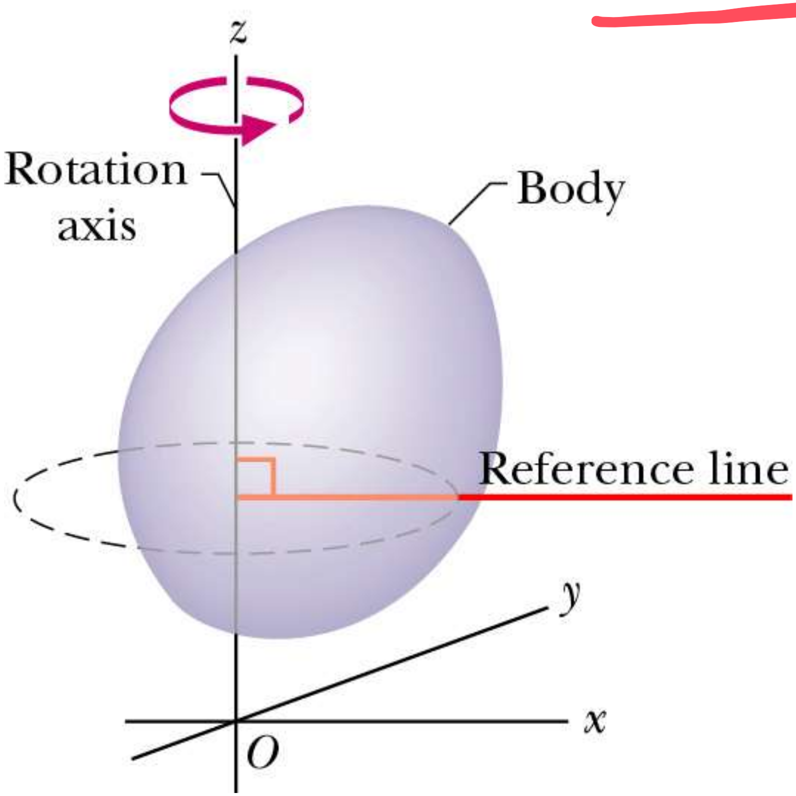
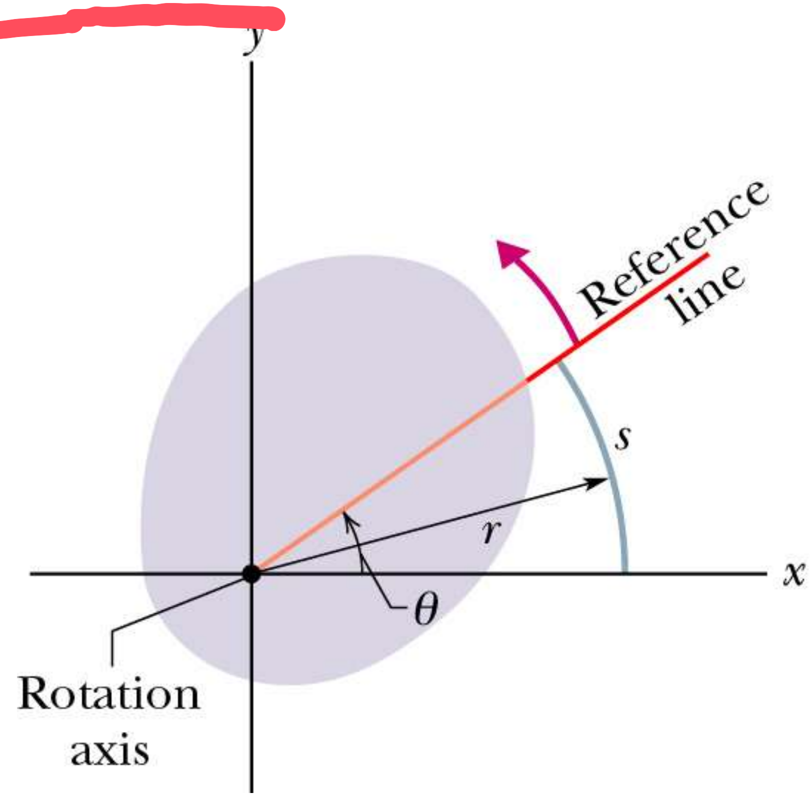
EGG !!!!!!!!





