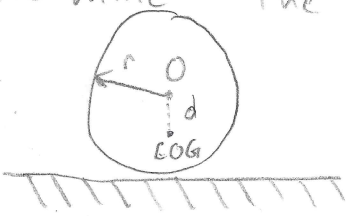
20-R-VIB-DY-52 Beginner

A $r = 0.5$ circle has a center of mass $d = 0.1m$ away from it's center. The circle has a mass $m = 1$ kg and mass moment of inertia $I = 0.15$ at the contact point with the floor. Determine the natural frequency of the circle.



FBD:

$$h = d(1 - \cos\theta)$$

$$E = T + V$$

$$= \frac{1}{2} I \omega^2 + mgh$$

$$= 0.075\dot{\theta}^2 + 9.81(1 - \cos\theta)$$

$$\dot{E} = \ddot{\theta}\, 0.15\dot{\theta} + 9.81 \sin\theta\, \dot{\theta}$$

small angle $\sin\theta = \theta$

$$\dot{E} = \dot{\theta}(0.15\ddot{\theta} + 9.81\theta)$$

$$\omega_n = \sqrt{\frac{9.81}{0.15}} = 8.087$$