Physics 1210

Spring 2016

Prof. Jang-Condell

Equation Sheet For Exam #3

Kinematics

$$v_{\text{avg}} = \frac{x_2 - x_1}{t_2 - t_1} = \frac{\Delta x}{\Delta t} \qquad \vec{\boldsymbol{v}} = \frac{d\vec{\boldsymbol{r}}}{dt} \qquad a_{\text{avg}} = \frac{v_2 - v_1}{t_2 - t_1} = \frac{\Delta v}{\Delta t} \qquad \vec{\boldsymbol{a}} = \frac{d\vec{\boldsymbol{v}}}{dt} \qquad g = 9.80 \text{ m/s}^2$$

$$x_1 = x_0 + v_0 t + \tfrac{1}{2}at^2 \qquad v_1 = v_0 + at \qquad v_1^2 = v_0^2 + 2a(x_1 - x_0) \qquad a_{\text{rad}} = \frac{v^2}{R} = \frac{4\pi^2 R}{T^2}$$

$$\sum \vec{\boldsymbol{F}} = m\vec{\boldsymbol{a}} \qquad \vec{\boldsymbol{w}} = m\vec{\boldsymbol{g}} \qquad f_s \le \mu_s N \qquad f_k = \mu_k N \qquad f = kv \qquad f = Dv^2 \qquad f_{\text{spring}} = -kx$$

Momentum/Impulse

$$\vec{\boldsymbol{p}} = m\vec{\boldsymbol{v}} \qquad J = \Delta(mv) = F\Delta t \qquad x_{\text{cm}} = \frac{\sum m_i x_i}{\sum m_i}$$

Work/Energy

$$W = \vec{\boldsymbol{F}} \cdot \vec{\boldsymbol{s}} = Fs\cos\theta \qquad K_1 + U_1 + W_{\text{other}} = K_2 + U_2 \qquad P = \frac{\Delta W}{\Delta t} = \vec{\boldsymbol{F}} \cdot \vec{\boldsymbol{v}}$$

$$W = \Delta K \qquad K = \tfrac{1}{2}mv^2 \qquad U_{\text{spring}} = \tfrac{1}{2}kx^2 \qquad U_{\text{grav}} = mgy \qquad F = -\frac{dU}{dx}$$

