Today 11/16 friday: finish ch 10
Sunday 11/18 problem club with Ali
Sunday 11/25 problem club with Ali
Tuesday Nov 27 expt 12 : last lab :) :(

What is the density of CH_4 at 20°C and 718 mmHg?

$PV = nRT \qquad n = \frac{m}{MM}$

$R = 0.0821\ L\,atm / mol\,k$

$PV = \frac{mRT}{MM}$

$MM = 16.05\ g/mol$

$\frac{m}{V} = \frac{P\,MM}{RT}$

$P = \frac{718\ mmHg}{} \Big| \frac{1\ atm}{760\ mmHg} = 0.94\ atm$

$d = \frac{P \cdot MM}{R \cdot T}$

$T = 20 + 273 = 293\ k$

$d = \frac{(0.94\ atm)(16.05\ g/mol)}{(0.0821\ L \cdot atm/mol\,k)(293)} = \boxed{0.63\ g/L}$

- What is the molar volume of a gas at STP using
  A) $R = 0.0821\ L\text{-}atm / mol\,k \quad (22.4\ L)$

$PV = nRT$

$(1\,atm)\,V = (1\,mol)(0.0821\ L\text{-}atm/mol \cdot k)(273\,k)$

$\boxed{V = 22.4\ L}$

B) $R = \frac{8.314\ J}{mol \cdot k}$ $\quad 1J = kg\, m^2/s^2$

$PV = nRT$

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

$V = \frac{1\ mol \mid 8.314\ kg\, m^2 \mid 273k \mid m\, s^2}{\mid s^2 \cdot mol \cdot k \mid \mid 1.01325 \times 10^5\ kg} = .02240\ m^3 = 22400\ cm^3$

$= 22400\ mL$

$= 22.4\ L$

· A gas has a density of 1.67 g/L at 55°C and 700mmHg. What is its density at STP?

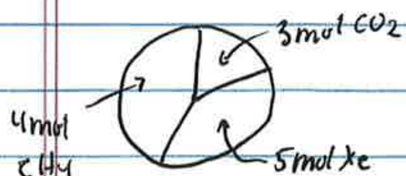
$\frac{P_1 MM_1}{d_1 T_1} = \frac{P_2 MM_2}{d_2 T_2}$

	①	②
P	700mmHg	760mmHg
MM	—	—
d	1.67g/L	
T	328k	273k

$\frac{(700mmHg)}{(1.67g/L)(328k)} = \frac{(760mmHg)}{(d_2)(273k)}$

$d_2 = 2.18g/L$

Mole fraction, $X = \frac{n_{one\ component}}{n_{total}}$



$X_{CO_2} = \frac{3\ mol}{12\ mol} = 0.25$

$X_{CH_4} = \frac{4\ mol}{12\ mol} = 0.333$

$X_{Xe} = \frac{5\ mol}{12\ mol} = 0.417$

1.00

pure samples: $PV = nRT$

mixtures: $P_{CO_2} V = n_{CO_2} RT$ $\quad (P_{CO_2}$ = partial pressure$)$

$P_{tot} V = n_{tot} RT$

$P_{CO_2} = X_{CO_2} \cdot P_{tot}$ $\quad n_{CO_2} = X_{CO_2} \cdot n_{tot}$

$P_{CH_4} = X_{CH_4} \cdot P_{tot}$ $\quad n_{CH_4} = X_{CH_4} \cdot n_{tot}$

$P_{Xe} = X_{Xe} \cdot P_{tot}$ $\quad n_{Xe} = X_{Xe} \cdot n_{tot}$

$P_{tot} = \sum P_i$ $\quad n_{tot} = \sum n_i$

law of combining volumes (stoichiometry of gases)

$PV = nRT$

at constant P and T: V and n are proportional

$$C_2H_2(g) + 2H_2(g) \rightarrow C_2H_6(g)$$

	$C_2H_2(g)$	$2H_2(g)$	$C_2H_6(g)$
	0.10 mol	0.20 mol	TY = 0.10 mol
you can do the same type of LR, TY problems with volume for gases that are in the same container	300 mL	600 mL	TY = 300 mL
	20.0 mL	58.0 mL	TY = 20.0 mL (with 18.0 mL H_2 left over)

Kinetic molecular theory (for gases)

$$E_k = \frac{1}{2}mu^2 = \frac{3RT}{2N_A}$$

u = speed

N_a = avagadros number

units: $(kg)\left(\frac{m}{s}\right)^2$ (J) $\quad \left(\frac{kg\,m^2}{s^2\,\cancel{mol}\cdot \cancel{K}}\right)\frac{(\cancel{K})}{(\cancel{mol^{-1}})}$ (J)

$$u^2 = \frac{3RT}{N_a m} \Rightarrow u = \sqrt{\frac{3RT}{N_a m}}$$

*mass has to be in kg

Average speed of Ar at 298 K.

$$u = \sqrt{\frac{(3)\left(8.314 \frac{kg\,m^2}{s^2\,mol\cdot K}\right) 298K \; mol}{0.0399 kg}} = \boxed{431\ m/s}$$

- speed is proportional to temperature
- speed is inversely proportional to molar mass