MEASURMENT

* PHYSICAL QUANTITY :- The quantity which can measured directly or indirectly is called physical quantity.

→ There are two type of physical quantity
(i) fundamental quantity
(ii) Derive quantity.

* FUNDAMENTAL QUANTITY :- The quantities which are defined independently or the quantities which do not depend on other quantity are called fundamental quantity.

→ There are seven fundamental quantity.
(i) mass, its unit is kilogram (kg)
(ii) length, its unit is metre (m)
(iii) Time, its unit is second (s)
(iv) Electric current, its unit is Ampere (A)
(v) Temprature, its unit is kelvin (K)
(vi) luminosity, its unit is candela (cd)
(vii) Amount of substance, its unit is mole (mol)

* DERIVE QUANTITY :- The quantities which define in term of fundamental quantity or the quantity which are derived from the fundamental physical quantity.

Eg :- Force, Pressure, impulse, velocity, acceleration etc.

* UNIT :- it is a standard which is used to measure the physical quantity.

→ CHARACTERISTIC OF UNIT :-
→ it should be well defined & easily reproducible.
→ it should have a suitable size.
→ it should not change with time.

→ The unit should not be affected by change of any physical condition.

→ it is internationally acceptable

→ it should be easily accessible.

SYSTEM OF UNIT ÷ There are four system of unit

(i) CGS UNIT ÷ it is the system of measurement in which the fundamental unit of measurement of length, mass & time are taken as 1 centimetre, 1 gram, 1 second.

(ii) M.K.S UNIT ÷ it is the system of ~~unit~~ measurement in which the fundamental unit of measurement of length, mass and time are taken as 1 metre, 1 kilogram, 1 second.

(iii) F.P.S UNIT ÷ it is the system of measurement in which the fundamental unit of measurement of length, mass and time are taken as 1 foot, 1 pound, 1 second.

Note ÷

→ CGS system of unit also called french system

→ MKS system of unit also called metric system

→ FPS unit of system also called british system.

(iv) SI SYSTEM ÷ it is derived from french system

→ it is stand for systeme'd international

→ There are seven fundamental unit in this system.

→ This system of extended version of M.K.S. system.

ADVANTAGE OF SI SYSTEM

(i) it is coherent system of unit

(ii) it is rational system of unit

(iii) it is metric system of unit

(iv) it is internationally accepted

* **COHERENT SYSTEM** :- it is the system in which ~~has only~~ the unit of all the quantities can be obtain from fundamental unit by a simple multiplication or division with out envolving the numerical value.

* **RATIONAL SYSTEM** :- it is the system which has only one unit for all the physical quantity, which are dimensionally similar, called rational system.

* **METRIC SYSTEM** :- The multiple & sub multiple can be expressed as the power of 10.

Prefixes	Multiplier factor	Prefixes	multiplier factor
Deci (d)	10^{-1}	Deca (D)	10^{1}
centi (c)	10^{-2}	Hecta (H)	10^{2}
mili (m)	10^{-3}	kilo (k)	10^{3}
micro (μ)	10^{-6}	Mega (M)	10^{6}
Nano (n)	10^{-9}	Giga (G)	10^{9}
Pico (P)	10^{-12}	Tera (T)	10^{12}
Femto (f)	10^{-15}	Peta (P)	10^{15}
Atto (a)	10^{-18}	Exa (E)	10^{18}
zepto (z)	10^{-21}	zetta (z)	10^{21}

* **SUPLEMENTARY UNITS** :-

→ There are two suplementary unit.

(i) Angle

(ii) solid angle

* **UNIT OF ANGLE** (Radian (rad)) :-

~~It is an angle substended at the~~

it is an angle substended at the centre of the circle with an arc whose length is equal to the radius of the circle.

→ Radian = $\frac{\text{arc}}{\text{radius}}$

→ 2π radian = $360°$

* UNIT OF SOLID ANGLE (steradian (sr)) :-

it is an angle substended at the centre of the sphere by the surface area of the sphere, whose magnitude is equal to the square of the radius.

