Review--Honors Gases ***Name_____***
Period _____ Date_____

Topics: ***Labs: P vs. Vol, Mg + HCl***

- Concept of pressure, gas pressure (due to collisions of molecules), and strength of atmospheric pressure
- Calculating pressure given force and area (P = Force/Area)
- Measuring pressure-- understanding barometers and converting between all pressure units (atm, mm Hg, kPa)
- Relationships between P, V, T, & n (explain bell jar, hemispheres, egg in flask, crushed can, NH_3 fountain — https://youtu.be/gMqRxbv_IW8)
- Ideal vs Real Gases (What conditions allows gases to be more ideal? What are assumptions of ideal gases?)
- Ideal Gas Law Calculations (PV= nRT) Useful for one set of conditions. Watch units-- atm, L, moles, K
- Remember-- You may use "1 mole of any gas = 22.4 L" if at STP (on reference sheet)
- Gas Law Calculations (when conditions of P, V, T, or n change-- don't forget Kelvin!!)
- Dalton's Law of --Partial Pressures (including collecting gases by water displacement.)
- Temperature as "average kinetic energy of molecules." At same temp, lighter molecules move faster on average than heavier molecules.
- Graham's Law of Effusion Calculations. Formula will be given on test.

$$\frac{\text{rate of effusion of Gas A}}{\text{rate of effusion of Gas B}} = \frac{\text{velocity of Gas A}}{\text{velocity of Gas B}} = \frac{\sqrt{\text{molar mass of Gas B}}}{\sqrt{\text{molar mass of Gas A}}}$$

- Explain how vapor pressures vary due to temp and type of substance (IMFs).
- Relationships between vapor pressure, atmospheric pressure, and boiling pts.
- Phase Diagrams-- being able to interpret data from a phase diagram.

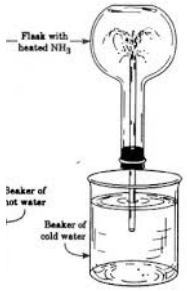
Practice Problems:

1) If one decreases the volume of a gas, why does the pressure of the gas increase? *(Explain in terms of molecules and collisions.)*

2) A table weighs 220 lbs. When it stands on four legs, it touches the floor with a total area of 8.0 in^2. What pressure does the table exert on the floor? (use Pressure = Force/Area)

3) What holds up the column of mercury in a mercury barometer?_____
4) An unsealed soda can with just a little water in it is heated until the water boils(Steam comes out of opening). Then, the can is quickly inverted and placed in a shallow cold water bath such that the opening of can is sealed off by water. In just a few seconds, the can miraculously gets crushed. Explain why the can gets crushed. Be specific—discuss what conditions change & discuss collisions.

5) Explain how the ammonia fountain works (https://youtu.be/gMqRxbv_IW8). Again—discuss collisions.



6) At the bottom of a mountain where the pressure is 1.0 atm and the temperature is 60°C, a balloon has a volume 2.0 L. What volume will the balloon have when brought up to the top of a mountain where the pressure is 0.86 atm and the temperature is –10°C?

7) 1.8 moles of O_2 gas is collected at 127°C and 737.2 mm Hg. What is the density of the O_2 gas?

8) The Ideal Gas Law does a poor job at predicting the properties of a gas that is at a high pressure and a low temperature. Why doesn't the Ideal Gas Law work well in this case?

9) An unknown gas effuses at a rate that is only 0.355 times that of O_2 at the same temperature. What is the molar mass of the unknown? What is the identity of the gas (it is a diatomic element)?

10) Suppose there is a flask containing both O_2 gas and H_2O gas. Both gases have the same temp.
   a) The O_2 molecules have **(more, less, equal)** average kinetic energy compared to the H_2O molecules.
   b) The O_2 molecules are moving on average **(faster, slower, the same)** compared to H_2O molecules.
   c) Suppose the total pressure of the gas mixture is 2.34 atm. The partial pressure due to the H_2O molecules is 785 mm Hg. What is the partial pressure of the O_2 gas (in atm)?

