Gas Laws

Gas Pressure

- _____ is defined as force per unit area.

- Units of pressure
  - Pascal (Pa) - SI Unit
  - Kilopascal (KPa)
  - Atmosphere (atm)
  - mmHg
  - Torr

Boyle's Law

- _____ states that the _____ and _____ of a gas at constant temperature are inversely proportional.

Boyle's Law

- In mathematical terms, this law is expressed as follows.

$$P_1 V_1 = P_2 V_2$$

- P_1 = initial pressure
- V_1 = initial volume
- P_2 = final pressure
- V_2 = final volume
- P_1 & P_2 can be in anything as long as they are the same
- V_1 & V_2 can be in anything as long as they are the same

Example

- A sample of Helium gas is compressed from 4.0 L to 2.5 L at a constant temperature. If the pressure of the gas in the 4.0 L volume is 210 KPa, what will the pressure be at 2.5 L?

Charles' Law

- Charles was a French physicist who looked at the relationship between _____ and _____
- He noted that as temperature went up, so did volume when pressure was held constant

Charles' Law: Volume & Temperature

- $\frac{V_1}{T_1} = \frac{V_2}{T_2}$
- V_1 = initial volume
- V_2 = final volume
- T_1 = initial temperature
- T_2 = final temperature
- V_1 & V_2 can be in any unit as long as they are the same
- T_1 & T_2 MUST be in Kelvin

Temperature conversions

$K = 273 + °C$

$°C = 0.56 (°F – 32)$

$°F = 1.8 °C + 32$

Example

- A sample of gas at 40.0 °C occupies a volume of 2.32 L. If the temperature is raised to 75.0 °C what will the new volume be?

Gay Lussac's Law

- Gay Lussac studied the relationship between _____ and _____
- He noticed that at a constant volume a _____ relationship existed between the Kelvin temperature and volume
- Giving the equation:
- $\frac{P_1}{T_1} = \frac{P_2}{T_2}$

Gay Lussac's Law: Pressure & Temperature

- $\frac{P_1}{T_1} = \frac{P_2}{T_2}$
- P_1 = initial pressure
- P_2 = final pressure
- T_1 = initial temperature
- T_2 = final temperature
- P_1 & P_2 can be in any unit as long as they are the same
- T_1 & T_2 MUST be in Kelvin

Example

- The pressure of a gas in a tank is 3.20 atm at 22.0 °C. If the temperature rises to 60.0 °C, what will the new pressure in the tank be?

Combined Gas Law

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

- Instead of memorizing all three equations, you can simply memorize this one
- Just delete what you don' t need

Example

- A gas at 110.0 kPa and 30.0°C fills a flexible container to a volume of 2.00 L. If the temperature was raised to 80.0°C and the pressure was increased to 440.0 kPa, what is the new volume?