CLIL - Stoichiometry

Atomic Mass

The units in which the masses of an atom are expressed are **atomic mass units**. At one time, the lightest atom was assigned a mass of 1 amu and the mass of any other atom was expressed in terms of this standard. Today atomic mass units are defined in terms of the ^{12}C isotope, which is assigned a mass of exactly 12.000 amu.

Isotopes

Isotopes are atoms of the same element with different numbers of neutrons, such as the ^{20}Ne and ^{22}Ne isotopes of neon or the ^{35}Cl and ^{37}Cl isotopes of chlorine.

Atomic Weight

The **atomic weight** of an element is the weighted average of the atomic masses of the different isotopes of an element. Naturally occurring carbon, for example, is a mixture of two isotopes, ^{12}C (98.89%) and ^{13}C (1.11%). Individual carbon atoms therefore have a mass of either 12.000 or 13.03354 amu. But the average ponderal mass of the different isotopes of carbon is 12.011 amu.

Molecular Weight

The **molecular weight** of a compound is the sum of the atomic weights of the atoms in the molecules that form these compounds.
Example: The molecular weight of the sugar molecule found in cane sugar is the sum of the atomic weights of the 12 carbon atoms, 22 hydrogen atoms, and 11 oxygen atoms in a $C_{12}H_{22}O_{11}$ molecule.
A mole of $C_{12}H_{22}O_{11}$ would have a mass of 342.299 grams. This quantity is known as the **molar mass**, a term that is often used in place of the terms **atomic weight** or **molecular weight**.
The term mole literally means a small mass. It is used as the bridge between chemistry on the atomic and macroscopic scale. If the mass of a single ^{12}C atom is 12.000 amu, then one mole of these atoms would have a mass of 12.000 grams. By definition, a mole of any substance contains the same number of elementary particles as there are atoms in exactly 12 grams of the ^{12}C isotope of carbon.
Example: A single ^{12}C atom has a mass of 12 amu, and a mole of these atoms would have a mass of 12 grams.
A mole of any atom has a mass in grams equal to the atomic weight of the element. The term mole can be applied to any particle: atoms, a mole of atoms, a mole of ions, a mole of electrons, or a mole of molecules. Each time we use the term, we refer to a number of particles equal to the number of atoms in exactly 12 grams of the ^{12}C isotope of carbon.
Avogadro's number (or Avogadro's constant) is the number of elementary particles in a mole of any substance For most calculations, four significant figures for Avogadro's constant are enough: $6.022 \bullet 10^{23}$.
A mole of any substance contains Avogadro's number of elementary particles. It doesn't matter whether we talk about a mole of atoms, a mole of molecules, a mole of electrons, or a mole of ions. By definition, a mole always contains $6.022 \bullet 10^{23}$ elementary particles.

(Adapted from Wikipedia)

Avogadro's biography

Count Lorenzo Romano Amedeo Carlo Avogadro di Quaregna e Cerreto (August 9, 1776 – July 9, 1856) was an Italian scientist, famous for his contributions to the theory of molarity and molecular weight. Avogadro's number (the number of molecules in one mole) is named in his honor, as is Avogadro's law.
Born in a noble ancient family of Piedmont, Avogadro was a brilliant student; he graduated in ecclesiastical law at a very young age (20) and began to practice. However, soon after he dedicated himself to the study of physics and mathematics, his preferred sciences, and in 1809 he started teaching them (then called **positive philosophy**) at a liceo (high school) in Vercelli.
Avogadro's Law implies that the relationship occurring between the weights of same volumes of different gases (at the same temperature and pressure) corresponds to the relationship between respective molecular weights. Hence, relative

molecular masses can be calculated from the masses of gas samples.
Avogadro developed this hypothesis after Joseph Louis Gay-Lussac had published in 1808 his law on volumes (and combining gases).
In honour of Avogadro's contributions to the theory of molarity and molecular weights, the number of molecules in NA, which is approximately $6.02214199 \bullet 10^{23}$.

(Adapted from Wikipedia)

Glossary

Stoichiometry	**Stechiometria**	Neutron	**Neutrone**
Atomic mass	**Massa atomica**	Electron	**Elettrone**
Isotope	**Isotopo**	Molecular mass	**Massa molecolare**
AMU	**UMA**	Molecular weight	**Peso molecolare**
Mole	**Mole**	Each	**Ciascuno**
Avogadro number	**Numero di Avogadro**	Mixture	**Miscela**
Often	**Spesso**		

Practise

Complete the text with the most suitable words.

(1) ..... derives from the Greek and measure of the weight. It is an application of the conservation of the mass law. (2) ..... is a very important number because is the the number of protons possessed by an atom. This number is specific for an atom because, for example, an atom having one proton is hydrogen, seven protons is nitrogen ect. Anhoter important concept is (3) ..... meaning the mass of an atom refered at (4) ..... (AMU), the twelfth portion of ^{12}C isotope. Infact in nature exist atoms having the same atomic number but different atomic mass. That atoms are called (5) .....
(6) ..... is the sum of atomic masses of the atoms presentin the molecule.
(7) ..... is equal to avogadro number of atoms or molecules. Mole is too the quantity in grams of the molecular (8) .....

Match the words in table A with the English equivalent in table B. Use a dictionary if needed.

Table A

A	Stechiometria
B	Numero atomico
C	Massa atomica
D	Isotopo
E	Mole
F	UMA
G	Protone
H	Neutrone
I	Elettrone
J	Massa molecolare
K	Miscela
L	Numero di Avogadro
M	Coefficiente stechiometrico
N	Ione
O	Formula
P	Reagente
Q	Prodotto
R	Atomo
S	Molecola
T	Composto

Table B

1	Ion
2	Isotope
3	Atom
4	Neutron
5	Stoichiometric coefficient
6	Atomic mass
7	Formula
8	Mole
9	Product
10	Proton
11	Molecule
12	Electron
13	Avogadro number
14	Atomic number
15	Reactant
16	AMU
17	Mixture
18	Stoichiometry
19	Compound
20	Molecular mass

Keys

Complete the text with the most suitable words.

(1) Stoichiometry derives from the Greek and mains measure of the weight. It is an application of the conservation of the mass law. (2) Atomic number is a very important number because is the number of protons possessed by an atom. This number is specific for an atom because, for example, an atom having one proton is hydrogen, seven protons is nitrogen ect. Another important concept is (3) atomic mass meaning the mass of an atom refered at (4) Atomic Mass Unit (AMU), the twelfth portion of ^{12}C isotope.
Infact in nature exist atoms having the same atomic number but different atomic mass. That atoms are called (5) isotopes.
(6) Molecular mass is the sum of atomic masses of the atoms presentin the molecule.
(7) Mole is equal to avogadro number of atoms or molecules. Mole is too the quantity in grams of the molecular (8) mass.

Match the words in table A with the English equivalent in table B. Use a dictionary if needed.

Table A	Table B
A	18
B	14
C	6
D	2
E	8
F	16
G	10
H	4
I	12
J	20
K	17
L	13
M	5
N	1
O	7
P	15
Q	9
R	3
S	11
T	19