Formulas

$$S = \frac{Distance\ Travelled}{Time\ Elapsed} \qquad <\underset{\rightarrow}{V}> = \frac{\underset{\rightarrow}{x}(t_2) - \underset{\rightarrow}{x}(t_1)}{t_2 - t_1}$$

$$\theta = \frac{S}{R} \qquad Sin\theta = \frac{O}{h} \qquad Cos\theta = \frac{a}{h} \qquad \tan\theta = \frac{O}{a}$$

$$ax^2 + bx + c = 0 \qquad x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$\text{Circumference} = 2\pi R \qquad \text{Area} = \pi R^2$$

$$\underset{\rightarrow}{V'} = S\underset{\rightarrow}{V} \qquad \underset{\rightarrow}{V'} \,||\, \underset{\rightarrow}{V} \qquad \underset{\rightarrow}{R} = (\underset{\rightarrow}{A} + \underset{\rightarrow}{B})$$

$$R = \sqrt{A^2 + B^2 + 2\ Cos\ (\underset{\rightarrow}{A}, \underset{\rightarrow}{B})} \qquad \tan\theta_R = \frac{B\ Sin(\underset{\rightarrow}{A}, \underset{\rightarrow}{B})}{A + B\ Cos\ (\underset{\rightarrow}{A}, \underset{\rightarrow}{B})}$$

$$V_d = V\ Cos\left(\underset{\rightarrow}{V}, \hat{d}\right) \qquad \underset{\rightarrow}{V} = V_x\hat{x} + V_y\hat{y}$$

$$V_x = V\,Cos\theta, \quad V_y = V\,Sin\theta, \quad V = \sqrt{V_x^{\,2} + V_y^{\,2}}$$

$$\tan\theta = \frac{V_y}{V_x} \qquad <\underset{\rightarrow}{a}> = \frac{\underset{\rightarrow}{V}(t_2) - \underset{\rightarrow}{V}(t_1)}{t_2 - t_1}$$

$$\underset{\rightarrow}{V} = V\hat{x} \qquad \underset{\rightarrow}{x} = (x_i + Vt)\hat{x}$$

$$\underset{\rightarrow}{a} = a\hat{x} \qquad \underset{\rightarrow}{V} = (V_i + at)\hat{x} \qquad \underset{\rightarrow}{x} = (x_i + V_i t + \frac{1}{2}at^2)\hat{x} \qquad V^2 = V_i^2 + 2a(x - x_i)$$

$$\underset{\rightarrow}{a} = -9.8\,m/s^2\,\hat{y} \qquad \underset{\rightarrow}{V} = (V_i - 9.8t)\hat{y}$$

$$\underset{\rightarrow}{y} = (y_i + V_i t - 4.9t^2)\hat{y}$$

$$V^2 = V_i^2 - 19.6(y - y_i)$$

$$\underset{\rightarrow}{V_i} = (V_i\,Cos\theta_i)\hat{x} + (V_i\,Sin\theta_i)\hat{y} \qquad \underset{\rightarrow}{a} = 0\hat{x} - 9.8\,m/s^2\,\hat{y}$$

$$\underset{\rightarrow}{V_x} = (V_i\,Cos\theta_i)\hat{x} \qquad \underset{\rightarrow}{V_y} = (V_i\,Sin\theta_i - 9.8t)\hat{y}$$

$$\underset{\rightarrow}{x} = (V_i\,Cos\theta_i)t\,\hat{x} \qquad \underset{\rightarrow}{y} = \left[(V_i\,Sin\theta_i)t - 4.9t^2\right]\hat{y} \qquad V^2 = (V_i\,Sin\theta_i)^2 - 19.6y$$

$$y = y_i + x\tan\theta_i - 4.9\left(\frac{x}{V_i\,Cos\theta_i}\right)^2$$

$$y_{top} = \frac{(V_i\,Sin\theta_i)^2}{19.6} \qquad t_{top} = \frac{V_i\,Sin\theta_i}{9.8}$$

$$R = \frac{V_i^2 \, Sin 2\theta_i}{9.8}$$

$$x' = x - V_R t \qquad y' = y \qquad z' = z \qquad t' = t$$

$$\underrightarrow{V'} = \underrightarrow{V} - \underrightarrow{V_R}$$

$$\sum \underrightarrow{F_i} = 0 \qquad M\underrightarrow{a} = \sum \underrightarrow{F_i}$$

$$\underrightarrow{W} = -Mg\hat{r} = -Mg\hat{y}$$

$$\underrightarrow{F_{SP}} = -k\Delta x\hat{x} \qquad \underrightarrow{F_{SP}} = -k\Delta y\hat{y}$$

$$f_k = \mu_k n \qquad f_S \le \mu_S n$$

$$\underrightarrow{r} = R\hat{r} \qquad \underrightarrow{V} = R\omega\hat{\tau} \qquad \underrightarrow{a_c} = -R\omega^2\hat{r}$$

$$\underrightarrow{\omega} = \pm\frac{2\pi}{T}\hat{z} \qquad T = \frac{1}{n_S} \qquad T = \frac{60}{n_m}$$

$$\underrightarrow{F_C} = -MR\omega^2\hat{r} = -\frac{MV^2}{R}\hat{r}$$

$$\underrightarrow{F_G} = -\frac{GM_1M_2}{r^2}\hat{r} \qquad \underrightarrow{F_G} = 0 \quad r < R_{shell} \qquad \underrightarrow{F_G} = -\frac{GM_{shell}\,m}{r^2}\hat{r} \quad r > R_{Shell}$$

$$\underrightarrow{F_G} = -\frac{4\pi}{3}\rho Gmr\hat{r} \qquad \underrightarrow{F_G} = -\frac{GMm}{r^2}\hat{r}$$

$$T_p{}^2 = \frac{4\pi^2}{GM_{SUN}}R_p{}^3 \qquad T_{Sat}{}^2 = \frac{4\pi^2}{GM_E}R_{Sat}{}^3$$

$$\Delta W = \underrightarrow{F}\cdot\underrightarrow{\Delta S} = F\Delta S\,Cos\left(\underrightarrow{F},\underrightarrow{\Delta S}\right) \qquad K = \frac{1}{2}MV^2$$

$$\Delta P = -\underrightarrow{F_{CO}}\cdot\underrightarrow{\Delta S} \qquad P_g = Mgh \qquad P_{sp} = \frac{1}{2}kx^2$$

$$K_f + P_f = K_i + P_i \qquad K_f + P_f = K_i + P_i + W_{NCF}$$

$$P_G = -\frac{GM_1M_2}{r} \qquad P_G = -\frac{GmM_{shell}}{r} \quad r > R_{Shell}$$

$$P_G = -\frac{GmM}{r} \quad r > R \qquad P_G = -\frac{GmM}{R} - \frac{GmM}{2R}\left[1 - \frac{r^2}{R^2}\right] \quad r < R$$

$$\underrightarrow{p} = M\underrightarrow{\upsilon} \qquad K = \frac{p^2}{2M}$$