Noteset 7C (Part 2) - In Class Noteset
Conversions with the Ideal Gas Law

Units and the Ideal Gas Law

"R" (Ideal gas constant) determines the units used for each measurement.

$$R = 0.0821 \frac{L \cdot atm}{mol \cdot k}$$

Base Units in Ideal gas law

P = Atmospheres (atm)
V = Liters (L)
T = kelvin (k)
n = mol (n)

Non-Base units need converting

Unit Conversion Review

1atm = 760mmHg = 101.3kPa

|3.92 atm|, convert to|mmHg|

$$3.92\ \text{atm} \left| \frac{760\ \text{mmHg}}{1\ \text{atm}} \right.$$

P = 2979.2 mmHg

1L = 1000mL

|1291.61mL| convert to|L|

$$1291.6\ \text{mL} \left| \frac{1\ \text{L}}{1000\ \text{mL}} \right.$$

V = 1.2916 L

Converting with the Ideal gas law

$T = \frac{PV}{nR}$

$P = 2.9\,atm \quad V = 6.3\,L$

$n = 1.5\,mol \quad T = \_\_\_\,K$

$$T = \frac{2.9\,\cancel{atm} \cdot 6.3\,K}{0.0821\,\frac{L \cdot \cancel{atm}}{\cancel{mol} \cdot K} \cdot 1.5\,\cancel{mol}}$$

$T = 219.00\,K^*$

$°C = K - 273.15$

$T = 219.00\,K \rightarrow °C$

$T_{°C} = 219.00 - 273.15$

$T_{°C} = -54.15\,°C$

$1\,atm = 760\,mmHg = 101.3\,kPa$

$1210\,mmHg \longrightarrow \underline{\quad}\,atm$ (for Ideal)

$$1210\,\cancel{mmHg} \left| \frac{1\,atm}{760\,\cancel{mmHg}} \right.$$

$P = 1.59\,atm^*$

$P = \underline{1.59^*}\,atm \quad V = 2.51\,L$

$n = \_\_\_\,mol \quad T = 300.0\,K$

$$n = \frac{PV}{RT} = \frac{1.59\,\cancel{atm} \cdot 2.51\,L}{0.0821\,\frac{L \cdot \cancel{atm}}{mol \cdot \cancel{K}} \cdot 300.0\,K}$$

$n = 0.16\,mol$

Mol, Molar Mass, and the Ideal Gas Law

Molar Mass: Mass of 1 mol of a substance (C = 12.01 g/mol)

$300.19\ g\ CO_2$ to mol CO_2

$MM_{CO_2} = 44.01\ g = 1\ mol$

$$300.19\ g\ CO_2 \left| \frac{1\ mol\ CO_2}{44.01\ g\ CO_2} \right.$$

$n_{CO_2} = 6.82\ mol$

$2.19\ mol\ H_2O$ to mass H_2O

$MM_{H_2O} = 18.02\ g = 1\ mol$

$$2.19\ mol\ H_2O \left| \frac{18.02\ g\ H_2O}{1\ mol\ H_2O} \right.$$

$mass_{H_2O} = 39.46\ g$

Conversions w/ Ideal gas law

Step 1

Convert to standard base units

V: mL → L

P: mmHg → atm

T: °C → k

n: mass → n (mol)

Step 2

Ideal gas law

V = L P = atm

T = k n = mol

Step 3

convert to non-base units

V: L → mL

P: atm → kPa

T: k → °C

n: mol (n) → mass