FUNDAMENTAL or BASE QUANTITIES:

Quantity	Name of unit	Symbol
Length	metre	M
Mass	kilogram	Kg
Time	second	S
Electric Current	ampere	A
Thermodynamic Temperature	kelvin	K
Amount of Substance	mole	Mol
Luminous Intensity	candela	Cd

SI PREFIXES:

Power of 10	Prefix	Symbol
18	Exa	E
15	Peta	P
12	Tera	T
9	Giga	G
6	Mega	M
3	Kilo	k
2	Hector	h
1	Deka	da
-1	Deci	d
-2	Centi	c
-3	Milli	m
-6	Micro	µ
-9	Nano	n
-12	Pico	p
-15	Femto	f
-18	Atto	a

CONVERSION TABLE:

Length:

$1\ metre = 100\ centimeters$	$1\ m = 100\ cm\ (10^2\ cm)$
$1\ centimeter = 10\ millimeters$	$1 cm = 10\ mm$
$1\ kilometers = 1000\ meter$	$1\ km = 1000\ m\ (10^3\ m)$
$1\ foot = 12\ inches$	$1\ ft = 12\ in$
$1\ yard = 3\ feet$	$1\ yd = 3\ ft$
$1\ yard = 36\ inches$	$1\ yd = 36\ in$
$1\ mile = 1760\ yards$	$1\ mi = 1760\ yd$
$1\ meter = 39.37008\ inches$	$1\ m = 39.37008\ in$
$1\ meter = 3.28084\ feet$	$1\ m = 3.28084\ ft$

$1\ meter = 1.09361\ yards$	$1m = 1.09361\ yd$
$1\ mile = 1609.344\ meters$	$1\ mi = 1609.344\ m$
$1\ mile = 1.609344\ kilometers$	$1\ mi = 1.609344\ km$
$1\ yard = 0.9144\ meters$	$1\ yd = 0.9144\ m$
$1\ yard = 91.44\ centimeters$	$1\ yd = 91.44\ cm$
$1\ foot = 30.48\ centimeters$	$1\ ft = 30.48\ cm$
$1\ inches = 2.54\ centimeters$	$1\ in = 2.54\ cm$
$1\ angstrom = 10^{-10}\ meters$	$1\ \dot{A} = 10^{-10} m$
$1\ angstrom = 10^{-8} meters$	$1\ \dot{A} = 10^{-8}\ m$

Area:

$1\ meter^2 = 10{,}000\ centimeters^2$	$1\ m^2 = 10{,}000\ cm^2$
$1\ meter^2 = 10.76391\ feet^2$	$1\ m^2 = 10{,}76391\ ft^2$
$1\ meter^2 = 1.19599\ yards^2$	$1\ m^2 = 1.19599\ yd^2$
$1\ foot^2 = 0.09290\ meter^2$	$1\ ft^2 = 0.09290\ m^2$
$1\ foot^2 = 929.03\ centimeters^2$	$1\ ft^2 = 929.03\ cm^2$
$1\ yard^2 = 0.83613\ meters^2$	$1\ yd^2 = 0.83613\ m^2$
$1\ inch^2 = 6.4516\ centimeter^2$	$1\ in = 6.4516\ cm^2$
$1\ foot^2 = 144\ inches^2$	$1\ ft^2 = 144\ in^2$

Volume:

$1\ meter^3 = 1{,}000{,}000\ centimeters^3$	$1\ m^3 = 10^6\ cm^3$
$1\ centimeter^3 = 1000\ millimeter^3$	$1\ cm^3 = 10^3\ mm^3$
$1\ foot^3 = 0.02832\ meter^3$	$1\ ft^3 = 0.02832\ m^3$
$1\ yards^3 = 0.76455\ meter^3$	$1\ yd^3 = 0.76455\ m^3$
$1\ inch^3 = 16.38706\ centimeter^3$	$1\ in^3 = 16.38706\ cm^3$
$1\ meter^3 = 35.31467\ feet^3$	$1\ m^3 = 35.31467\ ft^3$
$1\ meter^3 = 1.30795\ yards^3$	$1\ m^3 = 1.30795\ yd^3$

