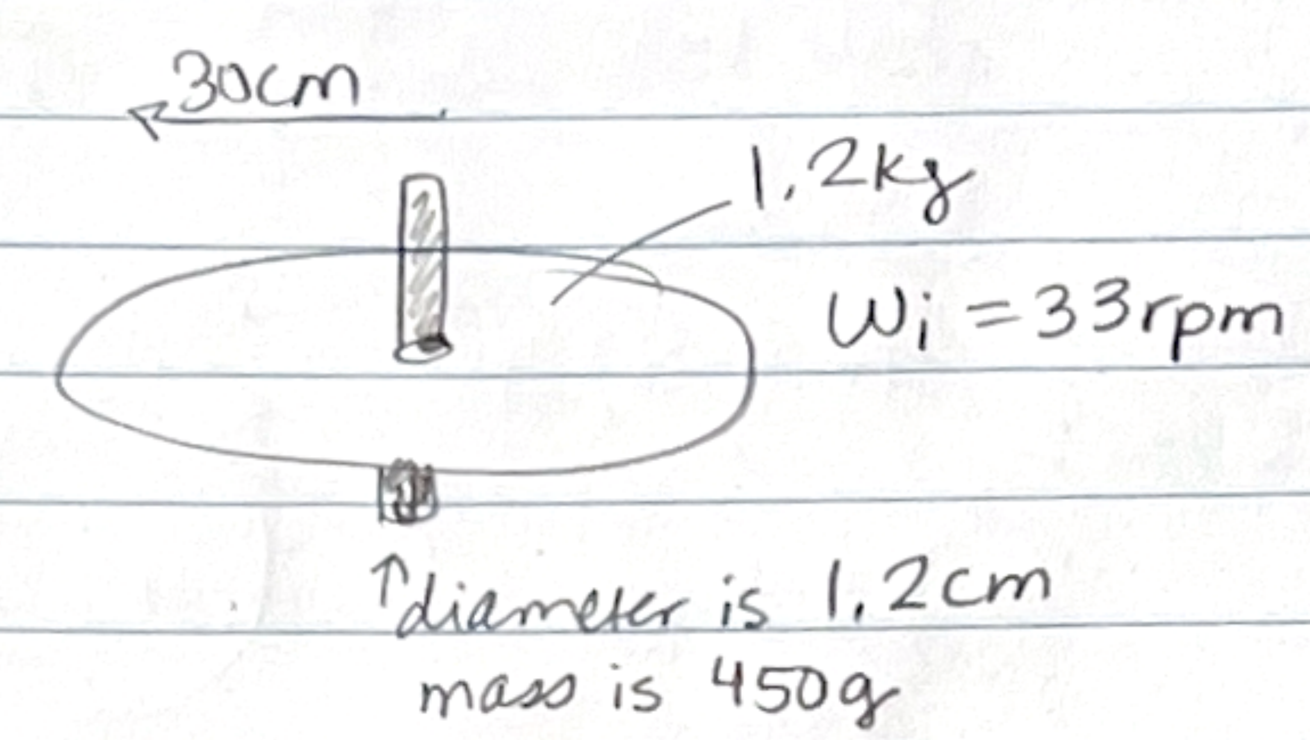
p. 333 #67



$W_i = 33\text{rpm} = 33\frac{\text{rev}}{\text{min}}\left(\frac{2\pi\text{ rad}}{1\text{rev}}\right)\left(\frac{1\text{ min}}{60\text{s}}\right) = 3.46\text{ rad/s}$

$W_f = 0$

$\Delta t = 15\text{ s}$

Find f_k

The brake pad causes a force of friction on the shaft that causes the torque that brings the turntable to rest. $\Sigma\tau = I\alpha \Rightarrow f_k \cdot r_{shaft} = I\alpha$

The shaft has mass that must be stopped too, so we have 2 cylinders/disks combined in this object

$I = \left(\frac{1}{2}m_{shaft} r_{shaft}^2\right) + \left(\frac{1}{2}m_{turntable} r_{turntable}^2\right)$

$= \frac{1}{2}(.450\text{ kg})(.006\text{ m})^2 + \frac{1}{2}(1.2\text{kg})(0.15\text{m})^2$

$= 8.1\times10^{-6} + .0135$

$= 0.0135\text{ kg}\cdot\text{m}^2$

Now I can know $f_k\, r_{shaft} = I\alpha$ 2 things. I see I can find α using kinematics:

$\alpha = \frac{\Delta w}{\Delta t}$

$\alpha = \frac{0 - 3.46\text{ rad/s}}{15\text{s}}$

$\alpha = -.23\text{ rad/s}^2$

Now, let's see what I know: $f_k\, r_{shaft} = I\alpha$

So now I can solve for f_k:

$f_k\, r_{shaft} = I\alpha$

$f_k(.006\text{ m}) = (0.0135\text{ kgm}^2)(-.23\text{ rad/s}^2)$

$f_k = -0.52\text{ N}$

So the friction force applied by the brake pad is 0.52N