A uniform stick d = 1 m long with a total mass of 750 g is pivoted at its center by means of a frictionless peg. A 5.6 g bullet is shot through the stick midway between the pivot and one end. It approaches at v0 = 409 m/s and leaves at vf = 260 m/s.

a) What is the moment of inertia of the stick about the pivot?
b) What is the angular momentum of the bullet about the pivot before the collision?
c) What is the angular momentum of the stick about the pivot after the collision?
d) With what angular speed is the stick spinning after the collision?
e) What is the net impulse, Istick exerted on the stick during the collision?

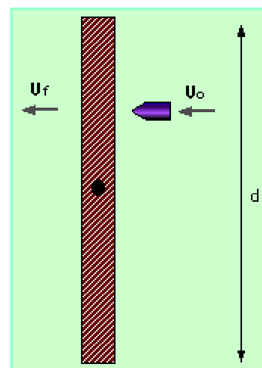
a) Moment of inertia of a uniform rod about its perpendicular bisector is given by

$$I = \frac{1}{12} M d^2 = \frac{0.750 * 1^2}{12} = 62.5 * 10^{-3} \text{ Kg*m}^2$$

b) The angular momentum is the moment of momentum or the product of momentum and perpendicular distance from the axis, hence
$L_1 = mv_0*(d/4) = 5.6*10^{-3}*409*0.25 = 0.5726$ Kg m^2/s

c) Angular momentum of the bullet after collision is given by
$L_2 = mv_f*(d/4) = 5.6*10^{-3}*260*0.25 = 0.3640$ Kg m^2/s

d) As there no external torque about the pivot applying law of conservation of angular momentum about the pivot the angular momentum L of the stick after collision is given by



$L = L_1 - L_2$

Or $L = 0.5726 - 0.3640 = 0.2086$ Kg m^2/s

The angular velocity of a rotating body is given by

$L = I*\omega$

Or $\omega = L/I = 0.2086/(62.5*10^{-3}) = 3.3376$ rad/s

e) Impulse = change in momentum
The total impulse on the stick will be zero as the center of mass of the stick is not moving initially as well as afterwards. The other Impulse is due to the pivot equal to that due to bullet and in opposite direction. Hence
I stick net = 0

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