Chapter 11 Problem 40 †

Given

$m = 0.880\ kg$
$l = 0.74\ m$
$h = 0.43\ m$
$I_{cm} = 0.048\ kg \cdot m^2$
$v = 50\ m/s$

Solution

a) Find the angular momentum about the pivot point.

First find the moment of inertia about the pivot point. Using the parallel-axis theorem

$$I = I_{cm} + mh^2 = 0.048\ kg \cdot m^2 + (0.88\ kg)(0.43\ m)^2$$

$$I = 0.211\ kg \cdot m^2$$

The angular velocity about the pivot point is

$$\omega = \frac{v}{r} = \frac{50\ m/s}{0.74\ m} = 67.6\ rad/s$$

The angular momentum is then

$$L = I \cdot \omega = (0.211\ kg \cdot m^2)(67.6\ rad/s) = 14.3\ kg \cdot m^2/s$$

b) Find the torque applied if this angular momentum is reached in 0.25 s.

Torque is the rate of change of angular momentum. Therefore, the average torque is

$$\tau = \frac{\Delta L}{\Delta t} = \frac{14.3\ kg \cdot m^2/s}{0.25\ s} = 57\ N \cdot m$$

†Problem from Essential University Physics, Wolfson