Reminders 10-20-10:
-Exam 2 Ch 4-6 Mon. Oct. 18
-Chapter 7 Quiz Next Wednesday

Objectives:
-Centripetal Acceleration
-Centripetal Force
-Examples
-Apparent Weight

- **An 0.12 kg object attached to a string is whirled in a horizontal circle whose radius is 0.75 m. The speed of the object is 3.0 m/s. What is the centripetal acceleration and the centripetal force acting on the object? What is the tension in the string?**

- ***Answer: 12 m/s²; 1.4 N***

$r = 0.75\,m \qquad v = 3.0\,m/s$

$m = 0.12\,kg$

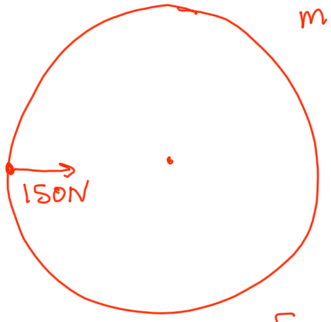
$$a = \frac{v^2}{r} = \frac{(3.0\,m/s)^2}{75\,m} = 12\,\frac{m}{s^2}$$

directed toward center of circle

$$T = \frac{mv^2}{r} = (.12\,kg)\left(12\,\frac{m}{s^2}\right) = 1.4\,N$$

Example

- **An automobile is rounding a turn of constant radius of curvature. A passenger notices that the arm rest is pushing toward the center of the turn with a constant force. The passenger has a mass of 78 kg. The force of the armrest on him is 150 N. The forward speed of the automobile is 21 m/s.**
  - **What is the acceleration of the car?**
  - **What is the radius of the turn?**
  - **What is the frictional force acting on the car?**
- ***Answer: 1.9 m/s²; 230 m***



$f_{net} = ma \qquad a = \frac{F}{m} = \frac{150\,N}{78\,kg}$

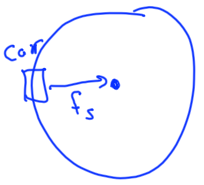
$= 1.9 \frac{m}{s^2}$

$a = \frac{v^2}{r} \qquad r = \frac{v^2}{a} = \frac{\left(21 \frac{m}{s}\right)^2}{1.9 \frac{m}{s^2}} = 230\,m$

for of friction on car

$m_{car} \frac{v^2}{r} = f_s$

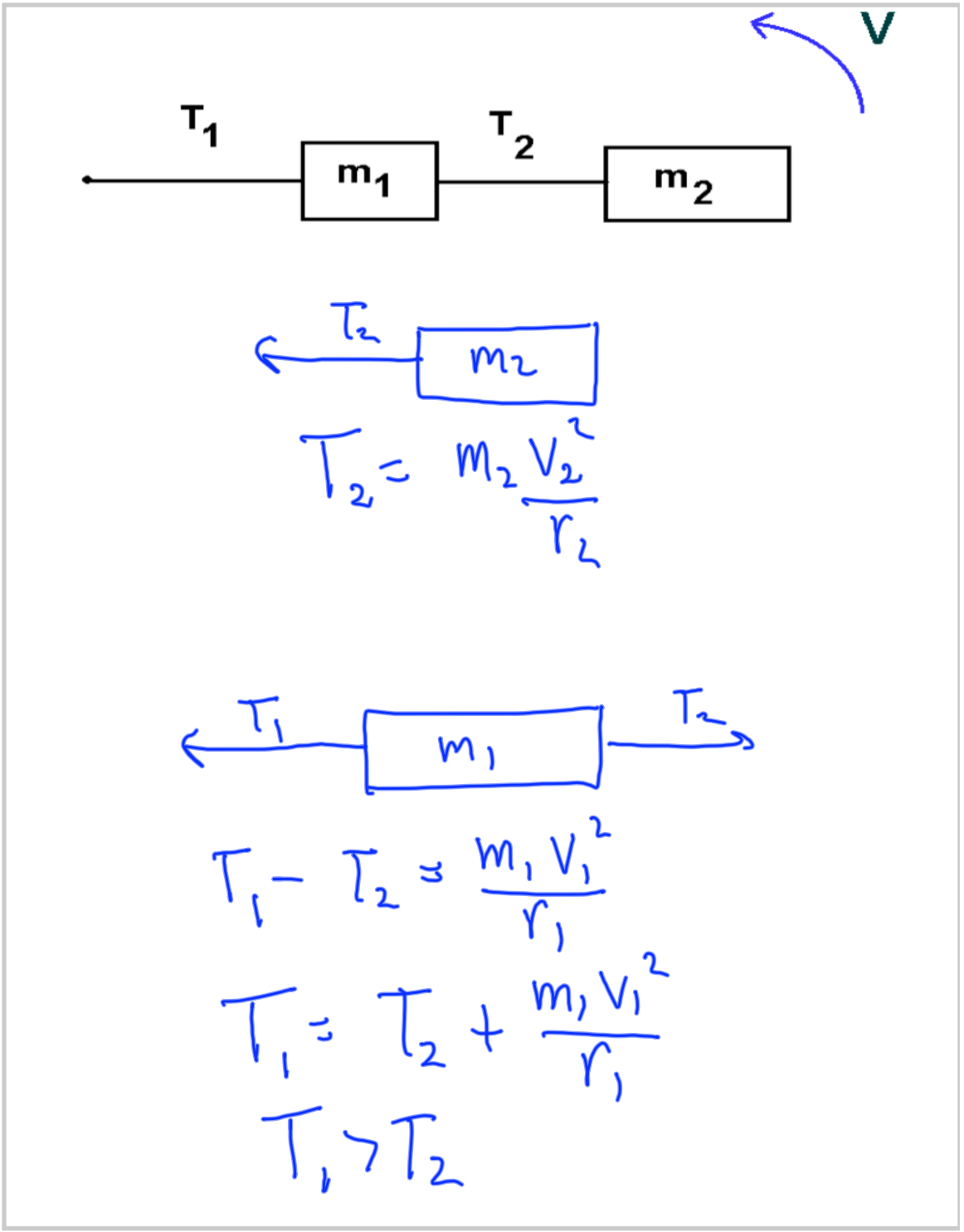
$m_{car}\left(1.9 \frac{m}{s^2}\right) = f_s$

