Uniform circular motion

Is when something moves in a circular path with constant speed, the velocity isn't

As the direction of the object changes all the time to create that circular path

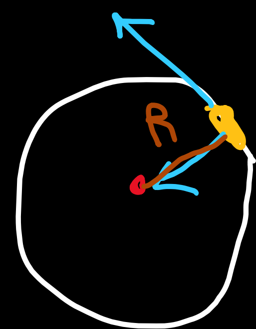
This states that there are two accelerations acting on an object moving in a circular motion

- **Tangential acceleration** that's pushing the particle forward, and is perpendicular to the centripetal force
- **Centripetal acceleration** that's pushing the particle towards the center

centripetal acceleration $= \frac{v^2}{R} = \omega^2 R$

where

- R is the radius to the center of the circular motion
- v is the forward velocity
- ω is the angular velocity



newton's second law states that there is a force, causing the circular motion, 1 force pushing forward, and one force pulling to the center, with the first force being perpendicular to the 2nd force

the 2nd one is called the **centripetal force** and it equals $m\frac{v^2}{R}$

to get the circular motion, the centripetal force has to be just the right value relative to the tangential force, because

If centripetal force > needed	If centripetal force < needed	If centripetal force is just right
		
The object will fall to the center because the tangential force can't push it away enough	the object will get far away from the center because the tangential force pushes it too hard	Circular motion

EXAMPLE

A ball of mass 0.5 kg is attached to the end of a cord whose length is 1.50 m. The ball is whirled in a horizontal circle. If the cord can withstand a maximum tension of 50.0 N, what is the maximum speed the ball can have before the cord breaks?

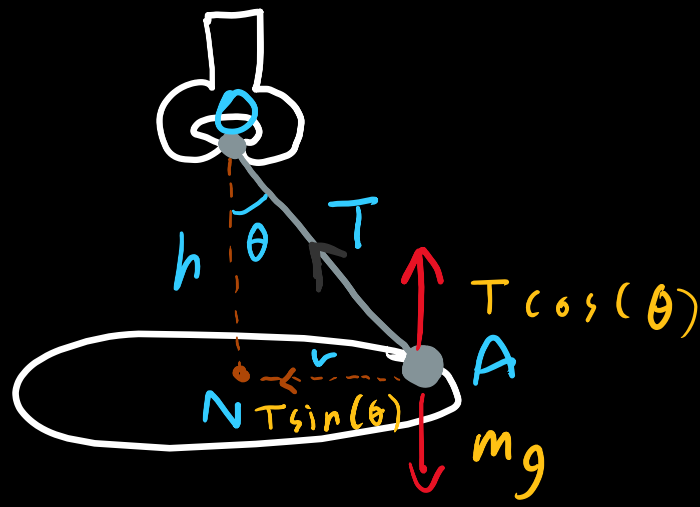
centripetal force = tension force

$T = m\frac{v^2}{r} \rightarrow 50 = .5\frac{v^2}{1.5} \rightarrow v^2 = 150$ m/s

$\downarrow$

$v = 12.2$ m/s

CONICAL PENDULUM



Here we have

T cos (ϴ) = mg "this means there is an equilibrium on the vertical axis"

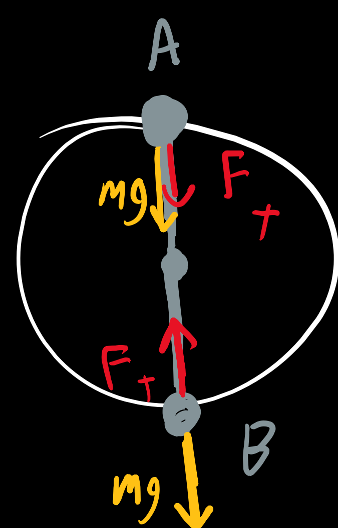
T sin (ϴ) = $mr\omega^2$

Tan ϴ = $\frac{sin(\theta)}{cos(\theta)}$ = $\frac{mr\omega^2}{mg}$ = $\frac{r\omega^2}{g}$

The tan formula tells us that

- $\omega = \sqrt{\frac{gTan(\theta)}{r}}$
- $r = l\,sin(\theta)$, with l equaling the length of the pendulum's rope
- By combining the two equations knowing that $\left(\omega = \frac{2\pi}{T}\right)$, we get that
  - $\frac{2\pi}{T} = \sqrt{\frac{gTan(\theta)}{l\,sin(\theta)}}$
  - We can use that to calculate the height (h) and the period (T)
    - $T = 2\pi\sqrt{\frac{gTan(\theta)}{l\,sin(\theta)}} = 2\pi\sqrt{\frac{l\cos(\theta)}{g}} = 2\pi\sqrt{\frac{h}{g}}$
    - $h = l\cos(\theta)$

VERTICAL CENTRIPETAL MOTION



Let's say you're rotating a rock using a rope

at point A

- $F_{centripetal} = F_t + mg = mv^2/r$
- $F_T = m(\frac{v^2}{r} - g)$

at point B

- $F_{centripetal} = F_t - mg = mv^2/r$
- $F_t = m(\frac{v^2}{r} + g)$