<u>*A rigid body rotates along a fixed axis*</u>

$$\theta = \frac{s}{r} \quad (radian\ measure)$$

$s = arc\ of\ the\ circle$

$*\ circumference: s = 2\pi r$

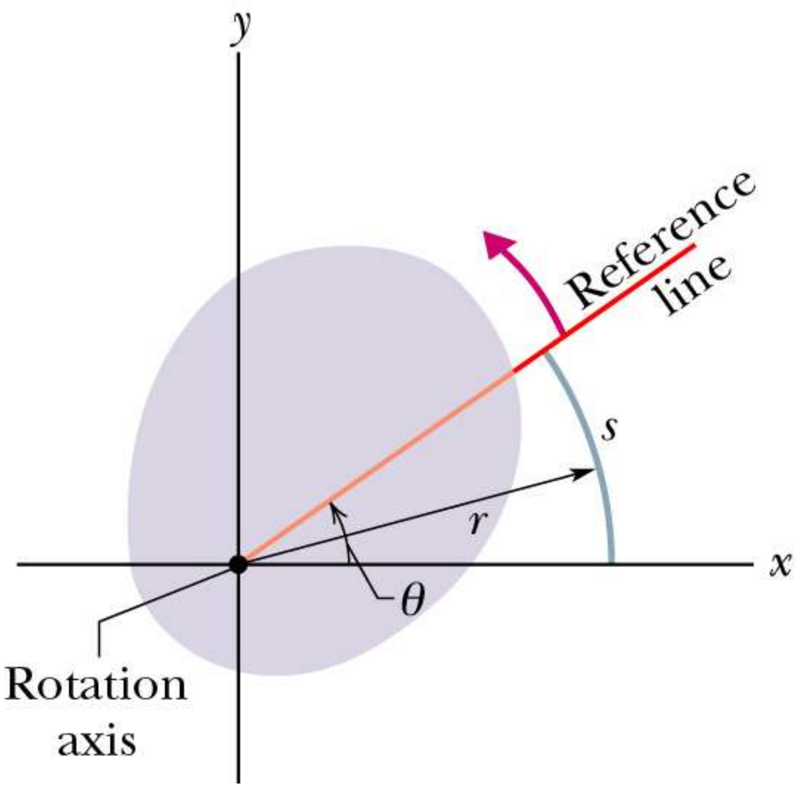
$*\ 1\ rev: \Delta\theta = 2\pi = 360^0$

