1. The magnitude of resultant of two vectors $\vec{A}$ and $\vec{B}$,
$R = \sqrt{A^2 + B^2 + 2AB\cos\theta}$

2. The direction (β) of resultant vector $\vec{R}$ with respect to vector $\vec{A}$,
$\beta = \tan^{-1}\left(\frac{B\sin\theta}{A + B\cos\theta}\right)$.

3. The scalar product of two vectors $\vec{A}$ and $\vec{B}$,
$\vec{A}\cdot\vec{B} = |\vec{A}|\,|\vec{B}|\cos\theta$.

4. Vector product of two vectors $\vec{A}$ and $\vec{B}$,
$\vec{A}\times\vec{B} = |\vec{A}|\,|\vec{B}|\sin\theta\,\hat{n}$

5. The components of two vectors $\vec{A}$ and $\vec{B}$;
$\vec{A} = A_x\hat{i} + A_y\hat{j} + A_z\hat{k}$
and, $\vec{B} = B_x\hat{i} + B_y\hat{j} + B_z\hat{k}$
Then $\vec{A}\cdot\vec{B} = A_xB_x + A_yB_y + A_zB_z$.
and angle, $\cos\theta = \frac{\vec{A}\cdot\vec{B}}{|\vec{A}||\vec{B}|} = \frac{A_xB_x + A_yB_y + A_zB_z}{|\vec{A}||\vec{B}|}$
$|\vec{A}| = \sqrt{A_x^2 + A_y^2 + A_z^2}$
$|\vec{B}| = \sqrt{B_x^2 + B_y^2 + B_z^2}$

6. In vector resolution,
X-component of $\vec{A} = |A_x| = A\cos\theta$
Y- Component of $\vec{A} = |A_y| = A\sin\theta$

7. The dot product of mutually perpendicular vectors,
$\hat{i}\cdot\hat{j} = 0,\ \hat{j}\cdot\hat{k} = 0,\ \hat{k}\cdot\hat{i} = 0$
$\hat{i}\cdot\hat{i} = 1,\ \hat{j}\cdot\hat{j} = 1,\ \hat{k}\cdot\hat{k} = 1$

8. The cross product of mutually perpendicular vectors,
$\hat{i}\times\hat{j} = \hat{k},\ \hat{j}\times\hat{k} = \hat{i},\ \hat{k}\times\hat{i} = \hat{j}$, reverses are negative in sign
$\hat{i}\times\hat{i} = 0,\ \hat{j}\times\hat{j} = 0,\ \hat{k}\times\hat{k} = 0$

mg

1. The gravitational force, $F = G\frac{m_1m_2}{r^2}$
2. The acceleration due to gravity, $g = \frac{GM}{R^2}$
3. The mean density of the earth, $\rho = \frac{3g}{4\pi GR}$
4. Acceleration due to gravity g at height h, $g' = g\left(1 - \frac{2h}{R}\right)$, for h<<R
5. Acceleration due to gravity g at depth x, $g' = g\left(1 - \frac{x}{R}\right)$
6. Acceleration due to gravity g due to the rotation of the earth, $g' = g\left(1 - \frac{R\omega^2\cos^2\phi}{g}\right)$
7. The intensity of gravitational field, $E = \frac{GM}{r^2}$
8. The gravitational potential, $V = \frac{-GM}{r}$
9. Gravitational potential energy is, $U = -\frac{GMm}{r}$
10. Total gravitational energy,
$T.E. = K.E. + P.E. = \frac{1}{2}mv^2 + \left(-\frac{GMm}{r}\right)$,
v = orbital velocity.
11. Escape velocity, $v_e = \sqrt{2gR}$
12. Motion of satellite,
Orbital velocity, $v = R\sqrt{\frac{g}{R + h}}$,
Time period, $T = \frac{2\pi}{R}\sqrt{\frac{(R + h)^3}{g}}$,
Height, $h = \left(\frac{T^2R^2g}{4\pi^2}\right)^{1/3} - R$
13. The Schwarzschild radius of black hole is, $R_s = \frac{2GM}{c^2}$.

