Chemical Quantities

Measuring matter

- A mass
- A volume
- A count

Count

- One dozen = 12
- One mole = Avogadro's number of items
- Avogadro's number = 6.022×10^{23}

Molar Mass – the mass of one mole of a substance

Determine the molar mass of the following substances.

1. Carbon — C = 12.011 g/mol

2. Iron — Fe = 55.847 g/mol

3. water — H_2O

2(H)	2(1.007 94 g/mol)
1(O)	1(15.9994 g/mol)
	18.015 28 g/mol

4. ammonium carbonate
   $(NH_4)_2CO_3$

2(N)	2(14.0067 g/mol)
8(H)	8(1.007 94 g/mol)
1(C)	1(12.011 g/mol)
3(O)	3(15.9994 g/mol)
	96.086 12 = 96.086 g/mol

Converting between moles and mass.

$$moles = \frac{mass}{molar\ \ mass} \qquad or \qquad mass = (moles)(molar\ mass)$$

Example: What is the mass of 5.00 mol of water?

Mass = (moles)(molar mass)
= (5.00 mol)(18.105 28 g/mol)
= 90.0764
= **90.1 g/mol**

Molar Volume

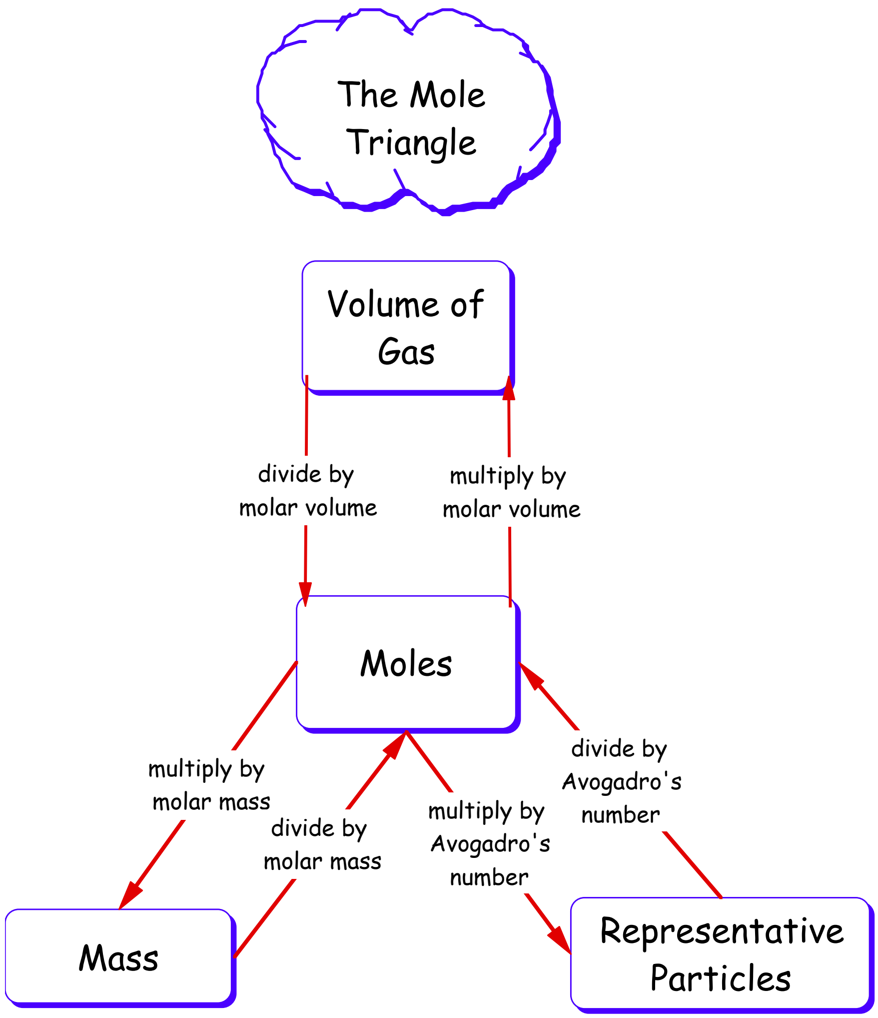
- The volume occupied by one mole of a gas at STP
- STP = standard temperature and pressure
- STP = 0°C and 101.3 kPa
- The molar volume of any gas at STP is 22.4 L/mol

$$moles = \frac{volume\ \ of\ \ \ gas}{molar\ \ mass} \quad or\ \ volume\ of\ \ gas = (moles)(molar\ volume)$$

Example: What is the volume of 3.00 mol of carbon dioxide at STP?

Volume = (moles)(molar volume)
= (3.00 mol)(22.4 L/mol)
= **67.2 L**

The Mole Triangle



$$mol = \frac{mass}{molar\ mass}$$

$$mol = \frac{volume\ of\ gas}{molar\ volume}$$

$$mol = \frac{representative\ particles}{Avogadro's\ Number}$$

Molarity

- A method of expressing the concentration of a solution

$$Molarity = \frac{moles\ of\ solute}{volume\ (L\ or\ dm^3)\ of\ solution}$$

$$C = \frac{n}{V}$$

$$C = concentration\ (molarity)$$

$$n = number\ of\ moles$$

$$V = volume\ (L\ or\ dm^3)$$

Example: Determine the molarity of a solution that contains 25.0 g of sodium hydroxide in 300.0 mL of solution.

$$mol = \frac{mass}{molar\ mass} = \frac{25.0\ g\ NaOH}{39.99711\ g/mol} = 0.625\ mol$$

$$C = \frac{n}{V} - = \frac{0.625\ mol}{0.3000\ L} = 2.08\ mol/L$$