Measuring systems

Weight

is a measure of gravitational force acting on a body which is directly proportional to the body mass.

Measure

is the determination of the volume or extent of a body. Temperature and pressure have significant effect on gases and liquids.

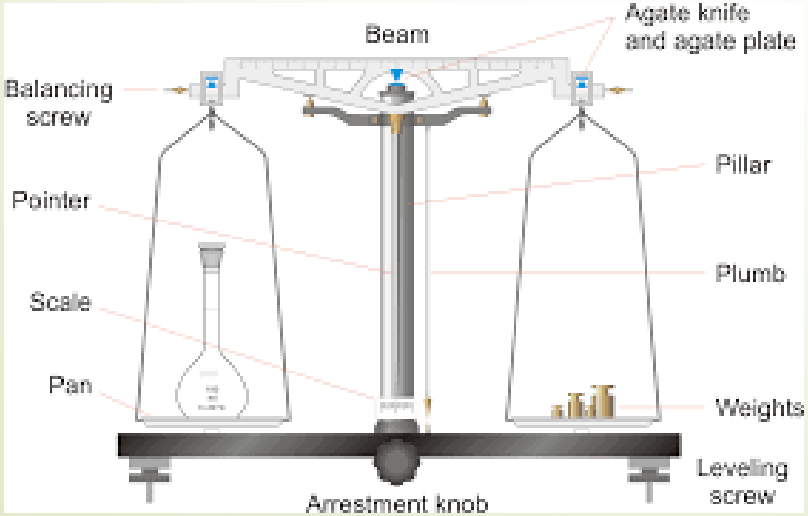
Balance, scale are the mechanical devices used for measuring weights.

Graduated cylinder, pipettes are the devices used for measuring volume.

Balances used in pharmacy practice:

These are instruments determining the relative weights of substances. They can be,

- Single beam equal arm balances
- Unequal arm balances,
- Compound lever balances
- Torsion balances



- Generally hydrostatic balances are used in pharmacy practice. These have a single beam and equal scales in both sides and carry pans in both sides to weigh substances.

- The balance must be checked for its zero point in horizontal position and the sensitivy of the balance must be known before weighing.

Measuring systems

- FPS (English) unit system (Foot-Pound-Second)
- CGS unit sytem (Centimeter-Gram-Second)
- MKS unit system (Meter-Kilogram-Second)
- Common systems; * Avoirdupois
  * Apothecary

Problem:

Difficulty in understanding the scientific data in different countries

Solution :

Usage of an international unit system ⟶ SI

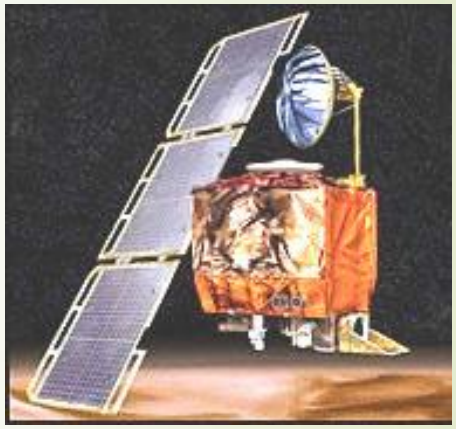
Why it is important to use an international system?

Small mistake → big loss

- Year: 1983
- An aeroplane in Canada has landed to the sea due to the loss of fuel
- Reason was a mistake in converting pound to litre and it was resulted with inadequate amount of refuel which caused the accident and death of 61 passengers

Small mistake → big loss

- Year 1999
- Mars Space craft of NASA was disappeared in space
- Reason was a mistake in converting of Newton to pound
- (1 Newton = 0.225 Pound)
- It resulted with a 125 million dolars of loss



Common unit systems used in pharmacy

- ✓ **Avoirdupois (imperial) system**
- ✓ **Apothecary (troy) system**

They are not official for today

- ❑ They were used for bulk buying/selling medicines (avoirdupois) in weight and compounding them by another (apothecary) in old England
- ❑ still have some place in daily life in England and USA.
- ❑ They use grain and minim as basic mass and volume units.

Grain: weight of wheat kernel (gm) 1 gm= 64.8 mg
Minim: one drop of water

	Mass	Volume
AVORDUPOIS	*grain (gm)* 437.5 gr = 1 ounce (oz) 16.0 oz = 1 pound (lb)	
APOTHECARY	*grain (gm)* 20 gr = 1 scruple 3 scruple = 1 dram 8 dram = 1 once 12 ounce = 1 pound	*minim* 60 minim = 1 fluid dram 8 fluid dram = 1 fluid ounce (fl oz) 16 fl oz = 1 pint 2 pint = 1 quart (qt) 4 qt = 1 galon (gal)

CGS and MKS systems

- CGS can be useful for dealing with small quantities or distances measuring in grams, centimeters.

- MKS can be preferred when larger units such as meter, kilogram is needed.

However, usage of different basic units in these systems can cause errors.

For example,

- Dyne is the basic unit of force in CGS
- Newton is the basic unit of force in MKS

These two basic units have a difference; Newton is 1000 times greater than dyne.

English unit system

Lenght	(Foot)	ft
Mass	(Pound, libre)	p, lb
Time	(Second)	s

CGS unit system

Lenght	(Centimeter)	cm
Mass	(Gram)	g
Time	(Second)	s

MKSA unit system

Lenght	(Meter)	m
Mass	(Kilogram)	kg
Time	(Second)	s
Electric intensity	(Amper)	*I*

International unit system (SI)
(Systéme International de'Unités)

This system was created by the International Bureau of Weights and Measures after 1950's due to the need of using a universal measuring system instead of converting the systems.

- **Also called as «Metric system»**
- SI was accepted by WHO in 1977 and by Turkey in1989.

Fractions

Prefix	Symbol	
deci	d	10^{-1}
centi	s	10^{-2}
milli	m	10^{-3}
micro	μ	10^{-6}
nano	n	10^{-9}
pica	p	10^{-12}
femto	f	10^{-15}
atto	a	10^{-18}

Multiples

Prefix	Symbol	
deka	da	10
hekto	h	10^{2}
kilo	k	10^{3}
mega	M	10^{6}
giga	G	10^{9}
tera	T	10^{12}
peta	P	10^{15}
exa	E	10^{18}

For very small or large quantities of weight or volume fractions and multiples can be used for avoiding the use of many zeros.