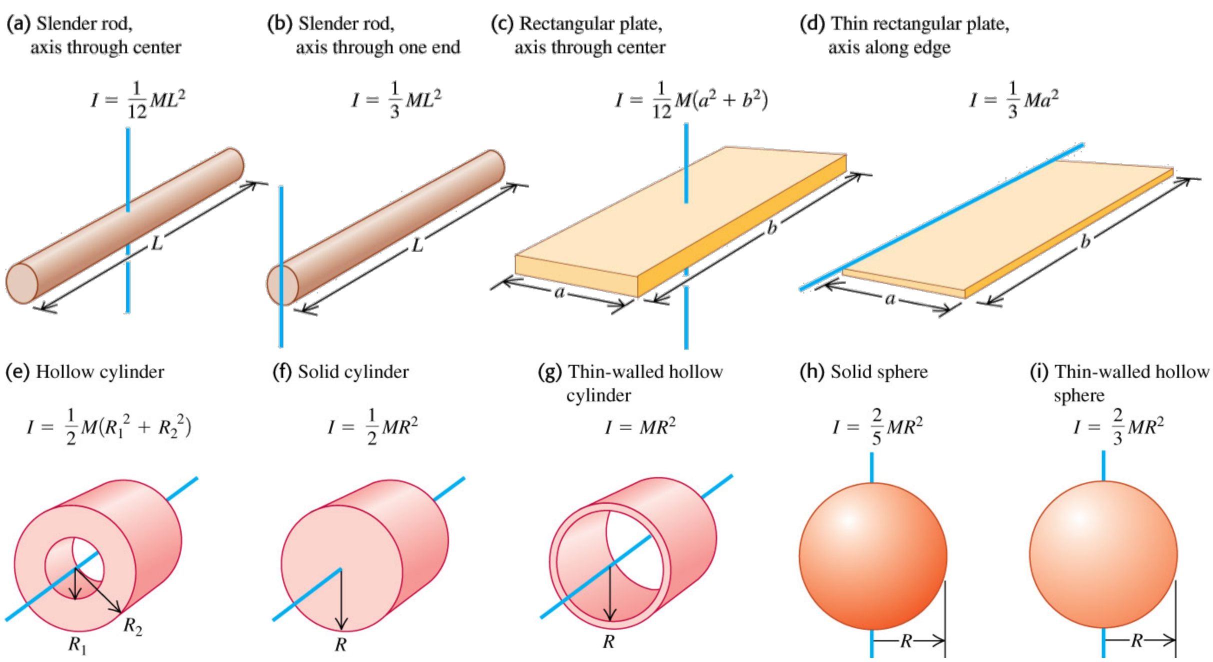
Angular Motion

$$\omega = \frac{d\theta}{dt} \qquad \alpha = \frac{d\omega}{dt} \qquad \theta_1 = \theta_0 + \omega_0 t + \tfrac{1}{2}\alpha t^2 \qquad \omega_1 = \omega_0 + \alpha t \qquad \omega_1^2 = \omega_0^2 + 2\alpha(\theta_1 - \theta_0)$$

$$s = r\theta \qquad v = r\omega \qquad a_{\tan} = r\alpha \qquad a_{\text{rad}} = \omega^2 r \qquad 2\pi = 360^\circ$$

$$I = \sum_i m_i r_i^2 \qquad I = I_{\text{cm}} + Md^2 \qquad \vec{\boldsymbol{\tau}} = \vec{\boldsymbol{r}} \times \vec{\boldsymbol{F}} = rF\sin\phi \qquad \sum \vec{\boldsymbol{\tau}} = I\vec{\boldsymbol{\alpha}} \qquad W = \Delta K = \tau\Delta\theta$$

$$K_{\text{rot}} = \tfrac{1}{2}I\omega^2 \qquad K_{\text{tot}} = \tfrac{1}{2}mv_{\text{cm}}^2 + \tfrac{1}{2}I_{\text{cm}}\omega^2 \qquad \vec{\boldsymbol{L}} = \vec{\boldsymbol{r}} \times \vec{\boldsymbol{p}} = rmv = I\omega \qquad \Delta L = \tau\Delta t \qquad \text{power} = \tau\omega$$



Fluids $p = \frac{dF_\perp}{dA}$ $p_2 - p_1 = -\rho g(y_2 - y_1)$ $p_1 + \rho g y_1 + \frac{1}{2}\rho v_1^2 = p_2 + \rho g y_2 + \frac{1}{2}\rho v_2^2$

$\rho_1 A_1 v_1 = \rho_2 A_2 v_2$

Gravity $G = 6.67\times10^{-11}$ N m^2/kg^2

$F_g = \frac{GM_1M_2}{r^2}$ $U_g = \frac{-GM_1M_2}{r}$ $v = \sqrt{\frac{Gm_1}{r}}$ $T = \frac{2\pi r}{v} = 2\pi\sqrt{\frac{r^3}{Gm_1}}$ $v_{\text{esc}} = \sqrt{\frac{2Gm_1}{r}}$

Periodic Motion $f = 1/T$ $\omega = 2\pi f$ $x = A\cos(\omega t + \phi)$ $E = \frac{1}{2}mv^2 + \frac{1}{2}kx^2 = \frac{1}{2}kA^2$

Spring $\omega = \sqrt{\frac{k}{m}}$ Simple pendulum $\omega = \sqrt{\frac{g}{L}}$ Physical pendulum $\omega = \sqrt{\frac{mgd}{I}}$ Damped oscillations $x = Ae^{-(b/2m)t}\cos(\omega' t + \phi);\ \omega' = \sqrt{\frac{k}{m} - \frac{b^2}{4m^2}}$

Mechanical Waves

$v = \lambda f$ $y(x,t) = A\cos(kx - \omega t)$ $k = \frac{2\pi}{\lambda}$ $v = \frac{\omega}{k}$

Waves on a string $v = \sqrt{\frac{F}{\mu}}$ $f_1 = \frac{v}{2L}$ $f_n = nf_1, (n = 1,2,3,\ldots)$ $P_{\text{av}} = \frac{1}{2}\sqrt{\mu F}\omega^2 A^2$

Sound $v = \sqrt{B/\rho}$ $p_{\max} = BkA$ $I = \frac{P}{4\pi r^2}$ $\frac{I_1}{I_2} = \frac{r_2^2}{r_1^2}$ $I = \frac{p_{\max}^2}{2\rho v} = \frac{p_{\max}^2}{2\sqrt{\rho B}}$ $\beta = (10\text{ dB})\log\frac{I}{I_0}$

Open pipe $f_n = \frac{nv}{2L}, (n = 1,2,3,\ldots)$ Closed pipe $f_n = \frac{nv}{4L}, (n = 1,3,5,\ldots)$ $f_{\text{beat}} = f_a - f_b$ $f_L = \frac{v + v_L}{v + v_S} f_S$