Mass:

$1\ gram = 1000\ milligrams$	$1\ g = 1000\ mg$
$1\ kilogram = 1000\ grams$	$1\ kg = 1000\ g \Rightarrow 1\ g = 10^{-3}\ kg$
$1\ tonne = 1000\ kilograms$	$1\ tonne = 1000\ kg$
$1\ atomic\ mass\ unit = 1.66054 \times 10^{-27} kg$	$1\ a.m.u. = 1.66054 \times 10^{-27} kg$
$1\ atomic\ mass\ unit = 1.66054 \times 10^{-24} grams$	$1\ a.m.u. = 1.66054 \times 10^{-24} g$
$1\ slug = 14.5939\ kilogram$	$1\ slug = 14.5939\ kg$

Force:

$1\, newton = 10^5\, dyne$	$1\, N = 10^5\, dyne$
$1\, newton = 0.2248\, pounds$	$1\, N = 0.2248\, lb$
$1\, dyne = 2.248 \times 10^{-6}\, pounds$	$1\, dyne = 2.248 \times 10^{-6}\, lb$
$1\, pound = 4.448\, newtons$	$1\, lb = 4.448\, N$

Velocity:

$1\, meter\ per\ second = 3.600\, km\ per\ hour$ $= 100\, centimeter\ per\ sec$	$1\frac{m}{s} = 3.600\frac{km}{hr} = 100\frac{cm}{sec}$
$1\, km\ per\ hour = 0.2778\, meter\ per\ second$ $= 27.78\, centimeter\ per\ sec$	$1\frac{km}{hr} = 0.2778\frac{m}{sec}$ $= 27.78\frac{cm}{sec}$
$1\, meter\ per\ second = 3.281\, feet\ per\ sec$	$1\frac{m}{sec} = 3.281\frac{ft}{sec}$
$1\, mile\ per\ hour = 1.609\, km\ per\ hour$ $= 0.4770\, meter\ per\ second$	$1\frac{mi}{hr} = 1.609\frac{km}{hr} = 0.4770\frac{m}{sec}$
$1\, foot\ per\ second = 1.097\, km\ per\ second$ $= 0.3408\, meter\ per\ second$	$1\frac{ft}{sec} = 1.097\frac{km}{hr}$ $= 0.3408\frac{m}{sec}$
$1\, centimeter\ per\ sec = 3.600 \times 10^{-2}\, km\ per\ sec$ $= 0.0100\, meter\ per\ sec$	$1\frac{cm}{sec} = 3.600 \times 10^{-12}\frac{km}{sec}$ $= 0.0100\frac{m}{sec}$

Pressure:

$1\, newton\ per\ meter^2 = 9.869 \times 10^{-6}\, atmosphere$	$1\frac{N}{m^2} = 9.869 \times 10^{-6}\, atm$
$1\, atmosphere = 1.013 \times 10^5\, N\ per\ meter^2$	$1\, atm = 1.013 \times 10^5\frac{N}{m^2}$
$1\, dyne\ per\ cm^2 = 9.869 \times 10^{-7}\, atmosphere$ $= 0.100\, N\ per\ meter^2$	$1\frac{dyne}{cm^2} = 9.869 \times 10^{-7}\, atm$ $= 0.100\frac{N}{m^2}$
$1\, atmosphere = 1.013 \times 10^6\, dyne\ per\ cm^2$	$1\, atm = 1.013 \times 10^6\frac{dyne}{cm^2}$
$1\, bar = 0.987167\, atmospheres$ $= 14.50\, pound\ per\ inch^2$	$1 bar = 0.987167\, atm$ $= 14.50\frac{lb}{in^2}$
$1\, pascal = 1\, newton\ per\ meter^2$ $= 1.45 \times 10^{-4}\, pound\ per\ inch^2$	$1\, Pa = 1\frac{N}{m^2} = 1.45 \times 10^{-4}\frac{lb}{in^2}$

Time:

