PHYS 4001 Quiz 1

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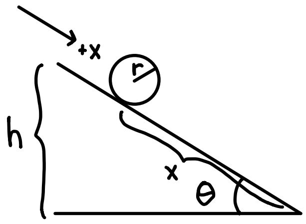

$$T = \frac{1}{2}m\dot{x}^2 + \frac{1}{2}I\left(\frac{\dot{x}}{r}\right)^2 \qquad \omega = \frac{\dot{x}}{r}$$

$$U = mgx\sin\theta$$

$$\mathcal{L} = T - U = \frac{1}{2}m\dot{x}^2 + \frac{1}{2}I\frac{\dot{x}^2}{r^2} - mgx\sin\theta$$

Want: I in terms of t

$$\frac{\partial\mathcal{L}}{\partial x} = \frac{d}{dt}\frac{\partial\mathcal{L}}{\partial \dot{x}} \qquad \frac{\partial\mathcal{L}}{\partial x} = -mg\sin\theta \qquad \frac{\partial\mathcal{L}}{\partial \dot{x}} = m\dot{x} + \frac{I\dot{x}}{r^2} \qquad \frac{d}{dt}\frac{\partial\mathcal{L}}{\partial \dot{x}} = m\ddot{x} + \frac{I\ddot{x}}{r^2}$$

$$-mg\sin\theta = m\ddot{x} + \frac{I\ddot{x}}{r^2}$$

$$-mg\sin\theta = \ddot{x}\left(m + \frac{I}{r^2}\right)$$

$$\ddot{x} = \frac{-mg\sin\theta}{m + \frac{I}{r^2}}$$

$$x = \frac{1}{2}\ddot{x}t^2$$

$$t^2 = \frac{2x}{\ddot{x}}$$

$$t = \sqrt{\frac{2x}{\ddot{x}}}$$

$$t = \sqrt{\frac{2x}{\frac{-mg\sin\theta}{m + \frac{I}{r^2}}}} \longrightarrow \text{Solve for } I \text{ for each measurement of } t$$