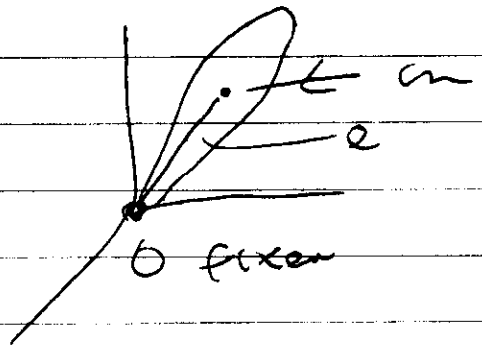
Example 2 problem 1 §3 T



I_1, I_2, I_3 are moments of inertia w.r.t. cm

moment of inertia w.r.t. O

$$\vec{a} = (0, 0, e)$$

$$I_1 \to I_1 + \mu e^2$$

$$I_2 \to I_2 + \mu e^2$$

ψ and ϕ are cyclic

$$\Rightarrow L = \frac{1}{2}(I_1 + \mu e^2)(\dot\theta^2 + \dot\phi^2 \sin^2\theta) + \frac{1}{2} I_3 (\dot\psi + \dot\phi \cos\theta)^2 - \mu g e \cos\theta$$

$$p_\psi = \frac{\partial L}{\partial \dot\psi} = I_3 (\dot\psi + \dot\phi \cos\theta) = I_3 \Omega_3 = M_3$$

conserved

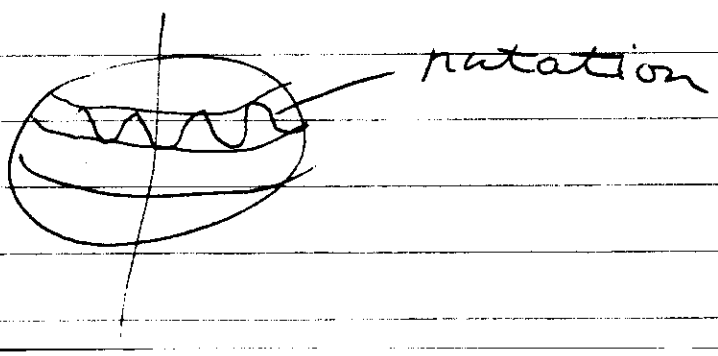
$$p_\phi = \frac{\partial L}{\partial \dot\phi} = (I_1 + \mu e^2) \sin^2\theta \, \dot\phi + I_3 (\dot\psi + \dot\phi \cos\theta) \cos\theta = M_z$$

conserved

M_z = projection of M_2 on z axis

$$E = T + U = \frac{1}{2}(I_1 + \mu e^2)(\dot\theta^2 + \dot\phi^2 \sin^2\theta) + \frac{1}{2} I_3 (\dot\psi + \dot\phi \cos\theta)^2 + \mu g e \cos\theta$$

We can eliminate $\dot\theta$ and $\dot\phi$ to obtain an equation for θ.



Result