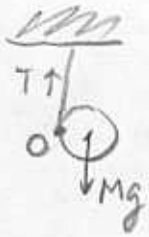
5. One end of a string is fixed on the ceiling. The string winds around a uniform solid spool of mass M, radius R, and length d.



A. (3 pts) What is the moment of inertia of the spool about the axis running through point O and parallel to the central axis of the spool in the figure?

(a) $M(d + R)R$.

(b) $2MR^2$,

(c) $M(d^2 + R^2)$.

**(d) $3/2\ MR^2$.

parallel axis thm:

$I_O = I_{c.m.} + Md^2$ (d here is R for us)

about O

$= \frac{1}{2}MR^2 + MR^2 = \frac{3}{2}MR^2$

B. (4 pts) The spool is released from rest. What is its downward acceleration?

**(a) $2g/3$.

(b) $(R/d)g$.

(c) $(d/R)g$.

(d) g.

$\tau_{about\ O} = MgR = I_O \cdot \alpha$ (torque eq)

$a = \alpha R$ geometry

$\Rightarrow MgR = \frac{3}{2}MR^2 \cdot \frac{a}{R}$

$\Rightarrow a = \frac{2}{3}g$.

C. (3 pts) Suppose the spool were a thin cylinder with the same dimensions and mass as above. What is its acceleration?

In this case $I_{cm} = MR^2 \Rightarrow I_O = 2MR^2$ instead of $\frac{3}{2}$

(a) $(R/d)g$.

**(b) $g/2$.

(c) $2g/3$.

(d) $(d/R)g$.