→ steradian = $\frac{\text{normal surface area}}{(\text{radius})^2}$

* SOME PRACTICAL UNITS :- for length

(i) Astronomical unit (A.U.) :-

→ it is the average distance of earth from the sun.

→ This unit is basically used in astronomy to measure the distance between planet.

→ 1 A.U. = 1.496×10^{11} m.

(ii) Light year :- it is the distance travell by the light in vaccum in one year.

→ This unit used in astronomy to measure the distance between nearby plannets.

1 Light year = speed of light in vaccum × 1 year

$= 3\times10^8$ m/s × 365 (1/4) days

$= 3\times10^8$ m/s × $\frac{365}{4}$ × 24×60×60 sec

→ 1 light year = 9.467×10^{15} m

(iii) Parallactic second (Parsec) :- it is the distance of at which an arc of one astronomical unit length substeds angle of one second.

→ 1 parsec = $\frac{1\ \text{A.U.}}{1\ \text{second}} = \frac{1.496\times10^{11}\text{m}}{\frac{1}{(60\times60)}\times\frac{\pi}{180}}$

$= \frac{1.496\times3600\times180\times10^{11}\text{m}}{\pi}$

= ~~1.49~~ 3.08×10^{16} m

* CLASSIFICATION OF PHYSICAL QUANTITY :-

→ On the basis of dimensional analysis there are four physical quantity.

(i) DIMENSIONAL VARIABLE :- These are the quantity which can change and posses a dimension.

Eg :- Velocity, acceleration, force, impulse etc...

(ii) DIMENSION-LESS VARIABLE :- These are the quantity which can changed but do not posses any dimension.

Eg :- Angle, strain, specific gravity etc....

(iii) DIMENSIONAL CONSTANT :- These are the quantity which remain constant & have a dimension.

Eg :- Gravitational constant. Plank's constant, Force constant etc....

(iv) DIMENSION-LESS CONSTANT :- ~~Thes~~ These are quantity which are not changed and do not have any dimension.

Eg :- Natural no. (1, 2, 3, 4 ..... ∞)

PRINCIPLE OF HOMOGEINITY :-

Principle of homogeinity state that dimension of fundamental quantity of every term in both side must be same in a correct relation.

APPLICATION OF PRINCIPLE OF HOMOGENEITY :-

(i) To convert the physical quantity from one system of unit to another system of unit.

(ii) To check the correctness of the given relation.

(iii) To derive the relation between various physical quantity.

(iv) Angstrom (Å) ÷ it is used to measure the wavelength of the light. Å = 10^{-10} m.

SOME PRACTICAL MICROSCOPIC UNIT ÷

(i) Micron (µm) = 10^{-6} m

(ii) Nano (nm) = 10^{-9} m.

(iii) Angstrom (Å) = 10^{-10} m.

(iv) Fermi (Fm) = 10^{-15} m

(v) Barn (barn) = 10^{-28} m.

* DIMENSION ÷ Dimension of the physical quantity are define as the power form of the fundamental unit in order to represent the physical quantity.

Eg ÷ Mass – $[M^1L^0T^0]$, [1,0,0] is the dimension of mass.

Force – $[M^1L^1T^{-2}]$, [1,1,-2] is the dimension of force

* DIMENSIONAL FORMULA ÷ The dimensional formula is defined as the expression of physical quantity in term of it basic unit with proper dimension.

Eg ÷ $[M^1L^0T^0]$ is dimensional formula of mass

$[M^0L^1T^{-1}]$ is the dimensional formula of velocity.

* DIMENSIONAL EQUATION ÷ ~~An equation~~

The dimensional equation is the equation which contain both physical quantity and dimensional formula. Physical quantity is at left hand side & dimensional formula is at right hand side of the equation respectively.

