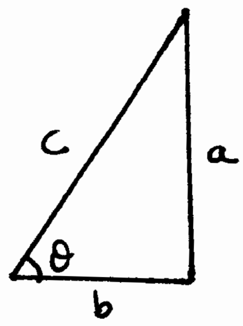
Formula Sheet



$a^2+b^2=c^2$

a = opposite side (for θ)

b = adjacent side (for θ)

c = hypotenuse

$$\tan\theta = \frac{\text{opposite}}{\text{adjacent}}$$

$$\sin\theta = \frac{\text{opposite}}{\text{hypotenuse}}$$

$$\cos\theta = \frac{\text{adjacent}}{\text{hypotenuse}}$$

For constant acceleration

$$\begin{cases} v_x = v_{0x} + a_x \Delta t \\ \Delta x = v_{0x}\Delta t + \frac{1}{2}a_x \Delta t^2 \end{cases}$$

$$v_x^2 = v_{0x}^2 + 2a_x \Delta x$$

$$\Delta x = \frac{1}{2}(v_{0x}+v_x)\Delta t$$

$$\text{Average velocity} = \frac{\text{displacement}}{\text{change in time}}$$

$$\text{Average speed} = \frac{\text{distance}}{\text{change in time}}$$

Quadratic equation

$ay^2+by+c=0$

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

$$v = \frac{dx}{dt}$$

$$a = \frac{dv}{dt} = \frac{d^2x}{dt^2}$$

$$\frac{d}{dx}(x^n) = n x^{n-1}$$

$$\int x^n\,dx = \frac{x^{n+1}}{n+1} + C$$ ← constant of integration

Newton's 1st "law": object @ rest or in motion with a constant velocity stays in that state of motion unless acted upon by a non-zero net force

Newton's 2nd "law": $\Sigma \vec{F} = m\vec{a}$

Newton's 3rd "law": Action-reaction

$f_{s,max} = \mu_s n$ $\qquad f_s \le \mu_s n$ $\qquad f_k = \mu_k n$

μ_s = coefficient of static friction $\quad \mu_k$ = coefficient of kinetic friction

Projectile motion

x-component	y-component
$x_0 =$	$y_0 =$
$x =$	$y =$
$v_{0x} =$	$v_{0y} =$
$a_x =$	$a_y =$
$v_x =$	$v_y =$

$\Delta t =$

centripetal acceleration

$$a_c = \frac{v^2}{r} = \omega^2 r$$

$$a_{total} = \sqrt{a_t^2 + a_c^2}$$

a_t = tangential acceleration

$v = \omega r \qquad \omega = 2\pi f = \frac{2\pi}{T} \qquad T$ = Period $\quad f$ = frequency

ω = angular velocity or ang. frequency

For projectile motion, when appropriate

$$\Delta y = (\tan\theta_0)\Delta x - \frac{g(\Delta x)^2}{2(v_0\cos\theta_0)^2}$$

complimentary angles: $\theta_1 + \theta_2 = 90°$

Gravitational force $\quad F_G = \frac{GMm}{r^2}$ where "g" $= \frac{GM}{R^2}$

For satellites in circular orbits

$$v = \sqrt{\frac{GM}{r}} \qquad T = 2\pi\sqrt{\frac{r^3}{GM}}$$

where $r = (R+h)$

$$\vec{\tau} = \vec{r}\times\vec{F} = rF\sin\phi \qquad \hat{i}\cdot\hat{i} = \hat{j}\cdot\hat{j} = \hat{k}\cdot\hat{k} = 1$$

$$\hat{i}\times\hat{j} = \hat{k} \qquad \hat{j}\times\hat{k} = \hat{i} \qquad \hat{k}\times\hat{i} = \hat{j} \qquad \hat{i}\times\hat{i} = \hat{j}\times\hat{j} = \hat{k}\times\hat{k} = 0$$

$$\hat{j}\times\hat{i} = -\hat{k} \qquad \hat{k}\times\hat{j} = -\hat{i} \qquad \hat{i}\times\hat{k} = -\hat{j} \qquad \hat{i}\cdot\hat{j} = \hat{i}\cdot\hat{k} = \hat{j}\cdot\hat{k} = 0$$

$$\hat{j}\cdot\hat{k} = \hat{k}\cdot\hat{j} = \hat{j}\cdot\hat{i} = \hat{k}\cdot\hat{i} = \hat{k}\cdot\hat{j} = 0$$