Steps to solving a mathematical problem relating to gas laws:

1. Identify the variables you are given and asked to solve for.
2. Determine which formula best fits the variables.
3. Rearrange the formula to solve for the appropriate variable.
4. Make any necessary conversions (L, atm, g, K)
5. Solve using the rearranged formula.

Not in sig figs!

A sample of gas has a volume of **2.5 L** at a pressure of **1.2 atm**. If the pressure is increased to **3.0 atm**, what will the new volume be (assuming the temperature remains constant)?

$$\frac{P_1V_1}{P_2} = \frac{P_2V_2}{P_2} \qquad V_2 = \frac{P_1V_1}{P_2} = \frac{1.2\,atm(2.5\,L)}{3.0\,atm} = \boxed{1.0\,L}$$

A gas has a volume of **2.0 L** when the pressure is **1.0 atm** and the temperature is **300 K**. If the pressure increases to **1.5 atm** and the temperature rises to **400 K**, what will be the new volume?

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2} \qquad V_2 = \frac{P_1V_1T_2}{T_1P_2} = \frac{1.0\,atm(2.0\,L)(400\,K)}{(300\,K)(1.5\,atm)} = \boxed{1.8\,L}$$

A gas is stored in a container at a pressure of **2.0 atm** and a temperature of **300 K**. If the container is heated until the temperature reaches **450 K**, what is the new pressure (assuming the volume stays constant)?

$$\frac{P_1}{T_1} = \frac{P_2}{T_2} \qquad P_2 = \frac{P_1T_2}{T_1} = \frac{2.0\,atm(450\,K)}{300\,K} = \boxed{3.0\,atm}$$

A gas occupies a volume of **5.00 L** at a pressure of **2.00 atm** and a temperature of **300 K**. How many **moles** of gas are in the sample?

$$PV = nRT \qquad n = \frac{PV}{RT} = \frac{2.00\,atm(5.00\,L)}{0.08206\,\frac{L\cdot atm}{mol\cdot K}(300\,K)} = \boxed{0.406\,mol}$$

The density of an unknown gas is **1.96 g/L** at **STP** (1.00 atm and 273 K). What is the **molar mass** of the gas?

$$d = \frac{PM}{RT} \qquad \sout{d = (1.00\,atm)} \qquad M = \frac{dRT}{P} = \frac{1.96\,g/L\,(0.08206\,\frac{L\cdot atm}{mol\cdot K})(273\,K)}{1.00\,atm} \boxed{= 43.9\,g/mol}$$

A balloon has a volume of **2.0 L** at a temperature of **300 K**. If it is heated to **450 K** (and the pressure stays constant), what will the new volume of the balloon be?

$$\frac{V_1}{T_1} = \frac{V_2}{T_2} \qquad V_2 = \frac{V_1T_2}{T_1} = \frac{2.0\,L(450\,K)}{300\,K} = \boxed{3.0\,L}$$

Review the postulates of the kinetic molecular theory:

1.

2.

3. refer to the gas laws WS

4.

5.

The average kinetic energy of all gas molecules is equal, so gas particles of smaller mass must have a greater speed, and gas particles of larger mass must have a lesser speed.

Label each example as effusion or diffusion:

- Air leaking from a tire puncture effusion
- Perfume bottle with a tiny nozzle effusion
- Fragrance scent released into an open room diffusion
- Smelling food from another room diffusion

Graham's Law formula: $\frac{\text{rate } 1}{\text{rate } 2} = \sqrt{\frac{M_2}{M_1}}$ M = molar mass

Hydrogen gas and an unknown gas are placed in separate containers with tiny pinholes. If hydrogen effuses through its container 4 times faster than another unknown gas, what is the molar mass of the unknown gas? $4 = \sqrt{\frac{M_2}{2.02}}$ $M_2 = 32$ g/mol

List and describe each of the intermolecular forces.

