Name________________________

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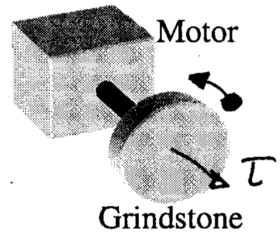
Quiz 8

A 1.5 kg grindstone in the shape of a uniform cylinder is initially at rest. The grindstone has a radius of 0.20 m. The motor attached to the grindstone takes 6.0 sec to bring the grindstone to a final rotation rate of 1800 rev/sec.



a. What is the moment of inertia for the grindstone? (1 points)

$I = \frac{1}{2}MR^2 = \frac{1}{2}(1.5\,kg)(.2m)^2 = \boxed{0.03\ kg\,m^2}$

b. What are the initial and final angular velocities? (1 points)

$\omega_0 = \boxed{0\ Rad/s}$

$\omega = 1800\ \frac{REV}{s}\left(\frac{2\pi\ RAD}{REV}\right) = \boxed{1.13\times10^4\ RAD/s}$ $(3600\pi\ RAD/s)$

c. What is the angular acceleration? (2 points)

$\alpha = \frac{\omega - \omega_0}{t} = \frac{1.13\times10^4\ RAD/s}{6\ sec} = \boxed{1.88\times10^3\ RAD/s^2}$ $(600\pi\ RAD/s^2)$

d. Through how many radians does the grindstone rotate while coming up to full speed? (2 points)

$\theta = \theta_0 + \omega_0 t + \frac{1}{2}\alpha t^2 = \frac{1}{2}\left(1.88\times10^3\ \frac{Rad}{s^2}\right)(6\ sec)^2 = \boxed{3.39\times10^4\ Rad}$ $(10800\pi\ RAD)$

e. How much torque is supplied by the grindstone's motor while bringing it up to speed? (2 points)

$|\vec{\tau}| = I\vec{\alpha} = (.03\ kg\text{-}m^2)\left(1.88\times10^3\ \frac{RAD}{s^2}\right)$ $(18\pi\ N\text{-}m)$

$= \boxed{56.4\ N\text{-}m}$

f. What is the final angular momentum of the grindstone? (2 points)

$|\vec{L}| = I\vec{\omega} = (.03\ kg\,m^2)(1.13\times10^4\ RAD/s) = \boxed{3.39\times10^2\ \frac{kg\,m^2}{s}}$ $(108\pi\ kg\,m^2/s)$

g. Extra Credit: (1 point) What is the kinetic energy of the grindstone wheel? Hint – what analogous rotational quantities can be substituted into the equation for linear kinetic energy?

$K = \frac{1}{2}I\omega^2 = \frac{1}{2}(.03\ kg\,m^2)(1.13\times10^4\ RAD/s)^2 = \boxed{1.91\times10^6\ J}$

$$\theta = \theta_0 + \omega_0 t + \frac{1}{2}\alpha t^2 \qquad \omega = \omega_0 + \alpha t \qquad \omega^2 = \omega_0^2 + 2\alpha(\theta - \theta_0)$$

$$I_{cyl} = \frac{1}{2}MR^2 \qquad \vec{\tau} = I\vec{\alpha} \qquad \vec{L} = I\vec{\omega}$$