Key Formula

1. Efficiency of Heat engine, $\eta = \frac{W}{Q_1}$

$= 1 - \frac{Q_2}{Q_1}$

2. Efficiency of Carnot engine $\eta = 1 - \frac{T_2}{T_1}$
3. Coefficient of performance in refrigerator,

$\beta = \frac{Q_2}{W} = \frac{Q_2}{Q_1 - Q_2} = \frac{T_2}{T_1 - T_2}$

4. Efficiency of petrol/diesel engine, $\eta = 1 - \left(\frac{1}{\rho}\right)^{\gamma-1}$
5. Change in entropy, $dS = \frac{dQ}{T}$

Key Formula

1. Energy of photon, E = h f, where h is Planck's constant and f is frequency of radiation.
2. Relation between stopping potential V_0 and maximum K.E. of photoelectron,

$$e V_0 = \frac{1}{2} m v_{max}^2$$

3. Einstein's photoelectric equation,

$$h f = \phi + \frac{1}{2} m v^2$$

4. Work function of metal, $\phi = h f_0$.

Key Formula

1. Kirchhoff's current law, $\Sigma I = 0$
2. Kirchhoff's voltage law, $\Sigma E = \Sigma IR$
3. Wheatstone bridge principle, $\frac{P}{Q} = \frac{X}{R}$
4. Unknown resistance by meter bridge,

$$X = \frac{(100 - l)R}{l}$$

5. Internal resistance by potentiometer,

$$r = \frac{R(l_1 - l_2)}{l_2}$$

6. Comparison of emf of two cells, $\frac{E_1}{E_2} = \frac{l_1}{l_2}$
7. Shunt resistance $S = \frac{I_g}{I - I_g} \times G$
8. Resistance R required to convert a galvanometer into voltmeter,

$$R = \frac{V}{I_g} - G$$

9. Joule's law of heating, $H = \frac{I^2 Rt}{J}$

Key Formula

1. Relation between thermo emf and temperature of hot junction,

$$E = \alpha \theta + \frac{1}{2} \beta \theta^2$$

2. Relation between neutral temperature, temperature of cold junction and temperature of inversion,

$$\theta_n = \frac{\theta_i + \theta_c}{2}$$

3. $\theta_n = -\frac{\alpha}{\beta}$
4. $\theta_i = -\frac{2\alpha}{\beta}$
5. Thermoelectric power, $P = \frac{dE}{d\theta} = \alpha + \beta \theta$
6. Peltier coefficient, $\pi = T \frac{dE}{dT}$

Key Formula

1. $I \propto \cos^2 \theta$, called Malus law where θ is the angle between the axis of polarizer and analyzer.
2. $\tan\theta p = \mu$, θ_p is polarizing angle and μ refractive index.
3. $\theta p + r = 90°$

Key Formula

1. $\frac{dN}{dt} = -\lambda N$
2. $N = N_0 e^{-\lambda t}$
3. $T_{1/2} = \frac{0.693}{\lambda}$
4. $T_{mean} = \frac{1}{\lambda} = \frac{T_{1/2}}{0.693}$
5. Activity, $R = R_0 e^{-\lambda t}$

$$\frac{N}{N_0} = \left(\frac{1}{2}\right)^n$$

Key Formula

1. Condition for secondary minima,

$a \sin\theta = n\lambda,\ n = \pm 1, \pm 2, \pm 3, \ldots$

2. Condition for secondary maxima,

$a \sin\theta = (2n + 1)\frac{\lambda}{2},\ n = \pm 1, \pm 2, \pm 3, \ldots$

3. Width of secondary maxima or minima,

$$\beta = \frac{\lambda D}{a}$$

4. Width of central maxima,

$$\beta_0 = \frac{2\lambda D}{a}$$

5. For n^{th} principal maxima in diffraction grating,

$(a + b) \sin \theta = n\lambda$

$$(a + b) = \frac{1}{N}$$

(a + b) is called grating element, N is the number of lines per unit length.

6. Resolving power of microscope,

$$\frac{1}{d} = \frac{2\mu \sin\theta}{\lambda}$$

7. Resolving power of telescope,

$$\frac{1}{d\theta} = \frac{1}{1.22} \frac{D}{\lambda}$$

D is the diameter of objective lens.