$1\ year = 365.2\ day = 8.766 \times 10^3\ hour = 5.259 \times 10^3\ minute = 3.156 \times 10^7\ second$
$1\ day = 2.738 \times 10^{-3} years = 24\ hours = 1440\ minutes = 8.640 \times 10^4\ seconds$
$1\ hour = 1.141 \times 10^{-4}\ year = 4.167 \times 10^{-2} days = 60\ minutes = 3600\ seconds$
$1\ minute = 1.901 \times 10^{-6}\ years = 6.944 \times 10^{-4} days = 1.667 \times 10^{-2} hour = 60\ seconds$
$1\ second = 3.169 \times 10^{-8}\ years = 1.157 \times 10^{-5}\ days = 2.778 \times 10^{-4} hours$ $= 1.667 \times 10^{-2} min.$

Power:

$1\ watt = 1.341 \times 10^{-3}\ horsepower$	$1\ W = 1 \frac{J}{sec} = 1.341 \times 10^{-3} hp$
$1\ horsepower = 745.7\ watt$	$1\ hp = 745.7\ W$
$1\ watt = 0.2389\ calorie\ per\ second$	$1\ W = 0.2389 \frac{cal}{sec}$
$1\ calories\ per\ second = 4.186\ watt$ $= 5.613 \times 10^{-3}\ horsepower$	$1 \frac{cal}{sec} = 4.186\ W = 5.613 \times 10^{-3}$
$1\ foot - pound\ per\ second = 1.356\ watt$	$1\ \frac{ft - ld}{sec} = 1.356\ W$

Energy:

$1\ joule = 10^7\ erg = 9.481 \times 10^{-4}\ Btu = 0.7376\ ft - lb = 0.2389\ cal$ $= 6.242 \times 10^{-12}\ MeV$
$1\ MeV = 1.602 \times 10^{-13} J = 3.827 \times 10^{-14} cal = 1.602 \times 10^{-6} erg = 1.182 \times 10^{-13}\ ft - lb$
$1\ calorie = 4.186 \times 10^7\ erg = 3.087\ ft - lb = 4.186\ J = 2.613 \times 10^{-13}\ MeV$
$1\ foot - pound = 1.356\ J = 0.3239\ cal = 8.464 \times 10^{12}\ MeV = 1.356 \times 10^7\ erg$
$1 erg = 10^{-7}\ joules = 2.389 \times 10^{-8}\ cal = 6.242 \times 10^{-5} MeV = 7.376 \times 10^{-8}\ ft - lb$
$1\ horsepower - hour = 2.685 \times 10^6\ joules = 6.414 \times 10^5\ cal$
$1\ British\ thermal\ unit = 1.055 \times 10^{10} erg = 1055\ joules = 252\ cal = 6.585 \times 10^{15}\ MeV$

Specific energy:

$1\ calorie\ per\ gram = 4.186 \times 10^7 \frac{erg}{g} = 4.186 \times 10^3 \frac{J}{kg}$
$1\ erg\ per\ gram = 10^{-4} \frac{J}{kg} = 2.389 \times 10^{-8} \frac{cal}{g}$
$1\ joule\ per\ kilogram = 2.389 \times 10^{-4} \frac{cal}{g} = 10^4 \frac{erg}{g}$

EQUATION OF MOTION IN STRAIGHT LINE WITH CONSTANT ACCELERATION:

$v = u + at$
$x = ut + \frac{1}{2}at^2$
$v^2 = u^2 + 2ax$

Here, x represents the position of particle at time t, u represents initial velocity of particle, v represents final velocity of the particle, a represents constant acceleration and t stands for time.

