

# PHYSICS FORMULA

- Vectors :-

$$|\vec{a} \cdot \vec{b}| =$$

$$\cos \theta = \frac{\vec{a} \cdot \vec{b}}{|\vec{a}| \cdot |\vec{b}|} \rightarrow \text{Dot product.}$$

$\hookrightarrow$  yields a scalar

$$\vec{c} = |\vec{a}| \cdot |\vec{b}| \sin \theta \rightarrow \text{cross product}$$

$\hookrightarrow$  yields a vector.

$$R = \sqrt{x^2 + y^2}$$

- Motion :-

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

$s$  = displacement

$t$  = time.

$$v = u + at$$

$a$  = acceleration (can be  $9.8 = g$ ).

$u$  = initial velocity.

$$v^2 - u^2 = 2as$$

$v$  = final velocity.

- SHM :-

$$x(t) = x_0 \cos(\omega t + \phi)$$

$\hookrightarrow$  diff this

$$\hookrightarrow v(t) = -x_0 \omega \sin(\omega t + \phi)$$

$\hookrightarrow$  max velocity.

$\hookrightarrow$  diff this

$$\hookrightarrow a(t) = -x_0 \omega^2 \cos(\omega t + \phi)$$

$\hookrightarrow$  max acceleration.


$$\omega^2 = \sqrt{k/m}$$

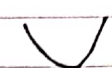
$$-kx = ma$$

$$kx = m(\omega^2 x)$$

$$k = m\omega^2$$

$$\left. \begin{array}{l} T = 2\pi \sqrt{m/k} \\ T = 2\pi \sqrt{l/g} \end{array} \right\} \rightarrow \text{Time period.}$$

- $K.E(t) = \frac{1}{2} m \omega^2 x_0^2 \sin^2(\omega t + \phi)$  

- $P.E(t) = \frac{1}{2} k x^2 = \frac{1}{2} k x_0^2 \cos^2(\omega t + \phi)$  

- $E(t) = \frac{1}{2} k x_0^2$

- Waves :-

- $y(x, t) = y_0 \sin(kx \pm \omega t)$   $y_0$  = max displacement (amplitude)  
 $\text{or}$   
 $y_0 \sin(kx \pm \omega t + \phi)$

- $k = 2\pi/\lambda \rightarrow$  wave number

- $v = f\lambda$  or  $v = \frac{\omega}{k} \rightarrow$  wave speed!

- $v = \sqrt{T/\mu} \rightarrow$  transverse speed.  
 $\mu = m/l \rightarrow$  mass per unit length.

- $\Delta y = \underbrace{2y_0 \cos \frac{\phi}{2}}_{\text{amplitude}} \underbrace{\sin(kx - \omega t + \frac{\phi}{2})}_{\text{oscillating part}} \rightarrow$  Superposition in same direction

$\pi$  - out of phase  $\rightarrow$  destructive.

0  $\rightarrow$  in phase  $\rightarrow$  constructive.

- $\Delta y = 2y_0 \sin(kx) \cos(\omega t) \rightarrow$  Superposition in opposite direction.  
 $\hookrightarrow$  standing wave



## - Coulombs law + Electric fields + Capacitance + Electricity :-

$$\bullet F = \frac{k q_1 q_2}{r^2}, \quad k = 9 \times 10^9 \text{ or } \frac{1}{4\pi\epsilon_0}$$

$$\bullet E = \frac{kq}{r^2}$$

$$\bullet E = \frac{V}{d}$$

$$\bullet \phi = \vec{E} \cdot \vec{A}$$

$$\bullet E = \frac{F}{q}$$

$$\bullet \phi = q/\epsilon_0 \rightarrow \text{Gauss's law.}$$

$$\bullet E = \frac{K}{2\pi\epsilon_0 r} \rightarrow \text{Gauss's law for cylinder.}$$

$$\bullet E = \frac{\lambda}{2\pi\epsilon_0 r} \rightarrow \lambda = Q/d \rightarrow \text{charge density, } \rightarrow \text{charge on isolated conductor.}$$

$$\bullet E = \frac{Q}{4\pi\epsilon_0 r^2} \rightarrow \text{hollow sphere}$$

$$\bullet i = nAve \rightarrow \begin{array}{l} n: \text{charge carrier density} \\ A: \text{cross sectional area} \\ v: \text{drift vel.} \\ e: \text{charge.} \end{array}$$

$$\bullet \vec{J} = \frac{i}{A} \propto E$$

$\sigma = \text{conductivity.}$

$E: \text{Electric field strength.}$

$$\bullet i = q = \int \vec{J} \cdot d\vec{A}$$

$$\bullet R = \frac{\rho L}{A}$$

$$\bullet \rho = \frac{m}{e^2 n \tau}$$

$m: \text{mass, } e: \text{charge, } n: \text{carrier density}$   
 $\tau: \text{time constant.}$

- $\frac{\Delta \rho}{\Delta T} = \rho_0 \alpha$

$\rho, T \Rightarrow$  original temperature and resistivity  
 $\rho_0, T_0 \Rightarrow$  new " " " "  
 $\alpha \rightarrow$  coefficient.

- $\rho - \rho_0 = \rho_0 \alpha (T - T_0)$

- $C = \frac{A \epsilon_0}{d} \rightarrow$  parallel plate capacitor

- $C = \frac{2\pi \epsilon_0 L}{\ln(b/a)} \rightarrow$  cylindrical "

- $C = 4\pi \epsilon_0 \frac{ba}{a-b} \rightarrow$  spherical "

- $C = 4\pi \epsilon_0 R \rightarrow$  isolated sphere

- $C_{NET} = C_1 + C_2 + \dots \rightarrow$  parallel

- $C_{NET} = \left( \frac{1}{C_1} + \frac{1}{C_2} + \dots \right)^{-1} \rightarrow$  series

- $C = q/V \rightarrow$  general formula.

- Magnetism :-

- $F = \underbrace{\vec{B} \times \vec{v}}_{\rightarrow \text{cross product}} q \sin \theta$

- $n = \frac{Bi}{etV_H}$ 
  - $n$  : charge carrier density
  - $B$  : Magnetic field strength
  - $e$  : charge
  - $t$  : thickness of metal
  - $V_H$  : Hall voltage