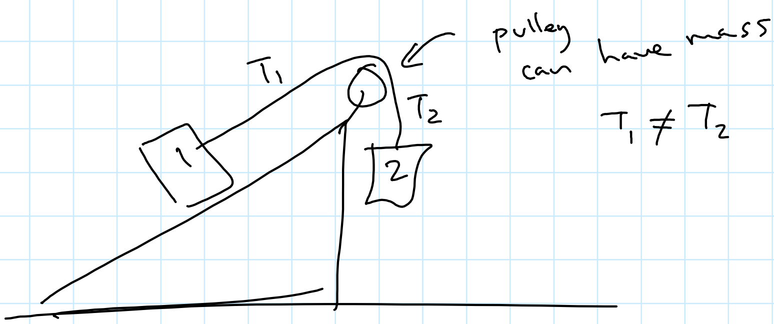
Phy 2A 6/5

Monday, June 5, 2017 10:36 AM

Intro to Rotational Motion
Rotational Kinematics

		Translational Motion	Rotational Motion
Kinematics:	position:	x	θ
	velocity:	$v = \frac{\Delta x}{\Delta t}$	$\omega = \frac{\Delta \theta}{\Delta t}$
	acceleration:	$a = \frac{\Delta v}{\Delta t}$	$\alpha = \frac{\Delta \omega}{\Delta t}$
	equations:	$v_f = v_i + at$	$\omega_f = \omega_i + \alpha t$
		$x_f = x_i + v_i t + \frac{1}{2} a t^2$	$\theta_f = \theta_i + \omega_i t + \frac{1}{2} \alpha t^2$
		⋮	⋮
Newton's Laws:	Inertia:	m	$I = mr^2$ for a pt object
	Force:	$\vec{F}$	Torque: $\vec{\tau}$
	2nd Law:	$\Sigma \vec{F} = m\vec{a}$	$\Sigma \vec{\tau} = I \alpha$
Energy:	Kinetic:	$K = \frac{1}{2} m v^2$	$K_R = \frac{1}{2} I \omega^2$
Momentum:		$\vec{p} = m\vec{v}$	$\vec{L} = I\vec{\omega}$



$T_1 \neq T_2$

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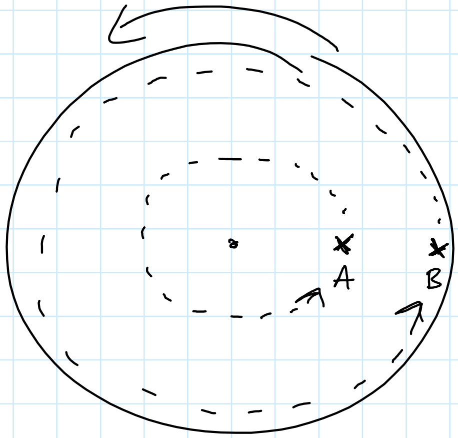
which is going faster: A or B?



which is going faster: A or B?

Translational or Linear Speed:

$$V = \frac{\text{distance}}{\text{time}}$$

$$(\text{distance})_B > (\text{distance})_A$$

$$t_B = t_A$$

so,

$$V_B > V_A$$

Rotational speed:

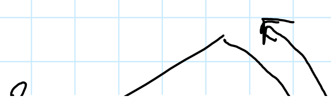
$$\omega = \frac{\Delta\theta}{\Delta t}$$

both complete a revolution in the same amount of time:

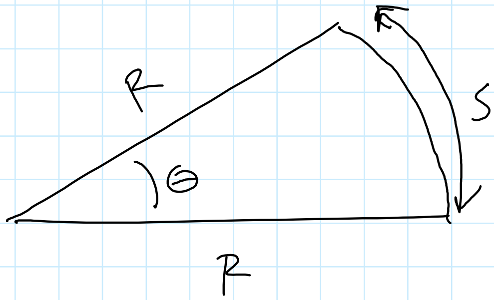
$$\omega_A = \omega_B$$

units

θ	ω	α
radians	$\frac{rad}{s}$	$\frac{rad}{s^2}$
degrees	$\frac{deg}{s}$	$\frac{deg}{s^2}$
revolutions	$\frac{rev}{s}$	$\frac{rev}{s^2}$



if θ is in Radians:



if θ is in Radians:

$$S = R\theta$$

$$V = R\omega$$

$$a = R\alpha$$

Kinematics: Start your washing machine: tub spins up to 10 $\frac{rad}{s}$ in 8 sec from rest (with constant acceleration, α). How many revolution did it rotate through in those 8 sec?

θ_i	0
θ_f	?
ω_i	0
ω_f	10 $\frac{rad}{s}$
α	?
t	8 s

Find α:

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

$$10 = 0 + \alpha (8)$$

$$\alpha = \frac{10}{8} = \frac{5}{4} = 1.25 \ \frac{rad}{s^2}$$

find θ_f:

$$\theta_f = \theta_i + \omega_i t + \frac{1}{2}\alpha t^2$$

$$= 0 + 0 + \frac{1}{2}(1.25)(8)^2$$

$$= 40 \text{ rad}$$

Convert to revolutions:

$$40 \text{ rad} \left(\frac{\text{rev}}{2\pi \text{ rad}} \right) = 6.37 \text{ rev}$$