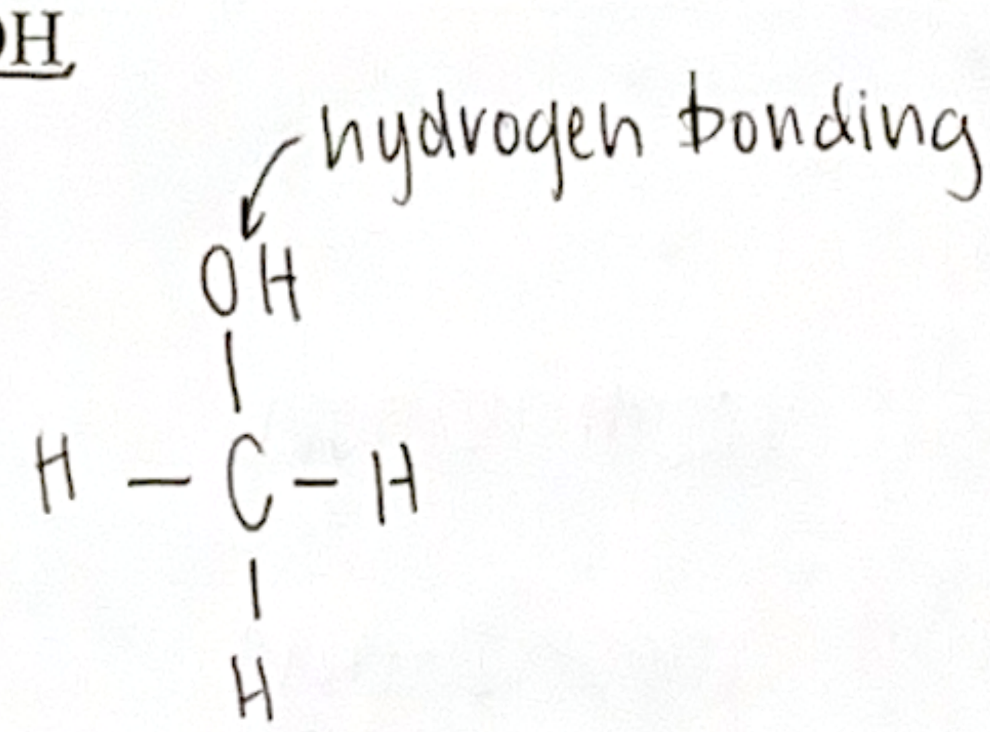
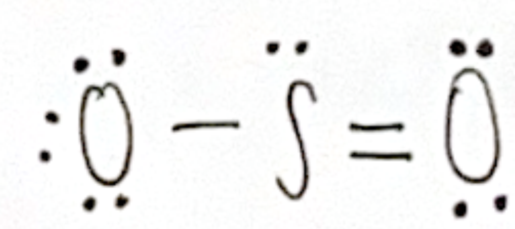
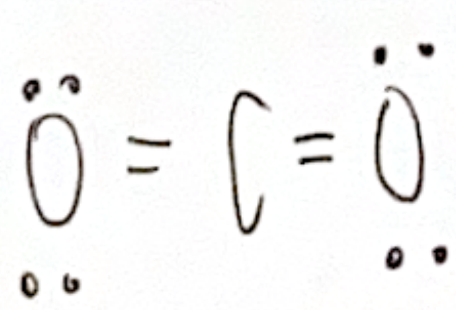
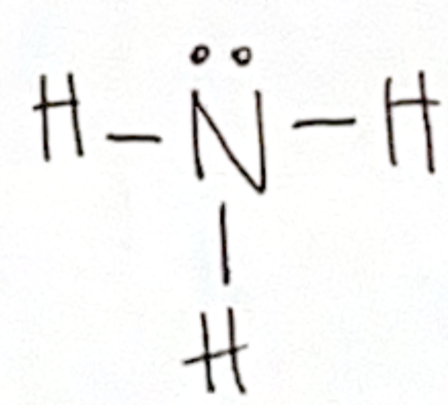
strength ↓

1. **London dispersion** - present in ALL molecules!
   ↳ caused by random, temporary dipole moments
2. **Dipole-dipole** - present in POLAR molecules!
   ↳ caused by electrostatic attraction between positive/negative ends
3. **Hydrogen bonding** - present in any molecule w/ H-FON!
   ↳ permanent dipole moment
4. **Ion-dipole** - present in ionic molecules

Steps to identify the types of intermolecular forces present in a molecule:

1. Draw a Lewis structure to determine its overall polarity and bonds.
2. Check for hydrogen bonding (H-FON).
3. Check for dipole-dipole forces (is the molecular polar but lacks hydrogen bonding?).
4. Confirm London dispersion forces.

Use the steps listed above to determine the types of intermolecular forces present in the following molecules.

CH_3<u>OH</u>  ✓ Hydrogen bonding ✓ Dipole-dipole forces ✓ London dispersion forces	SO_2  X Hydrogen bonding ✓ Dipole-dipole forces ✓ London dispersion forces
CO_2  X Hydrogen bonding X Dipole-dipole forces ✓ London dispersion forces	NH_3  ✓ Hydrogen bonding ✓ Dipole-dipole forces ✓ London dispersion forces

Define the following properties of liquids that are affected by intermolecular forces.

- Boiling point- when vapor pressure = external pressure causing L → G
- Melting point- when particles gain enough energy to overcome S → L
- Surface tension- resistance to external force by cohesion
- Capillary action- liquid flow against gravity via cohesion/adhesion
- Viscosity- liquid's resistance to flow

Name each transition below:

☆S→G sublimation

G→L condensation

S→L melting

L→G vaporization

☆G→S deposition

L→S freezing

In the following Pressure vs. Temperature diagram, identify the triple point and which regions represent a solid, liquid, and gas phase.