Formula sheet

$$g = |\vec{a}_{\text{free fall}}| = 9.81\,\text{m/s}^2 \quad \text{near earth's surface}$$

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

$$1\,\text{J} = 1\,\text{kg} \cdot \text{m}^2/\text{s}^2 = 1\,\text{N} \cdot \text{m}$$

$$\Delta\vec{r} = \vec{r}_f - \vec{r}_i$$

$$\text{speed} = v = |\vec{v}| \quad \vec{v}_{av} \equiv \frac{\Delta\vec{r}}{\Delta t} \quad \vec{v} = \lim_{\Delta t \to 0} \frac{\Delta\vec{r}}{\Delta t} \equiv \frac{d\vec{r}}{dt}$$

$$a_{x,av} \equiv \frac{\Delta v_x}{dt} \quad a_x = \lim_{\Delta t \to 0} \frac{\Delta v_x}{\Delta t} \equiv \frac{dv_x}{dt} = \frac{d}{dt}\left(\frac{dx}{dt}\right) = \frac{d^2x}{dt^2}$$

$$x_f = x_i + v_{x,i}\Delta t + \frac{1}{2}a_x\,(\Delta t)^2$$

$$v_{x,f} = v_{x,i} + a_x \Delta t$$

$$x(t) = x_i + v_{x,i}t + \frac{1}{2}a_x t^2$$

$$v_x(t) = v_{x,i} + a_x t$$

$$v_{x,f}^2 = v_{x,i}^2 + 2a_x\Delta x$$

$$\Delta\vec{p} = \vec{0} \quad \vec{p}_f = \vec{p}_i \quad \text{isolated system}$$

$$\vec{p} \equiv m\vec{v}$$

$$m_u = -\frac{\Delta v_{s,x}}{\Delta v_{u,x}} m_s$$

$$\vec{J} = \Delta\vec{p}$$

$$v_{1f} = \left(\frac{m_1 - m_2}{m_1 + m_2}\right) v_{i1} + \left(\frac{2m_2}{m_1 + m_2}\right) v_{2i} \quad \text{1D elastic}$$

$$v_{2f} = \left(\frac{2m_1}{m_1 + m_2}\right) v_{1i} + \left(\frac{m_2 - m_1}{m_1 + m_2}\right) v_{2i} \quad \text{1D elastic}$$

$$\vec{v}_{12} = \vec{v}_2 - \vec{v}_1 \quad \text{relative velocity}$$

$$v_{12} = |\vec{v}_2 - \vec{v}_1| \quad \text{relative speed}$$

$$\Delta U^G = mg\Delta x$$

$$\frac{a_{1x}}{a_{2x}} = -\frac{m_2}{m_1}$$

$$E_{\text{mech}} = K + U \quad K = \frac{1}{2}mv^2$$

$$\Delta E = \Delta K + \Delta U = 0 \quad \text{non-dissipative, closed}$$

$$\vec{a} = \frac{\sum \vec{F}}{m} \qquad \vec{a_{cm}} = \frac{\sum \vec{F}_{\text{ext}}}{m} \qquad \sum \vec{F} \equiv \frac{d\vec{p}}{dt}$$

$$\vec{J} = \left(\sum \vec{F}\right) \Delta t \quad \text{constant force}$$

$$\vec{J} = \int_{t_i}^{t_f} \sum \vec{F}(t)\,dt \quad \text{time-varying force}$$

$$\vec{F}_{12} = -\vec{F}_{21}$$

$$\Delta E = W$$

$$\Delta U_{\text{spring}} = \frac{1}{2}k\,(x - x_o)^2$$

$$P = \frac{dE}{dt}$$

$$P = F_{\text{ext,x}}\,v_x \quad \text{one dimension}$$

$$W = \left(\sum \vec{F}\right) \Delta x_F \quad \text{constant foce 1D}$$

$$W = \sum_n \left(F_{\text{ext,x}}\,\Delta x_{Fn}\right) \quad \text{const nondiss., many particles, 1D}$$

$$W = \int_{x_i}^{x_f} F_x(x)\,dx \quad \text{nondiss. force, 1D}$$

$$(F_{12}^s)_{\max} = \mu_s F_{12}^n$$

$$F_{12}^k = \mu_k F_{12}^n$$

$$\vec{A} = \vec{A}_x + \vec{A}_y = A_x\,\hat{\boldsymbol{\imath}} + A_y\,\hat{\boldsymbol{\jmath}}$$

$$\vec{A} \cdot \vec{B} = AB\cos\phi = A_x B_x + A_y B_y$$

$$W = \vec{F} \cdot \Delta\vec{r}_F \quad \text{const non-diss force}$$

$$W = \int_{\vec{r}_i}^{\vec{r}_f} \vec{F}(\vec{r}) \cdot d\vec{r} \quad \text{variable nondiss force}$$

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