PHYSICS FORMULAS

Density is mass per unit volume Density = mass / volume	velocity = displacement / time
Force = rate of change of momentum	Momentum = mass . velocity
Power is rate of work done Power = work / time Unit of power is watt **Potential energy (P)** PE = m.g.h m = mass g = acceleration due to gravity ($9.81 m/s^2$) h = height	**Kinetic energy (P)** P = (1/2).m.v^2 m = mass v = velocity
Gravity (Force due to gravity) F_g : Force of attraction G : Gravitational constant M_1 : Mass of first object M_2 : Mass of second object $F_g = \frac{G M_1 M_2}{r^2}$	Acceleration due to gravity at a depth 'd' from earth surface is : $g_d = g(1 - \frac{d}{R})$
Acceleration due to gravity at height 'h' from earth surface is : h is very much smaller than R $g_h = g(1 - \frac{2h}{R})$	**Escape velocity** Escape velocity **from** a body of mass M and radius r is For example if you want to calculate the escape verlocity of sa object from earth then, M is dmass of earth r is radius of earth
OPTICS **Index of refraction**	**Under constant acceleration linear motion**

$n = c/v$ n - index of refraction c - velocity of light in a vacuum v - velocity of light in the given material	v = final velocity u = intitial velocity a = acceleration t = time taken to reach velocity v from u s = displacement $v = u + a t$ $s = ut + (1/2) a t^2$ $s = vt - (1/2) a t^2$ $v^2 = u^2 + 2 a s$
Friction force (kinetic friction) When the object is moving then Friction is defined as : $F_f = \mu F_n$ where F_f = Friction force, μ= cofficient of friction F_n = Normal force	**Linear Momentum** Momentum = mass x velocity
Capillary action The height to which the liquid can be lifted is given by: $h = \frac{2\gamma\cos\theta}{\rho g r}$ γ: liquid-air surface tension(T)(T=energy/area) θ: contact angle ρ: density of liquid g: acceleration due to gravity r: is radius of tube	**Simple harmonic motion** Simple harmonic motion is defined by: $d^2x/dt^2 = - k x$
Time period of pendulum	**Waves** 1 f

	$= \frac{}{T}$ $\omega = \frac{2\pi}{T}$ v = f . λ where ω = Angular frequency, T=Time period, v = Speed of wave, λ=wavelength
Doppler effect Relationship between observed frequency f and emitted frequency f_0: $f = f_0\left(\frac{v}{v + v_s}\right)$ where, v=velocity of wave v_s=velocity of source. It is positive if source of wave is moving away from observer. It is negative if source of wave is moving towards observer.	**Resonance of a string** $\text{frequency} = f = \frac{nv}{2L}$ where, L: length of the string n = 1, 2, 3...
Resonance of a open tube of air(approximate) $\text{Approximate frequency} = f = \frac{nv}{2L}$	**Resonance of a open tube of air**(accurate)

where, L: length of the cylinder n = 1, 2, 3... v = speed of sound	$\text{frequency} = f = \frac{nv}{2(L+0.8D)}$ where, L: length of the cylinder n: 1, 2, 3... v: speed of sound d:diameter of the resonance tube
Resonance of a closed tube of air(approximate) $\text{Approximate frequency} = f = \frac{nv}{4L}$ where, L: length of the cylinder n = 1, 2, 3... v = speed of sound	**Resonance of a closed tube of air**(accurate) $\text{frequency} = f = \frac{nv}{4(L+0.8D)}$ where, L: length of the cylinder n: 1, 2, 3... v: speed of sound d:diameter of the resonance tube
intensity of sound $\text{intensity of sound} = \frac{\text{Sound Power}}{\text{area}}$	**Bragg's law** $n\lambda = 2d \sin\theta$ where n = integer (based upon order) λ = wavelength

intensity of sound in decibel= $10\log_{10}\frac{I}{I_0}$ $dB = 10\log_{10}\frac{I}{I_0}$ where I=intensity of interest in Wm^{-2} I_0=intensity of interest in $10^{-12}Wm^{-2}$	d = distance between the planes θ = angle between the surface and the ray
de Broglie equation $\lambda = \frac{h}{p} = \frac{h}{mv}$ where p = momentum λ = wavelength h = Planck's constant v = velocity	**Relation between energy and frequency** E = hν where E = Energy h = Planck's constant ν = frequency
Davisson and Germer experiment $\lambda = \frac{h}{\quad}$	**Centripetal Force (F)** $F = \frac{mv^2}{r} = m\omega^2 r$