$$*\ 1\ rad = \frac{360^0}{2\pi} = 57.3^0$$

$s = r\theta$

$for\ \theta = 1\ rad$

$s = r$



$\theta \quad angular\ position$

$angular\ displacement:$

$\Delta\theta = \theta_2 - \theta_1$

θ angular position

$\Delta\theta = \theta_2 - \theta_1$ angular displacement

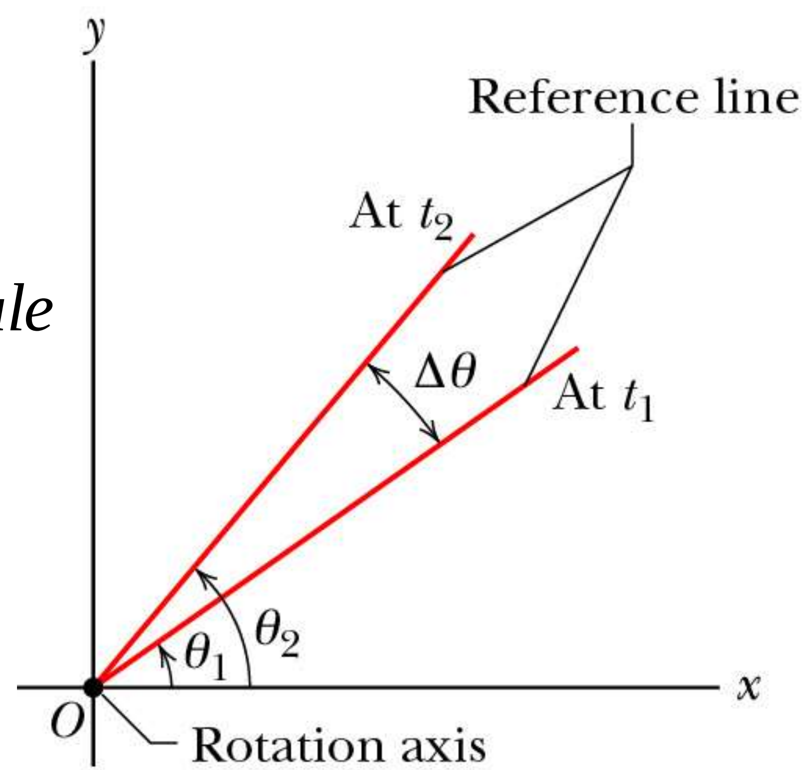
$*$ *angular velocity:*

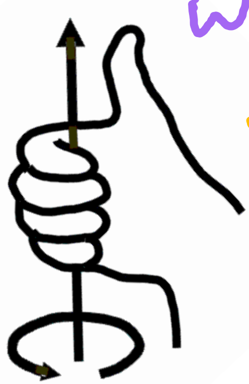
$$\omega_{avg} = \frac{\Delta\theta}{\Delta t} \qquad \omega = \frac{d\theta}{dt}$$

$*$ ω *has a "direction" – right hand rule*

counterclockwise – positive

clockwise – negative





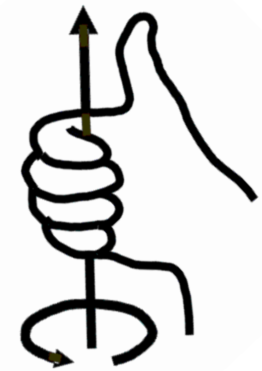
$$\omega(t) = \frac{d\theta(t)}{dt}$$

$$v(t) = \frac{dx(t)}{dt}$$

$$a = \frac{dv(t)}{dt}$$

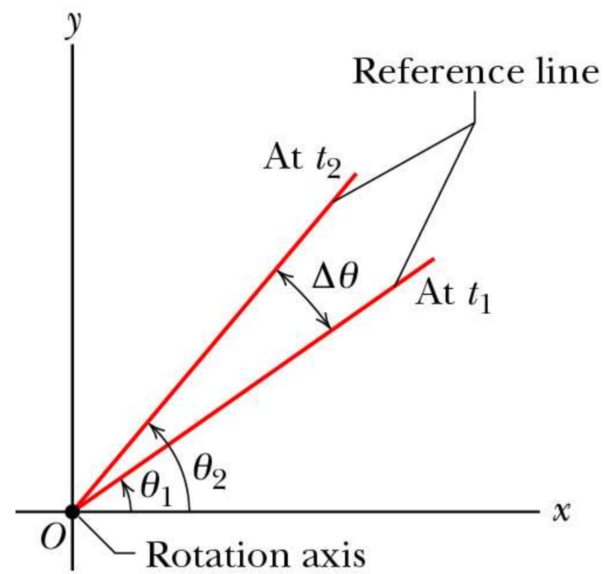
θ *angular position*

$\Delta\theta = \theta_2 - \theta_1$ *angular displacement*



* *angular velocity:*

$$\omega_{avg} = \frac{\Delta\theta}{\Delta t} \qquad \omega = \frac{d\theta}{dt} \qquad \alpha = \frac{d\omega(t)}{dt}$$



* *angular acceleration:*

$$\alpha_{avg} = \frac{\Delta\omega}{\Delta t} \qquad \alpha = \frac{d\omega}{dt}$$

α *is also a vector (right – hand rule)*

* *for counterclockwise – rotation in x – y plane*

$$\vec{\omega} = \omega\vec{k}, \quad \vec{\alpha} = \alpha\vec{k}$$

* for constant angular acceleration:

$$\Delta\omega = \omega - \omega_0 = \alpha t$$

$$\Delta\theta = \theta - \theta_0 = \omega_0 t + \frac{1}{2}\alpha t^2$$

$$\omega^2 - \omega_0^2 = 2\alpha(\theta - \theta_0)$$

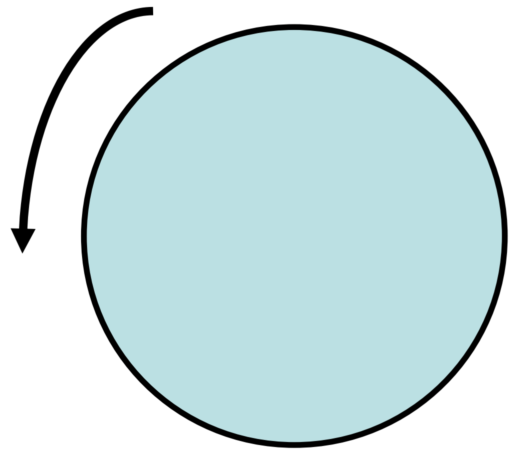
Rigid Body Under Constant Angular Acceleration	**Particle Under Constant Acceleration**
$\omega_f = \omega_i + \alpha t$	$v_f = v_i + at$
$\theta_f = \theta_i + \omega_i t + \frac{1}{2}\alpha t^2$	$x_f = x_i + v_i t + \frac{1}{2}at^2$
$\omega_f^2 = \omega_i^2 + 2\alpha(\theta_f - \theta_i)$	$v_f^2 = v_i^2 + 2a(x_f - x_i)$
$\theta_f = \theta_i + \frac{1}{2}(\omega_i + \omega_f)t$	$x_f = x_i + \frac{1}{2}(v_i + v_f)t$

A disk that initially spins at 2 revolutions/sec is braked uniformly to a stop in ½ second. What is its initial angular speed ω_0?

$v_i = 2\ r/s$

$v_o = 0\ r/s$

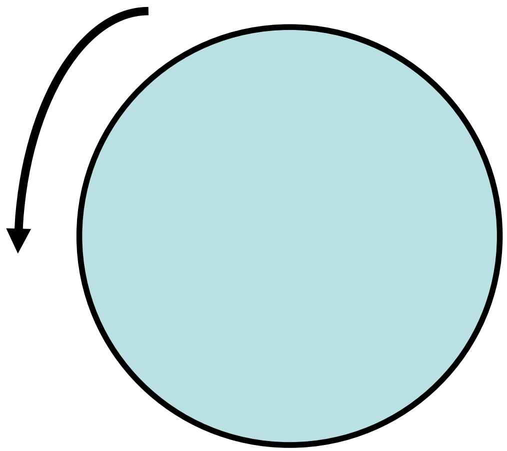
$t = 0.5\ s$



1. π / s
2. $2\pi / s$
3. $4\pi / s$
4. $8\pi / s$

$\omega_o = v_i \cdot 2\pi = 2 \cdot 2\pi = 4\pi/s$

A disk that initially spins at 2 revolutions/sec is braked uniformly to a stop in ½ second. What is the value of angular acceleration α ? (Negative α means stopping)



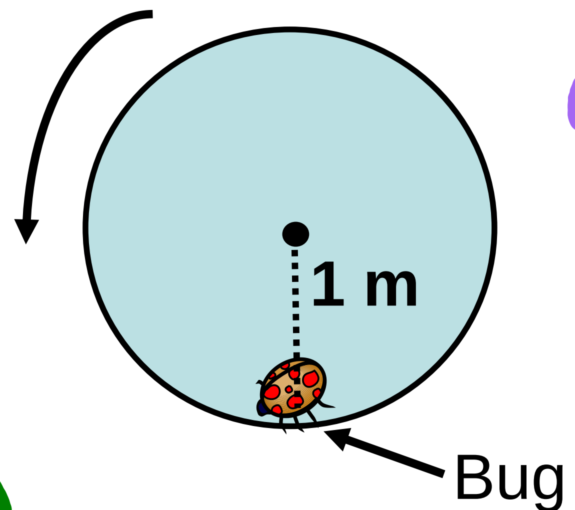
$\alpha = \frac{\Delta \omega}{\Delta t}$

$-\frac{4\pi}{0.5}$

$-8\pi/s^2$

1. $-4\pi/s^2$
2. $4\pi/s^2$
3. $-8\pi/s^2$
4. $8\pi/s^2$

A disk that initially spins at 2 revolutions/sec is braked uniformly to a stop in ½ second. A bug is stuck on the outer edge 1 meter from the center. How many revolutions does the bug go during the time it takes the disk to stop?



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

$$= 4\pi(.5) + \frac{1}{2}(-8\pi)(.25)$$

$$= 2\pi - \pi$$

$$= \pi = 0.5 \text{ rev.}$$

1. 0.25 revolution
2. 0.5 revolution
3. 1 revolution
4. 1.5 revolution
5. 2 revolution

A flywheel turns 40 revolutions as it slows from ω_0 = 1.5 rad/s to a stop. How long does it take?