Key Formula

1. Intensity of magnetisation, $I = \frac{M}{V} = \frac{m}{A}$
2. Magnetic field intensity, $B = B_0 + \mu_0 I$
3. Magnetic permeability, $\mu = \frac{B}{H}$
4. Relative permeability, $\mu_r = \frac{\mu}{\mu_0}$
5. Magnetic susceptibility, $\chi = \frac{I}{H}$
6. $\mu = \mu_0(1 + \chi)$
7. Curie law, $\chi = \frac{C}{T}$
8. Coulomb's law in magnetism, $F = \frac{\mu_0}{4\pi} \frac{m_1 m_2}{r^2}$
9. Magnetic field intensity, $B = \frac{\mu_0}{4\pi} \frac{m}{r^2}$
10. Torque experienced by a magnet in a magnetic field, $\vec{\tau} = \vec{M} \times \vec{B}$
11. Potential energy of a magnetic dipole in a uniform magnetic field, $U = -\vec{M} \cdot \vec{B}$
12. Tangent law, $H = B \tan \theta$

Key Formula

1. $W = \int_{V_1}^{V_2} P\, dV$
2. $dQ = dU + dW = dU + P\, dV$
3. $C_P - C_V = R$
4. $c_p - c_v = r$
5. $W = n R T\, ln \frac{V_2}{V_1}$

$W = n R T\, ln \left(\frac{P_1}{P_2}\right)$

6. PV^γ = constant
7. $TV^{\gamma-1}$ = constant
8. $P^{1-\gamma} T^\gamma$ = constant
9. $W = \frac{1}{\gamma - 1}(P_1 V_1 - P_2 V_2)$
10. $dU = nC_v\, dT$
11. $dQ = C_v\, dT + P\, dV$

Key Formula

1. Quantization of charge, $Q = \pm ne$
2. Millikan's oil drop experiment

(i) Radius of oil drop, $r = \sqrt{\frac{9\eta v_1}{2(\rho - \sigma)g}}$

(ii) Charge on the oil drop,

$$Q = 6\pi \eta \frac{(v_1 + v_2)}{E} \times \sqrt{\frac{9\eta v_1}{2(\rho - \sigma)g}}$$

3. Motion of charge particle in electric field.

(i) Acceleration of electron, $a = \frac{e E}{m_e}$

(ii) Relation between horizontal distance, x and vertical distance, y

$$y = \left(\frac{1}{2} \frac{eV}{m_e dv^2}\right) x^2$$

(iii) Vertical velocity gained in the direction of field, $v_y = \frac{eV}{m_e d} \times \frac{D}{v}$

(iv) The angle θ at which the electron beam emerge from the field, $\tan\theta = \frac{v_y}{v_x} = \frac{eVD}{dm_e v^2}$

Radius of the circular path of electron in magnetic field, $r = \frac{mv}{B e}$

5. Thomson's formula, $\frac{e}{m} = \frac{V^2}{2 V d^2 B^2}$

Key Formula

1. In intrinsic semiconductor, $n_e = n_h = n_i$
2. In extrinsic semiconductor, $n_e \times n_h = n_i^2$
3. Electric current in a semiconductor,

$I = I_e + I_h = e A (n_e v_e + x_h v_h)$

4. In transistor,

(i) $I_e = I_b + I_c$

Class 12 Physics formula By Ritik Yadav

Key Formula

1. Mean value of a.c., $I_m = \frac{2I_0}{\pi} = 0.637\, I_0$
2. Rms value of a.c., $I_r = \frac{I_0}{\sqrt{2}} = 0.707\, I_0$
3. Inductive reactance, $X_L = \omega_L = 2\pi f L$
4. Capacitive reactance, $X_c = \frac{1}{\omega c} = \frac{1}{2\pi f c}$
5. Impedance in LR circuit, $Z = \sqrt{R^2 + X_L^2}$
6. In LR circuit, $\tan \theta = \frac{L\omega}{R}$
7. Impedance in CR circuit, $Z = \sqrt{R^2 + X_c^2}$
8. In CR circuit, $\tan \theta = \frac{X_c}{R}$
9. Impedance in LCR circuit, $Z = \sqrt{R^2 + (X_L - X_c)^2}$
10. In LCR circuit, $\tan \theta = \frac{\left(L\omega - \frac{1}{C\omega}\right)}{R}$
11. Resonance frequency, $f_r = \frac{1}{2\pi \sqrt{LC}}$
12. Quality factor, $Q = \frac{1}{R}\sqrt{\frac{L}{C}}$
13. Average power over a complete cycle,

