FORMULAE :

(1) Average speed = $\frac{\text{total distance}}{\text{total time}} = \Delta d \ / \ \Delta t.$

(2) Average speed = $\frac{S_1 + S_2 + ...}{\frac{S_1}{v_1} + \frac{S_2}{v_2} + ...}$ where s_1 and s_2 are distance travelled with velocity v_1 and v_2.

(3) Average velocity : Average velocity=Displacement/Time interval

$\overline{V} = \Delta X / \Delta t.$

(4) Velocity = $\frac{\text{Displacement}}{\text{time}}.$

(5) Equation of motion

(i) $v = v_0 + at$

(ii) $x = v_0 t + \frac{1}{2} at^2$

(iii) $V^2 = v_0^2 + 2ax$

(6) Relative velocity

$$\mathbf{v_{AB}} = \sqrt{V_A^2 + v_B^2 + 2v_A v_B \cos\theta}$$

(7) Reaction time $\mathbf{t_r} = \sqrt{\frac{2d}{g}}s$

(8) Time of flight: $T_f = 2\ (v_o \sin\ \theta_o\ )/g$

(9) Centripetal acceleration: $\vec{a}_C = v^2/R$

(10) Multiplication of vectors by real numbers:

$$\left|\lambda \vec{A}\right| = \lambda \left|\vec{A}\right| \text{if} \lambda > 0$$

(11) Vector addition: $\vec{A} + \vec{B} = \vec{B} + \vec{A}$

(12) Subtraction of vectors: $\vec{A} - \vec{B} = \vec{A} + (-\vec{B})$

(13) Null vector: $\vec{A} - \vec{A} = 0$

$$|0| = 0$$

(14) Law of cosines: $R = \sqrt{A^2 + B^2 + 2ABCOS\theta}$

(15) Unit vector $\left|\hat{i}\right| = \left|\hat{j}\right| = \left|\hat{k}\right| = 1$

$$\vec{A} = \left|\vec{A}\right| n$$

$\mathbf{A_1} = A_x\, i$, $\mathbf{A_2} = A_y j$, $\vec{A} = Ax\, i + Ay\, j$

$\vec{A}_x = A \cos\theta$

$\vec{A}_y = A \sin\theta$

$\vec{A} = \sqrt{A_X^2} + \sqrt{A_Y^2}$

$\tan\theta = A_Y / A_X \qquad \theta = \tan^{-1}(A_Y / A_X)$

(16)Law of sines: $R / \mathrm{Sin}\theta = R / \mathrm{COS}\alpha$

(17) Velocity: $\vec{V} = \Delta \vec{r} / \Delta \vec{t}$

(18) Acceleration: $\vec{a} = \Delta \vec{v} / \Delta \vec{t}$

(19) Relative velocity: $v_{AB} = v_A - v_B$

(20) Motion in a plane with constant acceleration :

Position of particle $\vec{r} = \vec{r}_0 + \vec{v}_0 t + 1/2(\vec{a} t^2)$

(21) Equation of path of a projectile:

$$y = (\tan\theta_0)x - [g / 2(v_0 \cos\theta_0)^2]$$

(22) Maximum height of a projectile:

$$h_m = (v_0 \sin\theta_0)^2 / 2g$$

(23) Horizontal range of a projectile: $R = v_0^2 \sin 2\theta_0 / g$

(24) Angular displacement : $\omega = \Delta\theta / \Delta t$

$$\vec{v} = R\ \vec{\omega}$$

(25) Centripetal acceleration: $a_c = \omega^2 R$

In terms of frequency $a_c = 4\pi^2 v^2 R$

(26) Momentum: $\vec{p} = m\vec{v}$

(27) Force : $F = k\Delta p / \Delta t$

$F = k\, m\, a$

(28) Impulse = Force × time duration

= Change in momentum=$F.\Delta t$

(29) Newton's third law of motion: $\vec{F}_{AB} = -\vec{F}_{BA}$

(30) Static friction: $(f_s)_{max} = \mu_s N$

static friction $f_k = \mu_k N$

where μ_k is coefficient of kinetic friction

(31) Circular motion : $f = mv^2 / R$

(32) Maximum speed of circular motion:

$V_{max} = \sqrt{\mu_s Rg}$

(33) Centripetal acceleration due to earth's gravity:

$$a_m = v^2 / R_m = 4\Pi^2 R_m / T^2$$

(34) Gravitational force : $F = -GM_1M_2 / r^2$

(35) Gravitational constant :

$$F = GMm / d^2 = \tau \times \theta$$

G = 6.67×10-11 N m²/kg²

(36) Acceleration due to gravity of the earth:

$$g = F / m = GM_E / R_E^2$$

Above earth surface $g(h) = F(h) / m = GM_E / (R_E + h)^2$

Below earth surface $g(d) = g(1 - d / R_E)$

(37) Gravitational potential energy : $v = -Gm_1m_2 / r$

(38) Escape speed : $v = \sqrt{2gR_E}$

(39) Time period : $T_0 = 2\Pi\sqrt{R_E / g}$

(40) Kepler's third law : $T^2 = 4\Pi^2 R^3 / GM_E$

(41) Energy of an orbiting satellite : $E = -GM_E m / (2R_E + h)$