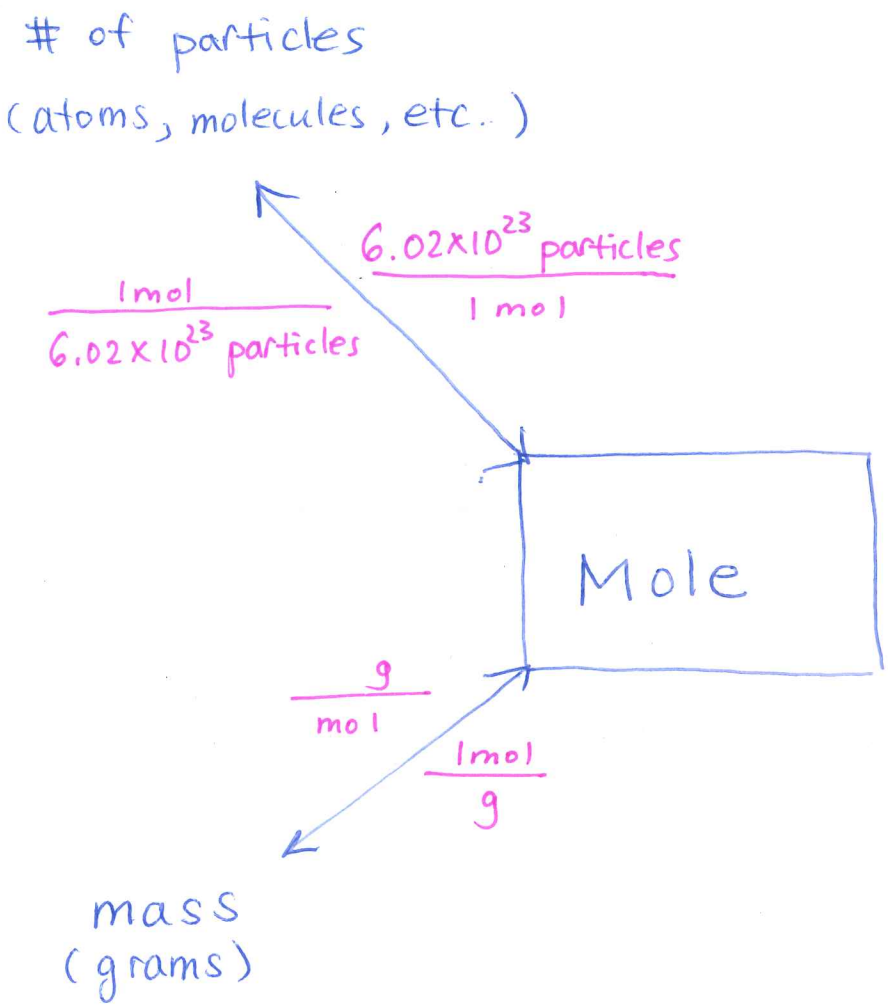
# of particles
(atoms, molecules, etc.)
6.02×10^23 particles / 1 mol
1 mol / 6.02×10^23 particles
Mole
g / mol
1 mol / g
mass
(grams)

Ex1) How many molecules are in 720.0g of $C_6H_{12}O_6$?

$720.0g\ C_6H_{12}O_6 \longrightarrow$ # of molecules of $C_6H_{12}O_6$

molar mass of $C_6H_{12}O_6$: $\frac{180.18g}{mol}$ or $\frac{mol}{180.18g}$ ①

N_A: $\frac{6.02\times10^{23}\ molecules}{1\ mol}$ or $\frac{1\ mol}{6.02\times10^{23}\ molecules}$ ②

mol $C_6H_{12}O_6$

① $720.0\cancel{g}\ C_6H_{12}O_6\left(\frac{mol}{180.18\cancel{g}}\right) = 3.996\ mol\ C_6H_{12}O_6$

② $3.996\cancel{mol}\ C_6H_{12}O_6\left(\frac{6.02\times10^{23}\ molecules}{1\ \cancel{mol}}\right) = 2.41\times10^{24}\ molecules$

All in ①

$\frac{720.0\cancel{g}\ C_6H_{12}O_6}{1}\left(\frac{1\ \cancel{mol}}{180.18\ \cancel{g}}\right)\left(\frac{6.02\times10^{23}\ molecules}{1\ \cancel{mol}}\right)$

$= 2.41\times10^{24}$ molecules. $C_6H_{12}O_6$

Ex2) How many molecules are in 8550g of SO_2?

$$8550\,g\ SO_2 \longrightarrow \text{molecules } SO_2$$

$$8550\,g\ SO_2 \xrightarrow{\frac{64.07\,g}{1\,mol}} mol \xrightarrow{\frac{6.02\times10^{23}\text{ molecules}}{1\,mol}} \text{molecules } SO_2$$

$$8550\,\cancel{g}\ SO_2 \left(\frac{1\,\cancel{mol}}{64.07\,\cancel{g}}\right)\left(\frac{6.02\times10^{23}\text{ molecules}}{1\,\cancel{mol}}\right)$$

$= 8.03\times10^{25}$ molecules of SO_2

EX3) How many grams are in 3.01×10^{24} molecules of $(NH_4)_2SO_4$?

$$3.01\times10^{24}\text{ molecules} \longrightarrow g\ (NH_4)_2SO_4$$

$$3.01\times10^{24}\text{ molecules} \xrightarrow{\frac{6.02\times10^{23}\text{ molecules}}{1\,mol}} mol \xrightarrow{\frac{132.17\,g}{1\,mol}} g\ (NH_4)_2SO_4$$

$$3.01\times10^{24}\,\cancel{\text{molecules}}\ (NH_4)_2SO_4 \left(\frac{1\,\cancel{mol}}{6.02\times10^{23}\,\cancel{\text{molecules}}}\right)\left(\frac{132.17\,g}{1\,\cancel{mol}}\right)$$

$= 660.85\,g\ (NH_4)_2SO_4$

$= 661\,g\ (NH_4)_2SO_4$

Ex4) How many grams are in 1.204×10^{24} molecules of acetic acid? (acetic acid = CH_3COOH)

↑ Acid in your vinegar.

1.204×10^{24} molecules CH_3COOH ⟶ g CH_3COOH

$\frac{6.02 \times 10^{23} \text{ molecules}}{1 \text{ mol}}$ ↘ mol ↗ $\frac{60.06 \text{ g}}{1 \text{ mol}}$

$$1.204 \times 10^{24} \cancel{\text{molecules}} \left(\frac{1 \cancel{\text{mol}}}{6.02 \times 10^{23} \cancel{\text{molecules}}} \right) \left(\frac{60.06 \text{ g}}{1 \cancel{\text{mol}}} \right)$$

$= 120.12 \text{ g } CH_3COOH = 120. \text{ g } CH_3COOH$

$(1.20 \times 10^2 \text{ g } CH_3COOH)$ ✓✓✓

120g → 2 s.f.

3.3 review Questions