Centripetal Acceleration + Force

$$a_c = \frac{v^2}{r} = \frac{4\pi^2 r}{T^2} = 4\pi^2 r f^2$$

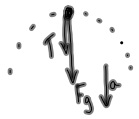
When doing centripetal force problem, it is basically an $F_{net} = ma$ problem. F_{net} is the centripetal force .... it is the unbalanced force that causes the acceleration. DO NOT DRAW a vector for centripetal force in your FBD. It is the resultant of all the forces that you DO draw.

PP|551

$m = 28\,g$
$v = 12.4\,m/s$
$r = 0.850\,m$

a) $T = ?$ (at top)
b) $T = ?$ (at bottom)
c) $v = ?$ if $T = 33.7\,N$

a) at the top



$\vec{F}_{net} = m\vec{a}$

$T + F_g = \frac{mv^2}{r}$

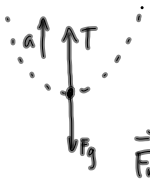
$T = \frac{mv^2}{r} - mg$

$T = \frac{(0.284\,kg)(12.4\,m/s)^2}{0.850\,m} - (0.284\,kg)(9.81\,m/s^2)$

$T = 51.4\,N - 2.79\,N$

$\boxed{T = 48.6\,N}$

b) At the bottom:



$\vec{F}_{net} = m\vec{a}$

$T - F_g = \frac{mv^2}{r}$

$T = \frac{mv^2}{r} + mg$

$T = 51.4\,N + 2.79\,N$

$\boxed{T = 54.2\,N}$

c) $v = ?$ when $T = 33.7\,N$

at top

$F_{net} = ma$

$T + F_g = \frac{mv^2}{r}$

$33.7\,N + 2.79\,N = \frac{(0.284\,kg)v^2}{0.850\,m}$

$36.49\,N = \frac{(0.284\,kg)v^2}{0.850\,m}$

~~$v = 10.5\,m/s$~~ ← the string will have already broken at 9.6 m/s

at bottom

$\vec{F}_{net} = m\vec{a}$

$T - F_g = \frac{mv^2}{r}$

$33.7\,N - 2.79\,N = \frac{(0.284\,kg)(v^2)}{0.850\,m}$

$30.9\,N = \frac{(0.284\,kg)v^2}{0.850\,m}$

The string will break when $v = 9.6\,m/s$ →

$\boxed{v = 9.6\,m/s}$

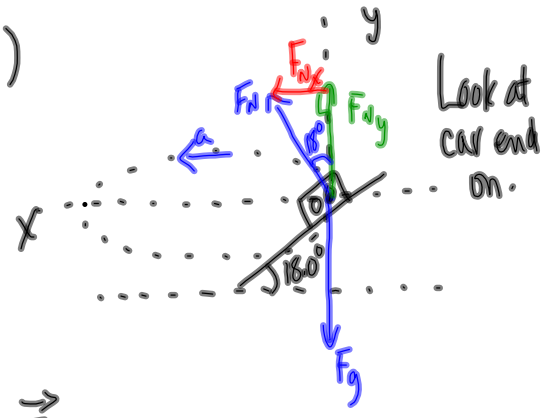
Curve Banking (MP|565)

$r = 382\text{ m}$

$\theta = 18.0°$

a) $v = ?$ (no friction)

b) If $v = 378.11\text{ km/h}$, did friction play a role



$\vec{F}_{net} = m\vec{a}$

$F_{Nx} = \frac{mv^2}{r}$

$mg\tan\theta = \frac{mv^2}{r}$

$\tan\theta = \frac{F_{Nx}}{F_{Ny}}$

$F_{Nx} = F_{Ny}\tan\theta$

$F_{Nx} = mg\tan\theta$

$v^2 = gr\tan\theta$

$v^2 = (9.81\text{m/s}^2)(382\text{m})\tan 18.0°$

The fastest you can go with no friction → $v = 34.9\text{ m/s}$

(126 km/h)

b) Since $126\text{ km/h} < 378.11\text{ km/h}$, friction must have played a role in reaching that spe

TO DO:

PP|566

Tomorrow

P571|22-28

Quiz

- Projectiles (all types)