1. Heat gained or heat lost by a body,
i. $Q = mS\Delta\theta$, (For same phase)
ii. $Q = mL$, (for same temperature)
2. Principle of calorimetry, Heat gained = Heat lost

1. Stress $= \frac{\text{Force}}{\text{Area}} = \frac{F}{A}$
2. Strain $= \frac{\text{Change in confugiration}}{\text{original configuration}}$
i. Longitudinal strain $= \frac{\text{Change in length}}{\text{Original length}} = \frac{\Delta L}{L} = \frac{e}{L}$
ii. Volumetric strain $= \frac{\text{Change in volume}}{\text{Original volume}} = \frac{\Delta V}{V}$
iii. Shear strain = angle of deviation from the original position = θ
3. Hooke's law, Stress $\propto$ strain
4. Moduli of elasticity,
i. Young's modulus of elasticity,
$Y = \frac{\text{Normal stress}}{\text{Longitudinal strain}} = \frac{FL}{Ae}$.
ii. Bulk modulus of elasticity, $K = \frac{\text{Normal stress}}{\text{volume strain}} = \frac{-dP\,V}{\Delta V}$.
iii. Modulus of rigidity, $\eta = \frac{\text{tangential stress}}{\text{shear strain}} = \frac{F}{A\theta}$.
5. Total potential energy stored in the stretched wire,
$W = \frac{1}{2}F.e = \frac{1}{2}$ stress × strain × volume of wire
Energy density, $U = \frac{1}{2}$ stress × strain. For a missile, we use, $\frac{1}{2}F.e = \frac{1}{2}mv^2$
6. The Poisson's ratio, $\sigma = \frac{\text{lateral strain}}{\text{longitudional strain}} = \frac{-\Delta D/D}{\Delta L/L}$

Ritik Yadav

"If you found science boring then you are learning it from wrong teachers."

1. Work done, $W = W = \vec{F}\cdot\vec{s} = Fs\cos\theta$
2. Kinetic energy, $E_K = \frac{1}{2}mv^2 = \frac{p^2}{2m}$
3. Work energy theorem,
W = change of kinetic energy $= \frac{1}{2}mv^2 - \frac{1}{2}mu^2$
4. Gravitational potential energy, $E_p = mgh$
5. Power,
$P = \frac{\text{Work done}}{\text{Time taken}} = \frac{W}{t} = \vec{F}\cdot\vec{v} = Fv\cos\theta$
6. For explosion of a body,
$\frac{E_1}{E_2} = \frac{m_2}{m_1}$ i.e., $E \propto \frac{1}{m}$
7. Work done by frictional force,
W = Frictional force × displacement

1. The angular displacement, $\theta = \frac{l}{r}$
2. Angular velocity, $\omega = \frac{\text{angular displacement}}{\text{time taken}} = \frac{\theta}{t}$
3. The relation of linear velocity and angular velocity: $v = r\omega$
4. Angular acceleration, $\alpha = \frac{\text{angular velocity}}{\text{time taken}} = \frac{\omega}{t}$
5. Let T, f and ω are related as, $\omega = 2\pi f$, $f = \frac{1}{T}$ and $\omega = \frac{2\pi}{T}$.
6. Centripetal acceleration, $\alpha = \frac{v^2}{r} = \omega^2 r$.
7. Centripetal force, $F = \frac{mv^2}{r} = m\omega^2 r$.
8. Motion in vertical circle,
i. At the lowest point, the maximum tension,
$T_{max} = \frac{mv^2}{r} + mg$
ii. At the highest point, the minimum tension,
$T_{min} = \frac{mv^2}{r} - mg$
iii. At horizontal diametrical points
$T_{av} = \frac{mv^2}{r}$
9. Motion of Cyclist, $\tan\theta = \frac{v^2}{rg}$
10. Motion at Banked Road,
$R\sin\theta = \frac{mv^2}{r}$, $R\cos\theta = mg$, $\tan\theta = \frac{v^2}{rg}$, $v_{max} = \sqrt{\mu rg}$.
11. Motion of Conical Pendulum, $T\sin\theta = \frac{mv^2}{r}$,
$T\cos\theta = mg$, $\tan\theta = \frac{v^2}{rg}$ and $t = 2\pi\sqrt{\frac{l\cos\theta}{g}}$

1. Rate of heat conduction, $\frac{dQ}{dt} = \frac{kA(\theta_1 - \theta_2)}{x}$
2. Stefan's law, $E = \sigma T^4$ here,
$E = \frac{Q/t}{A} = \frac{\text{Power radiated}}{\text{Surface areea}} = \frac{P}{A}$
Then, $P = \sigma AT^4$,
In general form, $P = e\sigma AT^4$, where e is called emissivity of a black body
3. Stefan-Boltzmann law, $E = \sigma(T^4 - T_0^4)$.
For any black body, $P = e\,\sigma A\,(T^4 - T_0^4)$.
4. Surface temperature of the sun, $T = \left[\frac{r^2S}{R^2\sigma}\right]^{1/4}$