Eg ÷ acceleration = $[M^0L^1T^{-2}]$

Frequency = $[M^0L^0T^{-1}]$

TO CONVERT THE PHYSICAL QUANTITY FROM ONE SYSTEM OF UNIT TO ANOTHER SYSTEM OF UNIT :

work $= [M^1L^2T^{-2}]$, its si unit = Joule
cgs unit = Erg

so, we have to change from si unit to cgs unit

1 Joule = ——— Erg.

$\Rightarrow n_1 u_1 = n_2 u_2$ ⟶ Main formula

$\Rightarrow n_2 = \frac{n_1 u_1}{u_2}$

u_1 = si unit
u_2 = cgs unit
& work $= [M^1L^2T^{-2}]$

$\Rightarrow n_2 = 1 \times \left(\frac{1kg}{1g}\right)^1 \times \left(\frac{1m}{1cm}\right)^2 \times \left(\frac{1s}{1s}\right)^{-2}$

$\Rightarrow n_2 = 1 \times \left(\frac{1000g}{g}\right) \times \left(\frac{100\,cm}{cm}\right)^2 \times 1$

$\Rightarrow n_2 = 1 \times 10^3 \times 10^4 \times 1 = 10^7$ erg.

∴ 1 Joule is equal to 10^7 erg.

TO CHECK THE CORRECTNESS OF THE GIVEN RELATION :

$s = ut + \frac{1}{2}at^2$

There are three term in the equation.

1st s = displacement $= [M^0L^1T^0]$

2nd ut = initial velocity × time $= [M^0L^1T^{-1}] \times [T] = [M^0L^1T^0]$

3rd at^2 = acceleration × time² $= [M^0L^1T^{-2}] \times [T]^2 = [M^0L^1T^0]$

∴ $s = ut + \frac{1}{2}at^2$ is the correct relation

* LIMITATION OF DIMENSIONAL ANALYSIS :

→ This methode does not help to find the value of the dimension less constant involved is various physical quantity.

→ The methode fail to derive the formula of the physical quantity which depend up on more than three factor

→ The methode is applicable only in case of the power function, it fail to derive the relation of quantities involving exponential & trigonometric

→ A methode can't directly applied to derive the relation which contain more than one term on one side or both side of the equati equation.

→ A dimensionally correct relation may not be true physical relation.

Physical quantity	Relation with other physical quantity	Dimensional formula
(1) Area →	length × breadth →	$[M^0L^2T^0]$
(2) Volume →	length × breadth × height →	$[M^0L^3T^0]$
(3) Density →	mass/volume →	$[ML^{-3}T^0]$
(4) speed or velocity →	$\frac{\text{displacement}}{\text{Time}}$ →	$[M^0L^1T^{-1}]$
(5) Accelaration →	$\frac{\text{Velocity}}{\text{Time}}$ →	$[M^0L^1T^{-2}]$
(6) Momentum →	mass × velocity →	$[M^1L^1T^{-1}]$
(7) Force →	mass × accelaration →	$[M^1L^1T^{-2}]$
(8) impulse →	Force × Time →	$[M^1L^1T^{-1}]$
(9) Pressure →	force/Area →	$[M^1L^{-1}T^{-2}]$
(10) Work →	force × displacement →	$[M^1L^2T^{-2}]$
(11) Power →	work/time →	$[M^1L^2T^{-3}]$
(12) Energy →	Amount of work →	$[M^1L^2T^{-2}]$
(13) Kinetic energy →	½ × mass × (velocity)^2 →	$[M^1L^2T^{-2}]$
(14) Potential energy →	Mass × gravity (g) × height →	$[M^1L^2T^{-2}]$
(15) Torque →	Force × ⊥ distance →	$[M^1L^2T^{-2}]$
(16) Heat →	Form of energy →	$[M^1L^2T^{-2}]$
(17) stress →	$\frac{\text{~~force~~ Restoring force}}{\text{area}}$ →	$[M^1L^{-1}T^{-2}]$

