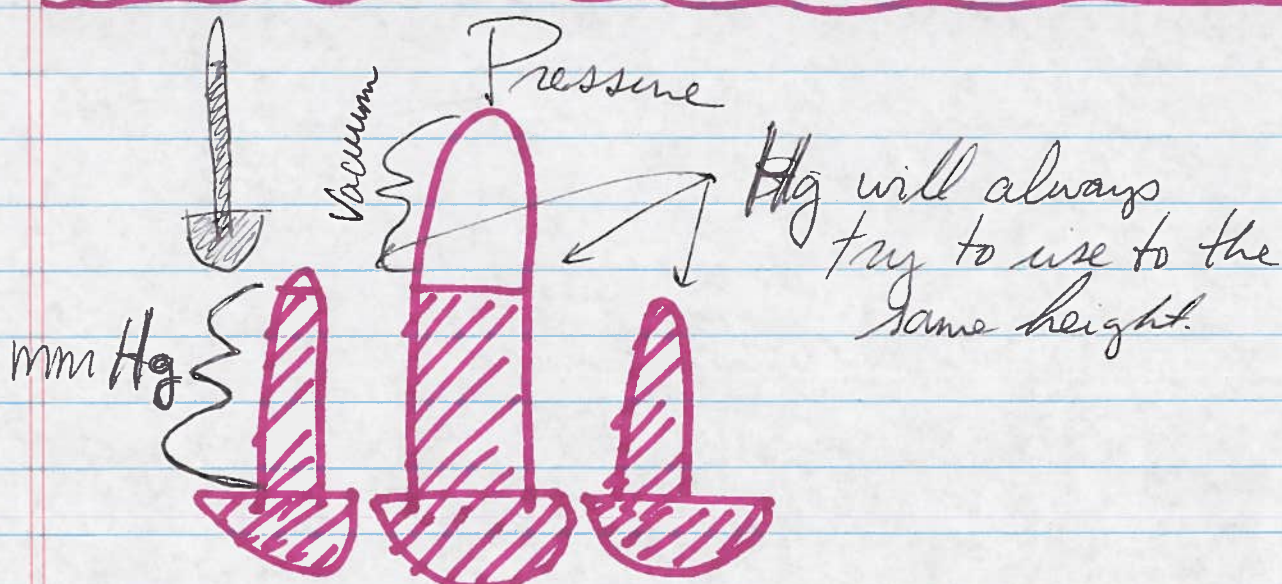
General Chemistry with Doc M
Wednesday 11/18/15

Today: Chp 10, Sect 1-4

Friday: 10.5 - 10.8

Next Week: No Class! No Lab!

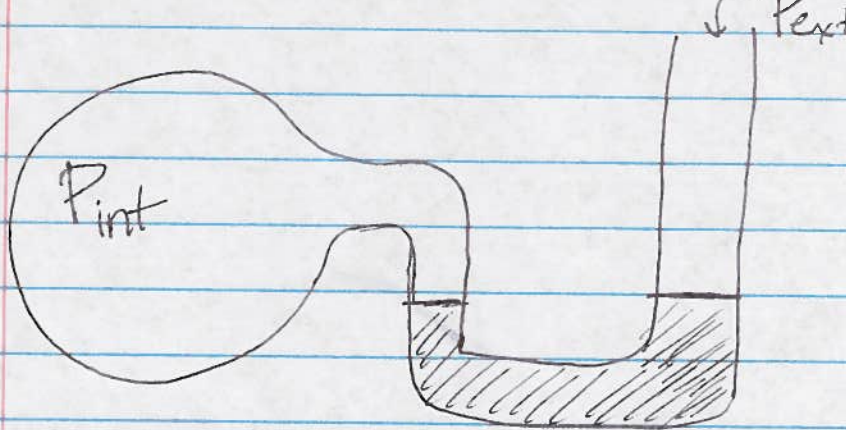


1 atm = 760 mm Hg (in Hg in US)

1 atm = 101.3 kPa

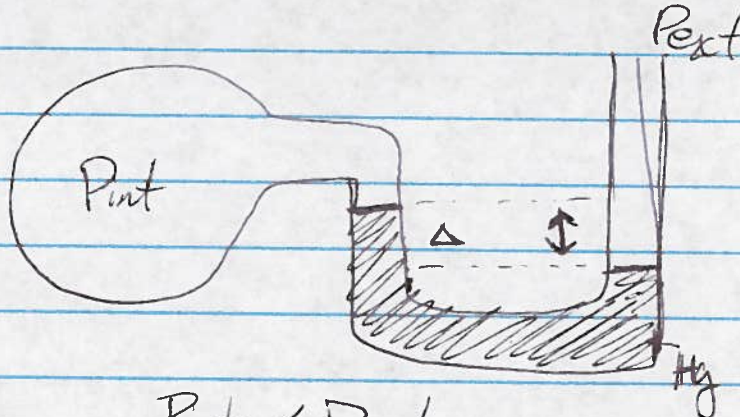
$$P = \frac{Force}{area} = \frac{mass \times acceleration}{area} = \frac{kg \times m/s^2}{m^2} = \frac{kg}{s^2 m} = Pa$$

↑ Pascal



manometer

$P_{int} = P_{ext}$



$P_{int} < P_{ext}$

$P_{int} = P_{ext} - \Delta$ ← mmHg → **Careful with Units**

If $P_{int} > P_{ext}$

$P_{int} = P_{ext} + \Delta$

Ideal Gas Law

$PV = nRT$

P: Pa ⟷ $\frac{8.314 J}{mol K}$

P: atm ⟷ $\frac{0.0821 L\,atm}{mol K}$

Don't mix them up

Ex/ What is the Pressure of 4.5 g He in a 50.0 L flask at 25°C?

