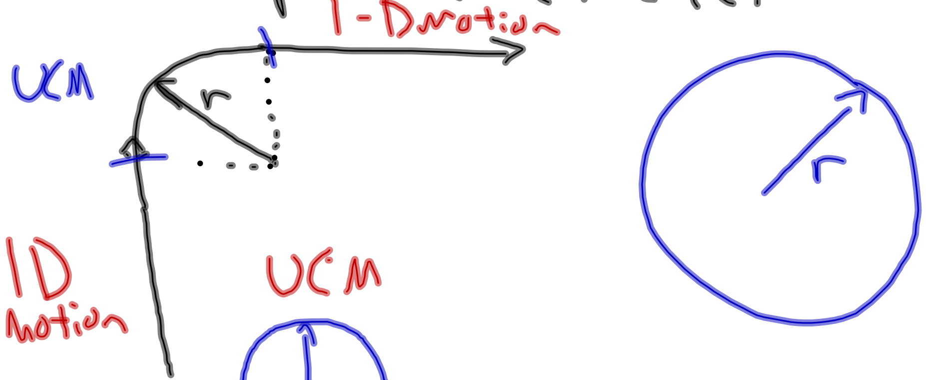
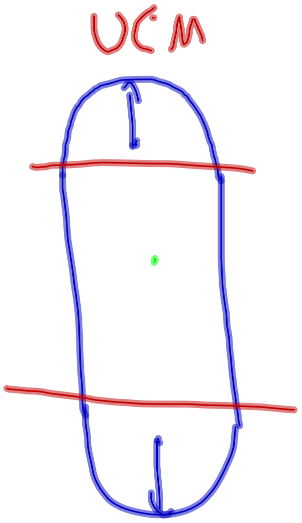
- Ch 5 Circular & Angular Motion

Uniform Circular Motion (UCM)

→ constant speed, about a constant radius.

* Doesn't have to be a complete circle.





key- For UCM must be @ a constant speed and remain a constant distance "r" from a point during the motion.

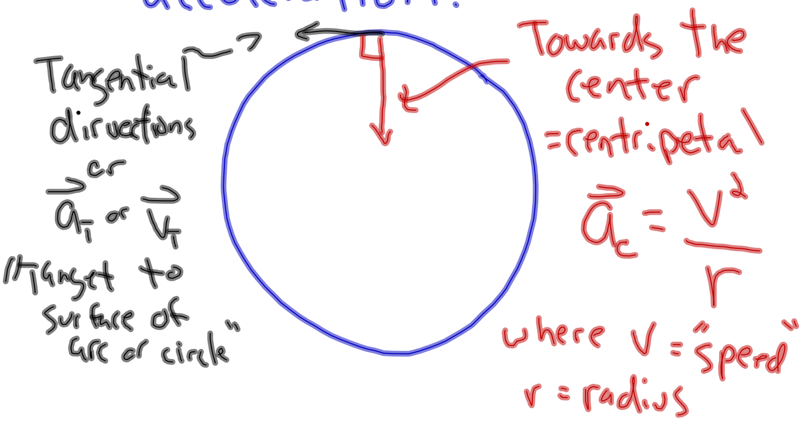
Speed is constant but velocity isn't. because it's constantly changing direction.

So, if $\vec{v}$ is changing, then it must be accelerating.

The problem is we defined

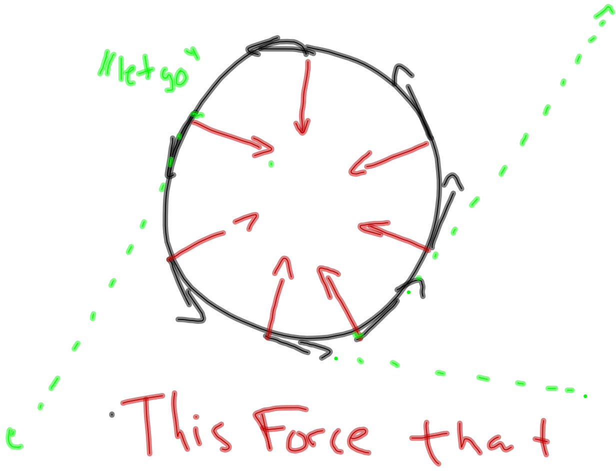
$$\vec{a} = \frac{\Delta \vec{v}}{\Delta t}$$

So For Circular Motion we define 2 types of acceleration.



True velocity is really $\vec{V_T}$

But some force that wants to "pull" you towards the center of rotation, which causes you to move in this circular motion.



This Force that "Pulls" thinss towards the center is called the Centripetal Force.

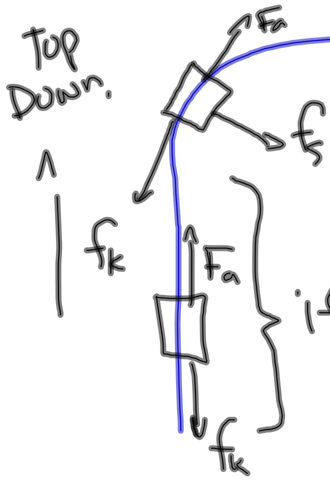
There is no such thing as a centripetal force.

The Force is the F_{net} From Gravity, Tension, Normal, Friction, etc. that happens to point towards the center of rotation.

$\vec{F}_c$ = Centripetal Force is Really when $\vec{F}_{net}$ points towards the center of rotation.