1. Equation of Motions,

Equations of motion in straight line	Equations of motion under gravity	
	For downward motion	For upward motion
$v = u + at$	$v = u + gt$	$v = u - gt$
$s = ut + \frac{1}{2}at^2$	$h = ut + \frac{1}{2}gt^2$	$h = ut - \frac{1}{2}gt^2$
$v^2 = u^2 + 2as$	$v^2 = u^2 + 2gh$	$v^2 = u^2 - 2gh$

2. Distance travelled in n^{th} second,
$s_n{}^{th} = u + \frac{a}{2}(2n - 1)$
3. Relative velocity of object A with respect to object B,
$\vec{v}_{AB} = \vec{v}_A - \vec{v}_B$
Similarly, relative velocity of B with respect to A,
$\vec{v}_{BA} = \vec{v}_B - \vec{v}_A$
4. Relative velocity when two objects are inclined,
$v_{AB} = \sqrt{v^2_A + v^2_B - 2v_Av_B\cos\theta}$
Direction of resultant,
$\tan\beta = \frac{v_B\sin\theta}{v_A - v_B\cos\theta}$
5. A projectile when fired horizontally from certain height,
Time of flight, $T = \sqrt{\frac{2H}{g}}$,
Horizontal range, $R = u\sqrt{\frac{2H}{g}}$
Velocity at any instant, $v = \sqrt{u^2 + g^2t^2}$
and direction of velocity with respect to x direction,
$\theta = \tan^{-1}\left(\frac{gt}{u}\right)$
6. Projectile fired at an angle with the horizontal,
Time of flight, $T = \frac{2u\sin\theta}{g}$
Horizontal range, $R = \frac{u^2\sin 2\theta}{g}$
Maximum height attained, $H = \frac{u^2\sin^2\theta}{2g}$
Maximum horizontal range, $R_{max} = \frac{u^2}{g}$ at $\theta = 45°$

1. Lens formula, $\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$.
2. Lens maker's formula, $\frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} + \frac{1}{R_2}\right)$
3. Linear magnification, $m = \frac{h_i}{h_o} = \frac{v}{u}$
4. Power of a lens, $P = \frac{1}{f\text{ (in metre)}}$.

1. R.I. of a prism, $\mu = \frac{\sin\left(\frac{A + \delta_m}{2}\right)}{\sin\frac{A}{2}}$
2. For a small angled prism, angle of deviation, $\delta = (\mu - 1)A$
1. $\frac{\sin i}{\sin r} = \frac{\mu_2}{\mu_1} = {}_1\mu^2$
2. Lateral displacement, $d = \frac{t\sin(i - r)}{\cos r}$
3. Apparent shift, $d = t\left(1 - \frac{1}{\mu}\right)$
4. Refractive index $= \frac{\text{Real depth}}{\text{Apparent depth}}$
5. $\mu = \frac{1}{\sin c}$, c is the critical angle

1. Relationship between focal length and radius of curvature, $f = \frac{R}{2}$.
2. Mirror formula, $\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$
3. Magnification, $m = \frac{h_i}{h_o} = \frac{v}{u}$.

1. Boyle's law, PV = constant, or, $P_1V_1 = P_2V_2$
2. Charles' law, $\frac{V}{T}$ = constant, or, $\frac{V_1}{T_1} = \frac{V_2}{T_2}$
3. Equation of state, $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$
4. Ideal gas equation, PV = nRT, where R is the universal gas constant
5. The Boltzmann's constant, $k_B = \frac{R}{N_A} = 1.38 \times 10^{-23}\ JK^{-1}$
6. Rms speed of gas molecules,
$c_{rms} = \sqrt{\frac{c_1^2 + c_2^2 + c_3^2 + \ldots\ldots + c_N^2}{N}}$
7. Pressure exerted by a gas, $P = \frac{1}{3}\frac{m}{V}\bar{c}^2$
8. The rms speed of gas molecules, $c_{rms} = \sqrt{\frac{3P}{\rho}}$
9. The mean kinetic energy per molecule of a gas,
$E_k = \frac{1}{2}m\bar{c}^2 = \frac{3}{2}k_BT$
10. Avogadro's number,
$N_A = \frac{\text{Molar mass}}{\text{Mass of 1 molecule}} = 6.023 \times 10^{23}$
11. Number of mole of substance, $n = \frac{\text{total mass of gas}}{\text{molar mass}} = \frac{m}{M}$
12. Variation of rms speeds,
$\frac{c_1}{c_2} = \sqrt{\frac{T_1}{T_2}}$, $\frac{c_1}{c_2} = \sqrt{\frac{\rho_2}{\rho_1}}$ and $\frac{c_1}{c_2} = \sqrt{\frac{M_2}{M_1}}$

