- Base Groups
- Uniform circular motion
- Forces

PHYS 210
General Physics I

$F_{Drag} \propto v$

Base Groups

- BGDG: What's one of the strangest things you've ever seen?
- BGWS
- RQ

Uniform Circular Motion

- Uniform = constant speed
- Circular = non-constant acceleration!
- The centripetal acceleration is
  - $a_c = v^2/r$, where r = radius of circular path
  - a_c is constant in magnitude, not direction
  - At any instant in time, the (constant speed) velocity vector is …

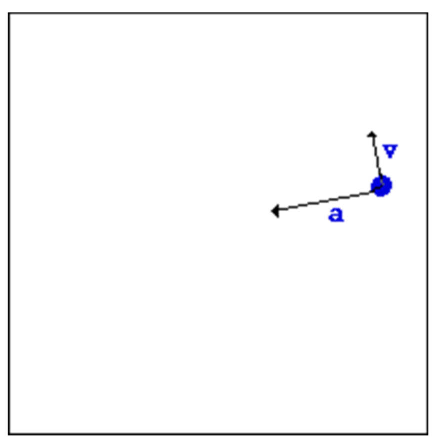
tangent to the circular path!

Uniform circular motion

- Note that the acceleration vector is not constant!
- But the magnitude of $\vec{a}$ is constant:

$$\boxed{|\vec{a}| = \frac{v^2}{r}}$$

where r = radius of circular path

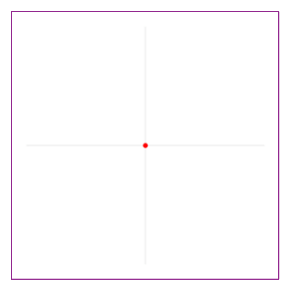


Rotational Motion – the variables

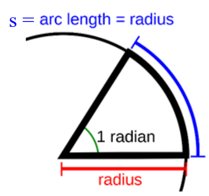
Rotational motion has variables that are closely analogous to those of linear motion

$$s = r\theta = arclength$$

Rotational Motion – the variables



Unit of angular measure: degrees or radians



$$\boxed{\theta = \frac{s}{r}}$$

2π rad = 360º
π rad = 180º

- An angle in radians is the ratio of two lengths, so has no “units”
- It’s the number of radii along an arclength
- We often indicate angles in radians with the “unit” of *rad*

Rotational Motion – the variables

Rotational motion has variables that are closely analogous to those of linear motion

$$s = r\theta = arclength$$

Angular velocity

$$\omega = \frac{d\theta}{dt}$$

Direction?

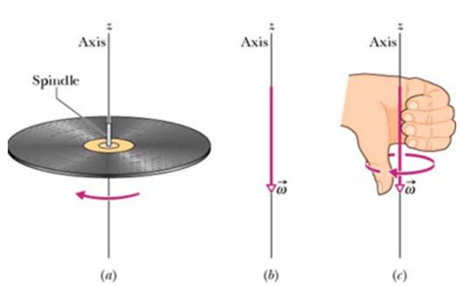
Use a RH rule!

Angular acceleration

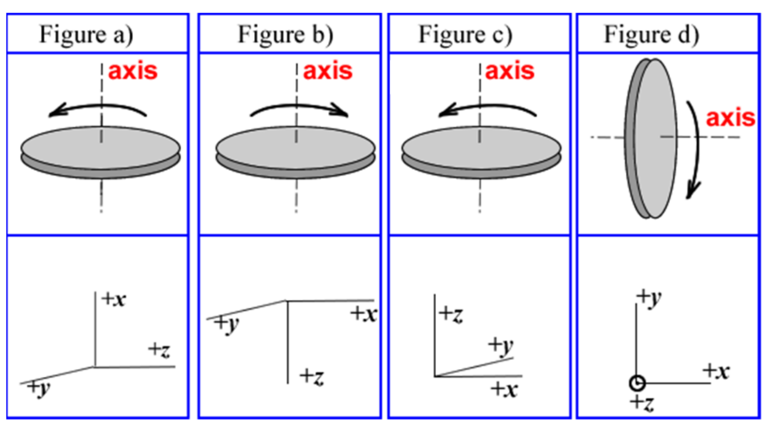
$$\vec{\alpha} = \frac{d\vec{\omega}}{dt}$$

Direction – check out ω

Rotational Motion – the variables



RHR for direction of $\vec{\omega}$



Direction of $\vec{\omega}$ and $\vec{\alpha}$ if $|\vec{\omega}|$ is increasing?

Direction of $\vec{\omega}$ and $\vec{\alpha}$ if $|\vec{\omega}|$ is decreasing?

Constant angular acceleration

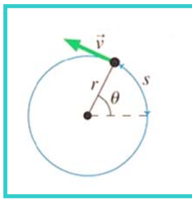
	Missing quantity
$\omega = \omega_o + \alpha\,\Delta t$	θ, θ_o
$\theta = \theta_o + \omega_o \Delta t + \frac{1}{2}\alpha\,\Delta t^2$	ω
$\omega^2 = \omega_o^2 + 2\alpha(\theta - \theta_o)$	Δt
$\theta = \theta_o + \frac{1}{2}(\omega + \omega_o)\Delta t$	α
$\theta = \theta_o + \omega\,\Delta t - \frac{1}{2}\alpha\,\Delta t^2$	ω_o

Equations for const. angular acceleration

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

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

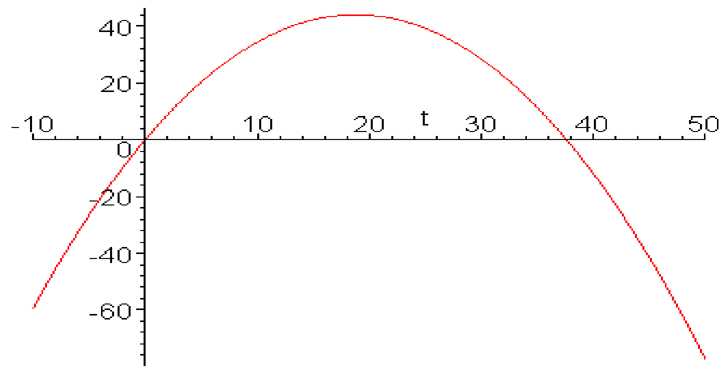
$$\omega_f^2 = \omega_i^2 + 2\alpha(\theta_f - \theta_i)$$



Constant angular acceleration

Rotational kinematics	Linear kinematics
$\omega_f = \omega_i + \alpha\,\Delta t$	$v_{fs} = v_{is} + a_s \Delta t$
$\theta_f = \theta_i + \omega_i \Delta t + \frac{1}{2}\alpha(\Delta t)^2$	$s_f = s_i + v_{is}\Delta t + \frac{1}{2}a_s(\Delta t)^2$
$\omega_f^2 = \omega_i^2 + 2\alpha\,\Delta\theta$	$v_{fs}^2 = v_{is}^2 + 2a_s \Delta s$

EX: **At t = 0, a flywheel has an angular velocity of 4.7 rad/s, a constant angular acceleration of -0.25 rad/s^2, and a reference line at $\theta_o = 0$. (a) Through what max angle will the reference line turn in the positive direction? What are the (b) first and (c) second times the ref line will be at $\theta = \theta_{max}$?**



PHYS 210 - General Physics I

- Rotational kinematics
- Forces!

Have a reasonably good Wednesday!