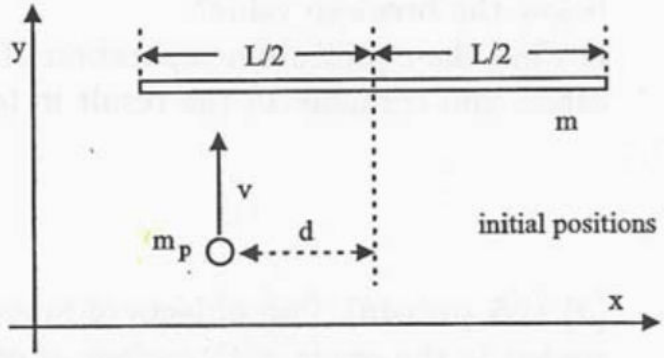
[2] (25 points) A thin, narrow bar of length L and mass m starts at rest on a frictionless horizontal plane. Choose the x axis along the length of this starting bar position. A point mass m_p slides with velocity V in the y direction and then hits the bar at a distance d from the bar's center of mass. We observe that the point mass is at rest after this elastic collision with the bar.



a) Find the final linear velocity $\vec{v}_{COM}$ (magnitude and direction) of the center of mass of the bar, in terms of given quantities.

b) What is the moment of inertia I of the bar for rotation about its center?

c) Find the final angular velocity ω of the bar about its center of mass, in terms of given quantities.

d) Using an additional condition, solve for the ratio m/m_p for this case where the final velocity of the point mass is zero. (HINT: what else is conserved?)