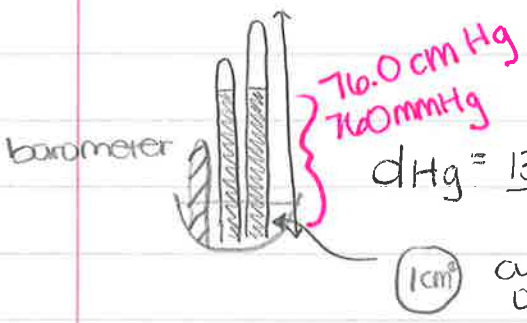
November 13th



$d_{Hg} = \frac{13.59\ g}{cm^3}$

$m_{Hg} = \frac{13.59\ g}{cm^3} \left| \frac{1\ cm^2}{} \right| \frac{76.0\ cm}{}$

$= 1032.84\ g$ inside tube

$P_{standard} \equiv 760\ mmHg \equiv 1\ atm \equiv 1.01322 \times 10^5\ Pa$

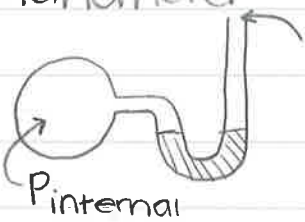
$\equiv 1.01322 \times 10^2\ kPa$ or $101.322\ kPa$

$P = force/area$

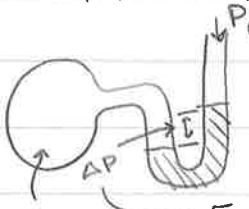
$= \frac{m a_g}{area} = \frac{1032.84\ g}{cm^2} \left| \frac{9.81\ m}{s^2} \right| \frac{1\ cm^2}{1 \times 10^{-4}\ m^2} \left| \frac{1\ kg}{1 \times 10^3\ g} \right. = 1.01322 \times 10^5\ \frac{kg}{s^2 m} \rightarrow Pa$

Pascal

Manometer



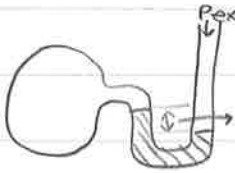
$P_{internal} = P_{external}$



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

$= 740\ mmHg + 50\ mm$

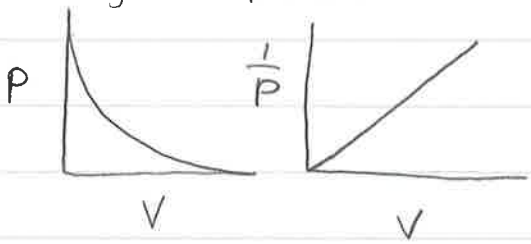
$= 790\ mmHg$



$P_{int} = P_{ext} - \Delta P$

Boyle

A gas sample @ constant temperature



$P \cdot V = constant$ Boyle's Law

Charles's Law: $T \uparrow V$ @ constant pressure

$V \propto T$

Gas Law (Ideal Gas Law)

$PV \propto nT$

$PV = nRT$ "other" form of R

$R = 8.314\ J/g\ deg$

$R = 0.0821\ L\ atm/mol\ K$

November 13th

What is the pressure exerted by 64.0 g O_2 occupying 50.0 L at 25°C?

$PV = nRT$ $R = 0.0821$ L·atm/mol·K

$P = ?$

$V = 50.0$ L

$n = \frac{64.0\text{ g } O_2}{32.0\text{ g } O_2 / \text{mol } O_2} = 2.00\text{ mol } O_2$

$T = 25°C + 273 = 298$ K

$P = \frac{nRT}{V} = \frac{2.00\text{ mol} \mid 0.082\text{ L·atm} \mid 298\text{ K}}{\text{mol·K} \mid 50\text{ L}} = 0.979$ atm

$P = \frac{0.979\text{ atm}}{1\text{ atm}} \mid 101.32\text{ kPa} =$

$P = 0.979\text{ atm} \mid \frac{760\text{ mmHg}}{1\text{ atm}} =$

At what temperature will 22 g He have a volume of 4500 mL at a pressure of 850 mmHg?