(A flywheel stores rotational energy. Need them in places such as generators with a varying electrical load)

A flywheel turns 40 revolutions as it slows from ω_0 = 1.5 rad/s to a stop. How long does it take?

(A flywheel stores rotational energy. Need them in places such as generators with a varying electrical load)

$$First\ \ method:$$

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

$$\alpha = \left(\frac{\omega^2 - \omega_0^2}{2\theta}\right) = \left(\frac{0 - \left(1.5\,{}^{rad}\!/_{s}\right)^2}{2(40\,rev)\left(2\pi\,{}^{rad}\!/_{rev}\right)}\right) = -4.48\times10^{-3}\,{}^{rad}\!/_{s^2}$$

$$\omega - \omega_0 = \alpha t$$

$$t = \left(\frac{\omega - \omega_0}{\alpha}\right) = \left(\frac{0 - 1.5\,{}^{rad}\!/_{s}}{-4.48\times10^{-3}\,{}^{rad}\!/_{s^2}}\right) = 335\sec$$

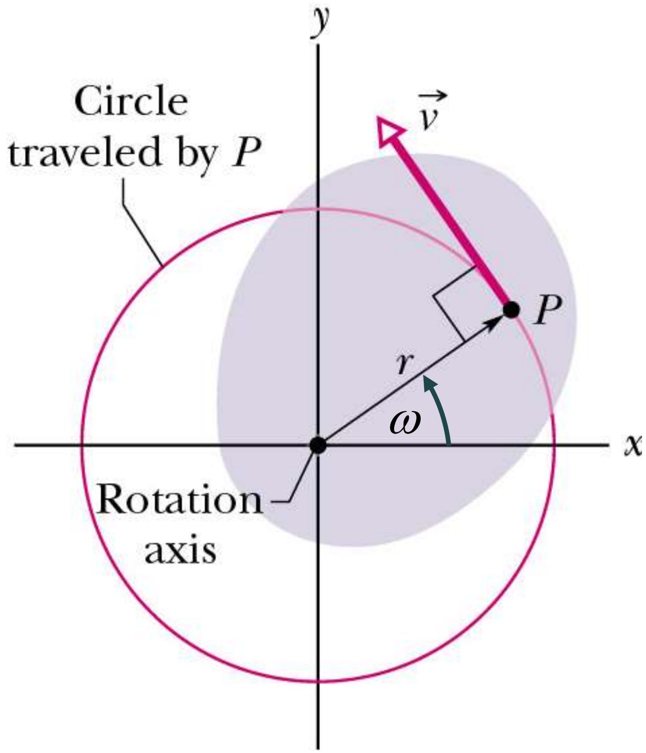
$$Second\ \ method:$$

$$t = \left(\frac{\theta}{\omega_{AV}}\right) = \left(\frac{(40\,rev)\left(2\pi\,{}^{rad}\!/_{rev}\right)}{0.75\,{}^{rad}\!/_{s}}\right) = 335\sec$$

$$s = r\theta$$

$$\frac{ds}{dt} = r\frac{d\theta}{dt}$$

$$V_t = \omega r$$



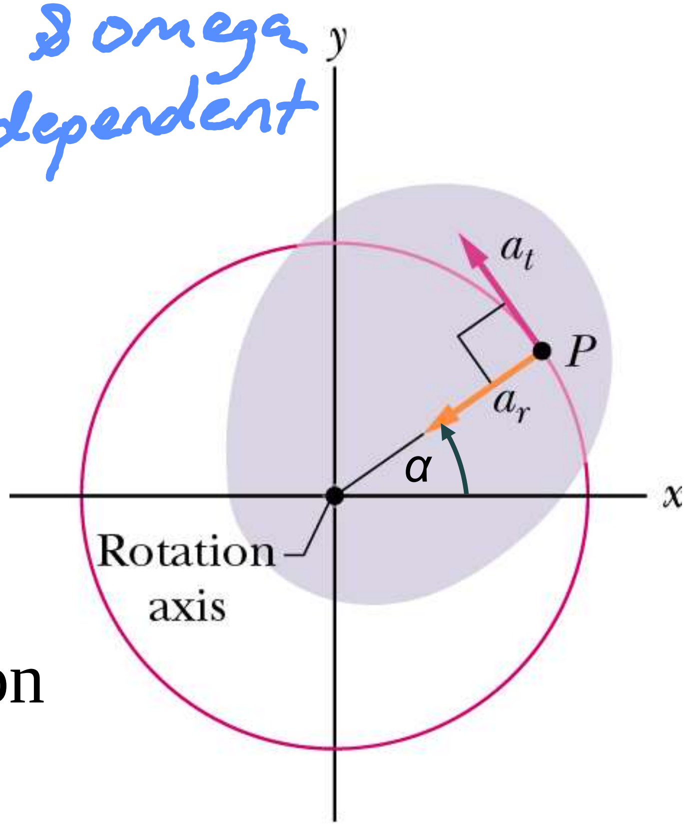
$$T = \frac{2\pi r}{V_t} = \frac{2\pi r}{\omega r} = \frac{2\pi}{\omega}$$

