# PHYSICS FORMULA

- Vectors :-

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

- $\cos\theta = \dfrac{\vec{a}\cdot\vec{b}}{|\vec{a}|\cdot|\vec{b}|}$ . → Dot product.
  ↳ yields a scalar

- $\vec{C} = |\vec{a}|\cdot|\vec{b}|\sin\theta$ → cross product
  ↳ yields a vector.

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

- Motion :-

- $S = ut + \frac{1}{2}at^2$
- $v = u + at$
- $v^2 - u^2 = 2as$

S = displacement.
t = time.
a = acceleration (can be 9.8 = g).
u = initial velocity.
v = final velocity.

- SHM :-

- $x(t) = x_0\cos(\omega t+\phi)$.
  ↳ diff this
  ↳ • $v(t) = -\underbrace{x_0\omega}_{\text{max velocity}}\sin(\omega t+\phi)$.
  ↳ diff this
  • ↳ $a(t) = -\underbrace{x_0\omega^2}_{\text{max acceleration}}\cos(\omega t+\phi)$
  ↳ ~~axe~~ max acceleration,

$\boxed{\bullet\ \omega = \sqrt{K/m}}$ .

$-kx = ma$

$\cancel{+}kx = m(\cancel{+}\omega^2 x)$

$\boxed{k = m\omega^2}$

$T = 2\pi\sqrt{m/K}$
$T = 2\pi\sqrt{l/g}$ . ] → Time period.

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

- Waves :-

- $y(x,t) = y_0 \sin(kx \pm \omega t)$.  $y_0$ = max displacement (amplitude)

  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.

  $\because \mu = m/l \rightarrow$ mass per unit length.

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

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

  $0 \rightarrow$ inphase $\rightarrow$ constructive.

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

  $\hookrightarrow$ Standing wave

- Columbs law + Electric fields + Capacitance + Electricity :-

- $F = \frac{kq_1q_2}{r^2}$ , $k = 9 \times 10^9$ or $\frac{1}{4\pi\epsilon_0}$
- $E = \frac{kq}{r^2}$ • $E = \frac{V}{d}$
- $\phi = \vec{E} \cdot \vec{A}$ • $E = \frac{F}{q}$.
- $\phi = q/\epsilon_0$ → gauss's law.
- $E = \frac{K}{2\pi\epsilon_0 r}$ → gauss's law for cylinder.
- $E = \frac{\lambda}{2\pi\epsilon_0 r}$ → $\lambda = Q/d$ → charge density. → charge on isolated conductor.
- $E = \frac{Q}{4\pi\epsilon_0 r^2}$ → hollow sphere
- $i = nAVe$ → n: charge carrier density
  A: cross sectional area
  V: drift vel.
  e = charge.
- $\vec{J} = \frac{i}{A}$ or $E\sigma$
  $\sigma$ = conductivity.
  E: Electric field strength.
- $i = q = \int \vec{J} \, d\vec{A}$.
- $R = \frac{\rho L}{A}$
- $\rho = \frac{m}{e^2 n \tau}$ m = mass, e = charge, n = carrier density
  $\tau$ = time constant.

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

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

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

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

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

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

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

- $C_{NET} = C_1 + C_2 + \cdots$ → parallel

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

- $C = q/V$ → general formula.

- Magnetism :-

- $F = \underbrace{\vec{B} \times \vec{v}}_{\text{crossproduct}}\, q \sin\theta$.

- $n = \frac{Bi}{etV_H}$

n = charge carrier density
B = Magnetic field strength
e = charge
t = thickness of metal
$V_H$ = Hall voltage.