$P = E_V I_V \cos \theta$

Key Formula

1. Magnetic flux through an area A, $\phi = BA \cos \theta$
2. Induced e.m.f., $\varepsilon = -N \frac{d\phi}{dt}$
3. Motional e.m.f., $\varepsilon = B\, l\, v$
4. Induced e.m.f. in a coil rotating in a uniform magnetic field,

$\varepsilon = \varepsilon_0 \sin \omega t$, where $\varepsilon_0 = N A B\omega$

5. In self induction, $\phi = LI$, $\varepsilon = -L \frac{dI}{dt}$
6. Self inductance of a solenoid, $L = \mu_0 \frac{N^2}{l} A$
7. In mutual induction, $\phi_s = M I_p$

$$\varepsilon_s = -M \frac{dI_p}{dt}$$

8. Mutual inductance of two long co–axial solenoid,

$$M_{12} = M_{21} = \mu_0 \frac{N_1 N_2 A}{l}$$

9. Energy stored in an inductor, $U = \frac{1}{2} LI^2$
10. Transformer ratio, $\frac{\varepsilon_S}{\varepsilon_P} = \frac{N_s}{N_p} = \frac{I_P}{I_S}$
11. Efficiency of transformer, $\eta = \frac{\varepsilon s\, Is}{\varepsilon p\, Ip}$

Key Formula

1. Lorentz magnetic force, $\vec{F} = q(\vec{v} \times \vec{B})$
2. Force on a current carrying conductor placed in a magnetic field, $\vec{F} = I(\vec{l} \times \vec{B})$
3. Torque on a rectangular coil in a uniform magnetic field, τ = BINA $\sin\theta$
4. Moving coil galvanometer

i. $I = G\phi$, ϕ is deflection and G is galvanometer constant

ii. $G = \frac{K}{B N A}$

iii. Current sensitivity $= \frac{\phi}{I} = \frac{B N A}{K}$

iv. Voltage sensitivity $= \frac{\phi}{V} = \frac{B N A}{K R}$

5. Hall constant, $R_H = \frac{E_H}{J_x B_z} = -\frac{1}{n e}$
6. Biot and Savart Law, $dB = \frac{\mu_0}{4\pi} \frac{I\, dl \sin \theta}{r^2}$
7. Biot and Savart Law in vector form,

$$d\vec{B} = \frac{\mu_0}{4\pi} \frac{I(d\vec{l} \times \vec{r})}{r^3}$$

8. Magnetic field at the centre of a circular coil,

$$B = \frac{\mu_0 n I}{2r}$$

9. Magnetic field on the axis of a circular coil,

$$B = \frac{\mu_0 n I a^2}{2(a^2 + x^2)^{3/2}}$$

10. Magnetic field due to a straight conductor,

$$B = \frac{\mu_0 I}{4\pi a}(\sin \theta_1 + \sin \theta_2)$$

11. For infinitely long conductor, $B = \frac{\mu_0 I}{2\pi a}$
12. Magnetic field due to a long solenoid,

$B = \mu_0 n I \quad \left[n = \frac{N}{l}\right]$

13. Force between two parallel current carrying conductor, $F = \frac{\mu_0 I_1 I_2}{2\pi r}$, per unit length
14. Ampere's circuital law, $\oint \vec{B} \cdot d\vec{l} = \mu_0 I$
15. Magnetic field at the midpoint of the Helmholtz coil, $B = 0.72 \frac{\mu_0 N I}{a}$
16. Magnetic field $\vec{B}$ of a moving point charge.

$$\vec{B} = \frac{\mu_0}{4\pi} \frac{q\vec{v} \times \hat{r}}{r^2}$$

Key Formula

1. Up-thrust $U = W_{air} - W_{liquid}$
 or $U = \rho g V$ = weight of displaced liquid
2. For floating body, $\frac{V_1}{V} = \frac{\rho}{\rho_1}$
3. Newton's law of viscosity $F = -\eta A \frac{dv}{dx}$
4. Poiseuille's formula $V = \frac{\pi P r^4}{8\eta l}$,
5. Stoke's law $F = 6\pi\eta r v$
6. Terminal velocity, $v = \frac{2r^2(\rho - \sigma) g}{9\eta}$
7. Bernoull's theorem, $E = \frac{P}{\rho} + gh + \frac{v^2}{2}$ = constant
 or $\frac{P}{\rho g} + h + \frac{v^2}{2g}$ = constant
8. Surface tension, $T = \frac{F}{l}$
9. Surface energy,
 $\sigma = \frac{\text{Work done in increasing surface area}}{\text{Increase in surface area}}$
10. Excess pressure inside a liquid drop, $\frac{2T}{R}$
11. Excess pressure inside a soap bubble = $\frac{4T}{R}$
12. Ascent formula, $h = \frac{2T\cos\theta}{r\rho g}$

