Topic 1 – Matter and Energy

Lesson 4 - Characteristics of gases and gas law calculations

Terms to Know

Composition of gases –

Factors that affect Gas behavior –

Volume –

Pressure –

Temperature –

Kinetic Molecular Theory –

Ideal Gases –

Real Gases –

Deviation from Ideal Gas Behavior – Effect of Molecular Mass –

Deviation from Ideal Gas Behavior – Effect of Temperature and Pressure –

Avogadro’s Law –



Relationship between volume and pressure at constant temperature –

Relationship between volume and temperature at constant pressure –

Relationship between pressure and temperature at constant volume –

Combined Gas Law –

P1V1 = P2V2

 T1  T2

Conversion Calculations

Pressure Conversion 1 atm = 101.3 kPa

Ex. What pressure in atm is equal to 259 kPa?

 259 kPa x $\frac{1 atm}{101.3 kPa}$ = 2.6 atm

Volume Conversion 1L = 1000 mL

Ex. What volume of He (g) in milliliters is equal to 1.33 L of He (g)?

 1.33 L x $\frac{1000 mL}{1 L}$ = 1330 mL

Temperature Conversion K = °C + 273

Ex. What Kelvin temperature is equal to 200°C?

 K = 200 + 273 = 473 K

ONLY KELVIN TEMPERATURE CAN BE USED IN GAS LAW CALCULATIONS!

Boyle’s Law

Example

At a constant temperature, what will be the new volume of a 20 L sample of oxygen gas if its pressure is changed from 2.5 atm to 5.0 atm?

Known Unknown

V1 = 20 L V2 = ?

P1 = 2.5 atm

P2 = 5.0 atm P1V1 = P2V2

 (2.5)(20) = (5)V2

 V2 = 10 L

Charles’ Law

Example

The volume of a confined gas is 25 mL at 280 K. At what temperature would the gas volume be 75 mL if the pressure is held constant?

Known Unknown

V1 = 25 mL T2 = ?

T1 = 280 K

V2 = 75 mL V1 = V2

 T1 T2

 25 = 75

 280 T2  T2 = 840 K

Gay-Lussac’s Law

Example

Pressure on a gas changes from 20 kPa to 50 kPa when the temperature of the gas is changed to 30°C. If volume was held constant, calculate the initial temperature of the gas.

Known Unknown

P1 = 20 kPa T1 = ?

P2 = 50 kPa

T2 = 30 + 273 = 300 P1 = P2

 T1 T2

 20 = 50\_

 T1 300

 T1 = 120 K = -153°C

STP stands for Standard temperature and pressure

Standard temperature 273 K or 0°C

Standard Pressure 1 atm or 101.3 kPa

Combined Gas Law

Example

Hydrogen gas has a volume of 100 mL at STP. If temperature and pressure are changed to 0.5 atm and 546 K respectively, what will be the new volume of the gas?

Known Unknown

V1 = 100 mL V2 = ?

T1 = 273 K

P1 = 1 atm P1V1 = P2V2

T2 = 546 K T1 T2

P2 = 0.5 atm (1)(100) = (0.5)V2

 273 546

 V2 = 400 mL