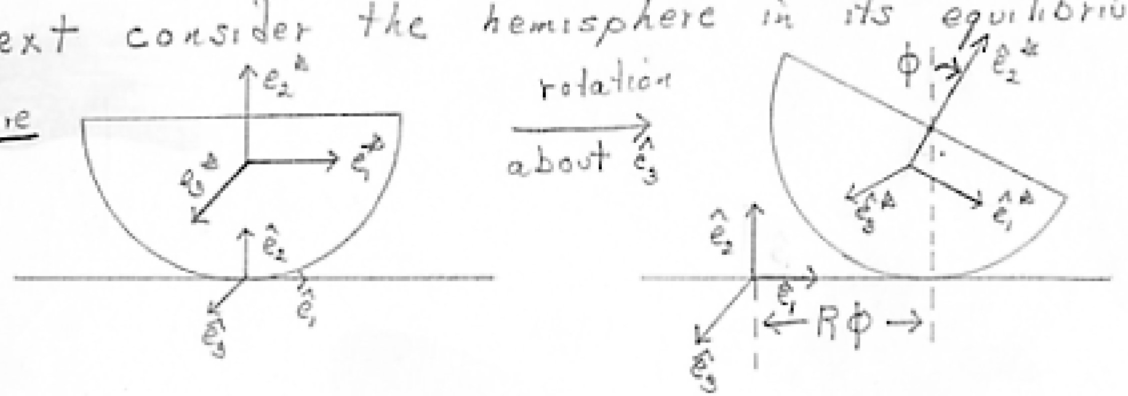
Steiner says $I^{0}_{ij} = \frac{M}{2}\left[\delta_{ij}\, \vec{a}^{\,2} - a_i a_j\right] + I^{CM}_{ij}$. Here $a_1 = a_3 = 0$ & $a_2 = \frac{3}{8} R$

$$\therefore \quad I^{CM}_{ij} = \frac{1}{5} M R^2 \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix} - \frac{M}{2} R^2 \begin{pmatrix} 9/64 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & \frac{9}{64} \end{pmatrix} = MR^2 \begin{pmatrix} \left(\frac{1}{5} - \frac{9}{128}\right) & 0 & 0 \\ 0 & 1/5 & 0 \\ 0 & 0 & \left(\frac{1}{5} - \frac{9}{128}\right) \end{pmatrix}$$

Next consider the hemisphere in its equilibrium and displaced positions:

Before



After

Before: $R_1^{CM} = 0$

$R_2^{CM} = 5/8\, R$

$R_3^{CM} = 0$

$\hat{e}_i^{*} = \hat{e}_i$

After: $R_1^{CM} = R\phi - \frac{3}{8} R \sin\phi \Rightarrow \dot{R}_1^{CM} = R\left(1 - \frac{3}{8}\cos\phi\right)\dot{\phi}$

$R_2^{CM} = R - \frac{3}{8} R \cos\phi \qquad \dot{R}_2^{CM} = \frac{3}{8} R \sin\phi\, \dot{\phi}$

$R_3^{CM} = 0 \qquad \dot{R}_3^{CM} = 0$

$\hat{e}_1^{*} = \hat{e}_1 \cos\phi - \hat{e}_2 \sin\phi \qquad \hat{e}_3^{*} = \hat{e}_3$

$\hat{e}_2^{*} = \hat{e}_1 \sin\phi + \hat{e}_2 \cos\phi$

Now differentiate to get the result shown on next page.