

## Chemistry (Math Notes)

### Module #11

A measurement particularly helpful for gases is \_\_\_\_\_.

Pressure is defined mathematically as the \_\_\_\_\_ per unit \_\_\_\_\_ exerted on an object.

(Formula:  $P = \text{force}/\text{area}$ ,  $P = f/a$ )

What are some units of pressure?

Unit	YES	NO
Pounds per square inch (psi)		
Newtons per square km ( $\text{N}/\text{km}^2$ )		
Grams per cm ( $\text{g}/\text{cm}$ )		
Newtons per meter ( $\text{N}/\text{m}$ )		
Atm (1 normal atmospheric pressure)		
mL of Hg (volume of Mercury)		
mm of Hg (height of Mercury - barometer)		
torr (= 1 mm of Hg)		

\*  $1.00 \text{ atm} = 101.3 \text{ kPa}(\text{kilopascal}) = 760.0 \text{ torr} = 760.00 \text{ mm Hg}$

## II. Gas Laws

1) Boyle's Law: Pressure and volume are \_\_\_\_\_ proportional and a constant is represented in each case.

$$\text{Formulas: } PV = \text{constant} \quad P_1 \times V_1 = P_2 \times V_2$$

There is a restriction for Boyle's Law: \_\_\_\_\_ must remain constant.

2) Charles' Law: Volume and temperature are \_\_\_\_\_ proportional and a constant is represented in each case.

$$\text{Formulas: } V/T = \text{constant} \quad V_1/T_1 = V_2/T_2$$

This is a \_\_\_\_\_ relationship when graphed  $V = (\text{constant})T$ , or

$$y = mx.$$

There is a restriction for Charles' Law: \_\_\_\_\_ must remain constant.

### 3) Combined Gas Law: Boyles + Charles

Formulas:  $P \times V/T = \text{constant}$

$$P_1V_1/T_1 = P_2V_2/T_2$$

This law can be used in \_\_\_\_\_ cases. There are \_\_\_\_\_ restrictions. **However, you must remember to use KELVIN temperature scale b/c temperature is in the denominator; therefore, temperature cannot equal \_\_\_\_\_.** Division by zero is undefined in math.

### III. Ideal Gases

To use any of these laws, the gas you are working with must be an ideal gas. So, how do you know you have an ideal gas? There are 3 properties of an ideal gas.

1.

2.

3.

In summary, gases tend to behave ideally at \_\_\_\_\_ temperatures and \_\_\_\_\_ pressures. **So, how do you define what is high and what is low?** Answer: by using standard temperature and pressure (STP)

STP - A temperature of \_\_\_\_\_ and a pressure of \_\_\_\_\_.

A gas with a temperature close to (or larger than) \_\_\_\_\_ and a pressure close to (or lower than) \_\_\_\_\_ will behave ideally. If these conditions are met, then \_\_\_\_\_ of these equations in this module can be used.

Examples:  $\text{NH}_3$

$\text{C}_6\text{H}_{24}$

$\text{NH}_3$  @ 45,000 torr & 100K

$\text{C}_6\text{H}_{24}$  @ 0.5 torr & 300K

Dalton's Law of Partial Pressures states that when \_\_\_\_\_ or more \_\_\_\_\_ are mixed together, the \_\_\_\_\_ pressure is the \_\_\_\_\_ of the individual pressures. (T.P. =  $P_1 + P_2 + P_3 + P_4 \dots$ )

**Example:**

Why does Dalton's Law work? \_\_\_\_\_

\_\_\_\_\_

This does not happen with \_\_\_\_\_.

(Avogadro used the fact that pressure and moles are directly proportional to each other to derive  $6.02 \times 10^{23}$ )

Dalton's Law is also useful for vapor pressure, which is the pressure of the vaporized gas \_\_\_\_\_ a liquid.

**Example:**

**See Table 2.1 (Vapor Pressure of H<sub>2</sub>O at certain temperatures)**

The **true** definition of boiling point is the \_\_\_\_\_ at which the vapor pressure of a liquid is \_\_\_\_\_ to normal atmospheric pressure (1 atm = 760 torr).

Alternate statement of Dalton's Law

Dalton's Law states that the pressure of a gas does not depend upon its \_\_\_\_\_, but its \_\_\_\_\_. Therefore, in a mixture of gases, the partial pressure of each gas should depend only on the \_\_\_\_\_ of that gas in the mixture. (ratio of moles = ratio of pressures)

$P_{\text{component}} / P_{\text{total}} = X$  (this is called the mole fraction and is a \_\_\_\_\_)

**Example:**

## DERIVED FORMULA:

### Ideal Gas Law vs. Combined Gas Law

The Ideal Gas Law is a combination of previous gas laws & various constants. You can calculate one of the variables at ONE set of circumstances, that is when \_\_\_\_\_ change is present. It can be used in \_\_\_\_\_.

**Equation:  $PV = nRT$**

**(P = pressure V = volume n = moles T = temperature in K R = ideal gas constant)**

*R's value is determined by the units used.*

*R = 0.082 L atm/mol K - NEED TO MEMORIZE THIS ONE!!!!*

$$R = 8.315 \text{ Pa} \cdot \text{m}^3/\text{mol K}$$

$$R = 8.315 \text{ J/mol K}$$

Combined gas law is used when a gas goes through a change in \_\_\_\_\_ ,  
\_\_\_\_\_, or \_\_\_\_\_.

**Equation:  $P_1V_1/T_1 = P_2V_2/T_2$**