

PHYS-101 Formula Sheet for the Final Exam

$\vec{v} = \vec{v}_o + \vec{a}t$ $\vec{r} - \vec{r}_o = \vec{v}_o t + \frac{1}{2} \vec{a}t^2$ $v^2 = v_o^2 + 2\vec{a} \cdot (\vec{r} - \vec{r}_o)$ $\vec{r} - \vec{r}_o = \frac{1}{2}(\vec{v} + \vec{v}_o)t$
$a_r = \frac{v^2}{r} \quad a_t = \frac{d \vec{v} }{dt}$ $\vec{a} = \vec{a}_t + \vec{a}_r$
$\vec{F}_{net} = m\vec{a} = \frac{d\vec{p}}{dt}$ $f_k = \mu_k N$ $f_s \leq \mu_s N$
$W = \int \vec{F} \cdot d\vec{s}; \quad P = \vec{F} \cdot \vec{v}$ <p>If <math>\vec{F}</math> is a constant <math>W = \vec{F} \cdot \vec{s}</math></p> $W_{net} = \Delta K = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$
$W_c = -\Delta U_c$ $\Delta U_s = \frac{1}{2}kx_f^2 - \frac{1}{2}kx_i^2, \quad F_s = -kx$ $\Delta U_g = mg(y_f - y_i)$ $W_{nc} = \Delta K + \Delta U = \Delta E; \quad W_{nc} = -F_k d$
$\vec{p} = m\vec{v}$ $\vec{J} = \Delta\vec{p} = \int \vec{F} dt = \vec{F}_{avg} \Delta t$ $\vec{p}_{1i} + \vec{p}_{2i} = \vec{p}_{1f} + \vec{p}_{2f}$ $\vec{R}_{cm} = \frac{\sum m_i \vec{r}_i}{\sum m_i} = \frac{1}{M} \int \vec{r} dm$ $\vec{v}_{cm} = \frac{\sum m_i \vec{v}_i}{\sum m_i}; \quad \vec{p}_{cm} = \sum m_i \vec{v}_i$
$\omega = \frac{d\theta}{dt}; \quad \alpha = \frac{d\omega}{dt}$ $s = r\theta, \quad v = r\omega$ $a_t = r\alpha; \quad a_r = r\omega^2$ <p>If <math>\alpha</math> is a constant:</p> $\omega = \omega_o + \alpha t$ $\theta - \theta_o = \omega_o t + \frac{1}{2} \alpha t^2$ $\theta - \theta_o = \frac{\omega + \omega_o}{2} t$ $\omega^2 = \omega_o^2 + 2\alpha(\theta - \theta_o)$ $I = \sum m_i r_i^2 = \int r^2 dm$ $I_p = I_{cm} + M d^2$
$\vec{\tau} = \vec{r} \times \vec{F} \quad \left  \vec{A} \times \vec{B} \right  = AB \sin \theta$

$P = \frac{dW}{dt} = \tau\omega$ <p>For a solid rotating about a fixed axis:</p> $K_{rot} = \frac{1}{2} I \omega^2; \quad L_z = I \omega$ $W = \int \tau d\theta$ $\vec{L} = \vec{r} \times \vec{p} = m(\vec{r} \times \vec{v})$ $\vec{\tau} = \frac{d\vec{L}}{dt}$ $\sum \tau_{ext} = \frac{dL}{dt} = I\alpha$
<p>For static equilibrium</p> $\sum \vec{F} = 0, \quad \sum \vec{\tau} = 0$ $E = \frac{F/A}{\Delta L/L_o}; \quad G = \frac{F/A}{\Delta x/h}; \quad B = \frac{\Delta P}{ \Delta V/V }$
$x = x_m \cos(\omega t + \phi)$ $k = m\omega^2; \quad T = \frac{2\pi}{\omega} = 2\pi \sqrt{\frac{m}{k}}$ $E = \frac{1}{2} kx_m^2 = \frac{1}{2} mv^2 + \frac{1}{2} kx^2$ $T = 2\pi \sqrt{\frac{L}{g}}; \quad f = 1/T$
$F_g = \frac{Gm_1 m_2}{r^2}; \quad U = -\frac{Gm_1 m_2}{r}$ $K = \frac{1}{2} mv^2 = \frac{GMm}{2r} \quad (\text{for circular orbits})$ $E = \frac{1}{2} mv^2 - \frac{GMm}{r} = -\frac{GMm}{2r}$ $v_{esc} = \sqrt{\frac{2GM}{R}}; \quad T^2 = \left( \frac{4\pi^2}{GM_s} \right) r^3$
$P = \frac{F}{A}; \quad \rho = \frac{m}{V}$ $P = P_o + \rho gh$ $F_b = m_f g = \rho_f V_f g$ $A_1 v_1 = A_2 v_2 = \text{constant}$ $P + \frac{1}{2} \rho v^2 + \rho gy = \text{constant}$
$G = 6.67 \times 10^{-11} \text{ N} \frac{\text{m}^2}{\text{kg}^2}$ $P_{atm} = 1.013 \times 10^5 \text{ Pa} = 1 \text{ atm}$ $I_{cm}(\text{cylinder}) = (1/2)MR^2; \quad I_{cm}(\text{thin rod}) = (1/12)ML^2$ $I_{cm}(\text{solid sphere}) = (2/5)MR^2; \quad I_{cm}(\text{hoop}) = MR^2$ $\rho_w = 1 \text{ g/cm}^3 \quad g = 9.8 \text{ m/s}^2$
$\vec{A} \cdot \vec{B} = A_x B_x + A_y B_y + A_z B_z \quad \vec{A} \cdot \vec{B} = AB \cos \theta$