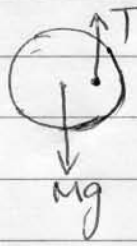
Date
NO

4. (a) $I = I_0 + MR'^2$

$= \frac{MR^2}{2} + M \cdot (\frac{R}{2})^2 = \frac{3}{4}MR^2$

(b)



Mg, gravity, give rise to nonzero torque.

(c) Newton's 2nd law

$$\begin{cases} Mg - T = Ma \\ Mg \times \frac{R}{2} = \frac{3}{4}MR^2\alpha \\ a = \frac{R}{2}\alpha \end{cases} \Rightarrow \begin{cases} Mg - T = Ma \\ 2g = 3R\alpha \Rightarrow a = \frac{g}{3} \\ R\alpha = 2a \end{cases}$$

(d) Energy conservation:

$Mgh = \frac{1}{2}Mv^2 + \frac{1}{2}M(\frac{v}{\frac{R}{2}})^2 \quad \frac{I_0}{2}(\frac{v}{\frac{R}{2}})^2$

$Mgh = \frac{1}{2}Mv^2 + \frac{1}{2} \cdot \frac{MR^2}{2} \cdot (\frac{v}{\frac{R}{2}})^2$

$v = \sqrt{\frac{2gh}{3}}$

(e) $a = \frac{dv}{dt} = \sqrt{\frac{2g}{3}}\frac{dh^{1/2}}{dt} = \sqrt{\frac{2g}{3}} \cdot \frac{1}{2}h^{-1/2}v$

$= \sqrt{\frac{2g}{3}} \cdot \frac{1}{2}h^{-1/2} \cdot \sqrt{\frac{2gh}{3}}$

$= \frac{1}{2} \cdot \frac{2g}{3} = \frac{g}{3}$

It agrees with the result from part (c).