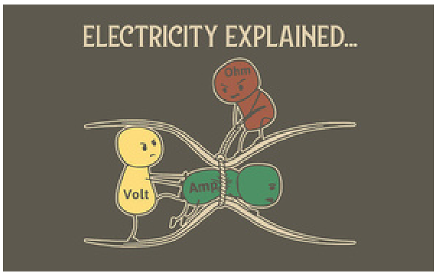
1. Quantization of charge, $q = \pm ne$
2. The electric field intensity, $E = \frac{F}{q_0}$
3. Electric force, $F = \frac{1}{4\pi\epsilon_0}\frac{q_1 q_2}{r^2}$

1. Electric field intensity, $E = \frac{1}{4\pi\epsilon_0}\frac{q}{r^2}$
2. Electric flux, $\phi = EA\cos\theta$
3. Gauss's theorem, $\phi = \frac{q}{\epsilon}$
4. Electric field intensity due to a charged hollow conducting sphere of radius R,
   i. $E = \frac{1}{4\pi\epsilon_0}\frac{q}{r^2}$ (outside the sphere)
   ii. $E = \frac{1}{4\pi\epsilon_0}\frac{q}{R^2}$ (on the sphere)
   iii. $E = 0$ (inside sphere)
5. Electric field intensity due to a plane sheet of charges, $E = \frac{\sigma}{2\epsilon_0}$
6. Electric field intensity due to a line charge, $E = \frac{1}{2\pi\epsilon_0}\frac{\lambda}{r}$

1. Electric current (I) $= \frac{dq}{dt} = \frac{Ne}{t}$, where N is total number of charge particles.
2. Drift Velocity, $I = v_d enA$, Where, v_d is drift velocity of electron.
3. Current density (J): $J = \frac{I}{A} = nev_d$
4. Combination of resistors:
   i. Series combination: $R = R_1 + R_2 + R_3 + \ldots$
   ii. Parallel combination, $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ldots$
   iii. The equivalent resistance of n equal resistors of equal resistance (r) when connected in series is $R = nr$.
   iv. The equivalent resistance of n equal resistors of equal resistance (r) when connected in parallel, $R = \frac{r}{n}$.
   v. The ratio of n identical resistors of equal resistance when connected in series to parallel is, $\frac{R_{series}}{R_{parallel}} = n^2$
5. Variation of resistance with temperature:
   i. The resistance at θ°C, $R_\theta = R_0(1 + \alpha\theta)$, where R_0 = resistance of conductor at 0°C and α = temperature coefficient of resistance $= \frac{R_\theta - R_0}{R_0\theta}$
6. Conversion of galvanometer into ammeter
   i. Internal resistance of ammeter is very small, $R_a = \frac{GS}{G+S}$
   ii. Value of shunt is, $S = \frac{I_g G}{I - I_g}$
7. Conversion of galvanometer into voltmeter:
   i. Internal resistance is very large; $R_V = R + G$
   ii. Value of multiplier, $R = \frac{V}{I_g} - G$
8. Electric power: $P = \frac{qV}{t} = IV = I^2R = \frac{V^2}{R}$
9. Electric energy: $(E) = I^2Rt = VIt = Pt = \frac{V^2t}{R}$
10. Emf, terminal potential and internal resistance:
   i. Relation, $E = V + Ir$
   ii. Efficiency of a source of emf, $\eta = \frac{P_0}{P_i} = \frac{V}{E} = \frac{R}{R+r}$
11. Terminal potential difference,
   i. While charging, $V > E$, $E = V - Ir$
   ii. While discharging, $V < E$, $E = V + Ir$

1. Capacitance, $C = \frac{q}{V}$
2. Capacitance of sphere, $C = 4\pi\epsilon_0 kR = 4\pi\epsilon R$
3. Capacitance of a parallel plate capacitor, $C = \frac{\epsilon_0 A}{d}$
4. Equivalent capacitance of series combination, $\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$
5. Equivalent capacitance of parallel combination, $C = C_1 + C_2 + C_3$
6. Energy stored in a charged capacitor, $U = \frac{1}{2}\frac{q^2}{C} = \frac{1}{2}CV^2$
7. Common potential, $V = \frac{C_1V_1 + C_2V_2}{C_1 + C_2}$
8. Dielectric constant, $K = \frac{\epsilon}{\epsilon_0}$