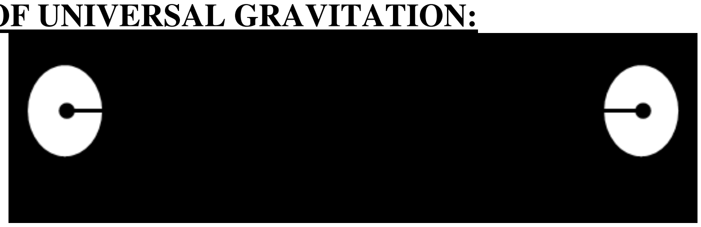
In case of gravitational acceleration: $(a = g)$

Downward Direction	Upward Direction
$v = u + gt$	$v = u - gt$
$y = ut + \frac{1}{2}gt^2$	$y = ut - \frac{1}{2}gt^2$
$v^2 = u^2 + 2gy$	$v^2 = u^2 - 2gy$

<u>EQUATIONS FOR PROJECTILE MOTION:</u>

Time of flight $T = \frac{2u \sin\theta}{g}$
Horizontal Range $R = \frac{u^2 \sin 2\theta}{g}$
Maximum height $H = \frac{u^2 \sin^2\theta}{2}$

<u>NEWTONS LAW OF UNIVERSAL GRAVITATION:</u>



- Figure shows that two objects of mass m_1 and m_2 are separated by distance r.
- Every object in the Universe attracts every other object with a force directed along the line of centers for the two objects that is proportional to the product of their masses and inversely proportional to the square of the separation between the two objects.

$$\vec{F} = G\frac{m_1 m_2}{r^2}\,\hat{r}$$

Where, $\vec{F}$ is the gravitational force,
m_1 and m_2 are the masses of the two objects,
r is the separation between the objects,
$\hat{r}$ is the unit vector joining two objects,

G is the universal gravitational constant $\left(G = 6.67 \times 10^{-11} \frac{N-m^2}{kg^2}\right)$

- The gravitational force between two objects forms an action and reaction pair.
- If we consider a system which has both bodies as its constituents then the net force becomes zero.

$$\vec{F}_{12} + \vec{F}_{21} = 0$$

Therefore magnitude of forces acting is same on both bodies but direction is opposite.

NEWTON'S LAW OF MOTION:

Newton's first law of motion:

- "An object at rest will remain at rest unless acted on by an unbalanced force. An object in motion continues in motion with the same speed and in the same direction unless acted upon by an unbalanced force."

- This law is often called "The law of inertia".

Newton's second law of motion:

- "Acceleration is produced when a force acts on a mass. The greater the mass of the object being accelerated the greater the amount of force needed to accelerate the object."
- The second law gives exact relationship between force, mass and acceleration.

$$\mathbf{F = ma}$$

Where, m is mass and a is acceleration.

Newton's third law of motion:

- "For every action there is equal and opposite re-action."

WORK DONE BY CONSTANT FORCE:

- An object undergoes displacement "S" along a straight line while acted on by the force "F", and angle between force and S is "θ". Then work done is given as,

$$\boldsymbol{W = \vec{F} \cdot \vec{S} = |\vec{F}||\vec{S}| \cos\theta}$$

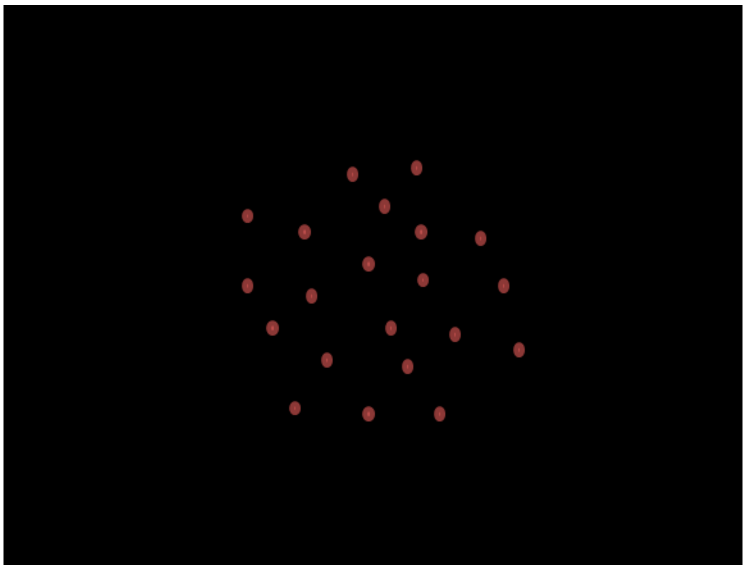
- Work is a scalar quantity and its SI unit is joule(J).

$$\mathbf{1\ J = 1\ N \cdot m = \frac{kg \cdot m^2}{s^2}}$$

- Dimension of the work is $[M^1L^2T^{-2}]$

CENTRE OF MASS:

- It is the point in a system which behaves as though the entire mass of system is concentrated there and its motion is same if the resultant of all forces acting on the system were applied directly to it.



