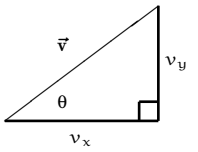
Formula sheet

$$g = 9.81\,\mathrm{m/s^2}$$

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

Vectors:

$$\vec{a} = a_x\,\hat{\imath} + a_y\,\hat{\jmath} + a_z\,\hat{k}$$
$$\vec{b} = b_x\,\hat{\imath} + b_y\,\hat{\jmath} + b_z\,\hat{k}$$
$$|\vec{a}| = \sqrt{a_x^2 + a_y^2}$$
$$\tan\theta = \frac{a_y}{a_x}$$
$$\vec{a} + \vec{b} = (a_x + b_x)\,\hat{\imath} + (a_y + b_y)\,\hat{\jmath} + (a_z + b_z)\,\hat{k}$$
$$\vec{a}\cdot\vec{b} = a_x b_x + a_y b_y + a_z b_z$$
$$|\vec{a}\cdot\vec{b}| = |\vec{a}||\vec{b}|\cos\varphi$$



$$v_y = |\vec{v}|\sin\theta$$
$$v_y = |\vec{v}|\cos\theta$$
$$\tan\theta = \tfrac{v_y}{v_x}$$

1-D motion:

$$v(t) = \frac{d}{dt}x(t)$$
$$a(t) = \frac{d}{dt}v(t) = \frac{d^2}{dt^2}x(t)$$

const. acc.

$$x_f = x_i + v_{xi}t + \frac{1}{2}a_x t^2$$
$$v_{xf}^2 = v_{xi}^2 + 2a_x\Delta x$$
$$v_f = v_i + at$$

Projectile motion:

$$v_x(t) = v_i\cos\theta$$
$$v_y(t) = v_i\sin\theta - gt$$
$$x(t) = x_i - v_x t$$
$$y(t) = y_i + v_{yi}t + \frac{1}{2}a_y t^2$$

over level ground:

$$\text{max height} = H = \frac{v_i^2\sin^2\theta_i}{2g}$$
$$\text{Range} = R = \frac{v_i^2\sin 2\theta_i}{g}$$

2-D motion:

$$\vec{r} = x(t)\,\hat{\imath} + y(t)\,\hat{\jmath}$$
$$x(t) = x_i + v_{ix}t + \frac{1}{2}a_x t^2$$
$$y(t) = y_i + v_{iy}t + \frac{1}{2}a_y t^2$$
$$\vec{v} = v_x(t)\,\hat{\imath} + v_y(t)\,\hat{\jmath}$$
$$v_x(t) = \frac{dx}{dt} = v_{xi} + a_x t$$
$$v_y(t) = \frac{dy}{dt} = v_{yi} + a_y t$$
$$\vec{a} = a_x(t)\,\hat{\imath} + a_y(t)\,\hat{\jmath}$$
$$a_x(t) = \frac{dv_x}{dt}$$
$$\vec{a}(t) = \frac{d^2s}{dt^2}\,\hat{T} + \kappa|\vec{v}|^2\,\hat{N} = \frac{d^2s}{dt^2}\,\hat{T} + \frac{|\vec{v}|^2}{R}\,\hat{N} \equiv a_N\,\hat{T} + a_T\,\hat{N}$$
$$a_c = \frac{v^2}{r} \quad \text{circ.}$$
$$T = \frac{2\pi r}{v} \quad \text{circ.}$$

Force:

$$\Sigma\vec{F} = \vec{F}_{net} = m\vec{a}$$
$$\Sigma F_x = ma_x$$
$$\Sigma F_y = ma_y$$
$$F_{grav} = mg = \text{weight}$$
$$\vec{F}_{12} = -\vec{F}_{21}$$
$$f_s \leqslant \mu_s n$$
$$f_{s,max} = \mu_s n$$
$$f_k = \mu_k n$$
$$|\vec{F}|_{drag} = -\frac{1}{2}C\rho A v^2$$
$$\vec{F}_c = -\frac{mv^2}{r}\,\hat{r}$$

Power	Prefix	Abbreviation
10^{-12}	pico	p
10^{-9}	nano	n
10^{-6}	micro	μ
10^{-3}	milli	m
10^{-2}	centi	c
10^{3}	kilo	k
10^{6}	mega	M
10^{9}	giga	G
10^{12}	tera	T