Mathematics

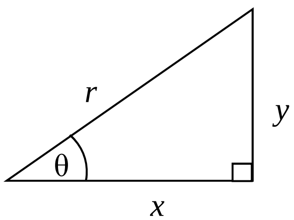
Quadratic equation:

$$ax^2 + bx + c = 0$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Trigonometry:

$$x^2 + y^2 = r^2$$



$$\sin\theta = y/r$$
$$\cos\theta = x/r$$
$$\tan\theta = y/x$$

$$\tan\theta = \frac{\sin\theta}{\cos\theta}$$

Calculus:

$$\frac{d}{dt}(a \cdot t^n) = a \cdot nt^{n-1}$$

$$\int x^n dx = \frac{x^{n+1}}{n+1}$$

Constants and Units

k = 10^3, μ = 10^{-6}, n = 10^{-9}

$$c = 3.0 \times 10^8 \; m/s$$
$$g = 9.80 \; m/s^2$$

Translational Kinematics

Three dimensions:

$$\vec{r} = x\hat{i} + y\hat{j} + z\hat{k}$$

$$\vec{v}_{av} = \frac{\Delta\vec{r}}{\Delta t} = \frac{\vec{r}_2 - \vec{r}_1}{t_2 - t_1} \qquad \vec{v} = \lim_{\Delta t - 0}\frac{\Delta\vec{r}}{\Delta t} = \frac{d\vec{r}}{dt}$$

$$\vec{a}_{av} = \frac{\Delta\vec{v}}{\Delta t} = \frac{\vec{v}_2 - \vec{v}_1}{t_2 - t_1} \qquad \vec{a} = \lim_{\Delta t - 0}\frac{\Delta\vec{v}}{\Delta t} = \frac{d\vec{v}}{dt}$$

One dimension:

$$v_{x,av} = \frac{\Delta x}{\Delta t} \qquad v_x = \lim_{\Delta t - 0}\frac{\Delta x}{\Delta t} = \frac{dx}{dt}$$

$$a_{x,av} = \frac{\Delta v_x}{\Delta t} \qquad a_x = \lim_{\Delta t - 0}\frac{\Delta v_x}{\Delta t} = \frac{dv_x}{dt}$$

Constant acceleration in one dimension:

$$x = x_0 + v_{0x}t + \tfrac{1}{2}a_x t^2$$

$$v_x = v_{0x} + a_x t$$

$$v_x^2 = v_{0x}^2 + 2a_x(x - x_0)$$

Uniform circular motion:

$$a = \frac{v^2}{r}$$

Particle Dynamics

$$\sum\vec{F} = m\vec{a} \qquad f_s \le \mu_s N$$
$$W = mg \qquad f_k = \mu_k N$$

N = normal force

Relative Motion

$\vec{v}_{PA} = \vec{v}_{PB} + \vec{v}_{BA}$ (*PA* means *P* relative to *A*, etc.)

Work, Kinetic Energy, Potential Energy

$$W = \vec{F} \cdot \vec{s} \qquad W = \int_A^B \vec{F} \cdot d\,\vec{s}$$

$$\vec{A} \cdot \vec{B} = |\vec{A}||\vec{B}|\cos\theta \qquad K = \frac{1}{2}mv^2$$

$$\mathrm{W} = \Delta\mathrm{K} = \mathrm{K_f} - \mathrm{K_i} \qquad \mathrm{E} = \mathrm{K} + \mathrm{U}$$

$$\Delta\mathrm{E} = \mathrm{E_f} - \mathrm{E_i} = \mathrm{W_{nc}}$$

$\mathrm{U_s} = \frac{1}{2}kx^2$ (spring)

$\mathrm{U_g} = mgz$ (gravity)

Power $= \dfrac{dW}{dt} = \vec{F} \cdot \vec{v}$