83. You are designing a clutch assembly which consists of two cylindrical plates, of mass $M_A = 6.0\,\text{kg}$ and $M_B = 9.0\,\text{kg}$, with equal radii $R = 0.60\,\text{m}$. They are initially separated (Fig. 8–57). Plate M_A is accelerated from rest to an angular velocity $\omega_1 = 7.2\,\text{rad/s}$ in time $\Delta t = 2.0\,\text{s}$. Calculate (*a*) the angular momentum of M_A, and (*b*) the torque required to have accelerated M_A from rest to ω_1. (*c*) Plate M_B, initially at rest but free to rotate without friction, is allowed to fall vertically (or pushed by a spring), so it is in firm contact with plate M_A (their contact surfaces are high-friction). Before contact, M_A was rotating at constant ω_1. After contact, at what constant angular velocity ω_2 do the two plates rotate?

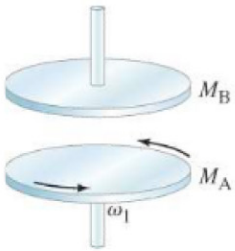

FIGURE 8–57
Problem 83.

84. A marble of mass m and radius r rolls along the looped rough track of Fig. 8–58. What is the minimum value of the vertical height h that the marble must drop if it is to reach the highest point of the loop without leaving the track? Assume $r \ll R$, and ignore frictional losses.

85. Repeat Problem 84, but do not assume $r \ll R$.

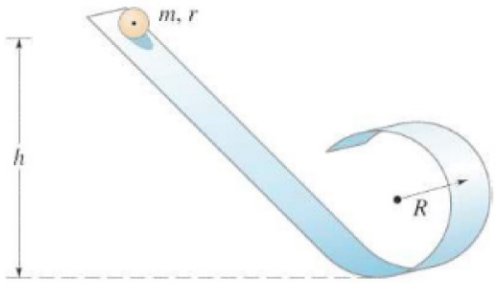

FIGURE 8–58 Problems 84 and 85.

86. The tires of a car make 85 revolutions as the car reduces its speed uniformly from 90.0 km/h to 60.0 km/h. The tires have a diameter of 0.90 m. (*a*) What was the angular acceleration of each tire? (*b*) If the car continues to decelerate at this rate, how much more time is required for it to stop?

Answers to Exercises

A: $f = 0.076\,\text{Hz}$; $T = 13\,\text{s}$.
B: $\vec{\mathbf{F}}_A$.
C: Yes; she does work to pull in her arms.
D: Work was done in pulling the string and decreasing the circle's radius.