$V_t = \omega r$

tangential acceleration

$$a_t = \frac{dV_t}{dt} = \frac{d\omega}{dt} r = \alpha r$$

velocity & omega time dependent



(b)

$V_t = \omega r$

"centripetal" (radial) acceleration

$$a_r = \frac{V_t^2}{r} = \frac{\omega^2 r^2}{r} = \omega^2 r$$

$s = r\theta$

$V_t = \omega r$

$a_t = \alpha r$ $\quad a_r = \omega^2 r$

A disk that initially spins at 2 revolutions/sec is braked uniformly to a stop in ½ second. A bug is stuck on the outer edge 1 meter from the center.

What is the initial angular speed of the bug?

$\omega = 4\pi/sec$

What is the initial tangential speed of the bug?

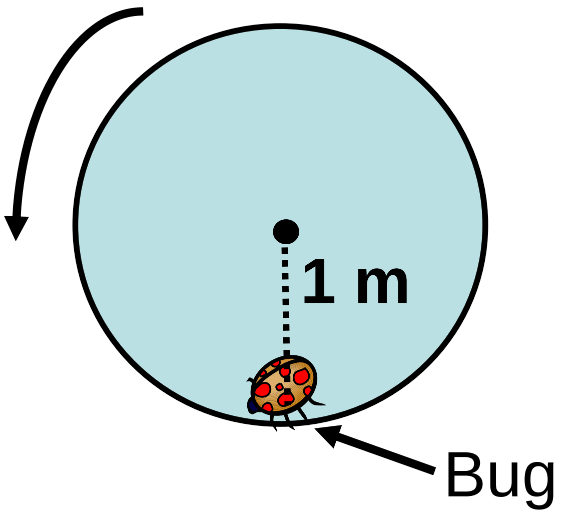
$V = \omega r = 4\pi \cdot 1 = 12.6 \, m/s$

What is the angular acceleration of the bug?
(magnitude and direction CW or CCW)

$\alpha = -8\pi/sec^2$

What is the tangential acceleration of the bug?
(magnitude and direction CW or CCW)

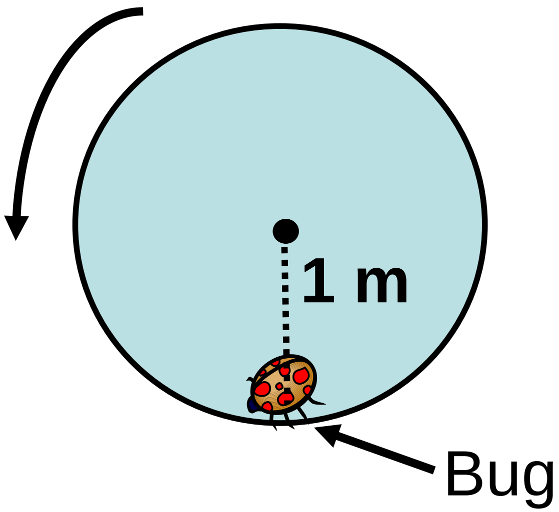
$a_t = \alpha r = -8\pi \cdot 1 = -25.1 \, m/s^2$



A disk that initially spins at 2 revolutions/sec is braked uniformly to a stop in ½ second. A bug is stuck on the outer edge 1 meter from the center.

What is the initial angular speed of the bug?
4π/s

What is the initial tangential speed of the bug?
12.6 m/s



What is the angular acceleration of the bug?
(magnitude and direction CW or CCW)
CW, 8π/s

What is the tangential acceleration of the bug?
(magnitude and direction CW or CCW)
CW, 25.1 m/s