1. The radius (R) of nucleus, $R = R_0A^{\frac{1}{3}}$, where $R_0 = 1.2 \times 10^{-15}$ m
2. Volume (V) of nucleus, $V = \frac{4}{3}\pi R_0^3 A$
3. Einstein's mass energy relation, $m = \frac{m_0}{\sqrt{1 - \frac{v^2}{c^2}}}$
4. Mass defeat (Δm), $(Zm_p + (A - Z)m_n) - M$.
5. Packing fraction $= \frac{\Delta m}{A}$
6. Binding energy (BE) $= \Delta m \times 931$ MeV, [∴ 1 amu = 931 MeV]
7. Binding energy per nucleon $= \frac{B.E.}{A}$
8. Equation for nuclear reaction is, ${}_ZX^A + a = {}_ZY^{A'} + b + Q$, where Q is energy released or observed.
9. Example of nuclear fission, ${}_{92}U^{235} + {}_0n^1 \rightarrow {}_{92}U^{236} \rightarrow {}_{56}B^{141} + {}_{36}Kr^{92} + 3\,{}_0n^1 + Q$, Q = 200 MeV
10. Example of nuclear fusion, ${}_1H^2 + {}_1H^2 \rightarrow {}_2He^4 + Q$, Q= 24 MeV



Ritik Yadav

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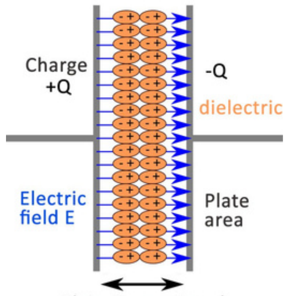
Values of Physical Constants

Charge of electron	$= 1.6 \times 10^{-19}$ C
Mass of electron	$= 9.1 \times 10^{-31}$ kg
Permittivity of free space (ϵ_0)	$= 8.854 \times 10^{-12}$ C²/Nm²

1. Cauchy's formula, $\mu = A + \frac{B}{\lambda^2} + \frac{C}{\lambda^4}$
2. Angular dispersion, $\delta_v - \delta_r = (\mu_v - \mu_r)A$
3. Dispersive power, $\omega = \frac{\delta_v - \delta_r}{\delta} = \frac{\mu_v - \mu_r}{\mu - 1}$, where $\mu = \frac{\mu_v + \mu_r}{2}$
4. For achromatism, $\frac{\omega_1}{f_1} + \frac{\omega_2}{f_2} = 0$, $\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2}$
5. Rayleigh's scattering law, $I \propto \frac{1}{\lambda^4}$

1. Relationship between C, F and K, $\frac{C}{100} = \frac{F - 32}{180} = \frac{K - 273}{100}$
2. The coefficient of linear, superficial and cubical expansions, $\alpha = \frac{\Delta l}{l_1\Delta\theta}$, $\beta = \frac{\Delta A}{A_1\Delta\theta}$ and $\gamma = \frac{\Delta V}{V_1\Delta\theta}$
3. Relation between α, β and γ be, $\alpha = \frac{\beta}{2} = \frac{\gamma}{3}$
4. Tension on a wall due to the expansion of rod, $F = YA\alpha(\theta_2 - \theta_1)$
5. The relation of real expansivity, apparent expansivity and expansivity of vessel, $\gamma_r = \gamma_a + \gamma_v$, since $\gamma = 3\alpha$
6. Variation of density with temperature, $\rho_\theta = \frac{\rho_0}{1 + \gamma\Delta\theta} = \rho_0(1 - \gamma\Delta\theta)$



Values of Physical Constants

Coefficient linear expansion of aluminium	$= 2.4 \times 10^{-5}$ K⁻¹
Coefficient linear expansion of brass	$= 2.0 \times 10^{-5}$ K⁻¹
Cubical expansivity of benzene	$= 1.2 \times 10^{-3}$ K⁻¹
Cubical expansivity of wood	$= 1.5 \times 10^{-4}$ K⁻¹
Density of mercury (ρ)	= 13600 kg/m³
Linear expansivity of brass (α)	$= 2 \times 10^{-5}$ K⁻¹
Linear expansivity of glass	$= 1.8 \times 10^{-6}$ K⁻¹
Linear expansivity of steel	$= 1.2 \times 10^{-5}$ K⁻¹
Cubical expansivity of mercury	$= 1.8 \times 10^{-4}$ K⁻¹
Young's modulus of steel	$= 2 \times 10^{11}$ N/m²
Specific heat capacity of ice	= 2100 Jkg⁻¹ k⁻¹
Specific heat capacity of water	= 4200 Jkg⁻¹ k⁻¹
Specific latent heat of melting of ice	$= 3.36 \times 10^5$ Jkg⁻¹
Specific latent heat of vaporization	$= 2.268 \times 10^6$ Jkg⁻¹