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Ch. 10 Gases Continued

List some characteristics of gases

- highly compressible
- expand to fill their containers
- have extremely low densities

* 2 or more gases form homogenous mixture.

What are the 4 variables needed to define the physical state of a gas?

- Pressure
- Temperature
- Volume
- Amount of gas

What are the units for standard atmospheric pressure?

$$1\ atm = 760\ torr = 760\ mm\,Hg = 101.325\ kPa = 1.01325\ bar$$

Convert 0.836 atm to torr

SIG FIGS!

$$0.836\ atm \cdot \frac{760\ torr}{1\ atm} = 635.36 \rightarrow \boxed{635\ torr}$$

(want / have)

Convert 172.8 kPa to torr

$$172.8\ kPa \cdot \frac{760\ torr}{101.325\ kPa} = \boxed{1296\ torr}$$

What is the Ideal-Gas Equation?

$$PV = nRT$$

R: 0.0821 $\frac{atm \cdot L}{mol \cdot K}$ constant

Standard Temperature & Pressure

What is the volume of one mole of ideal gas at STP?

22.4 L

A sealed container has a gas pressure of **1.8 atm** at a temperature of **15°C**. If the container is heated to **200°C**, what is the new pressure? Assume the volume and amount of gas remain constant.

Gay-Lussac's Equation $\frac{P_1}{T_1} = \frac{P_2}{T_2}$

$P_1 = 1.8$ atm

$T_1 = 15°C + 273.15 =$

$T_2 = 200°C + 273.15 =$

$P_2 = ?$

$P_2 = \frac{P_1 T_2}{T_1} \rightarrow \frac{(1.8 \text{ atm})(473.15 \text{ K})}{(288.15 \text{ K})} =$ **2.95 atm**

A **0.75 mol** sample of gas is at **20°C** and **1.5 atm**. The volume is **reduced to one-third** of its original volume, and the **final pressure is 3.6 atm**. What is the **final temperature** of the gas in **°C**?

$n = .75$ mol

$T_1 = 20.0°C$

$P_1 = 1.5$ atm

$V_2 = 1/3 V_1$

$P_2 = 3.6$ atm

$T_2 = ?$

Combined Gas Law $\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$

$T_2 = \frac{P_2 V_2 T_1}{P_1 V_1} = \frac{(3.6 \text{ atm})(1/3 V_1)(293.15 \text{ K})}{(1.5 \text{ atm}) V_1}$

$T_2 = 234.52 \text{ K} - 273.15 =$ **-38.63°C**

Magnesium carbonate is heated and decomposes to produce **CO_2 gas**, which is collected in a **500. mL** container. The collected gas exerts a **pressure of 2.8 atm** at a temperature of **27°C**.

How many moles of CO_2 were produced?

$V = 500.$ mL

$P = 2.8$ atm

$T = 27°C$

$n = ?$

Ideal Gas Law $PV = nRT$

$n = \frac{PV}{RT}$

$= \frac{(2.8 \text{ atm})(0.5 \text{ L})}{\left(0.0821 \frac{\text{atm} \cdot \text{L}}{\text{mol K}}\right)(300.15 \text{ K})}$

$= 0.0568 \rightarrow$ **0.057 mol CO_2**