PHYS 111 FINAL EXAM FORMULAS - FALL 2011

Vectors: $A_x = A\cos\theta$; $A_y = A\sin\theta$; $A = \sqrt{A_x^2 + A_y^2}$ $\theta = \tan^{-1}\frac{A_y}{A_x}$; $\vec{\mathbf{A}} = A_x\vec{\mathbf{i}} + A_y\vec{\mathbf{j}}$ $\vec{\mathbf{A}}+\vec{\mathbf{B}} = (A_x + B_x)\vec{\mathbf{i}} + (A_y + B_y)\vec{\mathbf{j}}$

$\vec{\mathbf{A}} \cdot \vec{\mathbf{B}} = A\cdot B\cos\theta = A_xB_x + A_yB_y$ $\vec{\mathbf{A}} \times \vec{\mathbf{B}} = AB\sin\theta = (A_xB_y - A_yB_x)\vec{\mathbf{k}}$ One-dimensional motion: $x = v_{avr}t$ $x = \frac{v_1 + v_2}{2}t$

$x = v_o t + \frac{1}{2}at^2$ $x = \frac{v^2 - v_0^2}{2a}$ $v = v_o + at$; Free-fall: $y = v_o t - \frac{1}{2}gt^2$, $v = v_o - gt$, $y = \frac{v^2 - v_o^2}{-2g}$;

$y_{max} = \frac{v_0^2}{2g}$ $r = r_0 + (v_{ox}t + \frac{1}{2}a_x t^2)\hat{\mathbf{i}} + (v_{oy}t + \frac{1}{2}a_y t^2)\hat{\mathbf{j}}$ $v = (v_{ox} + a_x t)\hat{\mathbf{i}} + (v_{oy} + a_y t)\hat{\mathbf{j}}$; Projectile motion: $x = v_{ox}t$;

$y = v_{oy}t - \frac{1}{2}gt^2$; $v_y = v_{oy} - gt$; $v_{ox} = v_o\cos\theta$; $v_{oy} = v_o\sin\theta$; $y = \frac{v_y^2 - v_{oy}^2}{-2g}$; $t_{tot} = \frac{2v_{0y}}{g}^2$

$R = \frac{v_o^2 \sin 2\theta}{g}$; $y = (\tan\theta)\cdot x - \frac{gx^2}{2(v_o\cos\theta)^2}$ $F_{net} = ma$; $F_g = mg$, $g = 9.8\ m/s^2$; incline: $F_{gx} = mg\sin\theta$, $F_{gy} = mg\cos\theta$,

Friction: $f_{s,max} = \mu_s N$; $f_k = \mu_k N$; Circular motion: $a_c = \frac{v^2}{R}$; period $T = \frac{2\pi R}{v}$; $F_{net} = \frac{mv^2}{r}$; work: $W = F\cdot d\cdot\cos\theta$

$W_g = mg(y_o - y_f)$ $W_{spr} = ½\, k(x_i^2 - x_f^2)$ $W_{tot} = K_f - K_i$ $W_{tot} = F_{net}\cdot d$ $K = ½\, mv^2$ Power: $P = \frac{dW}{dt}$ $P_{avg} = \frac{W}{\Delta t}$

$U_g = mgy$ $U_s = ½\, kx^2$ $U_{gi} + U_{si} + K_i + W_{fr} = U_{gf} + U_{sf} + K_f$ $\Delta U + \Delta K = W_{nc}$ $p = mv$; $F_{net}\Delta t = mv_f - mv_i$

$m_1v_{1i} + m_2v_{2i} = m_1v_{1f} + m_2v_{2f}$; perf. inelastic: $m_1v_{1i} + m_2v_{2i} = (m_1 + m_2)V$ elastic coll.: $v_{1f} = \frac{m_1 - m_2}{m_1 + m_2}v_{1i} + \frac{2m_2}{m_1 + m_2}v_{2i}$,

$v_{2f} = \frac{2m_1}{m_1 + m_2}v_{1i} + \frac{m_2 - m_1}{m_1 + m_2}v_{2i}$ rotational motion: 1 rev = 2π rad; $\omega = \omega_0 + \alpha t$; $\theta = \omega_0 t + \frac{1}{2}\alpha t^2$; $\theta = \frac{\omega^2 - \omega_0^2}{2\alpha}$

$s = \theta r$ $v = \omega r$; $a_t = \alpha r$ $\tau = rF\sin\phi$; $\tau_{net} = I\alpha$; work: $W = \tau\theta$; $W = \frac{1}{2}I\omega_f^2 - \frac{1}{2}I\omega_i^2$ $P_{avr} = \frac{W}{\Delta t}$

$I_{point\ mass} = mr^2$ $I_{disk,cyl} = \frac{1}{2}mR^2$ $I_{hoop} = mR^2$ $I_{rod} = \frac{1}{12}mL^2$ $I_{rod(end)} = \frac{1}{3}mL^2$ $I_{ball} = \frac{2}{5}mR^2$ $I_{shell} = \frac{2}{3}mR^2$

$I = I_{com} + MD^2$ Rolling: $v_{com} = R\omega$ $K = \frac{1}{2}I\omega^2 + \frac{1}{2}m v_{com}^2$ Angular momentum: $\vec{\mathbf{L}}_{point\ mass} = m\vec{\mathbf{r}} \times \vec{\mathbf{v}}$ $L = mrv\sin\theta$;

$\vec{\mathbf{L}} = m(r_xv_y - r_yv_x)\vec{\mathbf{k}}$ $L = I\omega$ $L_I = L_f$ Equilibrium: $\Sigma\vec{\mathbf{F}} = 0$: $\Sigma\vec{\boldsymbol{\tau}} = 0$

$G = 6.67\times10^{-11} Nm^2/kg^2$ $R_E = 6.37\times10^6$ m, $M_E = 5.98\times10^{24}$ kg $F = G\frac{m_1\cdot m_2}{R^2}$ $g = G\frac{M_p}{R^2}$; $U = -G\frac{M_E m_o}{R}$;

$G\frac{m_1\cdot m_2}{R^2} = m\frac{v^2}{R}$; period $T = \frac{2\pi R}{v}$; $v_{esc} = \sqrt{\frac{2GM_p}{R}}$ $v_{sat} = \sqrt{\frac{GM_p}{R}}$; $T^2 = \frac{4\pi^2}{GM}R^3$;

$E_{sat} = -G\frac{M_E m_o}{2R}$ Oscillations: $F = -kx$ $x = A\cos(\omega t + □)$ $v = -\omega A\sin(\omega t + □)$ $a = -\omega^2 x$ $\omega = 2\pi f = \frac{2\pi}{T}$

$\omega = \sqrt{\frac{k}{m}}$ period: $T_{spring} = 2\pi\sqrt{\frac{m}{k}}$; $f = \frac{1}{T}$ $T_{pend} = 2\pi\sqrt{\frac{L}{g}}$ $T_{phys.pend} = 2\pi\sqrt{\frac{I}{mgd}}$ $U_{spr} = ½\, kx^2$ $E_{tot} = ½\, kA^2$

$E_{tot} = ½kx^2 + ½mv^2$ $v_{max} = A\omega$ $a_{max} = A\omega^2$ $x_{cm} = \frac{m_1x_1 + m_2x_2}{m_1 + m_2}$ $y_{cm} = \frac{m_1y_1 + m_2y_2}{m_1 + m_2}$