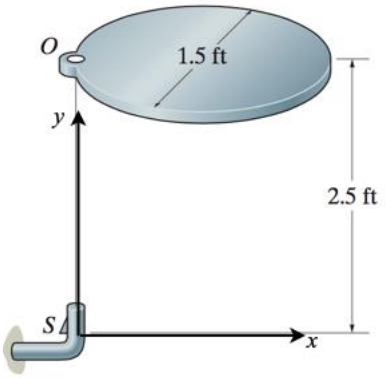
Quiz 19: Chapter 21

Due: Friday 11 Apr 25

Examine the solved problem below. Four errors! Your task is to locate and identify any mistakes, then correct them and calculate the proper result. If the same error occurs more than once, only count it as a single error, even if you have to correct it in more than one instance.

Each correctly identified error is worth 4 points, and the re-calculated results are worth 4 points as well. You must save your work in pdf format and submit via the Quiz 19 Assignment in the Chapter 21 folder in the Quizzes folder of the Online Classroom in Blackboard. Please do not use any other file format than pdf.

The circular plate has a weight $W = 19\text{lb}$ and a diameter $d = 1.5\text{ft}$. It is released from rest and falls horizontally $h = 2.5\text{ft}$ onto the hook at S, which provides a permanent connection. Determine the velocity of the mass center of the plate just after the collision (connection with the hook is made).



A) Conserve energy from instant of release (0) to instant just before collision (1):

$$T_0 + V_0 = T_1 + V_1$$
$$mgh_0 + 0 = \frac{1}{2}mv_1^2 + 0$$
$$(19\text{lb})\left(32.2\frac{\text{ft}}{\text{s}^2}\right)(2.5\text{ft}) = \frac{1}{2}(19\text{lb})v_1^2$$
$$v_1 = 161\frac{\text{ft}}{\text{s}}$$

B) Conserve angular momentum during the collision:

$$\overrightarrow{H_1} = \overrightarrow{H_2}$$
$$\overrightarrow{H_1} = \vec{r} \times m\overrightarrow{v_1} = (19\text{lb})\left[(0.75\text{ft})\hat{\imath} \times \left(161\frac{\text{ft}}{\text{s}}\right)\hat{\jmath}\right] = (2294\text{ft}\cdot\text{lb}\cdot\text{s})\hat{\text{k}}$$
$$\overrightarrow{H_2} = (I_x\omega_x)\hat{\imath} + (I_y\omega_y)\hat{\jmath} + (I_z\omega_z)\hat{\text{k}}$$

C) Solve the system:

x–direction: $0 = I_x\omega_x$ $\omega_x = 0$

y–direction: $0 = I_y\omega_y$ $\omega_y = 0$

z–direction: $(2294\text{ft}\cdot\text{lb}\cdot\text{s}) = I_z\omega_z = \left[\frac{1}{2}mr^2 + mr^2\right]\omega_z = \left[\frac{3}{2}mr^2\right]\omega_z$

$$(2294\text{ft}\cdot\text{lb}\cdot\text{s}) = \left[\frac{3}{2}(19\text{lb})(0.75\text{ft})^2\right]\omega_z$$
$$\omega_z = 143\frac{\text{rad}}{\text{s}}$$

D) Calculate the velocity vector $\overrightarrow{v_2}$:

$$\overrightarrow{v_2} = \overrightarrow{\omega_2} \times \vec{r} = \left(143\frac{\text{rad}}{\text{s}}\right)\hat{\text{k}} \times (0.75\text{ft})\hat{\imath}$$
$$\vec{v} = \left(107\frac{\text{ft}}{\text{s}}\right)\hat{\jmath}$$