(18) strain → $\frac{\text{change in length}}{\text{original length}}$ → $[M^0L^0T^0]$, No unit

(19) coefficient of elasticity → $\frac{\text{stress}}{\text{strain}}$ → $[M^1L^{-1}T^{-2}]$

(20) coefficient of viscosity → $\frac{\text{force}}{\text{Area} \times \text{velocity gradient}}$ → $[M^1L^{-1}T^{-1}]$

(21) surface tension → force/length → $[M^1L^0T^{-2}]$

(22) surface energy → Energy/~~Area~~ → $[M^1L^0T^{-2}]$

(23) force constant → $\frac{\text{Applied force}}{\text{extension (L)}}$ = $[M^1L^0T^{-1}]$

(24) frequency → $\frac{1}{\text{Time period}}$ = $[M^0L^0T^{-1}]$

(25) Plank's constant → Energy/frequency = $[M^1L^2T^{-1}]$

(26) Gravitational constant (G) → $\frac{\text{force} \times (\text{distance})^2}{\text{mass}^2}$ = $[M^{-1}L^3T^{-2}]$

(27) Angle → Arc/radius → $[M^0L^0T^0]$

(28) Angular velocity → $\frac{\text{Angular displacement}}{\text{Time}}$ = $[M^0L^0T^{-1}]$

(29) Angular acceleration → $\frac{\text{Angular velocity}}{\text{Time}}$ = $[M^0L^0T^{-2}]$

(30) Angular momentum → linear momentum × distance = $[M^1L^2T^{-1}]$

(31) Velocity gradient → velocity/distance = $[M^0L^0T^{-1}]$

(32) Moment of inertia → Mass × (distance)^2 = $[ML^2T^0]$

(33) Boltzmann's constant → Energy/Temprature = $[ML^2T^{-2}K^{-1}]$

(34) coefficient of friction → force/normal reaction = $[M^0L^0T^0]$

(35) Specific heat → $\frac{\text{Heat energy}}{\text{mass} \times \text{temprature}}$ = $[M^0L^2T^{-2}K^{-1}]$

(36) latent heat → Heat energy/mass = $[M^0L^2T^{-2}]$

(37) Thermal conductivity → $\frac{\text{Heat} \times \text{distance}}{\text{Area} \times \text{temprature} \times \text{time}}$ = $[ML^2T^{-2}]$

(38) Entropy → $\frac{\text{Heat}}{\text{temprature}}$ = $[M^1L^2T^{-2}K^{-1}]$

(39) charge → current × time = $[AT]$

(40) Electric field → Force/charge = $[M^1L^1T^{-3}A^{-1}]$

(41) Permitivity (ϵ) → $\frac{(\text{charge})^2}{\text{Force} \times (\text{distance})^2}$ = $[M^{-1}L^{-3}T^4A^2]$

(42) Relative permitivity or dielectric constant → ϵ_r or $k = \frac{\epsilon_0}{\epsilon}$ = $[M^0L^0T^0]$

(43) Electric potential → $\frac{\text{work done}}{\text{charge}}$ = $[M^1L^2T^{-3}A^{-1}]$

(44) Capacitance → $\frac{\text{charge}}{\text{potential difference}}$ = $[M^{-1}L^{-2}T^4A^2]$

(45) Resistance → $\frac{\text{Potential difference}}{\text{current}}$ = $[M^1L^2T^{-3}A^{-2}]$

(46) Specific resistance or resistivity → $\frac{\text{Resistance} \times \text{Area}}{\text{length}}$ = $[M^1L^3T^{-3}A^{-2}]$

(47) conductance → $\frac{1}{\text{Resistance}}$ = $[M^{-1}L^{-2}T^3A^2]$

(48) conductivity → $\frac{1}{\text{Resistivity}}$ = $[M^{-1}L^{-3}T^3A^2]$

(49) Magnetic field → $\frac{\text{Force}}{\text{current} \times \text{length}}$ = $[M^1L^0T^{-2}A^{-1}]$

(50) Magnetic flux → $\phi = BA$ = $[M^1L^2T^{-2}A^{-1}]$

(51) Magnetic Moment → current × Area = $[M^0L^2T^0A^1]$

* MEASUREMENT :- It is the process or set of operation which is used to compare the two physical quantity, one which has unknown magnitude with other, which is predefined quantity.