- In figure n- particle system is placed in Cartesian coordinates system.

- Position vector of center of mass is given as,

$$\vec{R}_{CM} = \frac{1}{M}\sum_i m_i \cdot \vec{r_i}$$

Where, $\vec{r_i}$ is the position vector of i^{th} particle.

- Co-ordinates of centre of mass:

$$X = \frac{1}{M}\sum_i m_i \cdot \vec{x_i}$$

$$Y = \frac{1}{M}\sum_i m_i \cdot \vec{y_i}$$

$$Z = \frac{1}{M}\sum_i m_i \cdot \vec{z_i}$$

Where, $M = \sum_i m_i$ is total mass of the system.

FRICTION:

- Friction is the force resisting the relative motion of solid surfaces, fluid layers, and material elements sliding against each other.

- **Kinetic Friction:** When two bodies in contact move with respect to each other, rubbing the surface in contact, the friction between them is called kinetic friction.
- The kinetic friction on a body A slipping against another body B is opposite to the velocity of A with respect to B.
- The magnitude of the kinetic friction is proportional to the normal force acting between the two bodies.

$$f_k = \mu_k \cdot N$$

Where, N is the normal force and μ_k is called coefficient of kinetic friction.

- **Static Friction:** Frictional force can also act between two bodies which are in contact but not sliding with respect to each other. The friction in such cases is called static friction.
- The maximum static friction that a body can exert on the other body in contact with it, is called "Limiting friction".

$$f_{max} = \mu_s \cdot N$$

When, f_{max} is the maximum possible force of static friction, μ_S is called coefficient of the static friction, and N is called normal force.

$$\therefore f_S < f_{max} = \mu_S \cdot N$$

LENS MAKER'S FORMULA AND LENS FORMULA:

- General equation for refraction at a spherical surface is,

$$\frac{\mu_2}{v} - \frac{\mu_1}{u} = \frac{\mu_2 - \mu_1}{R}$$

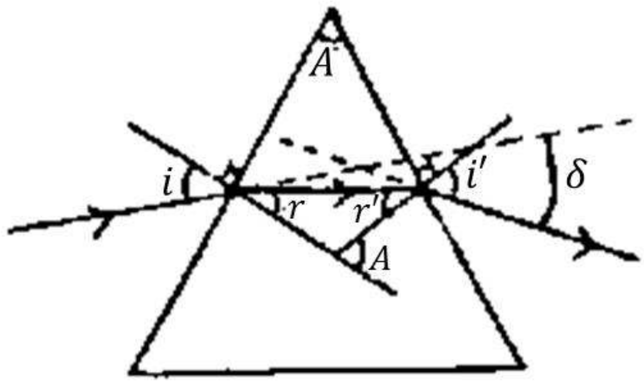
- Lens maker's formula: If refractive index of the material of the lens is μ and it is in air,

$$\frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

- Lens formula:

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$$

ANGLE OF MINIMUM DEVIATION:



- Angle of minimum deviation is calculated as,

$$\delta = i + i' - A$$

And,

$$\boldsymbol{\mu} = \frac{\mathbf{sin}\left(\frac{\boldsymbol{A} + \boldsymbol{\delta_m}}{\mathbf{2}}\right)}{\mathbf{sin}\frac{\boldsymbol{A}}{\mathbf{2}}}$$

SIMPLE HARMONIC MOTION:

- It is a motion that repeats itself after regular time interval such that the force acting on it is directed towards a point over the linen (which it execute momentum) and the force is also proportional to displacement of particle from that fixed point.