where e = charge of electron m = mass of electron V = potential difference between the plates thru which the electron pass λ = wavelength	
Circular motion formula $v = \omega r$ Centripetal acceleration (a) = $\frac{v^2}{r}$	**Torque (it measures how the force acting on the object can rotate the object)** Torque is cross product of radius and Force Torque = (Force) X (Moment arm) X sin θ $T = F L \sin \theta$ whete θ = angle between force and moment arm
Forces of gravitation $F = G (m_1.m_2)/r^2$ where G is constant. $G = 6.67E - 11\ N\ m^2 / kg^2$	**Stefan-Boltzmann Law** The energy radiated by a blackbody radiator per second = P $P = A\sigma T^4$ where, σ = Stefan-Boltzmann constant $\sigma = 5.6703 \times 10^{-8}$ watt/m^2K^4
Efficiency of Carnot cycle $\eta = 1 - \frac{T_c}{T_h}$	**Ideal gas law** $P V = n R T$ P = Pressure (Pa i.e. Pascal) V = Volume (m^3) n = number of of gas (in moles) R = gas constant (8.314472 .m^3.Pa.$K^{-1}$$mol^{-1}$]) T = Temperatue (in Kelvin [K])
Boyles law (for ideal gas) $P_1 V_1 = P_2V_2$ T (temperature is constant)	**Charles law (for ideal gas)**

	$\frac{V_1}{T_1} = \frac{V_2}{T_2}$ P (pressure is constant)
Translational kinetic energy K per gas molecule (average molecular kinetic energy:) $K = \frac{3}{2} kT$ k = 1.38066 x 10^{-23} J/K Boltzmanns constant	**Internal energy of monoatomic gas** $K = \frac{3}{2} nRT$ n = number of of gas (in moles) R = gas constant (8.314472 .m^3.Pa.$K^{-1}$$mol^{-1}$])
Root mean square speed of gas $V^2_{rms} = \frac{3kT}{m}$ k = 1.38066 x 10^{-23} J/K Boltzmanns constant m = mass of gas	**Ratio of specific heat (γ)** $\gamma = \frac{C_p}{C_v}$ C_p = specific heat capacity of the gas in a constant pressure process C_v = specific heat capacity of the gas in a constant

	volume process
Internal entergy of ideal gas Internal entergy of ideal gas (U) = c_v nRT	In **Adiabatic process** no heat is gained or lost by the system. Under adiabetic condition PV^{γ} = Constant $TV^{\gamma-1}$ = Constant where γ is ratio of specific heat. $\gamma = \frac{C_p}{C_v}$
Boltzmann constant (k) $k = \frac{R}{N_a}$ R = gas constant N_a = Avogadro's number.	**Speed of the sound in gas** R = gas constant(8.314 J/mol K) T = the absolute temperature M = the molecular weight of the gas (kg/mol) γ = adiabatic constant = c_p/c_v
Capillary action The height to which the liquid can be lifted is given by h=height of the liquid lifted T=surface tension r=radius of capillary tube $h = \frac{2T}{\rho r}$	**Resistance of a wire** $R = \frac{\rho L}{A}$ ρ = rsistivity L = length of the wire

— g	A = cross-sectional area of the wire
Ohm's law $V = I . R$ V = voltage applied R = Resistance I = current **Electric power (P) = (voltage applied) x (current)** $P = V . I = I^2 . R$ V = voltage applied R = Resistance I = current	**Resistor combination** **If resistors are in series then equivalent resistance will be** $R_{eq} = R_1 + R_2 + R_3 + ... + R_n$ **If resistors are in parallel then equivalent resistance will be** $1/R_{eq} = 1/R_1 + 1/R_2 + 1/R_3 + ... + 1/R_n$
In AC circuit average power is : $P_{avg} = V_{rms} I_{rms} \cos\varphi$ where, P_{avg} = Average Power V_{rms} = rms value of voltage I_{rms} = rms value of current	In AC circuit Instantaneous power is : $P_{Instantaneous} = V_m I_m \sin\omega t \sin(\omega t - \varphi)$ where, $P_{Instantaneous}$ = Instantaneous Power V_m = Instantaneous voltage I_m = Instantaneous current
Capacitors $Q = C.V$ where Q = charge on the capacitor C = capacitance of the capacitor V = voltage applied to the capacitor	**Total capacitance (Ceq) for PARALLEL Capacitor Combinations:** $C_{eq} = C_1 + C_2 + C_3 + ... + C_n$ **Total capacitance (Ceq) for SERIES Capacitor Combinations:** $1/C_{eq} = 1/C_1 + 1/C_2 + 1/C_3 + ... + 1/C_n$
Parallel Plate Capacitor A $C = \kappa$ ε_0 — d	**Cylindrical Capacitor** $C = 2 \pi \kappa$ L ε_0 —— ln