→ Measurement is represent by 'nx' where n is the quantity or numerical part and x is the quality or unit part

* MEASURING INSTRUMENT :- The instrument which shows the quantity of something that we observed around us.

Eg :- (i) vernier calliper
(ii) screw guage.
(iii) Multimetre
(iv) flow metre.

* LEAST COUNT :- The minimum measurement that can be accurately taken by a measuring instrument.

Eg :- least count of scale = ~~0.01~~ 0.1 cm.
least count of vernier calliper = 0.01 cm.
least count of screw guage = 0.001 cm.

Note :- (i) l.c. of vernier calliper = $\frac{\text{smallest division in main scale}}{\text{No. division in vernier scale}}$

(ii) l.c. of screw guage = $\frac{\text{Pitch of screw guage}}{\text{No. of division in circular scale}}$

* TYPE OF MEASUREMENT :-

There are two type of measurement are defined as

(i) Direct measurement :- Direct measurement involves measuring the exact amount the measurement you want to measure

Eg :- Tape, steel rule, vernier callipers & micrometre etc...

(ii) Indirect measurement :- An indirect measurement is a mathematical methode used to find unknown measurement of objects that are difficult to measure.

Eg :- Measuring height of tree, measuring voltage in circuit

* ERRORS IN MEASUREMENT :-

→ The errors in measurement is of two type.
(i) Systematic error (ii) Random error

* SYSTEMATIC ERRORS :- It is an error which remain constant or changes in a precitable with changing condition.

Eg :- Zeroing of a measuring intrument such as balance or a voltmetre.

→ The systematic error is divided in three type.

(i) Instrumental error :- The errors which occurs due to the faulty instrument or instrumental problem.

(ii) Inperfection in experimental technique :- occurs due to unstructural technics or other external condition like, pressure, temprature & humidity etc...

(iii) Personal error :- The errors which occurs due to the lack of the proper instrumental set up or individual carelessness or inexperience.

* RANDOM ERRORS :- The errors which occurs at the irregular period & due to the random flauctuation in experimental condition.

* ESTIMENT OF ERROR MEASUREMENT :-

(1) Absolute error :- Absolute error is define as the difference between a measure value or true value of the measurement.

→ it is denoted by $|\Delta a|$

→ value obtained, $a_1, a_2, a_3 \cdots a_n$

then mean $a = \bar{a} = \frac{a_1 + a_2 + a_3 + \cdots + a_n}{n}$

so, error in individual measurement is

$\Delta a_1 = \bar{a} - a_1$

$\Delta a_n = \bar{a} - a_n$

→ The individual measurement may positive or negative

→ The absolute error will always positive.

(ii) Mean absolute error: it is defined as the average error of the absolute errors.

→ it is denoted by $\overline{|\Delta a|}$

→ If absolute errors are, $|\Delta a_1|, |\Delta a_2| ---- |\Delta a_n|$

then mean absolute error $= \frac{|\Delta a_1| + |\Delta a_2| + ---- + |\Delta a_n|}{n}$

(iii) Relative error or fractional error:

→ it is denoted by $\delta a = \frac{\text{expected value} - \text{actual value}}{\text{actual value}}$

$$\delta a = \frac{\overline{|\Delta a|}}{\bar{a}} = \frac{\text{Mean absolut error}}{\text{mean error}}$$

(iv) Percent error:

$= \delta a \times 100\% = \frac{\text{mean absolut error}}{\text{mean error}} \times 100$

$= \delta a \times 100\%$

$= \frac{\Delta a_{mean}}{a_{mean}} \times 100$

* ERROR PROPAGATION:

(i) Error summation: If $z = x + y$

then $\Delta z = \Delta x + \Delta y$.

