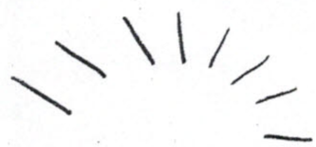
rigid body - is an extended object whose size & shape do not change as it moves

model - bicycle wheel (approximation model)

3 types of motion:

translational motion - <u>doesn't</u> rotate

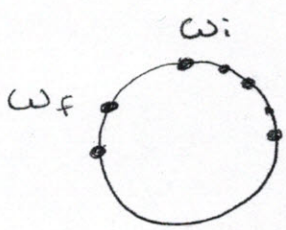
rotational motion - circular motion



combination motion - moves along a trajectory

☆ every pt. on a rotating rigid body has the same angular velocity, but different speeds <u>if</u> different distances from the axis of rotation

non-uniform circular motion



bicycle wheel

$t_i = \omega_i$ (angular velocity)

$t_f = t_i + \Delta t$

angular velocity $\Delta \omega = \omega_f - \omega_i$

$\boxed{\text{relate}}$ $a_x = \frac{\Delta v_x}{\Delta t} = \frac{(v_x)_f - (v_x)_i}{\Delta t}$

angular acceleration
non-uniform circular motion

$\alpha = \frac{\Delta \omega}{\Delta t}$ (change in angular velocity) / (time interval)

alpha

units rad/s^2

α positive when:

- counter-clockwise + speeding up
- clockwise + slowing down

α negative when:

- counter-clockwise + slowing down
- clockwise + speeding up

☆ "Synthesis 7.1"

		Linear Motion	Circular Motion	
Variables	position	x	θ	angle (rad)
	velocity (m/s)	$v_x = \frac{\Delta x}{\Delta t}$	$\omega = \frac{\Delta \theta}{\Delta t}$	angular velocity (rad/s)
	acceleration (m/s²)	$a_{\cancel{x}} = \frac{\Delta v_x}{\Delta t}$	$\alpha = \frac{\Delta \omega}{\Delta t}$	angular accelerati (rad/s²)
Equations	constant velocity	$\Delta x = v(\Delta t)$	$\Delta \theta = \omega(\Delta t)$	constant angular velocity
		$\Delta v = a(\Delta t)$	$\Delta \omega = \alpha(\Delta t)$	constant angular acceleration
	constant acceleration	$\Delta x = v(\Delta t) + \frac{1}{2} a(\Delta t)^2$	$\Delta \theta = \omega_i(\Delta t) + \frac{1}{2}\alpha(\Delta t)^2$	

7.2.3

Graphs:

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

- the angular velocity is the slope of the angular position-versus-time graph

$$\omega = \alpha(\Delta t)$$

- the angular acceleration is the slope of the angular velocity-versus-time graph

Tangential Acceleration

relate

$$a_c = \frac{v^2}{r} = \omega^2 r$$

uniform

$\vec{a}_c$ centripetal acceleration = change in direction of the particle's velocity (points towards the center)

a_t tangential acceleration = measures the rate at which the particle's speed around the circle increases

non-uniform

a_t

$$a_t = \frac{\Delta v}{\Delta t} = \frac{\Delta(\omega r)}{\Delta t} = \frac{\Delta \omega}{\Delta t} r$$

$$a_t = \alpha r$$

radius

tangential acceleration

angular acceleration