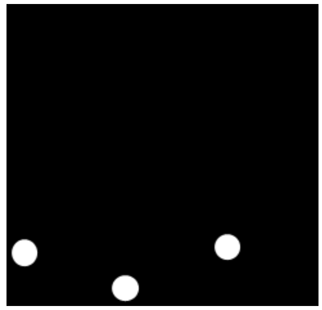
$$\boldsymbol{F} = -\boldsymbol{kx}$$
$$where, \boldsymbol{k} = \boldsymbol{\omega^2 m}$$

Here, k is force constant or spring constant,
ω^2 is a positive constant,
m is mass of the particle,
x is the displacement.

- The resultant force on particle is zero when it is at the centre of oscillation. The center of oscillation is, therefore, the equilibrium position.

SIMPLE PENDULUM:

- A Simple pendulum consists of a heavy particle suspended from a fixed support through a light inextensible string. Simple pendulum is an idealized model. In general a small metallic sphere is use to suspend through a string.



- Figure shows a simple pendulum in which a particle of mass m is suspended from the fixed support through a light string of length l.
- The position of the particle at any time can be described by the angle θ between string and corresponds to θ = 0.
- Formulas for angular acceleration, angular frequency and time period are given as follow respectively,

$$Angular\ acceleration\ (\alpha) = -\omega^2 \cdot \theta$$

$$Abgular\ frequency\ (\omega) = \sqrt{\frac{g}{l}}$$

$$Time\ period\ (T) = \frac{2\pi}{\omega} = 2\pi\sqrt{\frac{l}{g}}$$

THERMAL CONDUCTIVITY:

- Consider a solid bar of length s and area of cross-section A. The left end is maintained at Q_A temperature and right side at Q_B.
- Heat flow from higher temperature to lower temperature after some time, the temperature of each section becomes constant with time. This is known as steady state.
- In steady state, if ΔQ amount of heat crosses through any cross section in time Δt. Therefore conductive heat transfer can be expressed by "Fourier's Law".

$$\frac{\boldsymbol{\Delta Q}}{\boldsymbol{\Delta t}} = \frac{\boldsymbol{KA(Q_A - Q_B)}}{\boldsymbol{s}}$$

  Where, K is coefficient of thermal conductivity of material.
- The definition of thermal conductivity is stated as: "*the quantity of heat transmitted through a unit thickness of a material - in a direction normal to a surface of unit area - due to a unit temperature gradient under steady state condi*tions"
- SI unit of thermal conductivity is $\frac{W}{m \cdot K}$.

ELECTRIC CHARGE:

- Charge is the fundamental property of forms of matter that exhibit electrostatic attraction or repulsion in the presence of other matter.
- It is an intrinsic property of proton and electron, proton and electron are smallest unit of positively and negatively charge.
- SI unit of the charge is Coulomb (C).
- Like charges repel while unlike charges are attracted.
- If charge is quantized multiple of charge on an electron is,

$$Q = \pm ne$$
$$(e = 1.60218 \times 10^{-29} C)$$

- Net amount of charge in a system is conserved.

COULOMB'S LAW:

- Coulomb's law or Coulomb's inverse-square law is a law of physics describing the electrostatic interaction between electrically charged particles. The Coulomb's law can be stated as, "The magnitude of the electro static force of interaction between two point charges is directly proportional to the scalar multiplication of the magnitudes of charges and inversely proportional to the square of the distance between them."

$$\boldsymbol{F = k\frac{q_1 q_2}{r^2}}$$

Where q_1 and q_2 are the charges on the particles, r is the separation between them and k is constant.