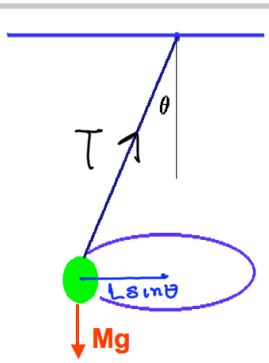


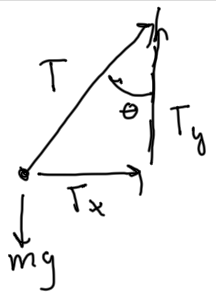
What is the maximum speed that the car can have to safely make the turn?

$m\frac{v^2}{r} \leq \mu_s mg \qquad g\mu_s = \frac{v^2}{r}$

$v = \sqrt{rg\mu_s}$


V
T1
T2
m1
m2
T2
m2
T2 = m2 V2^2 / r2
T1
m1
T2
T1 - T2 = m1 V1^2 / r1
T1 = T2 + m1 V1^2 / r1
T1 > T2





$T_x = T\sin\theta$

$T_y = T\cos\theta$

$$T\sin\theta = \frac{mv^2}{r}$$

$$T\cos\theta = mg$$

$$T = \frac{mg}{\cos\theta}$$

$$T = \frac{(2.00\,kg)(9.8)}{\cos 30} = 22.6\,N$$

$$v^2 = \frac{T\sin\theta\, r}{m} \qquad r = L\sin\theta$$

$$v = \sqrt{\frac{T\sin\theta\, L\sin\theta}{m}} = \sqrt{\frac{TL\sin^2\theta}{m}}$$

$$v = \sqrt{\frac{(22.6\,N)\sin^2(30)\,1\,m}{2.00\,kg}} = 1.6\,\frac{m}{s}$$

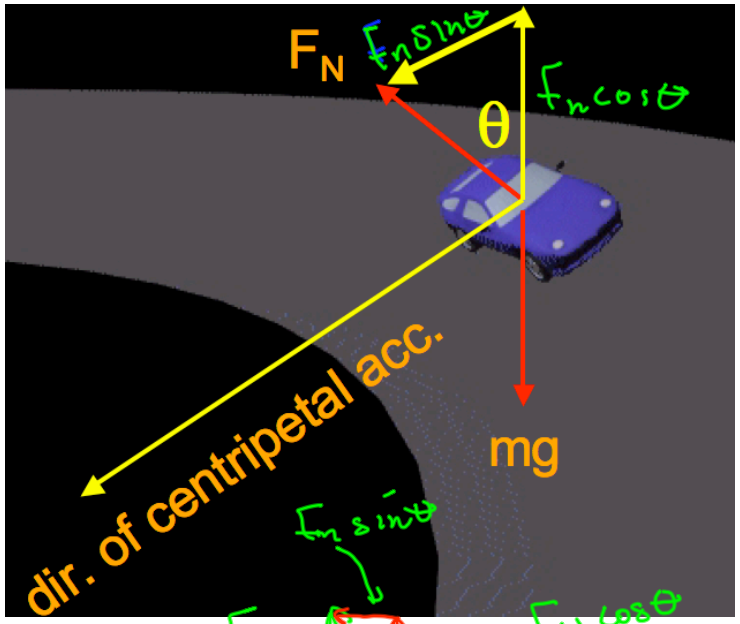
Another way:

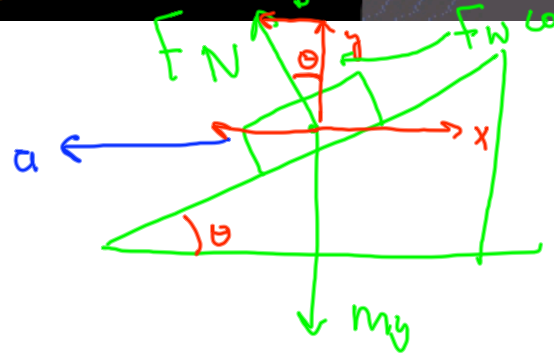
$$T\sin\theta = \frac{mv^2}{L\sin\theta}$$

$$T\cos\theta = mg$$

$$\frac{\sin\theta}{\cos\theta} = \frac{v^2}{gL\sin\theta}$$

$$v = \sqrt{gL\frac{\sin^2\theta}{\cos\theta}} = \sqrt{gL\tan\theta\sin}$$





no need to rotate coordinate system!

$$\sum F_x = F_N \sin\theta = mv^2/R$$

$$\sum F_y = F_N \cos\theta = mg$$

divide $\tan\theta = \frac{v^2}{Rg}$