# 2 Variable Gas Laws

Unit 7 Module 2

## Boyle's Law

The volume of a fixed number of moles of a gas varies *inversely* with the pressure at constant temperature.

 $\mathbf{P}_1\mathbf{V}_1=\mathbf{P}_2\mathbf{V}_2$ 



Volume



Decreasing volume increases collisions and increases pressure.



## Boyle's Law Example

A sample of  $O_2$  gas has a volume of 150. mL when its pressure is 0.947 atm. What will the volume be at a pressure of 0.987 atm if the temperature remains constant?

#### Charles' Law

The volume of a fixed amount of gas at constant pressure is *directly* proportional to its *Kelvin* temperature.

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$



Volume

## Charles' Law Example

A sample of Ne gas occupies a volume of 752 mL at 25°C. What volume will the gas occupy at 50.°C if the pressure remains constant?

#### Gay-Lussac's Law

The pressure of a gas at constant volume is *directly* proportional to the *Kelvin* temperature.

$$\frac{P_1}{T_1} = \frac{P_2}{T_2}$$





## Gay-Lussac's Example

The gas in an aerosol spray can is at a pressure of 3.00 atm at 5°C. Directions on the can warn the user not to keep the can in a place where the temperature exceeds 52°C. What would the pressure be at 52°C?

## Avogadro's Law

The volume of a gas under constant temperature and pressure conditions is *directly* proportional to the number of moles of gas. In other words, equal volumes of gases at the same temperature and pressure, regardless of the identity of the gas, will contain the same number of moles of gas.

$$\frac{V_1}{n_1} = \frac{V_2}{n_2}$$

## Avogadro's Law



# Avogadro's Law Simplified

At STP, one mole of gas occupies a volume of 22.4 liters. This can be expressed in the form of an equivalence statement which can then be written in the form of a conversion factor to perform dimensional analysis conversions:

1 mole gas at STP = 22.4 L

## Avogadro's Law Example #1

How many moles of nitrogen gas will be contained in a 2.00 L flask at STP? What will be the mass in grams of this volume of nitrogen gas at STP?

# Avogadro's Law Example #2

5.00 L of a gas is known to contain 0.965 mol. If the amount of gas is increased to 1.80 mol, what new volume will result (at a constant temperature and pressure)?