Atoms, molecules and stoichiometry

Relative atomic mass, *A*r

The *relative atomic mass* is the weighted average mass of naturally occurring atoms of an element on a scale where an atom of carbon-12 has a mass of exactly 12 units.

$$\text{relative atomic mass of element E} = \frac{\text{average mass of one atom of E}}{1/12^{\text{th}} \text{ the mass of one atom of } {}^{12}\text{C}}$$

Relative molecular mass, *M*r

The *relative molecular mass* of a compound (*M*r) is the relative mass of one molecule of the compound on a scale where the carbon-12 isotope has a mass of exactly 12 units.

Relative formula mass

For compounds containing ions we use the term **relative formula mass**

Molarity

One mole of an element is *the* amount that contains the same number of atoms as there are in 12.00g of carbon-12.

Avogadro's Constant

The number of atoms in a mole of atoms is very large: 6.02×10^{23} atoms. This number is called the Avogadro constant (or Avogadro number).

Question:

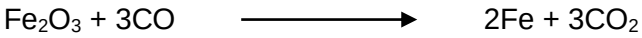
(a) Use these *A*r values (Fe = 55.8, N = 14.0, O = 16.0, S = 32.1) to calculate the amount of substance in moles in each of the following:

(i) 10.7 g of sulfur atoms **(ii)** 64.2 g of sulfur molecules (S_8) **(iii)** 60.45 g of anhydrous iron(III) nitrate, $Fe(NO_3)_3$.

(b) Use the value of the Avogadro constant (6.02×10^{23} mol^{-1}) to calculate the total number of atoms in 7.10 g of chlorine atoms. (A_r value: Cl = 35.5)

Mole Calculations

Question: Iron(III) oxide reacts with carbon monoxide to form iron and carbon dioxide.



$$Fe_2O_3 + 3CO \longrightarrow 2Fe + 3CO_2$$

Calculate the maximum mass of iron produced when 798 g of iron(III) oxide is reduced by excess carbon monoxide. (A_r values: Fe = 55.8, O = 16.0)