States of Matter Review

Terms:
- Kinetic molecular theory
- Real vs. Ideal Gases
- Pressure
- Boyle's Law
- Charles' Law
- Gay-Lussac's Law
- Combined Gas Law
- Avogadro's Hypothesis
- Ideal Gas Law
- Graham's Law of Effusion (Honors)
- Diffusion
- Dalton's Law of Partial Pressures
- STP
- Molar Gas Volume
- Stoichiometry
- Polar and Nonpolar Molecules
- Intermolecular Forces
  - Van der Waals (London Dispersion)
  - Dipole-dipole
  - Hydrogen Bonding
- Properties of Solids, Liquids, Gases
- Amorphous Solids
- Crystalline Solids
- Surface Tension
- Capillary Action
- Fluids
- Phase Diagrams
- Phase Changes (fusion, solidification, etc)
- Vapor Pressure
- Boiling Point

Practice Problems:

1) A sample of gas has a volume of 5.0 L at STP. If the temperature was changed to 25°C and the pressure was changed to 75.0 kPa, what would the volume be? Write your answer with significant figures and units. $\frac{(5.0\,L)(101.3\,kPa)}{273K} = \frac{V(75.0\,kPa)}{298K}$ $V = 7.4\,L$

2) A mixture of gases A, B, and C has a pressure of 800 kPa. If gas A has a partial pressure of 300 kPa and gas B has a partial pressure of 250 kPa, what is the partial pressure of gas C?
$800 = 300 + 250 + x$ = $x = 250\,kPa$

3) If water was boiling at a temperature of 70°C, what is the pressure of the surrounding atmosphere? (Use your vapor pressure worksheet.) ~230 torr

4) A) Under what conditions does a gas behave most unlike an ideal gas (in other words, when does a gas deviate from the kinetic molecular theory?) high pressures + low temps

B) Under what conditions does a gas would behave most like an ideal gas? low pressures + high temps

5) A student calculated the boiling point of water at STP to be 102°C in an experiment. What is the percent error in the measurement? $\frac{102-100}{100} \times 100 = 2\%$

6) A) What is the relationship between pressure and temperature if volume remains constant? $\frac{P_1}{T_1} = \frac{P_2}{T_2}$ direct.

B) Explain this relationship in terms of molecular movement. As temp ↑, molecules move faster + hit walls more often + w/greater force. This ↑ pressure.

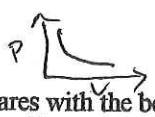
7) State Avogadro's Hypothesis: Equal volumes of gases @ the same temp + pressure contain equal #s of molecules

8) Define Boiling Point: The temp @ which the equilibrium vapor pressure of a liquid equals the atmospheric pressure

9) What is the volume of a 3.00 mole sample of oxygen gas at 70°C and 2.2 atm? $PV = nRT$
$V = 38.4\,L$ = 38 L $(2.2\,atm)V = (3.00\,mol)(0.0821)(343K)$

10) Which will diffuse faster, two gases in the same container, or two liquids in the same container? Explain.

11) A) A sample of gas is kept at constant temperature. If the pressure doubles, what will happen to the volume of that gas? It will decrease by half.

B) Draw a graph that shows this relationship. 

12) Explain how the behavior of gas molecules compares with the behavior of liquid molecules.
move in straight lines until a collision occurs. No significant intermolecular forces.

liquids slide past one another, are moving more slowly than gas molecules. Significant IMFs.

V.P. of liquid = atm!

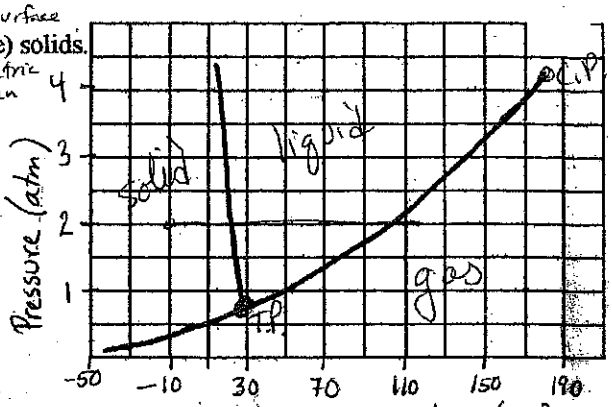
13) Compare and contrast boiling and evaporation. ← liquid to a vapor @ surface only.

liquid → vapor w/in liquid as well as at its surface

14) Compare and contrast amorphous solids and true (crystalline) solids.

↳ def V. + shape, high density, no compressibility ↳ more random ↳ orderly, geometric pattern

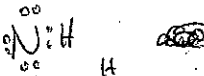
15) Below is a phase diagram.



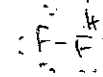
a) On the diagram, label solid, liquid, gas, triple point, and critical point.

b) If the pressure remains at 2.0 atm, but the temperature increases from -10°C to 120°C, describe all phase changes that occur. fusion, vaporization

16) For each of the following molecules, draw the dot diagram, identify if the molecule is polar or nonpolar, and then identify the type of intermolecular forces that would exist within a sample of each substance.

a) NH_3  polar, H-bonding

b) CH_4  nonpolar, V.D. Waals (London Disp)

c) F_2  nonpolar, V.D Waals (London Disp)

d) Which of the three substances above would you expect to have the lowest boiling point? Highest boiling point? CH_4, NH_3

17) When an electrical current is passed through liquid water, hydrogen gas and oxygen gas are formed as represented in the equation below.

$$2\,H_2O \rightarrow 2\,H_2 + O_2$$

a) Balance the equation.

b) What type of reaction is this? Decomp

c) If 15.0 grams of water are reacted, how many liters of oxygen gas would be formed at STP? $15.0\,g \times \frac{1\,mol\,H_2O}{18\,g} \times \frac{1\,mol\,O_2}{2\,mol\,H_2O} \times \frac{22.4\,L}{1\,mol\,O_2} = 9.33\,L$

d) If the reaction described in c took place at 50.0°C and 0.300 atm, what is the volume of the oxygen gas formed? $\frac{(9.33\,L)(1\,atm)}{273\,K} = \frac{V\,(0.300\,atm)}{323\,K}$ $V = 36.8\,L$

Honors

18) A sample of neon gas diffuses at a rate which is 3 times faster than gas Z. What is the molecular mass of gas Z? $\frac{rate_{Ne}}{rate_Z} = \sqrt{\frac{MM_Z}{20.2}} = 3$ $MM_Z = 182\,g/mol$

19) Determine the relative rate of effusion of ammonia gas, NH_3, as compared to xenon gas, Xe.

$$\frac{rate_{NH_3}}{rate_{Xe}} = \sqrt{\frac{131.3}{17.0}} = 2.78$$

NH_3 effuses at a rate 2.78 times the rate of Xe.