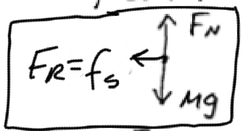
F_N is what person <u>feels</u> he weighs.

<u>use $\Sigma\vec{F} = M\vec{a}_R$</u> Radial (or Centri<u>pet</u>al) Force

1) Car turning on flat road.

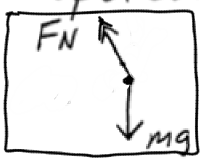


$F_N = mg$

$\Sigma F_R = \frac{MV^2}{r}$ $\quad \mu_s F_N = \frac{MV^2}{r}$ $\quad V^2 = \mu_s g r$

$f_s = \frac{MV^2}{r}$ ↗ $\quad \mu_s M g = \frac{MV^2}{r}$ ↗ $\quad V = \sqrt{\mu_s g r}$

2) Car turning on banked track so there is <u>no</u> <u>tendency</u> <u>to</u> <u>slide</u> up or down the track. In this case, no friction is needed.



$F_N > mg$

$\Sigma F_y = 0$ $\quad \Sigma F_R = \frac{MV^2}{r}$ $\quad \tan\theta = \frac{V^2}{gr}$

$F_N\cos\theta - mg = 0$ $\quad F_R = \frac{MV^2}{r}$ $\quad V^2 = gr\tan\theta$

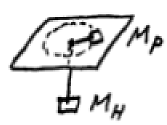
$F_N\cos\theta = mg$ $\quad F_N\sin\theta = \frac{MV^2}{r}$ $\quad V = \sqrt{gr\tan\theta}$

$F_N = \frac{mg}{\cos\theta}$ $\quad \frac{mg}{\cos\theta}\sin\theta = \frac{MV^2}{r}$

F is apparent weight.

3) Conical pendulum. Exactly the same as car on banked track, except F_N becomes F_T in string. θ is angle string makes with the vertical.

4) Plane banking while turning. Exactly the same as car on banked track and conical pendulum, except F_N is either the normal force on a passenger or it becomes F_L, the lift provided by the wing

5) 

Puck rotating on frictionless table. Hanging mass provide F_c.

$M_H g = F_T$

$\Sigma F = \frac{M_P V^2}{r}$ $\quad M_H g = \frac{M_P V^2}{r}$

$F_T = \frac{M_P V^2}{r}$ $\quad V^2 = \frac{M_H g r}{M_P}$

This is problem 25 on

6) ~~Passenger~~ in roller coaster going through a dip. Car, also.

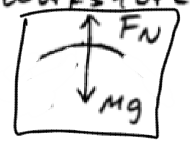
$F_N = \frac{MV^2}{r} + mg$

$F_R = F_N - mg$

$F_N = F_R + mg$ $\quad F_N = m\left(\frac{V^2}{r} + g\right)$

F_N is apparent weight. Rider <u>feels</u> heavier because $F_N > mg$. This causes car and rider to go up. <u>F_N</u> is what rider <u>feels</u> he weighs.

7) Passenger in roller coaster going <u>over</u> the top of a hill.
Works for car, too.



$\sum \vec{F} = m\vec{a}_R$

$F_R = mg - F_N$

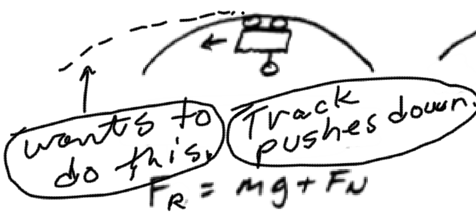
$F_R = mg - F_c$

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

$F_N = m\left(g - \frac{v^2}{r}\right)$

F_N is apparent weight, Rider <u>feels</u> lighter because $F_N < mg$.
This causes car and rider to go down.

8) Passenger in roller coaster going inside loop at the top.
Car is going fast enough so rider won't fall out.



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

$F_N = m\left(\frac{v^2}{r} - g\right)$

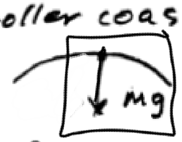
Rider feels a bit lighter than mg in the diagram.
$F_N < mg$ here.

$F_R = mg + F_N$

$F_N = F_R - mg$

F_N is apparent weight but rider feels his weight points up!

9) Passenger in roller coaster going inside loop at the top,
Car is going <u>just</u> fast enough so rider won't fall out,



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

$v^2 = gr$

$v = \sqrt{gr}$

The normal force is zero! The weight <u>is</u> the F_R.

$F_R = F_g$

10) Passenger in roller coaster going inside loop at the top,
Car is going too slow. $mg > F_R$.
Rider will fall out without seat belt or bar, F_N pulls rider up

$F_R = mg - F_N$

$F_N = mg - F_R$

F_N is apparent weight. Rider <u>feels</u> his weight down but less than mg in this diagram.

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

$F_N = m\left(g - \frac{v^2}{r}\right)$

Rider wants to go in a parabola smaller than the track, Seat belt keeps him up,