Unit 10: Gases Review

Based on the Kinetic Molecular Theory what are some properties of a gas?

- Gas are small particles that are moving very fast in linear random motion.
- They are very far apart (mostly empty space). Collisions are perfectly elastic.
- Average Kinetic energy (speed) is dependent on temperature.

Know the four variables that affect gases (P,V,n,T).

NUMBER OF MOLES:

What letter represents moles in gas law calculations? n = # mol

if given grams → moles (g/mol)

VOLUME:

Define volume:

- The space of the container taken up by the gas.
- Gases take the volume & shape of container. Spreads throughout.

Units of volume: mL, L, cm^3

1000 mL = 1L

PRESSURE:

Define pressure:

Force per unit area. The collisions of gas particles against side of container.

Units of pressure: atm, mmHg, kPa

**Be able to convert between the different units of pressure!!

TEMPERATURE:

Define Temperature:

- The average kinetic energy of the given gas.

Units for Temperature: °C or K

K = °C + 273

**Be able to convert between Celsius and Kelvin.

What are some ways to write STP? 0°C or 273K, 1atm or 760 mmHg or 101.3 kPa

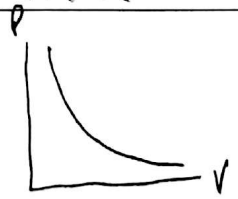
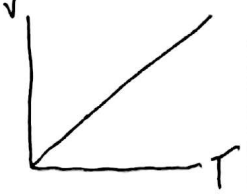
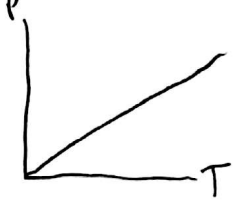
What are the conditions for a gas to be ideal?

High temp. & Low pressure.

-Be able to use the different gas laws and know when to use them!

-Remember to go over the different gas laws (Boyle's, Charles', Gay-Lussac's, and Avogadro's) and know each relationship. Also recognize each graphs for each gas law.

-Be able to identify which gas will effuse the fastest based on Graham's Law of effusion.

	Boyle's Law	Charles' Law	Gay-Lussac's Law	Avogadro's law
What are the variables (being tested)? (Which 2?)	P & V	V & T	P & T	V & n
What is being held constant? (Which 2?)	n & T	n & P	V & n	P & T
Formula	$P_1V_1 = P_2V_2$	$\frac{V_1}{T_1} = \frac{V_2}{T_2}$	$\frac{P_1}{T_1} = \frac{P_2}{T_2}$	$\frac{V_1}{n_1} = \frac{V_2}{n_2}$
Inverse or Direct?	inverse	direct	direct	direct
Sketch Graph				

Calculations: Solve the following problems, SHOWING ALL WORK WITH UNITS!

Use Dalton's

1. The partial pressure of water in a mixture of hydrogen and water is 450 mm Hg. If the partial pressure of hydrogen is 305 mm Hg, what is the atmospheric pressure?

$P_{total} = P_{H_2O} + P_{H_2} = 450\,mmHg + 305\,mmHg = 755\,mmHg$

$= ?\,atm$

$755\,mmHg \cdot \frac{1\,atm}{760\,mmHg} = 0.993\,atm$

Boyle's

2. What new pressure is needed to change the volume of a gas from 65.5 mL at 680 mm Hg to 0.040 L?

$P_1 = 680\,mmHg \quad P_2 = ?\,mmHg$

$V_1 = 65.5\,mL \quad V_2 = 0.040\,L \rightarrow 40\,mL$

$P_1V_1 = P_2V_2$

$(680)(65.5) = P_2(40)$

$P_2 = 1113.5\,mmHg$

inverse

Ideal gas

2 stepper

3. What is the mass, in grams, of a gas if 395 mL has a mass of at 100. °C and 800. mmHg?

$m = ?\,g\ O_2$ (oxygen)

$n = ?\,mol\ O_2$

$V = 395\,mL \rightarrow 0.395\,L$

$P = 800.\,mmHg \rightarrow 1.05\,atm$

$T = 100°C + 273 = 373\,K$

$PV = nRT$

$(1.05)(0.395) = n(0.082)(373)$

$0.0135\,mol = n$

↳ convert to grams

$0.0135\,mol\ O_2 \cdot \frac{32\,g\,O_2}{1\,mol\,O_2}$

$m = 0.432\,g\ O_2$

Charles'

4. If a volume of gas occupies 617 mL at 40 °C, what volume (L) will it occupy at standard temperature?

$V_1 = 617\,mL \quad V_2 = ?\,L$

$T_1 = 40°C + 273 = 313\,K \quad T_2 = 273\,K$

$\frac{V_1}{T_1} = \frac{V_2}{T_2} \rightarrow \frac{617}{313} = \frac{V_2}{273} \rightarrow V_2 = 538.2\,mL \rightarrow 0.5382\,L$

direct

Gay-Lussac

5. The pressure of a tank of gas is 2.0 atm at 40ºC. Assume volume remains constant, the pressure then decreased to 775 mmHg, what is the resulting temperature (in Kelvin)?

$P_1 = 2.0\,atm \quad P_2 = 775\,mmHg \Rightarrow 1.02\,atm$

$T_1 = 40°C + 273 = 313\,K \quad T_2 = ?\,K$

$\frac{P_1}{T_1} = \frac{P_2}{T_2} \rightarrow \frac{2.0}{313} = \frac{1.02}{T_2} \rightarrow T_2 = 159.6\,K$

direct

Combined gas

• Remember if constant cancel units

6. A 145 L sample of gas is at a pressure of 2.14 atm and a temperature of 156ºC. Assume the number of moles stay constant. What volume does the same sample of gas occupy when the temperature is decreased to 98ºC and 0.85 atm?

$P_1 = 2.14\,atm \quad P_2 = 0.85\,atm$

$V_1 = 145\,L \quad V_2 = ?\,L$

$n_1 = \quad n_2 =$

$T_1 = 156°C + 273 = 429K \quad T_2 = 98°C + 273 = 371K$

$\frac{P_1V_1}{n_1T_1} = \frac{P_2V_2}{n_2T_2} \rightarrow \frac{(2.14)(145)}{429} = \frac{(0.85)V_2}{371}$

$V_2 = 315.7\,L$

Avogadro's

7. A balloon with a volume of 5.55 L is known to contain 0.625 moles of gas. How many moles of gas remain if some of the gas is released and the new volume is 4.95 L? Assume temperature and pressure remains constant.

$V_1 = 5.55\,L \quad V_2 = 4.95\,L$

$n_1 = 0.625\,mol \quad n_2 = ?\,mol$

$\frac{V_1}{n_1} = \frac{V_2}{n_2} \rightarrow \frac{5.55}{0.625} = \frac{4.95}{n_2} \rightarrow n_2 = 0.56\,mol$

direct

Graham's Law

8. A container is filled with equal amounts of carbon monoxide, sulfur dioxide, oxygen gas, helium gas, and fluorine gas. If there is a small puncture, which gas will escape the container the fastest?

$CO = 28 \quad O_2 = 32 \quad F_2 = 38$

$SO_2 = 64 \quad He = 4.0$

CO b/c it's the lightest.

9. Use # 8 to help. Helium and fluorine gas (equal amounts) are placed in a container and allowed to escape. Which gas will effuse first and how much faster will to effuse compared to the other gas?

$\frac{r_1}{r_2} = \sqrt{\frac{M_2}{M_1}} \rightarrow \frac{r_{He}}{r_{F_2}} = \sqrt{\frac{38}{4.0}} = 3.08$

He is 3.08x faster than F_2