NEET CHEMISTRY

VOLUME - I

1. BASIC CONCEPTS

Introduction

Chemistry is the science of substances, their properties, structures and their transformation. As all objects in the universe are made of matter. Chemistry is the branch of the science which deals with the study of material object. Study of chemistry is very interesting. It covers various aspects of our culture and environment. All development in any science are based on scientific approach as in chemistry too. In order to achieve correct results, one has to rely upon the various skills connected with the measurements of quantities during a physical or chemical change. The degree of accuracy is closely linked with precision of the measuring instrument as well as on the skill of the person engaged in measurement. So we should be first familiar with some terminology used in chemistry.

Physical Property:

The property which can be measured without changing the chemical composition of the substance is known as physical property like mass, volume, density, refractive index etc.

Chemical property:

The property which can be evaluated at the cost of matter itself is known as chemical property. For example combustible nature of hydrogen gas can be verified by burning of hydrogen. The sweet taste of sugar is recognised by consuming it.

Units of Measurement:

All physical quantities have to be measured. The value of a physical quantity is expressed as the product of the numerical value and the unit in which it is expressed.

Fundamental units:

Fundamental units are those units which can neither be derived from one another nor they can be further resolved unit any other units

The seven fundamental units of measurement in SI system.

Quantity	Name of unit	Abbreviation
Mass	Kilogram	Kg
Length	Metre	M
Temperature	Kelvin	K
Amount of substance	Mole	Mol
Electric current	Ampere	A
Luminous intensity	Candela	Cd

Derived unit:

Some quantities are expressed as a function of more than one fundamental units known as derived units. For example, velocity, acceleration, work, energy etc.

Quantity with Symbol	Unit(S.I)	Symbol
Velocity(V)	Meter per sec	ms^{-1}
Area(A)	Square metre	m^2
Volume(V)	Cubic metre	m3
Density(ρ)	Kilogram m^{-3}	Kg m^{-3}
Energy(E)	Joule(J)	Kg m^2s^{-2}
Force(F)	Newton(N)	Kg ms^{-2}
Frequency (v)	Hertz	Cycle per sec
Pressure(P)	Pascal(Pa)	Nm-2
Electrical charge	Coulomb(C)	A-s(ampere-second)

Units and Dimensional Analysis: Conversion of units

The simplest way to carry out calculations that involve different units is to use dimensional analysis. In this method a quantity expressed in one unit is converted into an equivalent quantity with a different unit by using conversion factor which express the relationship between units:

Original quantity x conversion factor = equivalent quantity
(in former unit) (in other unit)

This is based on the fact that ratio of each fundamental quantity in one unit with their equivalent quantity in other unit is equal to one

For example in case of mass

$\frac{1\text{kilogram}}{2.205\text{pound}} = 1 = \frac{1\text{kilogram}}{1000\text{pound}}$. So 1 kg = 2.205 pound=1000gm.

In this way derived unit first expressed in dimension and each fundamental quantities like mass length time are converted in other system of desired unit to work out the conversion factor.

For example : How unit of work/energy ie. joule, in S.I system is related with unit erg in C.G.S system

Dimension of work = force x displacement = MLT^2 x L = ML^2T^{-2}

1 joule = 1 kg $(1 \text{ metre})^2$ $x(1\text{sec})^{-2}$

$$\Rightarrow 1\text{xkgx}\frac{1000\text{gm}}{1\text{kg}}\text{x}\left[1\text{metrex}\frac{100\text{cm}}{1\text{metre}}\right]^{-2}\text{x}[1\text{sec}]^{-2}$$

$$\Rightarrow 100\text{gmx}(100)^2\text{x}1\text{cm}^2\text{x}(1\text{sec})^{-2} \quad \Rightarrow 1000\text{x}10000\text{x}1\text{gmx}1\text{cm}^2\text{x}1\text{sec}^{-1}$$

$$1\text{joule} = 10^7\,\text{erg}$$

Similarly we can deduce other conversion factor for other quantity in different unit by the dimensional analysis method. Another interesting example is the conversion of litre - atmosphere to joule (the SI unit of energy) by multiplying with two successive unit factors. Thus,

$$1\text{Latmx}\left(\frac{10^{-3}\text{m}^3}{1\text{L}}\right)\text{x}\frac{101.325\text{Pa}}{1\text{atm}} = 101.325\text{Pam}^3$$

Knowing that $\text{Pa} = \frac{\text{N}}{\text{m}^2}$, we can write $101.325\text{Pam}^2 = 101.325(\frac{\text{N}}{\text{m}^2})\text{m}^3 = 101.325\text{Nm} = 101.325\text{J}$

Illustration 1

What is the mass of 1L of mercury in grams and in kilograms if the density of liquid mercury is 13.6g cm^{-3}?

Solution:

We know the relationship, 1L =1000cm^3 and also , density = $\frac{\text{mass}}{\text{volume}}$

We can write , mass = (volume) (density)

Therefore, the mass of 1L of mercury is equal to

$$(1L)\left(\frac{1000cm^3}{1L}\right)(13.6g\,cm^{-3}) = (1000cm^3)(13.6gcm^{-3}) = 1.36x10^4 g$$

The mass in kilograms can be calculated as

$$1.36\ x10^4 g = (13.6x10^4\ g)\left(\frac{1kg}{1000g}\right) = 13.6kg$$

(Remember, $\frac{1000cm^3}{1L}$ and $\frac{1kg}{1000g}$ are conversion factors with which we have to multiply for getting our answer in appropriate units).

Exercise – 1

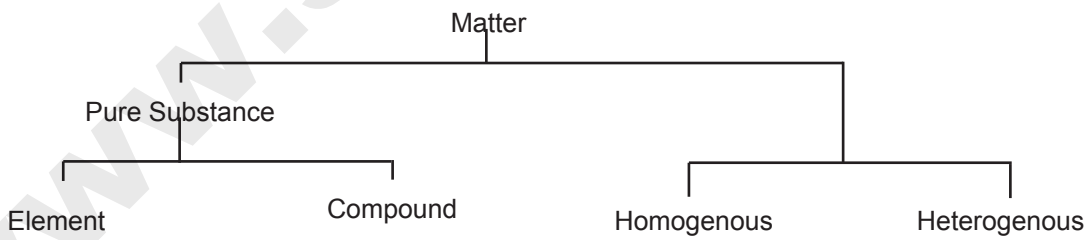
Vanadium metal is added to steel to impart strength. The density of vanadium is 5.96 g/cm^2. Express this in S.I units (kg/m^3).

Matter

Anything that exhibits inertia is known as matter. The quantity of matter is its mass. E.g. chalk table.

Classification of Matter

This classification of matter is based upon chemical composition of various substances. According to this matter can be further divided into two types, pure substance and mixture. Mixtures are also of two types, homogenous mixtures and heterogeneous mixtures.



Elements:

The primary stuff present in all the substance is known as element, whose smallest unit is known as atom. Total 112 elements are known till date of which 92 are naturally occurring elements rest are results of artificial transmutation. There are 88 metals, 18 non metals and 6 metalloids.

Compound:

A non elemental pure substance is called a compound in which more than one atom of elements are linked