Molar Mass and the Mole

Molar Mass (M) → is the mass of one mole of a substance

unit is g/mol

Avogadro's number is special because **6.022 x 10^{23} atoms of an element has a mass in grams that is equal to its atomic mass.**

Average atomic mass in u = Molar mass in g/mol

Example 1

Atomic mass Na = 22.990 u Molar Mass of Na = 22.990 g/mol

Example 2 Find the molar mass of NaCl:

22.990 g/mol + 35.453 g/mol

= 58.443 g/mol

You can use molar mass to write conversion factors for NaCl:

$\times \frac{58.443\ g}{1\ mol}$ OR $\times \frac{1\ mol}{58.443\ g}$

a) What is the mass of 2.56 mol NaCl?

1 mol = 58.443 g

∴ 2.56 mol = ?

$2.56\ mol \times \frac{58.443\ g}{1\ mol} = 149.61408\ g$ (5 SF; 3 SF) → 150 g or 1.5×10^2 g

b) How many mol are in a 35.2 g sample of NaCl?

1 mol = 58.443 g

35.2 g = ?

$35.2\ g \times \frac{1\ mol}{58.443\ g} = 0.602296254\ mole$ (3 SF; 5 SF) → 0.602 mol

Example 3 What is the mass of a 0.750 mol sample of CO_2?

M of CO_2 = 12.011 + (2 x 15.999) = 44.009 g

1 mol = 44.009 g

∴ 0.750 mol = ?

$0.750\ mol \times \frac{44.009\ g}{1\ mol} = 33.00675\ g$ → 33.0 g

Example 4 How many mol are in a 23.6 g sample of $Mg(NO_3)_2$?

M of $Mg(NO_3)_2$ = 24.305 + (2 x 14.007) + (6 x 15.999) = 148.313 g → 148.313 g/mol

1 mol = 148.319 g

∴ 23.6 g = ?

$23.6\ g \times \frac{1\ mol}{148.319\ g} = 0.159126154$ → 0.159 mol