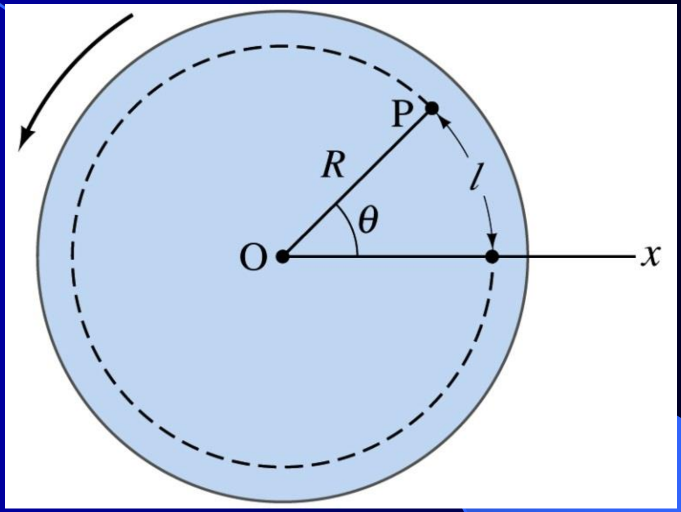
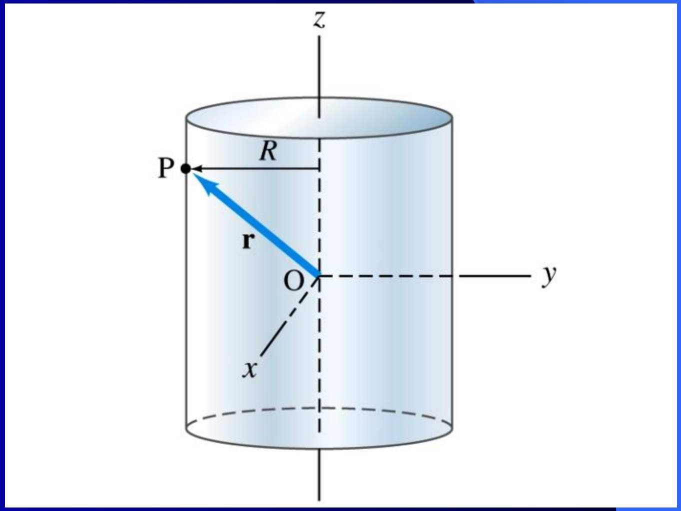
# Rotational Motion

- radian: $\theta = l/R$
- If $l = 2\pi R$, then $\theta = l/R = 2\pi$
- $360° = 2\pi$ rad
- 1 rad $= 360°/2\pi = 57.3°$

