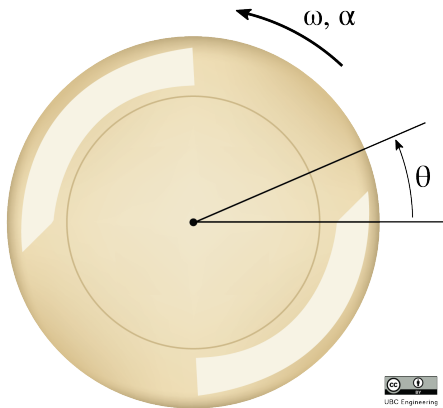


## 22-R-KM-JL-3



It is the final point of an ultimate frisbee game and the disc has been thrown into the end-zone. One particular observer notices that the disc rotates in such a way that its angular velocity can be modelled by the equation  $\vec{\omega} = 2\theta^{1/2} \hat{k}$  rad/s where  $\theta$  is in radians. Find the time required for the disc to reach an angular velocity of  $\vec{\omega} = 200 \hat{k}$  rad/s and its final displacement if at time  $t = 0$  in seconds it starts at the horizontal.

### Solution

To reach the final angular velocity we have  $\omega = 200 = 2\theta^{1/2} \implies \theta_f = 100^2 = 10000$  [rad]

Using the definition of angular velocity, we have  $\omega = d\theta/dt$  which, rearranging, gives the relationship  $dt = d\theta/\omega$ .

Integrating both sides gives:

$$\int_0^t dt = \int_{\theta_0}^{\theta_f} \frac{d\theta}{\omega}$$

$$t = \int_0^{10000} \frac{1}{2\theta^{1/2}} d\theta = \frac{2}{2} \theta^{1/2} \Big|_0^{10000} = 100 - 0 = 100 \text{ [s]}$$