Formulas for Physics 140/150

$x = x_0 + v_0 t + \frac{1}{2} a t^2$ $\quad$ $v = v_0 + at$ $\quad$ $v^2 = v_0^2 + 2a(x - x_0)$

$\mathbf{V}_{\mathrm{AC}} = \mathbf{V}_{\mathrm{AB}} + \mathbf{V}_{\mathrm{BC}}$ $\quad$ $g = 9.80\ \mathrm{m/s^2}$ $\quad$ $a_c = v^2/R$

$\vec{\mathbf{F}} = m\vec{\mathbf{a}}$ $\quad$ $f_k = \mu_k N$ $\quad$ $f_s \leq \mu_s N$

$\vec{\mathbf{p}}_{\mathrm{f}} - \vec{\mathbf{p}}_{\mathrm{i}} = \int \vec{\mathbf{F}}_{\mathrm{net}} dt$ $\quad$ $\mathbf{p} = m\mathbf{v}$ $\quad$ $\Delta\mathbf{p} = \vec{\mathbf{p}}_{\mathrm{f}} - \vec{\mathbf{p}}_{\mathrm{i}} = \int \vec{\mathbf{F}}_{\mathrm{net}} dt = \mathbf{F}_{\mathrm{av}} \Delta t$

$m_1 v_{1\mathrm{f}} + m_2 v_{2\mathrm{f}} = m_1 v_{1\mathrm{i}} + m_2 v_{2\mathrm{i}}$ $\quad$ Elastic collision : $v_{2\mathrm{f}} - v_{1\mathrm{f}} = -[v_{2\mathrm{i}} - v_{1\mathrm{i}}]$

$\vec{\mathbf{r}}_{\mathrm{cm}} = \frac{1}{M} \sum_{\mathrm{n}} m_{\mathrm{n}} \vec{\mathbf{r}}_{\mathrm{n}}$ $\quad$ $\vec{\mathbf{v}}_{\mathrm{cm}} = \frac{1}{M} \sum_{\mathrm{n}} m_{\mathrm{n}} \vec{\mathbf{v}}_{\mathrm{n}}$ $\quad$ $M\vec{\mathbf{a}}_{\mathrm{cm}} = \vec{\mathbf{F}}_{\mathrm{ext}}$

$\Delta\theta = \omega_0 t + \frac{1}{2}\alpha t^2$ $\quad$ $\omega = \omega_0 + \alpha t$ $\quad$ $\omega^2 = \omega_0^2 + 2\alpha\Delta\theta$

$v_{\mathrm{t}} = r\omega$ $\quad$ $a_{\mathrm{t}} = r\alpha$ $\quad$ $a_{\mathrm{R}} = v_{\mathrm{t}}^2/r = r\omega^2$

$I = \sum m_n r_n^2$, $\quad$ $I = \int r^2 dm$ $\quad$ $I = I_{\mathrm{cm}} + Mh^2$

$\tau = rF_\perp = r_\perp F = r\sin\theta F$ $\quad$ $\vec{\tau} = \vec{\mathbf{r}} \times \vec{\mathbf{F}}$ $\quad$ $\tau = I\alpha$

$L = I\omega$, $mvr_\perp = mv_\perp r = mvr\sin\theta$ $\quad$ $\frac{dL}{dt} = \tau_{\mathrm{ext}}$

$K = \frac{1}{2}mv^2$, $\frac{1}{2}I\omega^2$ $\quad$ $U = mgy$, $kx^2/2$ $\quad$ $F_{\mathrm{spring}} = -kx$

$x(t) = x_{\mathrm{m}} \cos(\omega t + \phi)$ $\quad$ $\omega = \sqrt{k/m}$, $\quad T = 2\pi/\omega$, $\quad f = 1/T = \omega/2\pi$

$\theta(t) = \theta_{\mathrm{m}} \cos(\omega t + \phi)$ $\quad$ simp. pend. : $\omega = \sqrt{g/L}$ $\quad$ phys. pend. : $\omega = \sqrt{Mgd/I}$

$F = Gm_1 m_2/r^2$ $\quad$ $U = -Gm_1 m_2/r$ $\quad$ $G = 6.67 \times 10^{-11}\ \mathrm{N \cdot m^2/kg^2}$

$W_{\mathrm{F}} = Fs\cos\theta$ $\quad$ $W_{\mathrm{tot}} = K_2 - K_1$ $\quad$ $W_{\mathrm{other}} = (K_2 + U_2) - (K_1 + U_1)$

$y(x,t) = A\cos(kx - \omega t)$ $\quad$ $k = 2\pi/\lambda$ $\quad$ $\lambda/T = \lambda f = v_{\mathrm{wave}}$

Moments of Inertia :

rod around center : $I = \frac{mL^2}{12}$ $\quad$ rod around end : $I = \frac{mL^2}{3}$ $\quad$ disk around center : $I = \frac{mR^2}{2}$

thin sph. shell : $I = \frac{2mR^2}{3}$ $\quad$ solid sphere : $I = \frac{2mR^2}{5}$ $\quad$ thin hoop about diam : $I = \frac{mR^2}{2}$

Distances :

$\mathrm{Earth - Moon} = 3.84 \times 10^8\ \mathrm{m}$ $\quad$ $\mathrm{Earth - Sun} = 1.50 \times 10^{11}\ \mathrm{m}$ $\quad$ $\mathrm{Earth\ radius} = 6.37 \times 10^6\ \mathrm{m}$

Masses :

$\mathrm{Earth} = 5.98 \times 10^{24}\ \mathrm{kg}$ $\quad$ $\mathrm{Moon} = 7.35 \times 10^{22}\ \mathrm{kg}$ $\quad$ $\mathrm{Sun} = 1.99 \times 10^{30}\ \mathrm{kg}$