University Physics 1A

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Angular Motion

A pulley consists of a hub of radius 0.160m attached to a wheel of radius 0.600m. Initially the pulley is rotating clockwise at 6.50 rad/s, and at some time later it is rotating counterclockwise at 2.50 rad/s. The angular position at the second time is 24.0 rad clockwise relative to the first time. A string wrapped around the hub and is attached to a block.

(a) Find the angular acceleration of the pulley. Be sure to give a vector direction, not using "clockwise" or "counterclockwise".

$$\begin{aligned} \omega^2 &= \omega_0^2 + 2\alpha\theta \\ (-6.5)^2 &= 2.5^2 + 2\alpha 24.0 \\ \alpha &= 0.75\frac{rad}{s} \quad (+\hat{k} \text{ direction}) \end{aligned}$$

(b) Find the time between the two points mentioned.

$$\begin{aligned} \omega &= \omega_0 + \alpha t \\ 2.5 &= (-6.5) + 0.75t \\ t &= 12s \end{aligned}$$

(c) Find the acceleration of the block, including its direction.

$$\begin{aligned} a_{tangential} &= \alpha r \\ &= 0.75(0.160) \\ &= 0.12\frac{m}{s^2} \end{aligned}$$

(d) The string from the block touches the pulley at the hub. At the initial time find the centripetal acceleration of that point on the hub.

$$\begin{aligned} a_{centripetal} &= \frac{v^2}{r} \\ &= r\omega^2 \\ &= 0.160(6.5^2) \\ &= 6.76\frac{m}{s^2} \end{aligned}$$

Moment of Inertia

$$\begin{aligned} KE &= \frac{1}{2}mv^2 \\ &= \frac{1}{2}m(r\omega^2) \\ &= \frac{1}{2}(mr^2)\omega^2 \\ I_{ring} &= \text{moment of inertia} = mr^2 \\ I_{disk} &= \sum_i m_i r_i^2 \\ &= \int r^2 \, \mathrm{d}m \end{aligned}$$

You can find all my notes at `http://omgimanerd.tech/notes`. If you have any questions, comments, or concerns, please contact me at alvin@omgimanerd.tech