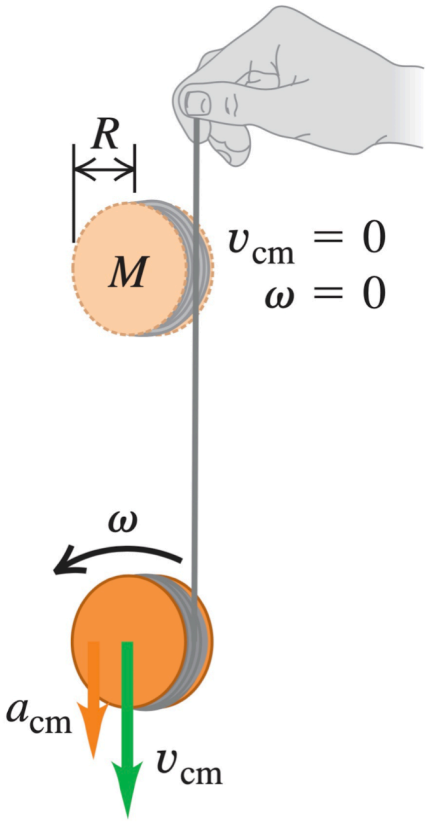
A uniform solid disk of mass *M* and radius *R* has a string wrapped around its rim. The disk unrolls on the string starting from rest through a vertical height *h*.

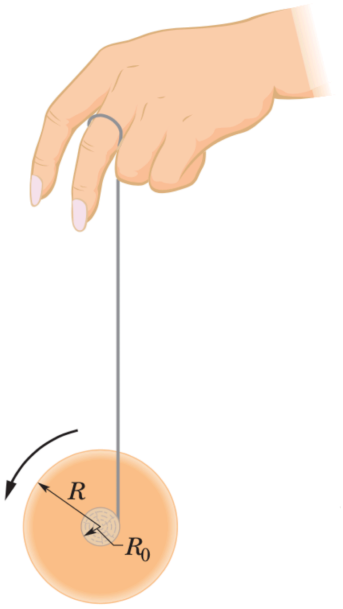
a) Determine the speed of the center of mass after the full vertical drop. *Solve using two methods.*

b) Determine the rotational speed of the rim of the disk after the full vertical drop.

c) Determine the time to reach the bottom.



A yo-yo of total mass M is formed from two uniform solid disks of radius R connected by a massless axle of radius R_0. The yo-yo unrolls on a string wrapped around the axle starting from rest through a vertical height h.



a) Determine the speed of the center of mass after the full vertical drop.
b) Determine the rotational speed of the rim of the yo-yo after the full vertical drop.
c) Determine the time to reach the bottom.

Suppose M = 0.13 kg, R = 0.10 m and $R_0 = R/5$ and h = 1.35 m.

d) After the full drop, the yo-yo falls onto a high-friction rug and would like to roll on the rug with its full rim velocity. What would its kinetic energy be if it could roll on its rim like this?
e) What is the total potential energy available from the full drop?
f) Noticing the discrepancy between d) and e) what actually happens when the yo-yo encounters the rug.