(ii) Error in subtraction: If $z = x - y$

then $\Delta z = \Delta x + \Delta y$

(iii) Error in Multiplication: If $z = xy$

then $\frac{\Delta z}{z} = \frac{\Delta x}{x} + \frac{\Delta y}{y}$

(iv) Error is division :- If $z = \frac{x}{y}$

then $\frac{\Delta z}{z} = \frac{\Delta x}{x} + \frac{\Delta y}{y}$

(v) Error in quantity with power :-

If $z = \frac{k x^n y^m}{e^q}$ then $\frac{\Delta z}{z} = n \frac{\Delta x}{x} + m \frac{\Delta y}{y} + q \frac{\Delta e}{e}$

→ Here k is constant.

***SIGNIFICANT FIGURE OR NUMBER :-**

→ All the non zero digit (1-9)

→ All the zero between two non-zero digit.

→ If the number is less than 1, the zero on the right of the decimal point are significant.

→ If the number have trailing zero without a decimal then the zero are not significant.

Eg :- 139m = 13900 cm = 139000 m.m.

Here we have three significant figure has trailing zero being non-significant.

→ Scientific notation for every measurement to remove the confusion in determining the no. of significant.

Q-1
if the diameter of a ball of a ball Point Pen is given by (0.70 ± 0.01) m.m. what does it mean.

Ans $0.70 + 0.01 = 0.71$

or

$0.70 - 0.01 = 0.69$

it means two value of the diameter is lying bet.n 0.69 mm and 0.71 mm.

Q-2
If radius of a sphere is measured with a screw Gause and the observation as follow

$R_1 = 2.46$ cm, $R_2 = 2.40$ cm, $R_3 = 2.48$ cm.

$R_4 = 2.43$ cm and $R_5 = 2.42$ cm

Find out the Percentage error in measurement of the radius of the ~~shape~~ sphere.

Ans

$$R_{mean} = \bar{R} = \frac{R_1 + R_2 + R_3 + R_4 + R_5}{5}$$

$$= \frac{2.46 + 2.40 + 2.48 + 2.43 + 2.42}{5}$$

$$= \frac{12.19}{5} = 2.438 \text{ cm}$$

$$|\Delta R_1| = |\bar{R_1} - R_1|$$

$$= |2.438 - 2.46| = |-0.022| = 0.022$$

$|\Delta R_2| = |2.438 - 2.40| = |0.038| = 0.038$

$|\Delta R_3| = |2.438 - 2.48| = |-0.042| = 0.042$

$|\Delta R_4| = |2.438 - 2.43| = |0.008| = 0.008$

$|\Delta R_5| = |2.438 - 2.42| = |0.018| = 0.018$

$$\Delta R_{mean} = |\overline{\Delta R}| = \frac{|\Delta R_1| + |\Delta R_2| + |\Delta R_3| + |\Delta R_4| + |\Delta R_5|}{5}$$

$$= \frac{0.022 + 0.038 + 0.042 + 0.008 + 0.018}{5}$$

$$= \frac{0.108}{5}$$

$$= 0.0256 \text{ cm}$$

$$\text{Percentage} = \frac{|\overline{\Delta R}|}{\overline{R}} \times 100\%$$

$$= \frac{0.0256 \text{ cm}}{2.438 \text{ cm}} \times 100\%$$

$$= 0.0105 \times 100\%$$

$$= 1.05\%$$

* Significant figures or numbers :-

(I) All the non zero digit (1-9)

(II) All the zero betⁿ two non-Zero digit ~~called~~ all are significant no. [10.01] → All sign

(III) If the no. is less then 1. the zero on the right of the decimal are not significant or the rest Part significant.

0.00[1430] → significant
↳ not sign.

(IV) If the number has trailing zero without a decimal point, then the zero are not significant.