$P = \frac{850\text{ mmHg}}{760\text{ mmHg}} \mid 1\text{ atm} = 1.12$ atm

$V = 4.5$ L

$n = \frac{22\text{ g}}{4.0026\text{ g}} \mid 1\text{ mol} = 5.5$ mol

$T = ?$

$PV = nRT$

$1.12 \cdot 4.5 = 5.5 \cdot 0.0821 \cdot T$

$T = 11.2$ K

(Type I calculations)

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

$n = \frac{\text{mass}}{MM}$ → $MM = \frac{dRT}{P}$

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

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

Type II calcs

$$\frac{P_1 V_1}{n_1 T_1} = \frac{P_2 V_2}{n_2 T_2}$$

for changes in circumstances "Peas + vegetables on the rice table"

"STP" → standard temperature & pressure
↳ 273 K, 1 atm

November 13th

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

	①	②
P	1 atm	740/760 = 0.974 atm
V	9.4 L	?
n		
T	273 K	298 K (25 + 273)

* units between the two HAVE to match!

↳ * has to be in kelvin

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2} \longrightarrow \frac{1\text{ atm} \cdot 9.4\text{ L}}{273\text{ K}} = \frac{0.974\text{ atm} \cdot V}{298\text{ K}}$$

↳ $\boxed{V = 10.5\text{ L}}$

A bicycle tire is inflated to 55 psi at 15°C. What is its pressure at 35 °C?

	①	②
P	55 psi	?
V	–	–
n	–	–
T	288 K	308 K

$$\frac{P_1}{T_1} = \frac{P_2}{T_2}$$

$$\hookrightarrow \frac{55\text{ psi}}{288\text{ K}} = \frac{P_2}{308\text{ K}} \rightarrow \boxed{P_2 = 58.82\text{ psi}}$$

Chapter 10 Day 1 (Sections 10.1 – 10.4) (Unit 5) 13 November 2019

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?

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

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

4. A sample of argon in a vessel exerts a pressure of 94.3 kPa at 300 K. What is the pressure at 450 ^oC?

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

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 ^oC and 733 mmHg. What is the molar mass of the unknown gas? Could it possibly be $SF_6(g)$?

Questions in final exam format (multiple choice):

7. A basketball is inflated to a pressure of 2.10 atm in a 20.0 ^oC garage. What is the pressure of the basketball outside where the temperature is -5.00 ^oC?

   A. 1.92 atm B. 2.29 atm
   C. 2.10 atm D. 2.50 atm

8. A 75.0 L steel tank at 20.0 ^oC contains acetylene gas, C_2H_2, at a pressure of 1.20 atm. Assuming ideal behavior, how many grams of acetylene are in the tank?

   A. 3.74 g B. 54.8 g
   C. 97.3 g D. 1425 g

9. What is the density of carbon monoxide gas at STP?

   A. 0.510 g/L B. 0.800 g/L
   C. 1.96 g/L D. 1.25 g/L

10. If the pressure in a gas container that is connected to an open-end U-tube manometer is 106 kPa and the pressure of the atmosphere at the open end of the tube is 700 mm Hg, the level of mercury in the tube will be

    A. 95 mm higher in the arm open to the atmosphere.
    B. 95 mm higher in the arm connected to the gas cylinder.
    C. 795 mm higher in the arm open to the atmosphere.
    D. 795 mm higher in the arm connected to the gas cylinder.

Preparing for the final exam. Go to our Chm 203 course website and scroll down past the old exams and right before the pictures. There is a link to 96 practice questions (in three parts). Allow plenty of time! Do a few every day and get help when you are stuck.

Now try these problems from the book:

Section 10.1. (Gases and gas pressure) Problem 1-4, 24, 26, 34 – 46, even.
Section 10.2. (The gas laws) Problems 5, 6.
Section 10.3. (Ideal gas law) Problems 7 – 10, 48 – 62, even.
Section 10.4. (Stoichiometric relationships) Problems 11 – 14, 64 – 78, even.
Practice Test, page 411, 1 – 6.