where C = [Farad (F)] κ = dielectric constant A = Area of plate d = distance between the plate ε_0 = permittivity of free space (8.85 X 10^{-12} $C^2/N\ m^2$)	(b/a) where C = [Farad (F)] κ = dielectric constant L = length of cylinder [m] a = outer radius of conductor [m] b = inner radius of conductor [m] ε_0 = permittivity of free space (8.85 X 10^{-12} $C^2/N\ m^2$)
Spherical Capacitor $C = 4 \pi \kappa \varepsilon_0 \frac{a\,b}{b-a}$ where C = [Farad (F)] κ = dielectric constant a = outer radius of conductor [m] b = inner radius of conductor [m] ε_0 = permittivity of free space (8.85 X 10^{-12} $C^2/N\ m^2$)	**Magnetic force acting on a charge q moving with velocity v** F = q v B sin θ where F = force acting on charge q (Newton) q = charge (C) v = velocity (m/sec^2) B = magnetic field θ = angle between V (velocity) and B (magnetic field)
Force on a wire in magnetic field (B) F = B I l sin θ where F = force acting on wire (Newton) I = Current (Ampere) l = length of wire (m) B = magnetic field θ = angle between I (current) and B (magnetic field)	In an RC circuit (Resistor-Capacitor), the time constant (in seconds) is: τ = RC R = Resistance in Ω C = Capacitance in in farads.

In an RL circuit (Resistor-inductor), the time constant (in seconds) is: $\tau = L/R$ R = Resistance in Ω C = Inductance in henries	Self inductance of a solenoid = L = $\mu n^2 LA$ n = number of turns per unit length L = length of the solenoid.
Mutual inductance of two solenoid two long thin solenoids, one wound on top of the other $M = \mu_0 N_1 N_2 LA$ N_1 = total number of turns per unit length for first solenoid N_2 = number of turns per unit length for second solenoid A = cross-sectional area L = length of the solenoid.	Energy stored in capacitor $E = \frac{1}{2} C V^2$
Coulomb's Law Like charges repel, unlike charges attract. $F = k (q_1 . q_2)/r^2$ where k is constant. $k = 1/(4 \pi \varepsilon_0) \approx 9 \times 10^9 N.m^2/C^2$ q_1 = charge on one body q_2 = charge on the other body r = distance between them Calculator based upon Coulomb's Law	Ohm's law V = IR where V = voltage I = current R = Resistence
Electric Field around a point charge (q) $E = k (q/r^2)$ where k is constant. $k = 1/(4 \pi \varepsilon_0) \approx 9 \times 10^9 N.m^2/C^2$ q = point charge r = distance from point charge (q)	**Electric field due to thin infinite sheet** $E = \frac{\sigma}{2 \varepsilon_0}$ where E = Electric field (N/C) σ = charge per unit area C/m^2 $\varepsilon_0 = 8.85 \times 10^{-12} C^2/N$

	m^2
Electric field due to thick infinite sheet $E = \frac{\sigma}{\varepsilon_0}$ where E = Electric field (N/C) σ = charge per unit area C/m^2 ε_0 = 8.85 X 10^{-12} $C^2/N\ m^2$	**Magnetic Field around a wire (B) when r is greater than the radius of the wire.** $B = \frac{\mu_0 I}{2 \pi r}$ where I = current r = distance from wire and r ≥ Radius of the wire
Magnetic Field around a wire (B) when r is less than the radius of the wire. $B = \frac{\mu_0 I r}{2 \pi R^2}$ where I = current R = radius of wire r = distance from wire and r ≤ Radius of the wire (R)	**Magnetic Field At the center of an arc** $B = \frac{\mu_0 I \varphi}{4 \pi r}$ where I = current r = radius from the center of the wire
Bohr's model $L = \frac{nh}{}$	**Emitting Photons(Rydberg Formula)** 1 1

$= \frac{}{2\pi}$ where L = angular momentum n = principal quantum number = 1,2,3,...n h = Planck's constant.	$\frac{}{n_1^2}$ $\frac{}{n_2^2}$ where $n_1 < n_2$ E_0 = 13.6 eV
Half life of radioactive element $t_{1/2} = \frac{\ln(2)}{\lambda}$	**Average life of radioactive element** $\tau = \frac{1}{\lambda}$