5 pts. a) $\alpha = \frac{W_1 - W_0}{\frac{1}{2} M (\frac{\theta}{t})^2} = \frac{0 - 39.0 \text{rev/s}^2}{32.0 \text{s}} = 1.22 \text{rev/s}^2 \times \frac{2\pi \text{rad}}{\text{rev}} = \frac{7.66 \text{rad/s}^2}{32.0 \text{s}} = 0.24 \text{rad/s}^2$ (angular acceleration)

10 pts. b) $I = 2 M (\frac{\theta}{t})^2 + \frac{M r^2}{12} = \frac{1}{2} (M + M) \frac{1}{12} (1.20 \text{m})^2 (1.06 \text{kg} + 0.6 \text{kg}) = 1.53 \text{kgm}^2$ (moments of inertia)

$I = 1.53 \text{kgm}^2 \times 7.66 \text{rad/s}^2 = 11.7 \text{Nm}$ = Retarding torque (5 pts)

5 pts. c) $W_f = \Delta KE = 0 - \frac{1}{2} I \omega_0^2 = -\frac{1}{2} (1.53 \text{kgm}^2)(39.0 \times 2\pi \text{rad/s})^2$ $W_f = -4.60 \times 10^4 \text{J}$ = Work done by friction

5 pts. d) $W_f = -T \theta$ $\theta = \frac{-W_f}{T} = \frac{-4.60 \times 10^4 \text{J}}{11.7 \text{Nm}} = 3.92 \times 10^3 \text{rad}$

$\theta = 3.92 \times 10^3 \text{rad} \times \frac{1 \text{rev}}{2\pi \text{rad}} = \frac{62.4 \text{rev}}{32.0 \text{s}}$ in the

7. A uniform steel rod of length 1.20 m and mass 6.40 kg has attached to each end a small ball of mass 1.06 kg. The rod is constrained to rotate in a horizontal plane about a vertical axis through its midpoint. At a certain instant it is observed to be rotating with an angular speed of 39.0 rev/s. Because of axle friction it comes to rest 32.0 s later. Compute, assuming a constant frictional torque

(a) the angular acceleration,
(b) the retarding torque exerted by axle friction,
(c) the total work done by the axle friction, and
(d) the number of revolutions executed during the 32.0 s.