5.5 Angular Acceleration

Accelerate This!

Angular Acceleration

The analogue to linear acceleration is angular acceleration (symbol =α (units: rad/s^2)): speeding up or slowing down the rotation of a body in uniform circular motion.

$\alpha = \frac{\Delta\omega}{\Delta t}$	**ω = angular speed (rad/s)** **t = time (s)**

CD Examples

1. A CD accelerates uniformly from rest to its operational speed of 500. rpm in 3.50 s.

What is the angular acceleration during this time?

Convert ω in rpm to rad/s:

$$\omega = 500.\,rpm \bullet \frac{0.105\,rad/s}{1\,rpm} = 52.5\,rad/s$$

Then plug values into the definition of α:

$$\alpha = \frac{\Delta\omega}{\Delta t} = \frac{52.5\,rad/s}{3.50\,s} = 15.0\,rad/s^2$$

CD Examples

2. What is the angular acceleration at operational speed?

Since the CD player reached its operational speed after 3.50 s (and goes at a constant rate), it now has no more angular acceleration.

CD Examples

3. If it stops uniformly in 4.50 s, what's α then?

$$\alpha = \frac{\Delta\omega}{\Delta t} = \frac{0\ rad/s - 52.5\,rad/s}{4.50\,s} = -11.7\,rad/s^2$$

Tangential Acceleration (a_t)

As a body rotates faster, the tangential speed of a measuring point increases.
Units = m/s^2.

Tangential acceleration (a_t) math:

$a_t = r \bullet \alpha$	**r = radius (m)** **α = angular acceleration (rad/s^2)**

4. a_t Example

What is the tangential acceleration of a 0.40 m radius object that starts from rest, and reaches an angular speed of 15 rad/s in 10 seconds?

First, find α:

$$\alpha = \frac{\Delta\omega}{\Delta t} = \frac{15\,rad/s}{10\,s} = 1.5\,rad/s^2$$

Then, find a_t:

$$a_t = r \bullet \alpha = 0.40\,m \bullet 1.5\,rad/s^2 = 0.6\,m/s^2$$

Homework 5.5

Preview 5.6

Problems 5.5 in your Booklet
Due: Next Class