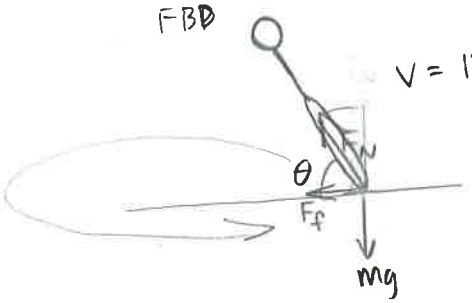
10 pts total Physics F14 Super Quiz III Dec. 3, 2014

1. You're riding your bicycle at about 17 m/s and wish to go around a corner with a 50 m radius of curvature.
   a) What angle will your bicycle make with the vertical?
   b) If there was a scale under you and you have a mass of 50 kg, what would the scale read?

This is a Dynamics problem

(a)



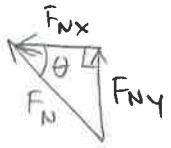
$v = 17\ m/s$ ↓ $a_c = \frac{v^2}{r} = \frac{(17\ m/s)^2}{(50\ m)} = 5.8\ m/s^2$

$\Sigma F = ma_c$

no vertical acceleration

$F_{NY} = mg$

yes: centripetal acceleration



$F_{NX} = ma_c$

$F_{NX}\tan\theta = F_{NY}$

$\frac{mg}{\tan\theta} = \frac{ma_c}{\tan\theta}$

$F_{NX} = \frac{F_{NY}}{\tan\theta} = \frac{mg}{\tan\theta}$

$\frac{g}{a_c} = \tan\theta$

$\theta = \tan^{-1}\left(\frac{10\ m/s^2}{5.8\ m/s^2}\right)$

$\theta = 59.89° \approx \boxed{60°}$

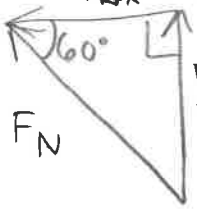
(b) ~~no vertical acceleration~~

~~so... $mg = F_g = (50\ kg)(10\ m/s^2) = 500N$ or $50\ kg$~~

between the biker and the seat

The scale reads the compressional (Normal) force.

$F_{NX} = ma_c = (50\ kg)(5.8\ m/s^2) = 290N$

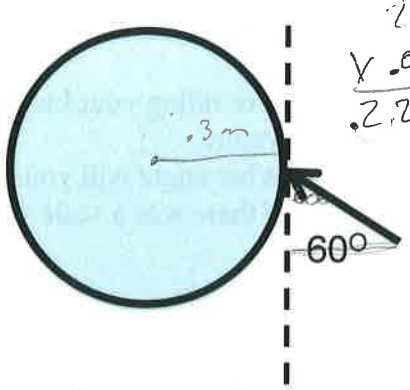


$F_{NY} = mg = (50\ kg)(10\ m/s^2) = 500N$

$\sqrt{(290N)^2 + (500N)^2} = F_N = \boxed{578N}$ or $\boxed{57.8\ kg}$

$\frac{500}{\sin 60°} = F_N \approx 577$ ✓

2. A flat disk of radius 30 cm and mass 5 kg is secured, but free to rotate about its center. A 1 kg blob of clay moving at 10 m/s strikes the surface at a 60° angle and sticks to the rim.
   a) What is the final rotational velocity of the system?
   b) How would the situation be different if the disk were not secured at the center, but was instead just floating in space.



4
2.5
x .09
.225

a $10\,m/s \cos 60° = \perp v = 5\,m/s$

$\frac{5\,m}{s} \times \frac{1\,rad}{.3\,m} = 16.67\,rad/s = \omega_b$

$I_b\omega_b = I_f\omega_f$

$I_b = (1kg)(.3m)^2 = .09\,kgm^2$ $I_f = (1kg)(.3m)^2 + \frac{1}{2}(5kg)(.3m)^2$

$I_f = .09\,kgm^2 + .225\,kgm^2$

$I_f = .315\,kgm^2$

~~16.67 rad/s~~

$L = \omega_{clay} \times I_{clay} = I_f\omega_f$

$(16.67\,rad/s)(.09\,kgm^2) = (.315\,kgm^2)\,\omega_f$

$\omega_f = 4.76\,rad/s$

16.6
3|50

16.67
x .09
1.5003

4.76
315|1500.30
1260
2403
2205
1980
1890

b it would still rotate at this velocity, but it would also be knocked forward because linear momentum would have to be conserved

$\vec{P}_f = \vec{P}_o$

$(m_{clay} + m_{disc})\vec{v}_f = (m_{clay})\cdot\vec{v}_{o\,clay}$

a) Please write and sign the following statement: "I did not (or will not) communicate any information of this test with those in the other class."