[139] m = [139][00] cm = [139][000] mm
✓ ✓ ✗ ✓ ✗

Que
Find the no of significant figures in the following observation.

(a) 0.001 sec —— 1

(b) 4.34×10^{4} m/sec —— 3

(c) 0.5250 kg —— 4

(d) 6.0780 N/m2 —— 5

(e) 31.052 Calori —— 5

(f) 0.0009012 m —— 4

(g) 1.0203×10^{12} Hz —— 5

(h) 1.5×10^{-9} ampere —— 2

conversion from one system of unit to other

Q-1 To convert 5 J —— Erg

M·K·S system-1	Physical quantity	C·G·S system-11
$m_1 = 1kg$	work $[M^1L^2T^{-2}]$	$m_2 = 1 gram$
$L_1 = 1m$	$a = 1$	$L_2 = 1cm$
$T_1 = 1sec$	$b = 2$	$T_2 = 1sec$
$n_1 = 5$	$c = -2$	$n_2 = ?$

$$n_2 = n_1 \times \left[\frac{m_1}{m_2}\right]^a \times \left[\frac{L_1}{L_2}\right]^b \times \left[\frac{T_1}{T_2}\right]^c$$

$$= 5 \times \left[\frac{1kg}{1 gram}\right]^1 \times \left[\frac{1m}{1cm}\right]^2 \times \left[\frac{1sec}{1sec}\right]^{-2}$$

$$= 5 \left[\frac{10^3 gram}{1 gram}\right]^1 \times \left[\frac{10^2 cm}{1 cm}\right]^2$$

$$= 5 \times 10^3 \times 10^4$$

$$= 5 \times 10^7$$

5 Joule $= 5 \times 10^7$ erg

Q-2 To convert 1 N —— dyne

M·K·S system-1	Physical quantity	C·G·S system-1
$m_1 = 1kg$	Force $[M^1L^1T^{-2}]$	$m_2 = 1gm$
$L_1 = 1m$	$a = 1$	$L_2 = 1cm$
$T_1 = 1sec$	$b = 1$	$T_2 = 1sec$
$n_1 = 1$	$c = -2$	$n_2 = ?$

$$n_2 = n_1 \left[\frac{m_1}{m_2}\right]^a \times \left[\frac{L_1}{L_2}\right]^b \times \left[\frac{T_1}{T_2}\right]^c$$

$$= 1 \left(\frac{1kg}{1gram}\right)^a \times \left[\frac{1m}{1cm}\right]^b \times \left[\frac{1sec}{1sec}\right]^c$$

$$= 1 \left[\frac{10^3 gm}{1 gm}\right]^1 \times \left[\frac{10^2 cm}{1 cm}\right]^1$$

$$= 1 \times 10^3 \times 10^2$$

1 N = 10^5 Dyne

Q-3

To convert 50 Dyne —— N ?

M.K.S system-1	pysical quantity force	c.g.s system-2
M_1 - 1 kg	$[M^1 L^1 T^{-2}]$	M_2 - 1 gm
L_1 - 1m	a = 1	L_2 - 1cm
T_1 - 1sec	b = 1	T_2 - 1sec
n_1 =	c = -2	n_2 = 50

$$n_1 = n_2 \left[\frac{m_2}{m_1}\right]^a \times \left(\frac{L_2}{L_1}\right)^b \times \left(\frac{T_2}{T_1}\right)^c$$

$$= 50 \left(\frac{1gm}{1kg}\right)^1 \times \left[\frac{1cm}{1m}\right]^1 \left[\frac{1sec}{1sec}\right]^{-2}$$

$$= 50 \left[\frac{1 gm}{10^3 gm}\right]^1 \times \left[\frac{1cm}{10^2 cm}\right]^1$$

$$= 50 (10^{-3} \times 10^{-2})$$

$$= 50 \times 10^{-5}$$

50 Dyne = 50×10^{-5} N