$$k = \frac{1}{4\pi\epsilon_0} = 8.98755 \times 10^9 \ \frac{N - m^2}{C^2}$$

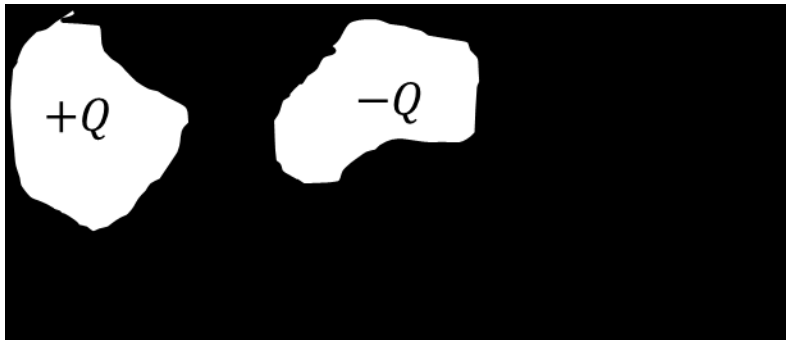
- The force is attractive when both charges are of opposite sign and force is repulsive when both charges are of same sign. Vector form of force can be written as,

$$\boldsymbol{\vec{F} = k\frac{q_1 q_2 \vec{r}}{r^3}}$$

Where, $\vec{r}$ is the position vector of the force-experiencing particle with respect to the force-exerting particle.

CAPACITANCE AND CAPACITOR:

- A combination of two conductors placed closed to each other is called a capacitor. One of the conductors is given a positive charge and the other is given an equal negative charge.
- The conductor with the positive charge is called the positive plate and the other is called the negative plate. The charge on the positive plate is called the charge on the capacitor and the potential difference between the plates is called the potential of the capacitor.



- Figure shows two conductors. One of the conductors has a positive charge +Q and the other has an equal, negative charge –Q. The first one is at potential V_+ and the other is at a potential V_-.
- For given capacitor, the charge Q on the capacitor is proportional to the potential difference V between the plates,

$$Q \propto V$$
$$\therefore Q = CV$$

Where, C is called the capacitance of the capacitor. It depends on the shape, size and geometrical placing of the conductors and the medium between them.

- The SI unit of capacitance is $\frac{coulomb}{volt} = farad\ (F)$.

ELECTRIC CURRENT AND CURRENT DENSITY:

- Transfer of charge from one side of an area to another side, is called electric current through the area.
- If the moving charges are positive the current is in direction of the motion, and the moving charges are negative the current is opposite to direction of the motion.
- Let ΔQ charge crosses an area in time Δt, the average current through the area during this time is,

$$\bar{i} = \frac{\Delta Q}{\Delta t}$$

The current at time t is,

$$\boldsymbol{i = \lim_{\Delta t \to 0} \frac{\Delta Q}{\Delta t} = \frac{dQ}{dt}}$$

- Therefore electric current can be define as, the rate of transfer of charge from one side of area to another side of area.
- SI unit of current is “ampere” which is symbolized A.

$$1\ A = \frac{1\ coulomb}{1\ second} = 1\frac{C}{s}$$

- <u>Current density:</u>

- To define the current density at a point, as figure (a) shows a small area ΔS through P perpendicular to the flow of charges. If Δi be the current through the area ΔS, the average current density is given as,

$$\vec{j} = \frac{\Delta i}{\Delta S}$$

The current density at point P is,

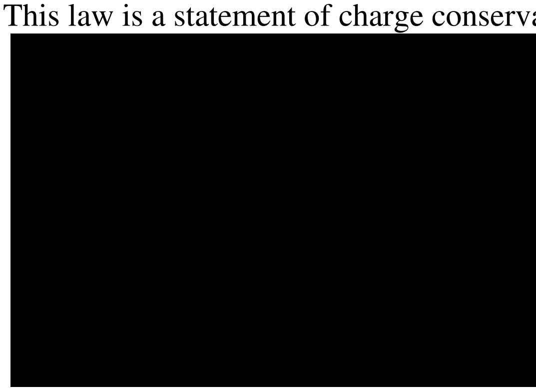
$$\boldsymbol{j} = \lim_{\Delta S \to 0} \frac{\Delta i}{\Delta S} = \frac{di}{dS}$$

- Let consider an area ΔS which is not perpendicular to the current (figure (b)). The normal to the area makes an angle θ with the direction of the current, the current density is,

$$\boldsymbol{j} = \frac{\Delta i}{\Delta S \cos \theta}$$

KIRCHOFF'S LAW:

