Inspiring Greatness
ISD
INDEPENDENCE SCHOOL DISTRICT

High School Science Virtual Learning

College Chemistry
Gas Law Review

April 10, 2020

High School Dual Credit Chemistry
Lesson: [4/10/20]

Objective/Learning Target:
Students will be able to do use all gas laws in various college based questions.

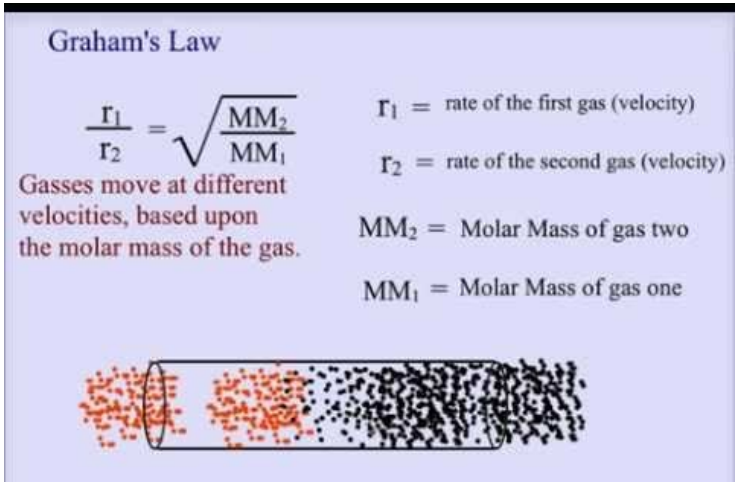
Let's Get Started:

1. What is Graham's Law of effusion?

2. What is a mole fraction (X)?

Let's Get Started: Answer Key

1. Rates of diffusion and effusion of gases are inversely proportional to the square roots of their molecular masses.



Let's Get Started: Answer Key

2. Mole fraction is a concentration unit defined as the ratio of the molar amount of a mixture component to the total number of moles of all mixture components.

Mole Fraction (X)

$$X_{Solute} = \frac{\text{Moles of solute}}{\text{Total moles of solution}}$$

$$X_{Solvent} = \frac{\text{Moles of solvent}}{\text{Total moles of solution}}$$

Where:

$$X_{solute} + X_{Solvent} = 1$$

Lesson Activity:

Directions:

1. Watch the following video and answer questions on the handout as you watch it.
2. Remember that pressure does come in a variety of units. Please see prior notes for the relationship.

Links:

- Video
- Handout

Practice

Complete the following questions using the information you learned during the lesson activity.

Questions:

1. The united state national weather service reports pressure in both inches of Hg and millibars. Convert a pressure of 29.2 in. Hg into:
   a. torr
   b. atm
   c. kPa
   d. mbar
2. A can of hairspray is used until it is empty except for the propellant, isobutane gas.
   a. On the can is the warning “Store only at temperatures 120^{O}F (48.8^{O}C). Do not incinerate.” Why?
   b. The gas in the can is initially at 24^{O}C and 360 kPa, and the can has a volume of 350 mL. If the can is left in a car that reaches 50^{O}C on a hot day, what is the new pressure in the can?

Questions Continued:

3. Methane, CH_4, is being considered for use as an alternative automotive fuel to replace gasoline. One gallon of gasoline could be replaced by 655 g of CH_4. What is the volume of this much methane at 25^oC and 745 torr?
4. Use the ideal gas law to derive a formula for the density of a gas in g/L.
5. A gas mixture used for anesthesia contains 2.83 mol oxygen, O_2, and 8.41 mol nitrous oxide, N_2O. The total pressure of the mixture is 192 kPa.
   a. What are the mole fractions of O_2 and N_2O?
   b. What are the partial pressures of O_2 and N_2O?
6. It takes 243 s for 4.46×10^{-5} mol Xe to effuse through a tiny hole. Under the same conditions, how long will it take 4.46×10^{-5} mol of Ne to effuse?

Once you have completed the practice questions check with the answer key.

1. (a) 742 torr (b) 0.976 atm (c) 98.9 kPa (d) 989 mbar
2. (a) The can contains an amount of isobutane gas at a constant volume, so if the temperature is increased by heating, the pressure will increase proportionately. High temperature could lead to high pressure, causing the can to burst. (Also, isobutane is combustible, so incineration could cause the can to explode.) (b) We are looking for a pressure change, due to a temperature change a constant volume, so we will use Amonton's/Gay-Lussac's Law. Taking P_1 and T_1 as initial values, and T_2 as the temperature where the pressure is unknown $P_2 \rightarrow P_2 = 390$ kPa. *Remember to convert temperatures from Celsius to Kelvin.
3. 1.02×10^3 torr
4. $d = PM/RT$ where d = density, P = pressure, M = molar mass of gas, R = gas constant, and T = temperature

Once you have completed the practice questions check with the answer key.

5. (a) $X_{O2} = 0.525$ and $X_{N2O} = 0.748$ (b) $P_{O2} = 48.4$ kPa and $P_{N2O} = 143.6$ kPa
6. 95.3 seconds

More Practice:

Follow the links below to do more practice.

1. Boyle's Law
2. Combined Gas Law
3. Partial Pressure
4. Ideal Gas Law

Additional Practice:
Click on the link below for additional practice.

- The Kinetic Molecular Theory of Gases

- Worksheets!