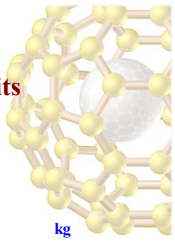
Units of Measurement

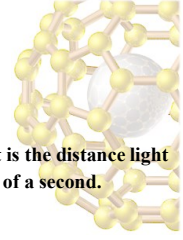


SI (Systeme Internationale) Units

- There are two types of units:
  - fundamental (or base) units
  - derived units.
- There are 7 base units in the SI system.

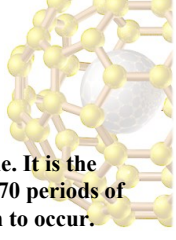
– mass	kilogram	kg
– length	meter	m
– time	second	s
– electric current	ampere	A
– thermodynamic temperature	kelvin	K
– luminous intensity	candela	cd
– amount of substance	mole	mol

Length and Mass



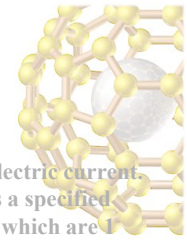
- **Length meter [m]**
  - **The meter is the basic unit of length. It is the distance light travels, in a vacuum, in 1/299792458*th* of a second.**
- **Mass kilogram [kg]**
  - The kilogram is the basic unit of mass. It is the mass of an international prototype in the form of a platinum-iridium cylinder kept at Sevres in France. *It is now the only basic unit still defined in terms of a material object, and also the only one with a prefix [kilo] already in place.*

Time



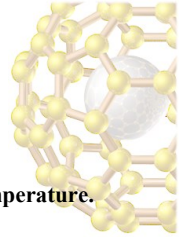
- **second [s]**
- **The second is the basic unit of time. It is the length of time taken for 9192631770 periods of vibration of the caesium-133 atom to occur.**

Electric Current



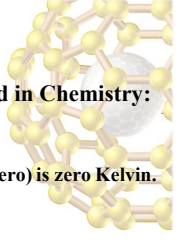
- ampere [A]
- The ampere is the basic unit of electric current. It is that current which produces a specified force between two parallel wires which are 1 meter apart in a vacuum. *It is named after the French physicist Andre Ampere (1775-1836).*

Temperature



- **kelvin [K]**
- **The kelvin is the basic unit of temperature.**
- **It is 1/273.16*th* of the thermodynamic temperature of the triple point of water. *It is named after the Scottish mathematician and physicist William Thomson 1st Lord Kelvin (1824-1907).***

Temperature Scales



There are two temperature scales used in Chemistry:

Kelvin Scale

Lowest temperature possible (absolute zero) is zero Kelvin.
Absolute zero: 0 K = -273.15°C.

Celsius Scale

Water freezes at 0°C and boils at 100°C.
To convert: K = °C + 273.15.

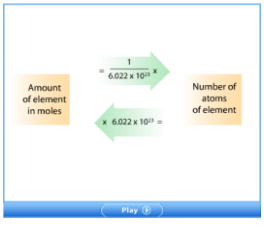
Luminous Intensity

- candela [cd]
- The candela is the basic unit of luminous intensity. It is the intensity of a source of light of a specified frequency, which gives a specified amount of power in a given direction.

The Amount of Substance:

- **mole [mol]**
- **The mole is the basic unit of substance. It is the amount of substance that contains as many elementary units as there are atoms in 0.012 kg of carbon-12.**
- **602,000,000,000,000,000,000,000 atoms**

How big is a mole?



Derived Units

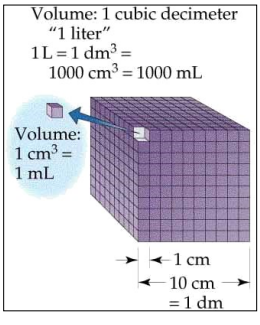
- **Derived units are obtained from the 7 base SI units.**
- **Example:**
  - **Velocity**

$$\text{Units of velocity} = \frac{\text{units of distance}}{\text{units of time}} = \frac{\text{meters}}{\text{seconds}} = \text{m/s}$$

Density
(most common derived unit in chemistry

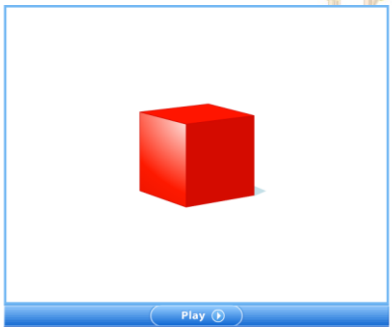
- **Used to characterize substances.**
- **Defined as mass divided by volume.**
- **Units: g/cm^3.**

Volume

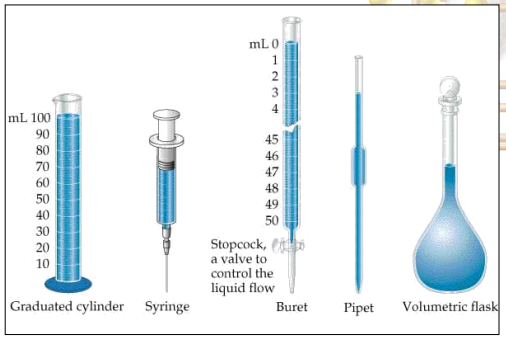


- **The units for volume are given by (units of length)^3.**
  - **i.e., SI unit for volume is 1 m^3.**
- **We usually use 1 mL = 1 cm^3.**
- **Other volume units:**
  1 L = 1 dm^3 = 1000 cm^3 = 1000 mL.

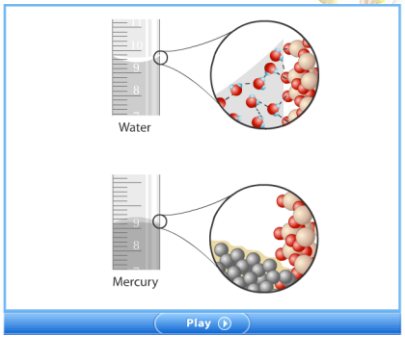
In other words



Measuring Volume



how to read a graduated cylinder



Uncertainty in Measurement

- **All scientific measures are subject to error.**
- **These errors are reflected in the number of figures reported for the measurement.**
- **These errors are also reflected in the observation that two successive measures of the same quantity are different.**

Uncertainty in Measurement

Precision and Accuracy

- **Measurements that are close to the "correct" value are accurate.**
- **Measurements which are close to each other are precise.**
  - **Measurements can be**
  - **accurate and precise;**
  - **precise but inaccurate;**
  - **neither accurate nor precise.**

Precision and Accuracy