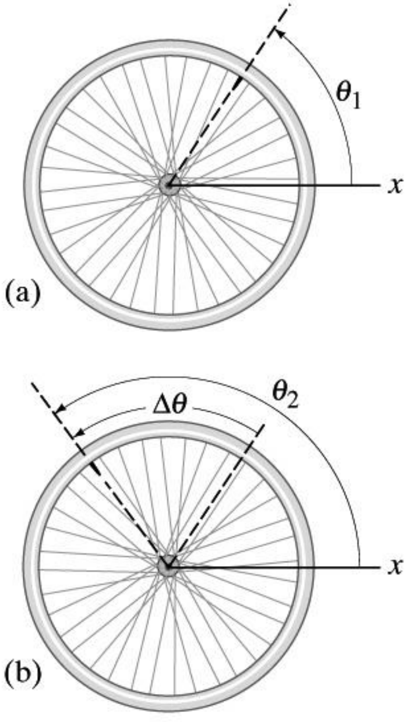



- r versus R
- Axis of rotation



# Rotational Motion

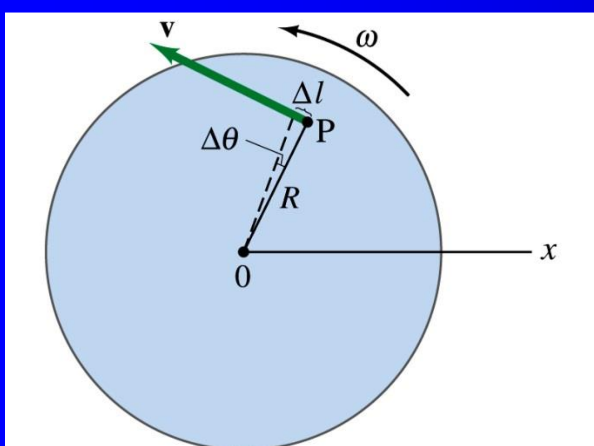
- $\Delta\theta = \theta_2 - \theta_1$
- Angular velocity
  - ave. $\omega = \Delta\theta/\Delta t$
  - $\omega = \lim_{\Delta t \to 0} \Delta\theta/\Delta t$
- Angular acceleration
  - Ave. $\alpha = \Delta\omega/\Delta t$
  - $\alpha = \lim_{\Delta t \to 0} \Delta\omega/\Delta t$

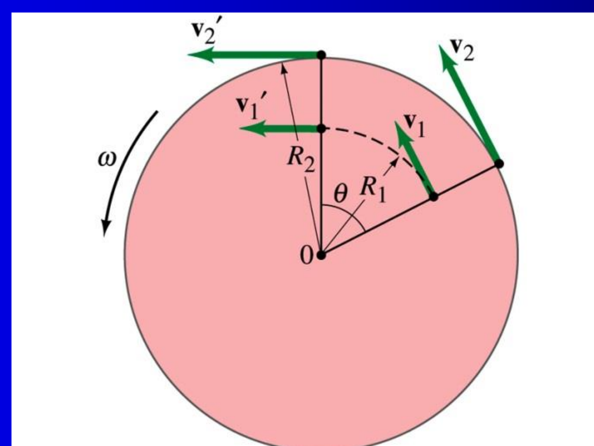


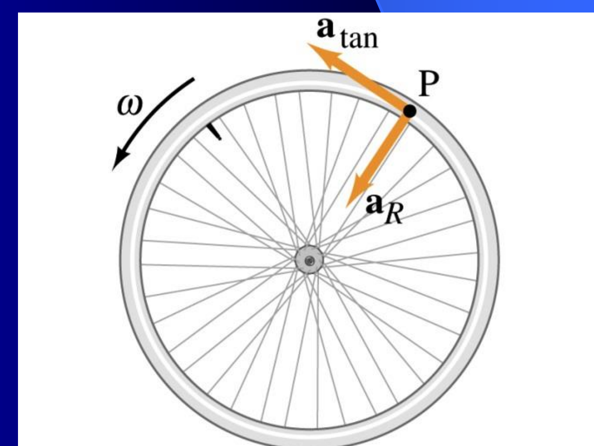
Angular acceleration (rad/s²)

# Linear vs Angular Quantities

- $v = dl/dt = R\, d\theta/dt = R\omega$
- $a_{tan} = \Delta v/\Delta t = R\, \Delta\omega/\Delta t = R\alpha$
- $a_R = v^2/R = (R\omega)^2/R = \omega^2 R$
- $\mathbf{a} = \mathbf{a}_{\mathbf{tan}} + \mathbf{a}_{\mathbf{R}}$
- $1\text{ rev/s} = 2\pi\text{ rad/s} \Rightarrow f = \omega/2\pi \Rightarrow \omega = 2\pi f$



# Uniformly Accelerated Motion

$\omega = \omega_0 + \alpha t$

$\theta = \omega_0 t + ½\alpha t^2$

$\omega^2 = \omega_0^2 + 2\alpha\theta$

Ave. $\omega = (\omega + \omega_0)/2$

$v = v_0 + at$

$x = v_0 t + ½at^2$

$v^2 = v_0^2 + 2ax$

Ave. $v = (v + v_0)/2$