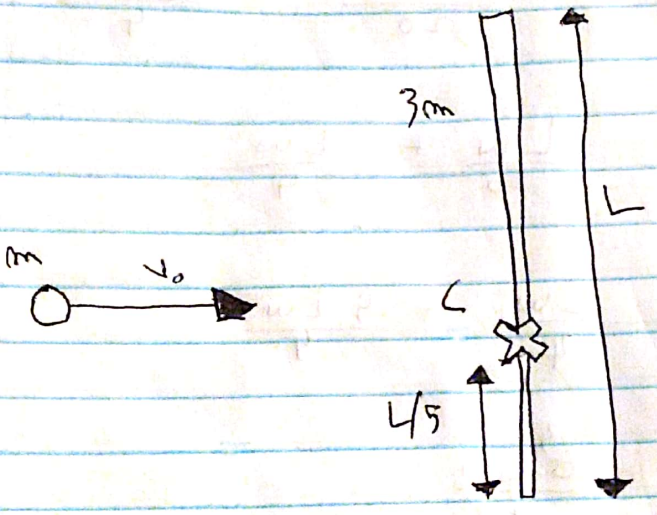
NAME :- SHREYAS SRINIVASA
PALOMAR ID :- 012551187

05/04/2021

PHYS-230
LAB QUIZ #11

A point mass of mass m and initial velocity v_0 is moving towards a thin, vertical rod of length L and mass 3m as shown in the diagram below (values shown below). They experience a perfectly inelastic collision at the point labeled as C (so that the point mass gets stuck to the rod at that point). Determine the final linear and angular velocities of the system.



$m = 1.23$ kg
$L = 2.54$m
$v_0 = 5.68$ m/s

Ans:- Using conservation of linear momentum,

$$m v_0 = 3m v$$

Using conservation of linear momentum again, we get

$$m v_0 = (3m + m) v$$

or, $$v = \frac{m v_0}{4m} = \frac{v_0}{4},$$

where v is the speed after collision.

P.T.O

Using conservation of linear momentum,

$$\frac{m V_0 L}{5} = \frac{m v L}{5} + \frac{1}{12} \cdot \frac{3}{4} m L^2 \cdot w$$

$$\Rightarrow \frac{m V_0 L}{5} = \frac{m v L}{5} + \frac{m L^2 w}{4}$$

$$\Rightarrow \frac{m V_0 L}{5} = \frac{m V_0 L}{20} + \frac{m L^2 w}{4}$$

$$\Rightarrow \frac{m V_0 L}{5} = \frac{m L^2 w}{20} + \frac{m L^2 w}{4}$$

$$\Rightarrow \frac{V_0}{5} = \frac{Lw}{20} + \frac{Lw}{4}$$

$$\Rightarrow V_0 = \frac{Lw}{4} + \frac{5Lw}{4}$$

$$\Rightarrow V_0 = \frac{6Lw}{4}$$

$$\Rightarrow w = \frac{2V_0}{3L}$$

Angular velocity, $w = \frac{2 \times 5.68}{3 \times 2.54}$

$= \frac{11.36}{7.62}$

$= 1.58 \text{ rad/s}$

Linear speed, $v = \frac{V_0}{4} = \frac{5.68}{4} = 1.42 \text{ m/s}$