# Equation List – P251 Final Exam

$g = 9.81 \text{ m/s}^2,$ $\qquad G = 6.67 \times 10^{-11} \text{ N·m}^2/\text{kg}^2$

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

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

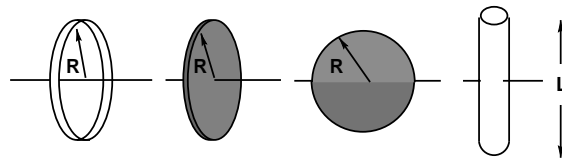$v = dx/dt, \quad a = dv/dt, \quad a_c = v^2/r, \quad s = r\theta, \quad v = \omega r, \quad a_t = \alpha r$

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$\Sigma\vec{F}_{ext} = M\vec{a} = d\vec{p}/dt \qquad \Sigma\vec{\tau}_{ext} = I\vec{\alpha} = d\vec{L}/dt$

$\vec{\tau} = \vec{r} \times \vec{F} \qquad \vec{L} = \vec{r} \times \vec{p} = I\vec{\omega}$

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$W = \int \vec{F} \cdot d\vec{r}, \qquad K = \frac{1}{2}MV^2$

$F_{spr} = -kx, \qquad U_{spr} = \frac{1}{2}kx^2, \qquad F_g = GM_1M_2/r^2, \qquad U_g = -GM_1M_2/r$

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$M_{cm}\vec{r}_{cm} = \Sigma M_i\vec{r}_i, \qquad \vec{p}_{cm} = M\vec{v}_{cm}$

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$\vec{a} \cdot \vec{b} = a_i b_i + a_j b_j + a_k b_k = |\vec{a}||\vec{b}|\cos\theta$

$\vec{a} \times \vec{b} = (a_j b_k - a_k b_j)\hat{i} - (a_i b_k - a_k b_i)\hat{j} + (a_i b_j - a_j b_i)\hat{k}$

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Ring: $I = MR^2$; Solid disk: $I = \frac{1}{2}MR^2$; Solid sphere: $I = \frac{2}{5}MR^2$
Hollow sphere: $I = \frac{2}{3}MR^2$ Uniform bar: $I = \frac{1}{12}ML^2$



Parallel-axis theorem: $I = I_{cm} + MR^2$

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$x = (-b \pm \sqrt{b^2 - 4ac})/2a$