- Current Law: "For a junction or a node in a circuit the sum of the currents entering equals the sum of the currents leaving."
- This law is a statement of charge conservation.



$$I_3 = I_1 + I_2$$

- VOLTAGE LAW: "the total voltage around a closed loop must be zero."

$$\sum V = 0$$

Sine conversion:

[redacted]

$$V_b - V_a = -V$$

[redacted]

$$V_b - V_a = +V$$

[redacted]

$$V_b - V_a = -IR$$

[redacted]

$$V_b - V_a = +IR$$

TEMPERATURE DEPENDENCE OF RESISTIVITY AND RESISTANCE:

- As the temperature of a conductor is increased, the thermal agitation increases and the collisions become more frequent. The average time τ between successive collisions decreases and hence the drift speed decreases. Thus, the conductivity decreases and resistivity increases as the temperature increases.

$$\boldsymbol{\rho(T) = \rho(T_o)[1 + \alpha(T - T_0)]}$$

  Where, $\rho(T)$ and $\rho(T_o)$ are resistivity at temperatures T and T_0 respectively; α is the constant for the given material.

- The temperature of a given conductor depends on its length and area of cross-section besides the resistivity. As temperature changes, the length and the area also change. But these changes are quite small and the factor $\frac{l}{A}$ may be treated as constant.

$$R(T) = R(T_0)[1 + \alpha(T - T_0)]$$

LORENTZ FORCE:

- The Lorentz force is the combination of the electric and magnetic force on a point charge due to electromagnetic field.
- If a particle of charge q moving with velocity **v** in an electric field **E** and magnetic field **B**, then force acting on the charge particle is,

$$\vec{F} = q\left[\vec{E} + \left(\vec{v} \times \vec{B}\right)\right]$$

- Above equation is equation of Lorentz force.

THE BIO AND SAVART'S LAW:

- The magnetic field at point P, due to a current element dl, is given as,

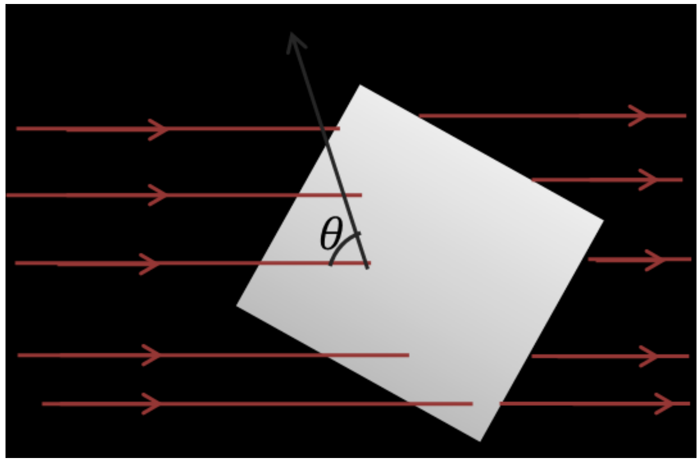
$$d\vec{B} = \frac{\mu_0}{4\pi}\, i\, \frac{d\vec{l} \times \vec{r}}{r^3}$$

Above equation is the mathematical form of Biot – Savart law.
Magnitude of the magnetic field is given as,

$$dB = \frac{\mu_0}{4\pi} \frac{idl \sin\theta}{r^2}$$

Where, θ is the angle between $d\vec{l}$ and $\vec{r}$. The direction of the field is perpendicular to the plane containing the current element and the point P according to the rules of cross product.

MAGNETIC FLUX:



- Magnetic flux is the number of magnetic field lines passing through a surface placed in a magnetic field.
- If the magnetic field at an element is $\vec{B}$, magnetic flux through area is:

$$\boldsymbol{\phi = \vec{B} \cdot d\vec{S} = B\, dS \cos\theta}$$

  Here, $d\vec{S}$ is the perpendicular vector to the surface and has magnitude equal to are dS.
  θ is angle between $\vec{B}$ and $d\vec{S}$.

- Unit of magnetic flux (ϕ) is weber (Wb).