(centripetal acceleration)

if $\vec{F}_{net} = \vec{F}_c = m\vec{a}_c = \frac{mv^2}{r}$



so $\vec{F}_{net} = \vec{f}_s = \vec{F}_c$

so $f_s = f_{s_{max}} = \mu_s \vec{F}_N = \frac{mv^2}{r}$

if $\vec{v}$ is constant

$\vec{F}_a - \vec{f}_k = 0$

To calculate the max safe speed

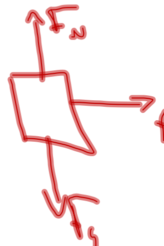
$\vec{f}_{s_{max}} = \mu_s \vec{F}_N = \frac{mv^2}{r}$

Assume flat level ground

Side view of car as it goes through turn

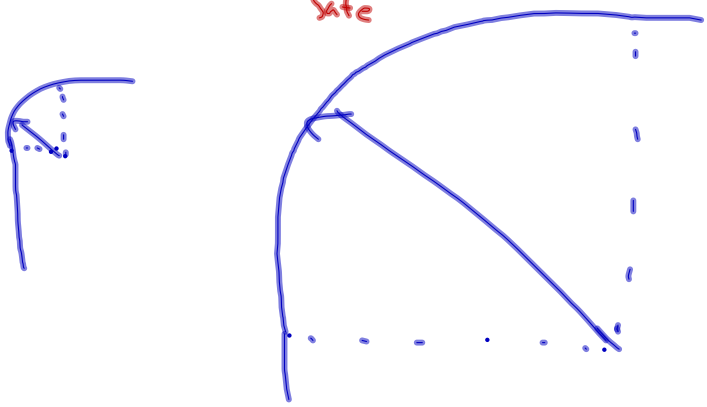
$\vec{F}_N = \vec{F}_g$

$\vec{F}_N = mg$

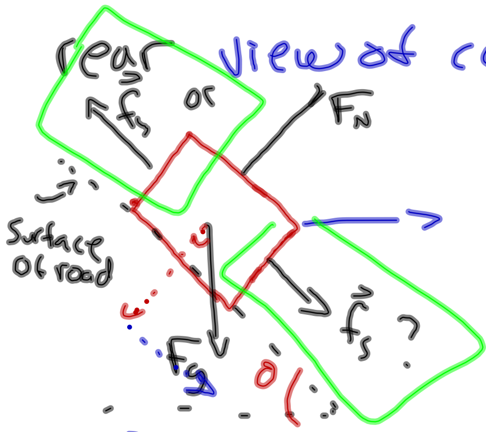


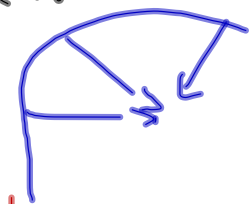
$\sqrt{r \cdot \mu_s \cdot mg} = \sqrt{\frac{mv^2}{r} \cdot r}$

$V_{max\ safe} = \sqrt{\mu_s g \cdot r}$

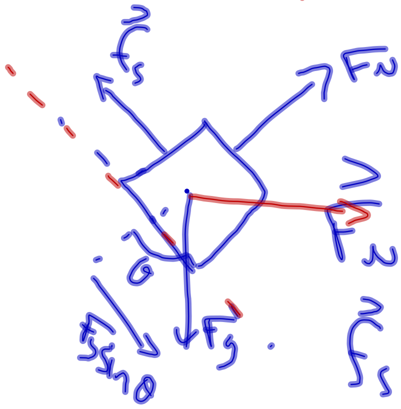


If you're on a "Banked Curve"





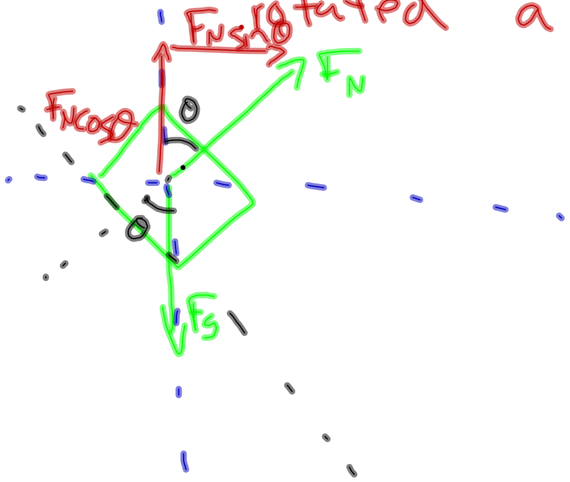
what we know
"Not leaving surface of road"
$\vec{F_N} = \vec{F_g}\cos\theta$



$\vec{F_N} = \vec{F_g}\cos\theta$

$\vec{f_s} = \vec{F_g}\sin\theta$

Based upon this FBD
No net force towards center because we rotated axis.



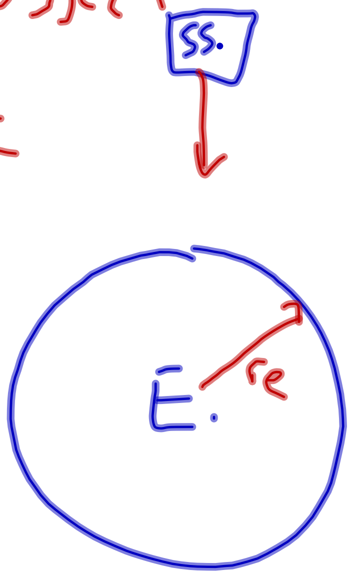
m = mass of object

M_e = mass of earth

r_e = radius of earth

$h_{orbital}$ = altitude of orbit from surface of earth

G = Universal gravitational constant



$$F_g = G\frac{m_1 m_2}{r_2^2}$$

For objects orbiting earth

$$F_g = G\frac{m M_e}{r^2}$$

where

$$r = r_e + h_{orbital}$$