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

$$n = \frac{4.5 g\ He}{} \left| \frac{1 mol\ He}{4.0026 g\ He} \right. = 1.125 mol\ He$$

$$T = 25°C + 273.15 = 298.15 K$$

$$V = 50.0 L$$

$$P = \frac{1.125 mol \times \frac{.0821 L\,atm}{mol K} \times 298 K}{50.0 L} = .55 atm$$

$PV = nRT$ $n = \frac{m}{MM}$ gas density $= \frac{m}{V} = \frac{g}{L}$

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

$MM = \frac{mRT}{PV} = \frac{dRT}{P}$ $d = \frac{MM * P}{RT}$

When the change is involved:

$$\frac{P_1V_1}{n_1T_1} = R = \frac{P_2V_2}{n_2T_2} \Rightarrow \frac{P_1V_1}{n_1T_1} = \frac{P_2V_2}{n_2T_2}$$

Ex/ A gas sample occupies 9.4 L at STP. What is its volume at 25°C and 740 mmHg?

* Gas law Chemistry "STP": Standard temp 273K

	1	2
P	760 mmHg	740 mmHg
V	9.4 L	V_2
n	same	same
T	273	298

① + ② must have same units

← must be K

what we want

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_1}$$

$$V_2 = \frac{P_1 \times V_1 \times T_2}{P_2 \times T_1} = \frac{760 \times 9.4 \times 298}{740 \times 273} = 10.5 L$$

Folder Activity Chapter 10 Number 1 18 November 2015

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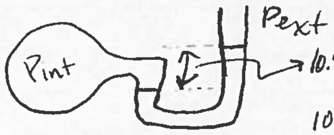
1. A manometer containing mercury in its well exhibits a difference in mercury levels of 10.52 cm with the column being higher on the arm open to the external atmosphere. Sketch this arrangement. If the external pressure is 717 mmHg, what is the internal pressure in mmHg?



$P_{int} = P_{ext} + \Delta l = 717\,mmHg + 105.2\,mmHg = \boxed{822.2\ mmHg}$

$10.52\,cm \times \frac{1\,m}{100\,cm} \left| \frac{1000\,mm}{1\,m} \right| = 105.2\,mm$

2. Convert the pressure you determined to units of kPa.

$760\,mmHg = 101.3\,kPa$

$\frac{822.2\,mmHg \mid 101.3\,kPa}{\mid 760\,mmHg} = \boxed{109.6\ kPa}$

3. What volume is occupied by 27.0 g $CH_4(g)$ at STP?

STP = { 273 K, 1 atm }

$PV = nRT$

$V = \frac{nRT}{P} = \frac{(1.683)(.0821)(273)}{1\,atm}$ (mol, L atm/mol K, K)

$\frac{27.0\,g\,CH_4 \mid 1\,mol\,CH_4}{\mid (12.0107 + 4 \times 1.00794)\,g\,CH_4} = 1.683\,mol\,CH_4$

$\boxed{= 37.7\,L}$

4. A sample of argon in a 400 L vessel exerts a pressure of 94.3 kPa at 300 K. What is the pressure at 450 °C?

$\frac{P_1V_1}{n_1T_1} = \frac{P_2V_2}{n_2T_2}$

	1	2
P	94.3 kPa	P?
V	400 L	400 L ← same
n	same	same
T	300 K	(450 + 273) K

$\frac{94.3}{300} = \frac{P}{723}$

$P = \frac{94.3}{300} \times 723 = \boxed{227.263\ kPa}$

5. What is the density of ammonia at 25 °C and 735 mmHg? Start by deriving the equation that you will use.

① $PV = nRT$ ⇒ ⑥ $PV = \frac{dV}{MM} RT$ ⇒ ⑦ $d = \frac{P * MM}{R * T} = \frac{.967 * 17.03}{.0821 * 298} =$

② $n = \frac{m}{MM}$ ⇒ ⑤ $n = \frac{dV}{MM}$

③ $d = \frac{m}{V}$ ⇒ ④ $m = dV$

$P = 735\,mmHg \times \frac{1\,atm}{760\,mmHg} = .967\,atm$

$MM = 14.0067 + 3 \times 1.00794 = 17.03\,g/mol$

$R = .0821\,\frac{L\,atm}{mol\,K}$ $T = 25 + 273 = 298\,K$

6. A sample of an unknown gas, thought to be pure, is used to fill a 250.0 mL container. The mass of the gas was determined to be 1.132 g at 95 °C and 733 mmHg. What is the molar mass of the unknown gas? Could it possibly be $SF_6(g)$?

$PV = nRT$

$n = \frac{PV}{RT} = \frac{.964\,atm * .250\,L}{.0821\,\frac{L\,atm}{mol\,K} * 368\,K} = 7.98 \times 10^{-3}\,mol$

$P = \frac{733\,mmHg \mid 1\,atm}{\mid 760\,mmHg} = .964\,atm$

$V = .250\,L$

$n = ?$

$R = .0821\,L\,atm/mol\,K$

$T = 95 + 273 = 368\,K$

$n = \frac{m}{MM}$ ⇒ $MM = \frac{m}{n} = \frac{1.132\,g}{7.98 \times 10^{-3}\,mol} = 141.9\,g/mol$

$MM_{SF_6} = 32.065 + 6 \times 18.988 = 145.996$