**16.90** A flywheel is rigidly attached to a shaft of 30-mm radius that can roll along parallel rails as shown. When released from rest, the system rolls 5 m in 40 s. Determine the centroidal radius of gyration of the system.

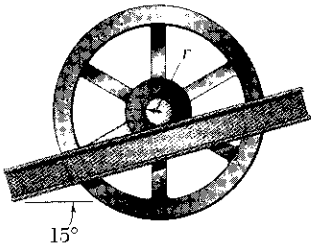


**Fig. P16.90 and P16.91**

**16.91** A flywheel of centroidal radius of gyration $\bar{k}$ is rigidly attached to a shaft that can roll along parallel rails. Denoting by $\mu_k$ the coefficient of static friction between the shaft and the rails, derive an expression for the largest angle of inclination $\beta$ for which no slipping will occur.

**16.92** A homogeneous sphere *S*, a uniform cylinder *C*, and a thin pipe *P* are in contact when they are released from rest on the incline shown. Knowing that all three objects roll without slipping, determine, after 6 s of motion, the clear distance between (*a*) the pipe and the cylinder, (*b*) the cylinder and the sphere. Give the answers in both U.S. customary and SI units.

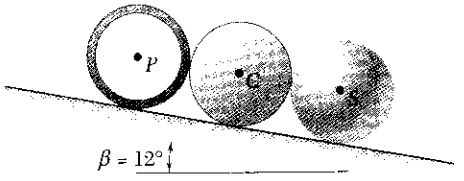


**Fig. P16.92**

**16.93 through 16.96** A drum of 80-mm radius is attached to a disk of 160-mm radius. The disk and drum have a combined mass of 5 kg and combined radius of gyration of 120 mm. A cord is attached as shown and pulled with a force **P** of magnitude 20 N. Knowing that the coefficients of static and kinetic friction are $\mu_s = 0.25$ and $\mu_k = 0.20$, respectively, determine (*a*) whether or not the disk slides, (*b*) the angular acceleration of the disk and the acceleration of *G*.

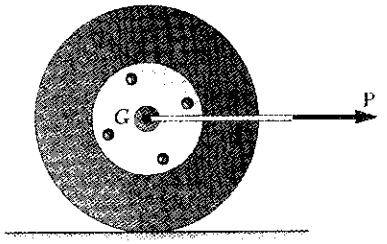


**Fig. P16.93 and P16.97**

**16.97 through 16.100** A drum of 4-in. radius is attached to a disk of 8-in. radius. The disk and drum have a total weight of 10 lb and combined radius of gyration of 6 in. A cord is attached as shown and pulled with a force **P** of magnitude 5 lb. Knowing that the disk rolls without sliding, determine (*a*) the angular acceleration of the disk and the acceleration of *G*, (*b*) the minimum value of the coefficient of static friction compatible with this motion.

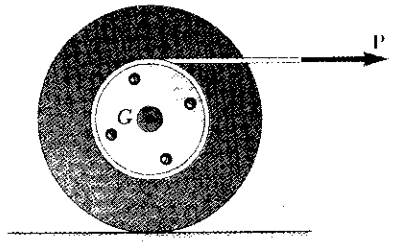


**Fig. P16.94 and P16.98**

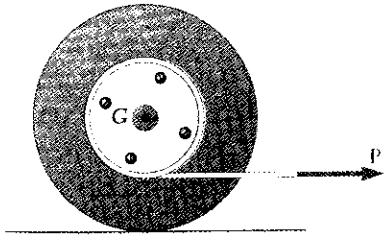


**Fig. *P16.95* and P16.99**

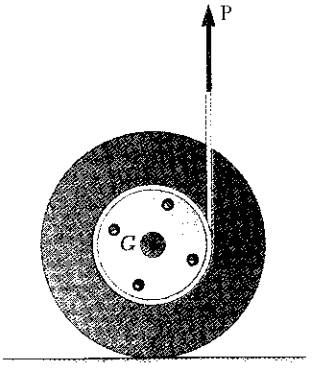


**Fig. P16.96 and P16.100**