11) Sketch a graph of Pressure vs. Volume for gas. Then, sketch a graph of Volume of a gas vs. Temp.

12) Ammonia gas is made by the following reaction: $N_2\,(g) + 3\,H_2\,(g) \longrightarrow 2\,NH_3\,(g)$

a) If 20.0 g of N_2 gas is reacted with excess H_2 gas, how many moles of NH_3 (g) should be produced?

b) What volume would that amount of NH_3 gas have if it were collected at 373 K and 2.10 atm?

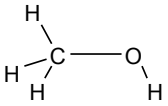
c) What volume would that same amount of NH_3 gas have if it were collected at STP?

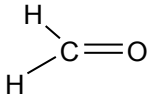
13) Acetaldehyde is a common liquid that vaporizes readily. When acetaldehyde vapor is collected at 0.0°C and 331mm Hg, the density of the vapor is 0.855 g/L. What is the molar mass of acetaldehyde?

14) A hot air balloon rises because the density of the air inside the balloon is lower than the density of the air outside. Air has an average molar mass of 28.8g/mol and a density of 1.18 g/L at 25°C. What is the density of the air inside a balloon that has been heated to 125°C? Assume that the balloon is made of rigid material that cannot expand.

15) You are given a solid mixture of $NaNO_2$ and NaCl and are asked to analyze it for the amount of $NaNO_2$ present. To do so you allow it to react with sulfamic acid (HSO_3NH_2) in water according to the balanced eq: **$NaNO_2$ (aq) + HSO_3NH_2 (aq) ⟶ $NaHSO_4$ (aq) + H_2O (l) + N_2 (g)** What is the mass of $NaNO_2$ in the solid mixture if the reaction of solid mixture with excess sulfamic acid produces 325 mL of N_2 gas?
NEEDED INFO*: The N_2 gas was collected over water at a temperature of 21.0°C. The total pressure of the collected gas is 731.0 mm Hg. Vapor pressure of H_2O (g) at 21.0°C = 18.6 mm Hg*

16) If compared at the same temperature, which liquid below would have the higher vapor pressure? Why?

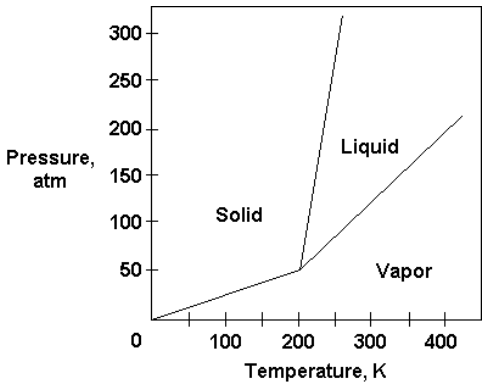
a) 

b) 

17) Explain why it takes less time to cook food in a pressure cooker than in an open pot of boiling water?
HINT: The pressure in a pressure cooker is higher than normal atmospheric pressure. (Assume one puts the pasta in the water only after the water is boiling.) ***You must include a discussion of bubbles in your answer.***

18) Look at the phase diagram at the right.

a) What is the condensation pt of this substance at 200 atm? ____
b) What is the melting point of this substance at 100 atm? _____
c) Over what pressure range can this substance sublime? ____
d) If temperature is held constant at 225 K and then the pressure is increased from 0 atm to 300 atm, what phase changes occur?
_____.
e) Which phase is denser for this substance– solid or liquid? _____



Answers: 2) P = 28 lbs/in^2; 6) V_2 = 1.8 L; 7) D = 0.95 g/L; 9) $MM_{Gas\ X}$ = 254 g/mol; 10c) P_{O_2} = 1.31 atm; 12a) 1.43 mol NH_3; 12b) V = 20.8 L; 12c) 32.0 L at STP; 13) MM = 44.0 g/mol; 14) D = 0.884 g/L ; 15) 0.871 g $NaNO_2$