

57. (a) With  $r = 0.60$  m, we obtain  $I = 0.060 + (0.501)r^2 = 0.24 \text{ kg} \cdot \text{m}^2$ .  
(b) Invoking angular momentum conservation, with SI units understood,

$$\begin{aligned}\ell_0 &= L_f \\ mv_0 r &= I\omega \\ (0.001)v_0(0.60) &= (0.24)(4.5)\end{aligned}$$

which leads to  $v_0 = 1.8 \times 10^3 \text{ m/s}$ .