

Physics 113, Summer 2007
Equation sheet for Exam 2

General Kinematics Equations in 1-D

$$\Delta x = x(t_2) - x(t_1)$$

$$\bar{v} = \frac{\Delta x}{\Delta t} \quad v(t) = \frac{dx(t)}{dt} \quad x(t) = \int v(t) dt$$

$$\bar{a} = \frac{\Delta v}{\Delta t} \quad a(t) = \frac{dv(t)}{dt} \quad v(t) = \int a(t) dt$$

Constant acceleration equations

$$v_x = v_{0x} + a_x t \quad v_y = v_{0y} + a_y t$$

$$x = x_0 + v_{0x} t + \frac{1}{2} a_x t^2 \quad y = y_0 + v_{0y} t + \frac{1}{2} a_y t^2$$

$$v_x^2 - v_{0x}^2 = 2a_x \Delta x \quad v_y^2 - v_{0y}^2 = 2a_y \Delta y$$

$$\bar{v}_x = \frac{v_{0x} + v_x}{2} \quad \bar{v}_y = \frac{v_{0y} + v_y}{2}$$

$$g = 9.8 \frac{m}{s^2}$$

$$R = \frac{v_0^2 \sin(2\theta)}{g}$$

$$\vec{a}_c = -\frac{v^2}{r} \hat{r} \quad v = \frac{2\pi r}{T} \quad f = \frac{1}{T}$$

$$\Sigma \vec{F} = m\vec{a} \quad (\Sigma F_x = ma_x \quad \Sigma F_y = ma_y \quad \Sigma F_z = ma_z)$$

$$\Sigma \vec{F}_c = m\vec{a}_c$$

$$F_{f-s} \leq \mu_s N \quad F_{f-k} = \mu_k N$$

$$\vec{F}_g = -\frac{Gm_1 m_2}{r_{12}^2} \hat{r} \quad \text{where } G = 6.67 \times 10^{-11} \text{ N m}^2 \text{ kg}^{-2}$$

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

$$W = \int_A^B \vec{F} \cdot d\vec{\ell} \quad W = \vec{F} \cdot \vec{d} \quad (\text{constant force})$$

$$K = \frac{1}{2} mv^2 \quad W_{net} = \Delta K$$

$$\vec{F}_s = -k_s \vec{x} \quad W_s = -\frac{1}{2} kx_f^2 + \frac{1}{2} kx_0^2$$

$$\Delta U = -W_c$$

$$U_s = mgy \quad U_g = -\frac{GM_E m}{r}$$

$$U_s = \frac{1}{2} k_s x^2$$

$$E_{\text{Mech}} = K + U \quad E_{\text{initial_Mech}} + W_{\text{NC}} = E_{\text{final_Mech}}$$

$$P_{\text{ave}} = \frac{W}{\Delta t} \quad P = \frac{dW}{dt} \quad P_{\text{ave}} = \frac{\vec{F} \cdot d\vec{\ell}}{dt} = \vec{F} \cdot \vec{v}$$

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

$$\Sigma \vec{F} = \frac{d\vec{p}}{dt}$$

$$\vec{P}_{\text{system}} = \Sigma_i \vec{p}_i \quad \Sigma \vec{F}_{\text{ext}} = \frac{d\vec{P}_{\text{system}}}{dt}$$

$$\vec{r}_{\text{com}} = \frac{1}{M} \int \vec{r} dm \quad M = \int dm$$

$$x_{\text{com}} = \frac{1}{M} \int x dm \quad (\text{similarly for } y \text{ and } z)$$

$$dm = \lambda dl \quad \text{or} \quad dm = \sigma dA \quad \text{or} \quad dm = \rho dV$$

$$x_{\text{com}} = \frac{\Sigma_i (m_i x_i)}{M} \quad M = \Sigma_i m_i \quad (\text{similarly for } y \text{ and } z)$$

$$\vec{v}_{\text{com}} = \frac{\Sigma_i (m_i \vec{v}_i)}{M}$$

Rotation

$$\theta = \frac{\ell}{r} \quad 360^\circ = 2\pi \text{ radians} = 1 \text{ revolution}$$

$$\Delta\theta = \theta_2 - \theta_1$$

$$\omega = \frac{d\theta}{dt}$$

$$\alpha = \frac{d\omega}{dt}$$

Constant alpha equations

$$\theta = \theta_0 + \omega_0 t + \frac{1}{2} \alpha t^2$$

$$\omega^2 - \omega_0^2 = 2\alpha\Delta\theta$$

$$\omega = \omega_0 + \alpha t$$

$$\bar{\omega} = \frac{\omega_0 + \omega}{2}$$

$$v = r\omega$$

$$a = r\alpha$$

$$a_c = \omega^2 r$$

$$I = \sum m_i r_i^2 \quad \text{or} \quad I = \int r^2 dm$$

$$I = I_{\text{cm}} + Md^2$$

$$K_{\text{rot}} = \frac{1}{2} I \omega^2$$

$$|\vec{A} \times \vec{B}| = AB \sin \theta = A_\perp B = AB_\perp$$

$$\vec{\tau} = \vec{r} \times \vec{F}$$