Lab — Uniform Angular Acceleration

- Create a model for uniform angular acceleration.

- Determine the order of length of time for the three masses and blank spinner (from approximately the same initial $\bar{\omega}$)

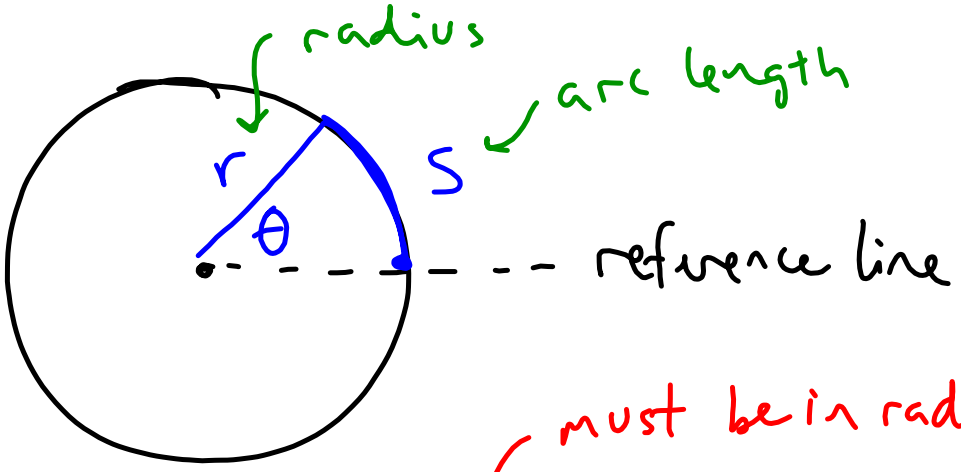
Uniform Angular Acceleration Model

- Properties
- Representations
- Rules of Behavior (use sentences)

Uniform Angular Acceleration Model

- Properties
  - Time
  - Angle (change in angle)
  - Angular velocity
- Representations
  - Linguistic
  - Mathematical:
    - $\bar{\alpha} = \frac{d\bar{\omega}}{dt}$

      ↑ Greek lowercase alpha
    - $\bar{\omega}_f = \bar{\omega}_i + \bar{\alpha}t$
    - $\Delta\bar{\theta} = \bar{\omega}_i t + \frac{1}{2}\bar{\alpha}t^2$
    - $\bar{\omega}_f^2 = \bar{\omega}_i^2 + 2\bar{\alpha}\Delta\bar{\theta}$



must be in radians!

$$s = \theta r$$

$$v = \omega r$$

$$a = \alpha r$$

$$\theta(\text{rad}) = \frac{\pi}{180^\circ}\theta(\text{deg})$$

A wheel rotates with a constant angular acceleration of 3.5 rad/s/s.

1) If the angular speed of the wheel is 2.00 rad/s at t_i = 0, through what angular displacement does the wheel rotate in 2.00 s?

$\omega_i = 2\ rad/s$

$t = 2\ s$

$\alpha = 3.5\ rad/s^2$

$\Delta\theta =$

$\Delta\theta = \omega_i t + \frac{1}{2}\alpha t^2$

$= (2\ rad/s)(2\ s) + \frac{1}{2}(3.5\ rad/s^2)(2)^2$

$= 11\ rad$

2) Through how many revolutions has the wheel turned during this interval?

$\Delta\theta\ (revs) = \frac{11\ rad}{2\pi} = 1.75\ revs$

3) What is the angular speed of the wheel at t = 2.00 s?

$\omega_i = 2\ rad/s$

$t = 2$

$\alpha = 3.5\ rad/s^2$

$\omega_f = ?$

$\omega_f = \omega_i + \alpha t$

$= 9\ rad/s$

1) Find the angular speed of a CD in revolutions per minute when information is being read from the innermost first track (r = 23 mm) and the outermost final track (r = 58 mm). Velocity is 1.3 m/s.

$$\omega_i = \frac{v}{r_i} = \frac{1.3\ m/s}{0.023\ m} = 57\ rad/s \Rightarrow 540\ rev/min$$

$$\omega_f = \frac{v}{r_f} = \frac{1.3\ m/s}{0.058\ m} = 22\ rad/s \Rightarrow 210\ rev/min$$

2) The maximum playing time for a standard music disc is 74 minutes and 33 seconds. How many revolutions does the disc make during this time?

74 min 33 seconds $\Rightarrow$ 74.55 min.

$$\Delta\theta = \frac{1}{2}(\omega_f + \omega_i)t$$

$$= 28000\ rev$$

3) What is the angular acceleration over the length of playing time?

$$\omega_f = \omega_i + \alpha t$$

$$\alpha = \frac{\omega_f - \omega_i}{t}$$

$$= -0.0076\ rad/s^2$$