Answers- Week 11

11-1. A rigid body consists of many point masses m_i located at $\vec{r}_i$ so that the separation between any two points, $(\vec{r}_i - \vec{r}_j)$ is fixed. Such a body will move without changing its size or shape.

11-3. About the y-axis $I = 2Md^2$
About the 45° line also $I = 2Md^2$

11-5. $I = \frac{1}{3} M_E R_E^2 \omega_E^2$

$M_E = 6x10^{24}$kg, $R_E = 6400x10^3$m, $\varpi_E = 7.3x10^{-5}$ rad/s

$k = \frac{1}{2} I\omega^2 = 2.2x10^{29}$ Joules

11-7. $\vec{\omega} = \vec{\omega}_o + \vec{\alpha} t \qquad so \quad \vec{\alpha} = +0.4\, rad/s^2$

$\vec{\tau} = I\vec{\alpha} = \frac{1}{2} M r^2 \vec{\alpha} = [\vec{r} \times \vec{F}]$

$\vec{F} = -2x10^{-3}\, N\,\hat{x}$

11-9. Equilibrim Eqs. are $N_{Rx} - f_s = 0$, $f_s \leq \mu_s N_{Ry}$

$N_{Ry} - Mg - M_1 g = 0$

$-MgCos\theta \frac{\ell}{2} - M_1 gCos\theta\, \ell' + N_{Rx}\, \ell\, Sin\theta = 0$

So $N_{Rx} = (\frac{Mg}{2} + M_1 g \frac{\ell'}{\ell})\, Cot\theta$

If θ becomes very small, $Cot\theta$ will become very large, N_{Rx} will become larger than $\mu_s N_{Ry}$ and the ladder will slip.

11-11. The Sphere will reach first because the acceleration is $a = \frac{g\, Sin\theta}{1 + \frac{I}{M r^2}}$ down the incline.

So $a_{ring} = \frac{g\, Sin\theta}{2}$, $a_{sphere} = \frac{g\, Sin\theta}{1.4}$

11-13. $\Delta P = \frac{F}{\pi r^2} = 33\, N/m^2$