{42.1\,g/mol}{14.03\,g/mol}\right) = C_3H_6$