Key Formula

- $f = \frac{1}{T}$
- $y = r\sin\omega t$ or $y = r\sin(\omega t \pm \phi)$
 $u = r\omega\cos\omega t = \omega\sqrt{r^2 - y^2}$
 $a = -\omega^2 r\sin\omega t = -\omega^2 y$
- $T = 2\pi\sqrt{\frac{l}{g}}$, time period of a simple pendulum
- Time period of a oscillating mass attached to a spring, $T = 2\pi\sqrt{\frac{m}{k}}$
- In angular S.H.M., $T = \frac{2\pi}{\omega} = 2\pi\sqrt{\frac{I}{k}}$
- K.E. in S.H.M $\frac{1}{2}m\omega^2(r^2 - y^2)$
- P.E. in S.H.M. $\frac{1}{2}m\omega^2 y^2$
 Total energy in S.H.M.
 $E = \frac{1}{2}m\omega^2 r^2 = 2m\pi^2 f^2 r^2$

Key Formula

1. Bohr atomic model,
 (i) $m v r = \frac{nh}{2\pi}$
 (ii) $h f = E_{n_2} - E_{n_1}$
2. Radius of n^{th} orbit,
 $r_n = \frac{\epsilon_0 n^2 h^2}{\pi m e^2}$
3. Velocity of electron, $v_n = \frac{e^2}{2\epsilon_0 n h}$
4. Energy of electron in the n^{th} orbit,
 $E_n = \frac{me^4}{8\epsilon_0^2 n^2 h^2}$
5. Wave number of a radiation,
 $\bar{f} = \frac{1}{\lambda} = R\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$
6. $E_n = -\frac{13.6}{n^2}$ eV
7. De–Broglie wavelength, $\lambda = \frac{h}{mv}$
8. De–Broglie wave length of an electron,
 $\lambda = \frac{h}{\sqrt{2mE}}$, where E is K.E.
9. If the electron is accelerated through potential difference V, $\lambda = \frac{\lambda}{\sqrt{2meV}}$
10. Heisenberg uncertainty principle,
 $\Delta x\,\Delta P \geq \frac{h}{2\pi}$.
11. If f_{max} is the maximum frequency of the emitted X–ray and V is the potential difference, $f_{max} = \frac{eV}{h}$ and minimum wave length $\lambda_{min} = \frac{hc}{eV}$
12. Bragg's equation, $2d\sin\theta = n\lambda$,
 n = 1, 2, 3 ... and d is the distance between the atomic planes.

Key Formula

1. Pressure amplitude, $\Delta P_m = B\,a\,k = v^2\rho\,ka$
2. Intensity of sound, $I = \frac{1}{2}\rho v\omega^2 a^2$
 $I = \frac{\Delta P_m^2}{2\sqrt{\rho B}}$
3. Intensity level, $\beta = (10\text{ dB})\log_{10}\frac{I}{I_0}$
4. Doppler effect:
 (i) Source in motion $f' = \frac{v}{v \pm u_s} f$
 (ii) Observer in motion $f' = \left(\frac{v \pm u_0}{v}\right) f$
5. Source and observer in motion, $f' = \frac{v \pm u_0}{v \pm u_s} f$
6. Effect of motion of the medium
 $f' = \frac{(v \pm v_m) - u_0}{(v \pm v_m) - u_s} f$
7. Beat frequency, f = change in frequency due to superposition of two waves = $f_1 - f_2$

Key Formula

1. Lowest frequency produced in the pipe.
 $f = \frac{v}{4L}$ (for closed organ pipe)
 $f = \frac{v}{2L}$ (for open organ pipe)
2. End correction of the pipe of internal radius r,
 c = 0.6 r
3. The velocity of sound at 0 °C,
 $v_0 = v\sqrt{\frac{T_0}{T}} = v\sqrt{\frac{273}{273 + \theta}}$
4. The velocity of sound at STP, $v_0 = v - 0.61\,\theta$
5. Velocity on stretched string, $v = \sqrt{\frac{T}{\mu}}$
6. Frequency, $f = \frac{1}{2L}\sqrt{\frac{T}{\mu}}$
7. Frequency, $f = \frac{1}{Ld}\sqrt{\frac{T}{\pi\rho}}$

