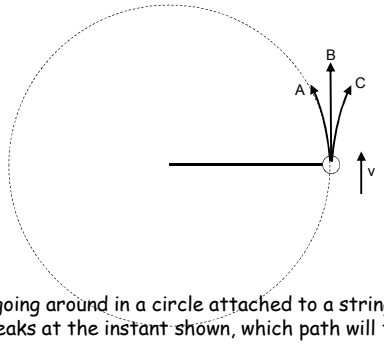
Circular Motion

ConcepTest



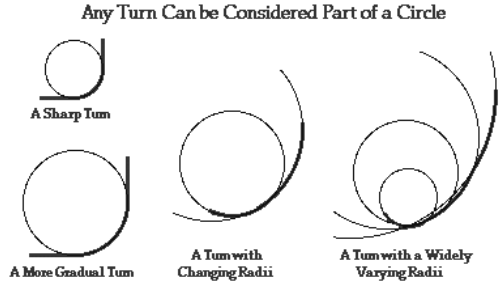
A ball is going around in a circle attached to a string. If the string breaks at the instant shown, which path will the ball follow?

Frames of Reference 1

ConcepTest

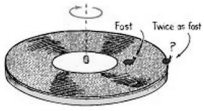
- A car rounds a curve while maintaining a constant speed. Is there a net force on the car as it rounds the curve?
  - 1. No – its speed is constant
  - 2. Yes
  - 3. It depends on the sharpness of the curve and the speed of the car.

Circles and Turns



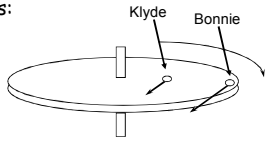
Speed

- Rotational Speed
  - Rotations or revolutions per time
  - rpm, rps
- Linear or Tangential Speed
  - circumference/time



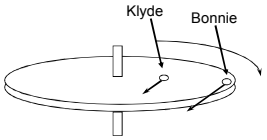
Merry-Go-Round ACT

- Bonnie sits on the outer rim of a merry-go-round with radius 3 meters, and Klyde sits midway between the center and the rim. The merry-go-round makes one complete revolution every two seconds.
  - Klyde's rotational speed is:
    - (a) **the same as Bonnie's**
    - (b) **twice Bonnie's**
    - (c) **half Bonnie's**



ConcepTest

- Bonnie sits on the outer rim of a merry-go-round with radius 3 meters, and Klyde sits midway between the center and the rim. The merry-go-round makes one complete revolution every two seconds.
  - Klyde's linear speed is:
    - (a) **the same as Bonnie's**
    - (b) **twice Bonnie's**
    - (c) **half Bonnie's**



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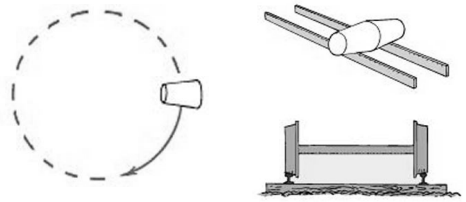
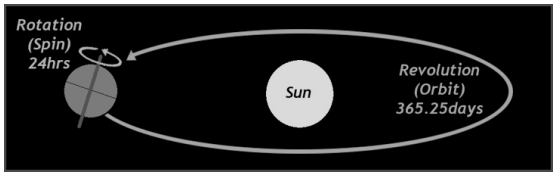
Tapered Wheels



- Part with larger diameter covers greater distance each revolution
- Wheel turns toward smaller diameter

You Say You Want a Revolution

- Rotation – motion about an interior axis
  - Day/night
- Revolution – motion about an exterior axis
  - Year



Rotation of Moon

- http://www.youtube.com/watch?v=exIpL0Uhr_k
- http://www.youtube.com/watch?v=OZIB_leg75Q
- http://www.youtube.com/watch?v=7DNEI4VMKrw&NR=1

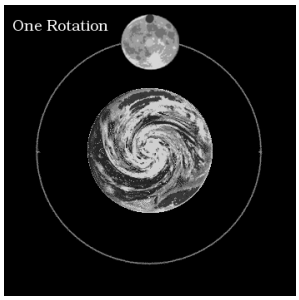


Image from http://www.bautforum.com

Fictitious Force & Inertia

- In an accelerated frame of reference, you always "feel" a force opposite the acceleration.
- This force is often called a "fictitious force" because it is really just your own inertia.
- The **actual force** is always opposite the "force that you feel"
  - Accelerating down runway
  - Coming to an abrupt stop

Centripetal Acceleration

- Whirl ball on string
- Spin with accelerometer
- Bucket of water
  - Gravity helps provide centripetal acceleration
- An object moving in a circle experiences acceleration toward the center of the circle
  - Centripetal – center-pointing
  - Fictitious force -- Centrifugal

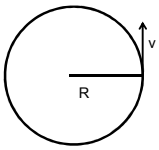
Danger Zone

- http://www.youtube.com/watch?v=c59V0RUiaEM

Circular Motion Frame of Ref

Right Hand Turn

Formulas



- T: Period – the time for one complete circle (or cycle or roundtrip)
- Tangential Speed: v
- Centripetal Acceleration: a_c

$$v = \frac{2\pi R}{T}$$

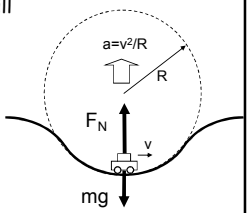
$$a_c = \frac{v^2}{R}$$

$$a_c = \frac{4\pi^2 R}{T^2}$$

ConcepTest

Suppose you are driving through a valley whose bottom has a circular shape. If your mass is m, what is the magnitude of the normal force F_N exerted on you by the car seat as you drive past the bottom of the hill

A. $F_N < mg$
B. $F_N = mg$
C. $F_N > mg$



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Circular Motion Practice 1

- A 900-kg car moving at 10 m/s takes a turn around a circle with a radius of 25.0 m. Determine the acceleration and the net force acting upon the car.

Circular Motion Practice 2

- Determine the net force acting upon a 40-kg child who makes 10 revolutions around the Cliffhanger in 29.3 seconds. The radius of the barrel is 2.90 meters.