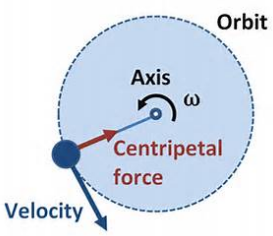
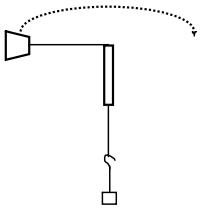
5.4 Centripetal Force



1. Centripetal Force Demonstration: You do!!

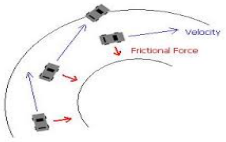
Take the tube/stopper/string/mass assembly and play with it!
Swing the stopper in a circle fast enough to pull the mass upwards.

Question: what's the relation between string radius and angular speed?



Centripetal Force (F_c)

For any acceleration to happen, centripetal or linear, a force must be present.
For circular motion, this is "center seeking", or centripetal force. Many forces can be centripetal:
a swinging ball on a string = tension;
car going around a curve = friction;
satellite in orbit = gravity;
riders on the "Gravitron" = normal force; others.



A Note on Centrifugal Force

Centrifugal force (means "center fleeing"), and is often called "fictitious", in that it's not a true force: it is not part of an interaction but is a result of rotation — with no reaction-force counterpart.

Conceptually, it can be considered a reaction force against centripetal force: an apparent force that draws a rotating body away from the center of rotation.

It is caused by the inertia of the body as the body's path is continually redirected.

F_c Math

Centripetal force uses Newton's 2nd Law:

$F_c = ma_c$	**m = mass (kg)** **a_c = centripetal acceleration (m/s^2)**

Review: different ways to calculate a_c:

$a_c = \frac{v_t^2}{r}$	**v_t = tangential speed (m/s)** **r = radius (m)** **ω = angular speed (rad/s)**
$a_c = r \bullet \omega^2$	

2. Centripetal Force Example

What centripetal acceleration does a 1.52 kg mass experience on a rope with 158 N tension?

Hint: F_c equals tension (this force causes acceleration).

Since T = F_c:

$$T = F_c = ma_c$$

$$a_c = \frac{F_c}{m} = \frac{158\,N}{1.52\,kg} = 104\,m/s^2$$

3. Velocity Example

If the rope's radius is 2.50 m, how fast is the mass traveling (v_t)?

$$a_c = \frac{v_t^2}{r}$$

$$v_t = \sqrt{a_c \bullet r} = \sqrt{104\,m/s^2 \bullet 2.50\,m} = 16.1\,m/s$$

Homework 5.4

Preview 5.5

Problems 5.4 in your Booklet
Due: Next Class