Key Formula

1. Velocity of longitudinal wave in gas, $v = \sqrt{\frac{B}{\rho}}$
2. Velocity of longitudinal wave in solid, $v = \sqrt{\frac{Y}{\rho}}$
3. Velocity of transverse wave in stretched string, $v = \sqrt{\frac{T}{\mu}}$
4. Velocity of electromagnetic wave, $v = \sqrt{\frac{1}{\mu\varepsilon}}$
5. Newton's formula for velocity of sound in air, $v = \sqrt{\frac{P}{\rho}} \cong 280\text{ ms}^{-1}$
6. Laplace formula for velocity of sound in air, $v = \sqrt{\frac{\gamma P}{\rho}} \cong 331.2\text{ ms}^{-1}$

Class 12
Physics formula
By Ritik Yadav

Key Formula

1. Relation between path difference and phase difference, $\phi = \frac{2\pi}{\lambda} \times x$
2. Optical path, $L = \mu \cdot d$
3. $\frac{I_1}{I_2} = \frac{a_1^2}{a_2^2}$, where I_1, I_2 intensities and a_1, a_2 are amplitude of the waves.
4. $R = \sqrt{(a_1^2 + a_2^2 + 2a_1 a_2\cos\phi)}$
 R is the amplitude of the resultant wave.
5. Breadth of the fringe, $\beta_a = \frac{\lambda_a D}{d}$ (in air)
 $\beta_m = \frac{\lambda_m D}{d} = \frac{\lambda_a D}{\mu d} = \frac{\beta_a}{\mu}$ (in the medium)
6. Condition for maxima
 $\phi = 2n\pi$ (n = 0, 1, 2, ...)
 $x = n\lambda$
7. Condition for minima
 $\phi = (2n + 1)\pi$, n = 0, 1, 2, . . .
 or $\phi = (2n - 1)\pi$, n = 1, 2, . . .
 $x = (2n \pm 1)\frac{\lambda}{2}$

Key Formula

1. Energy of photon,
 E = hf
2. Snell's law
 $\frac{\sin i}{\sin r} = \frac{c}{v} = \mu$

Key Formula

1. Relation between frequency and time period,
 $f = \frac{1}{T}$
2. Wave velocity v, frequency f and wave length λ are related as, $v = \lambda f$
3. Equation of a progressive wave in the positive direction of x–axis, $y = a\sin\frac{2\pi}{\lambda}(vt - x)$
 and in negative direction, $y = a\sin\frac{2\pi}{\lambda}(vt + x)$
4. Differential equation of wave motion,
 $\frac{d^2y}{dt^2} = v^2\frac{d^2y}{dx^2}$
5. Equation of stationary wave,
 $y = 2a\cos\frac{2\pi}{\lambda}x\sin\omega t$
6. Condition for nodes, $x = \left(n + \frac{1}{2}\right)\frac{\lambda}{2}$
7. Condition for antinodes, $x = \frac{n\lambda}{2}$

Key Formula

1. $I = \sum_{i=1}^{n} m_i r_i^2$
2. $I = I_{cm} + Mr^2$
3. $I_z = I_x + I_y$
4. M.I. of a uniform rod
 (i) $I = \frac{Ml^2}{12}$, about an axis passing through its centre and perpendicular to the length.
 (ii) $I = \frac{Ml^2}{3}$, about an axis at the end of the rod and perpendicular to the length.
 (iii) M.I. of a circular ring, $I = MR^2$
 (iv) M.I. of a thin circular disc, $I = \frac{MR^2}{2}$
5. Radius of gyration,
 $K = \sqrt{\frac{r_1^2 + r_2^2 + \ldots + r_n^2}{n}}$
6. Angular momentum, $L = mr^2\omega = I\omega$
7. $\tau = \frac{dL}{dt}$
8. $I\omega$ = constant
9. $P = \tau\omega$
10. K.E. of rotating body, $\frac{1}{2}I\omega^2$
11. K.E. of rolling body, $E = \frac{1}{2}I\omega^2 + \frac{1}{2}mv^2$
12. Acceleration of a rolling body on an inclined pla
 $a = \frac{mg\sin\theta}{m + (I/r^2)}$