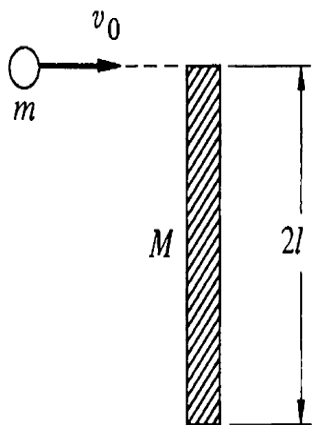


6.31 A cylinder of radius  $R$  spins with angular velocity  $\omega_0$ . When the cylinder is gently laid on a plane, it skids for a short time and eventually rolls without slipping. What is the final angular velocity,  $\omega_f$ ?

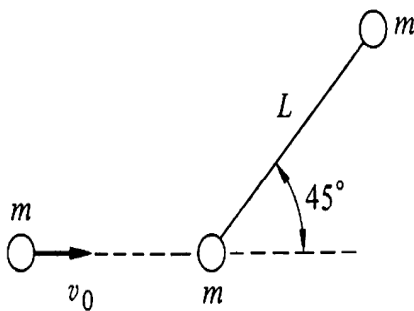
Ans. clue. If  $\omega_0 = 3 \text{ rad/s}$ ,  $\omega_f = 1 \text{ rad/s}$



6.37 a. A plank of length  $2l$  and mass  $M$  lies on a frictionless plane. A ball of mass  $m$  and speed  $v_0$  strikes its end as shown. Find the final velocity of the ball,  $v_f$ , assuming that mechanical energy is conserved and that  $v_f$  is along the original line of motion.

b. Find  $v_f$  assuming that the stick is pivoted at the lower end.

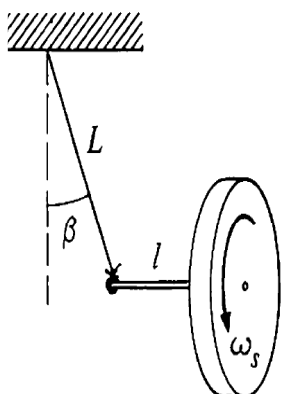
Ans. clue. For  $m = M$ , (a)  $v_f = 3v_0/5$ ; (b)  $v_f = v_0/2$



6.38 A rigid massless rod of length  $L$  joins two particles each of mass  $m$ . The rod lies on a frictionless table, and is struck by a particle of mass  $m$  and velocity  $v_0$ , moving as shown. After the collision, the projectile moves straight back.

Find the angular velocity of the rod about its center of mass after the collision, assuming that mechanical energy is conserved.

Ans.  $\omega = (4\sqrt{2}/7)(v_0/L)$



7.3 A gyroscope wheel is at one end of an axle of length  $l$ . The other end of the axle is suspended from a string of length  $L$ . The wheel is set into motion so that it executes uniform precession in the horizontal plane. The wheel has mass  $M$  and moment of inertia about its center of mass  $I_0$ . Its spin angular velocity is  $\omega_s$ . Neglect the mass of the shaft and of the string.

Find the angle  $\beta$  that the string makes with the vertical. Assume that  $\beta$  is so small that approximations like  $\sin \beta \approx \beta$  are justified.