Name: Key

Notes - 10.1 Angular Acceleration

1. What is the definition of angular speed ω? What are the units of ω?

$\omega = \frac{\Delta\theta}{\Delta t}$ $\left[\frac{rad}{s}\right]$

2. How are velocity and angular speed related?

$v = \omega r$

3. What is the definition of angular acceleration α? What are the units of α?

$\alpha = \frac{\Delta\omega}{\Delta t}$ $\left[\frac{rad}{s^2}\right]$ $\left[\frac{rad/s}{s}\right]$

4. Suppose a teenager puts her bicycle on its back and starts the rear wheel spinning from rest to a final angular velocity of 250 rpm in 5.00 s.

A. Calculate the angular acceleration in rad/s^2. Show your work.

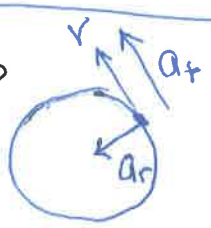
$$\alpha = \frac{\Delta\omega}{t} = \frac{250\frac{rev.}{min}\left(\frac{2\pi\,rad}{1\,rev}\right)\left(\frac{1\,min}{60\,s}\right)}{5.00\,s} = \boxed{5.24\frac{rad}{s^2}}$$

B. If she now slams on the brakes, causing an angular acceleration of -87.3 rad/s^2, how long does it take the wheel to stop? Show your work.

$$t = \frac{\Delta\omega}{\alpha} = \frac{-250\frac{rev}{min}\left(\frac{2\pi\,rad}{1\,rev}\right)\left(\frac{1\,min}{60\,s}\right)}{-87.3\frac{rad}{s^2}} = \boxed{0.300\,s}$$

5. How are tangential acceleration and angular acceleration related?

$a_t = \alpha r$



6. What is the difference between tangential acceleration a_t and radial acceleration a_r? What is another name for radial acceleration?

$a_t \longleftrightarrow \alpha \neq 0 \Leftrightarrow \omega \uparrow$ or $\downarrow$

$a_r = \frac{mv^2}{r} = m\omega^2 r$ change of direction

7. A powerful motorcycle can accelerate from 0 to 30.0 m/s (about 108 km/h) in 4.20 s. What is the angular acceleration of its 0.320-m-radius wheels? Show your work.

$$\alpha = \frac{a_t}{r} = \frac{\frac{\Delta v}{t}}{r} = \frac{\frac{30.0\frac{m}{s} - 0}{4.20\,s}}{0.320\,m} = \boxed{22.3\frac{rad}{s^2}}$$