Angular acceleration

$$\alpha = \frac{\Delta\omega}{\Delta t} \qquad \text{rad}/s^2$$

~~"0-60 mph in 5s" 60 mi/hr/s~~

Compare

$$v = \frac{\Delta x}{\Delta t} \qquad a = \frac{\Delta v}{\Delta t}$$

$$\omega = \frac{\Delta\theta}{\Delta t} \qquad \alpha = \frac{\Delta\omega}{\Delta t}$$

Instead of $\Delta x = v_i \Delta t + \frac{1}{2} a (\Delta t)^2$

we get $\Delta\theta = \omega_i \Delta t + \frac{1}{2}\alpha(\Delta t)^2$

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

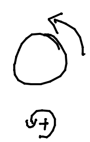
$\omega_f^2 = \omega_i^2 + 2\alpha\Delta\theta$

etc

Speeding up: α & ω same sign.

Slowing down: α & ω opposite sign

eg. Wheel spins initially at $5 \frac{\text{rev}}{s}$ c.c.w. slows to a halt in 10s. α?



A) $\Delta\theta$:

B) ω_i = $5 \text{ rev}/s \times \frac{2\pi \text{ rad}}{1 \text{ rev}} = 10\pi \frac{\text{rad}}{s}$

C) $\omega_f = 0$

D) α = NEED

E) Δt = 10 s

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

$$\frac{\omega_f - \omega_i}{\Delta t} = \alpha = \frac{0 - 10\pi \text{ rad}/s}{10 s} = -3.14 \text{ rad}/s^2$$

How many times does it go around?

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

$$= \frac{1}{2}(10\pi + 0)(10s) = 50\pi \text{ rad}$$

$$50\pi \text{ rad} \times \frac{1 \text{ rev}}{2\pi \text{ rad}} = \boxed{25 \text{ rev}}$$

Which point has larger angular velocity?

A) A B) B $\boxed{\text{C) Both same}}$

All points on a rigid wheel have same angular velocity.

B has farther to go, in same amount of time, so its <u>linear</u> velocity is larger.

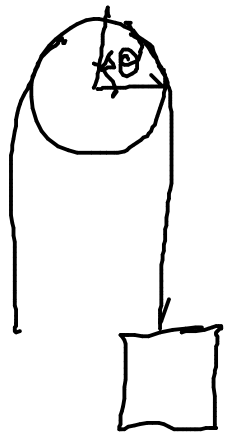
$$\text{distance} = r\,\Delta\theta \quad \leftarrow \text{radians}$$

$$\text{speed} = \frac{\text{distance}}{\text{time}} = r\,\frac{\Delta\theta}{\Delta t}$$

$$\boxed{v = r\omega}$$ only for ω in rad/s,

"faster" could mean "larger v"

or "larger ω".



point on pulley moves through an angle $\Delta\theta$

& move through a distance $r\Delta\theta$

How far does block move then?

Block moves in sync with rope

Rope moves in sync with pulley

IF rope doesn't slip

radius of pulley

$\therefore$ rope & block move a distance $r\Delta\theta$

$$\frac{d}{\Delta t} = r\frac{\Delta\theta}{\Delta t}$$

speed of block $= r \times \omega$ of pulley

$$v = r\omega$$