5	Temperature	Kelvin	K
6	Luminous intensity	Candela	cd
7	Quantity of matter	mole	mol
Sr.No	Supplementary physical quantity	Supplementary unit	Symbol
1	Plane angle	Radian	rad
2	Solid angle	Steradian	sr

Choice of a standard unit

The unit chosen for measurement of nay physical quantity should statisfy following requirements

i) It should be of suitable size

ii) It should be accurately defined

iii) It should be easily accessible iv) Replicas of unit should be available easily

iv) It should not change with time

v) It should not change with change in physical condition like temperature, pressure etc

1.03 Systems of units

a) The f.p.s system is the British engineering system of units, which uses foot as the unit of length, pound as the unit of mass and second as the unit of time.

b) The c.g.s system is the Gaussian system which uses the centimeter, gram and second as the three basic units.

c) The M.K.S system is based on metre, kilogram and second as the three basic units

d) International system of unit (SI) This system is introduced in 1960, by the General Conference of Weight and Measures. This system of units is essentially a modification over the m.k.s. system

Following are advantages of SI over all other system

1. SI system assigns only one unit to a particular quantity. For example joule is the unit for all types of energy, while in MKS system joule is unit for energy and calories is unit for heat energy.

2. SI system follows decimal system i.e. the multiples and submultiples of units are expressed as power of 10

3. SI system is based on certain fundamental units, from which all derived units are obtained by multiplying or division without introducing numerical factors

1.04 Some important Practical Units

1. Astronomical unit (AU)

It is the average distance of the centre of the sun from the centre of the earth

1AU $=1.496\times10^{11}$ m $\cong 1.5\times10^{11}$ m

2. Light Year (ly)

One light year is the distance travelled by light in vacuum in one year.

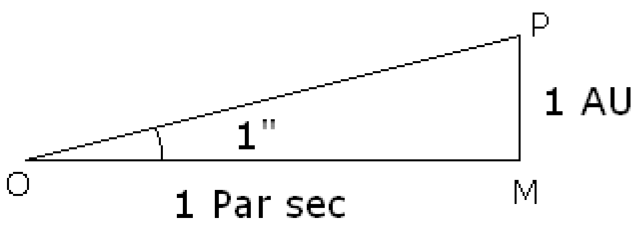
1 light year = $3\times10^{8}\times(365\times24\times60\times60)$ meter

1ly = 9.46×10^{15} m

3. Par sec.

Dimension, Measurement and error

One Par sec is the distance at which an arc 1AU long subtends an angle of 1″ (one second)



Conversion of 1 Par sec in metre

Since angle is very small tanθ =θ = PM/OM

1″ = 1 AU/ 1 Par sec

1 Par sec = 1AU/1″   -- -- eq(1)

We know that $1'' = \frac{\pi}{180\times60\times60}\, rad$ and 1AU =1.496×10^{11} m

Substituting values of 1″ and 1AU in eq(1) and on simplification we get

1 Par sec = 3.1×10^{16} m

4. Relation between AU, ly and par sec

1 ly = 6.3×10^{4} AU

1 parsec = 3.26 ly

1 Å (angstrom) = 10^{-12} m

1 amu = 1.66×10^{-27} kg

Metric prefixes

Sr.No	Power of 10	Prefix	Symbol
1	10^{-1}	deci	d
2	10^{-2}	centi	c
3	10^{-3}	milli	m

Sr.No	Power of 10	Prefix	Symbol
9	10^{1}	deca	da
10	10^{2}	hecto	h
11	10^{3}	kilo	k

4	10^{-6}	micro	μ		12	10^{6}	mega	M
5	10^{-9}	nano	n		13	10^{9}	giga	G
6	10^{-12}	pico	p		14	10^{12}	tera	T
7	10^{-15}	femto	F		15	10^{15}	peta	P
8	10^{-18}	atto	a		16	10^{18}	exa	e

Exercise 1.01

1. How many astronomical units are there in 1 metre?

2. Calculate the number of light years in one meter

3. How many amu make 1 kg

Answers : 1) 6.68×10^{-12} AU, 2) 1.057×10^{-16} ly 3) 0.6×10^{27} amu

1.05 SI Derived Units

Derived units are units which may be expressed in terms of base units by means of mathematical symbols of multiplication and division.

Certain derived units have been given special names and symbols, and these special names and symbols may themselves be used in combination with the SI and other derived units to express the units of other quantities.

Following are the few examples

SrNo	Physical quantity	Relation with other quantities	SI unit

1	Area	Length × breadth	m^2
2	Density	$\frac{mass}{volume}$	kg m^{-3}
3	Speed or velocity	$\frac{displacement}{time}$	ms^{-1}
4	Linear momentum	Mass × velocity	$Kgms^{-1}$
5	Acceleration	$\frac{change\ in\ velocity}{time}$	ms^{-2}
6	Force	Mass × acceleration	$Kgms^{-2}$ or N
7	Moment of force (torque)	Force × displacement	N-m
8	Work	Force × displacement	J (joule)
9	Power	$\frac{work}{time}$	Js^{-1} or W(watt)

1.6 Significant figure

In scientific work all numbers are assumed to be derived from measurements and therefore the last digit in each number is uncertain. All certain digits plus the first uncertain digit are significant.

For example if we measure a distance using metre scale. Least count of metre scale is 0.1 cm. Now if we measure a length of rod and it is between 47.6 cm and 47.7cm then we may estimate as 47.68 cm. Now this expression has 3 significant figure 4,7,6 are precisely known but last digit 8 is only approximately known.

Common rules for counting significant figure

Rule 1: All nonzero digits are significant

Example: x= 2365 have four significant digits

Rule 2: All the zeros between two nonzero digits are significant no matter where the decimal point is it at all.

Example: X = 1007 has four significant digits, Where as x = 2.0807 have five significant digit

Rule3: If the number is less than 1 then zeros on the right of decimal point but to the left of the first nonzero digit are not significant.

Example: X = 0.0057 has only two significant digits, but x = 1.0057 have five significant digits according to Rule2

Rule4: All zeros on the right of the last non zero digit in the decimal part are significant

Example: X = 0.00020 have two significant digits

Rule5: All zeros on the right of non-zero digit are <u>not</u> significant

Example: X = 8000 have only one significant digit while x = 32000 have only two significant digits

Rule6: All zeros on the right of the last nonzero digit become significant, when they come from a measurement. Also note that change in the units of measurement of a quantity does not change the number of significant digits.

Example: If measured quantity is 2030 m then number has 4 significant digits. Same can be converted in cm as 2.030×10^5 cm here also number of significant digits is to be four.

Illustration