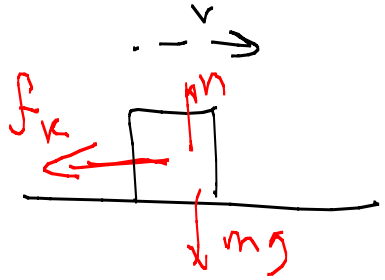
Phys 2110-5 9/29/12

Note Title 9/28/2012

# Forces Lots a problems

## Friction forces




$$f_k = \mu_k n$$

$$f_s^{(max)} = \mu_s n$$

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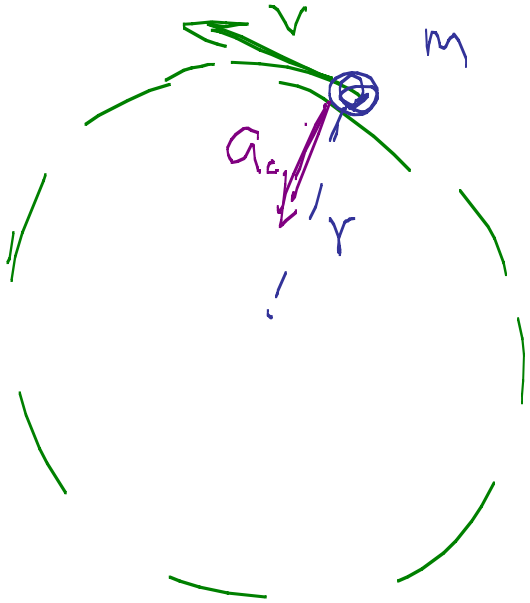



$$a_c = \frac{v^2}{r}$$

So there must be a net force

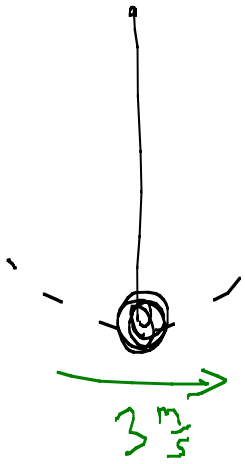
is toward cent

$$F_{net} = F_{cent} = m a_c = \frac{m v^2}{r}$$

# Example

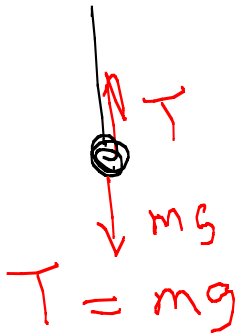

Release mass

At bottom of swing, $v = 3.0 \frac{m}{s}$




Find tension in string at bottom position.

Don't do

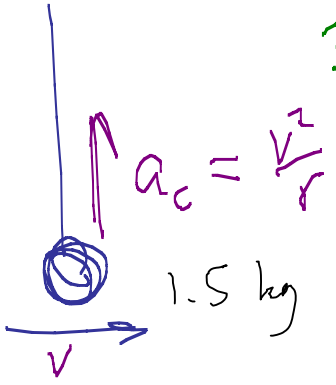



$T = mg$

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

Acceleration toward center

Forces don't cancel..




These add up to force toward center, $\frac{mv^2}{r}$

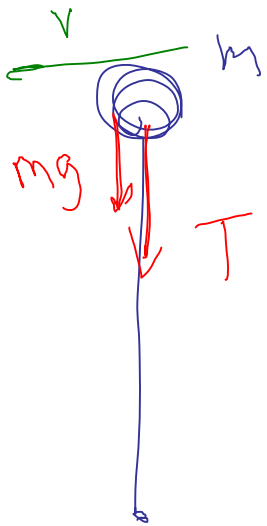
Inward forces $T - mg = \frac{mv^2}{r}$

$$T = mg + \frac{mv^2}{r} = m\left(g + \frac{v^2}{r}\right) = 28.2\,N$$

$r = 1.0\,m$

$v = 3.0\,\frac{m}{s}$

At top of swing (again $v = 3.0\ m/s$)




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

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

plug m $= \underline{9.3\ N}$

5.24 A 940-g rock is whirled in a horizontal circle at end of 1.30 m-long string.

a) If breaking strength of string is 120 N what's minimum angle string can make w/ horizontal?

b) What is rock's speed?

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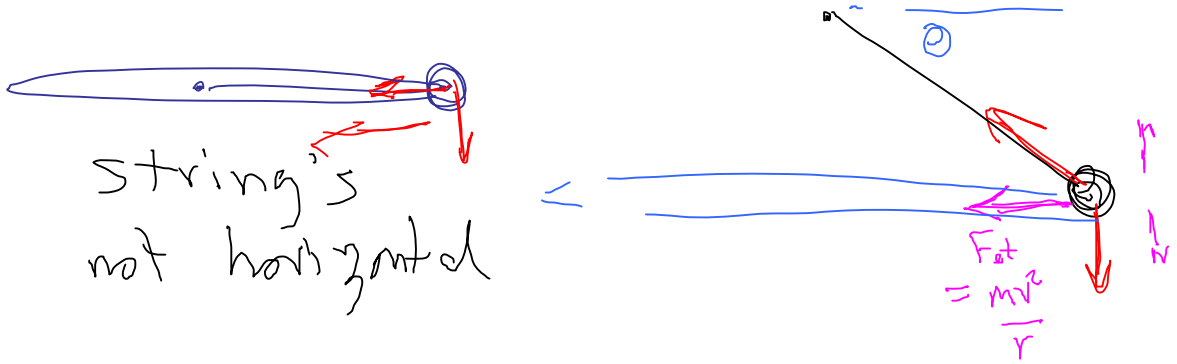
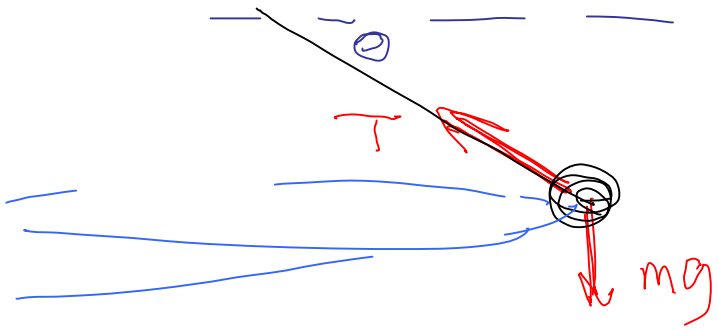





Vertical force add to zero.

$$T\sin\theta - mg = 0$$

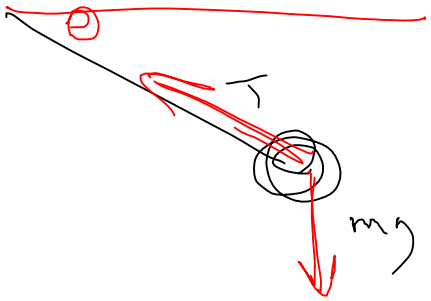
$$T = \frac{mg}{\sin\theta}$$

$m = 0.940\ kg$

$T = 120\ N$

$$\sin\theta = \frac{mg}{T} = \frac{(.940\ kg)(9.8\ \frac{m}{s})}{120\ N}$$

$$\theta = 4.4^\circ$$



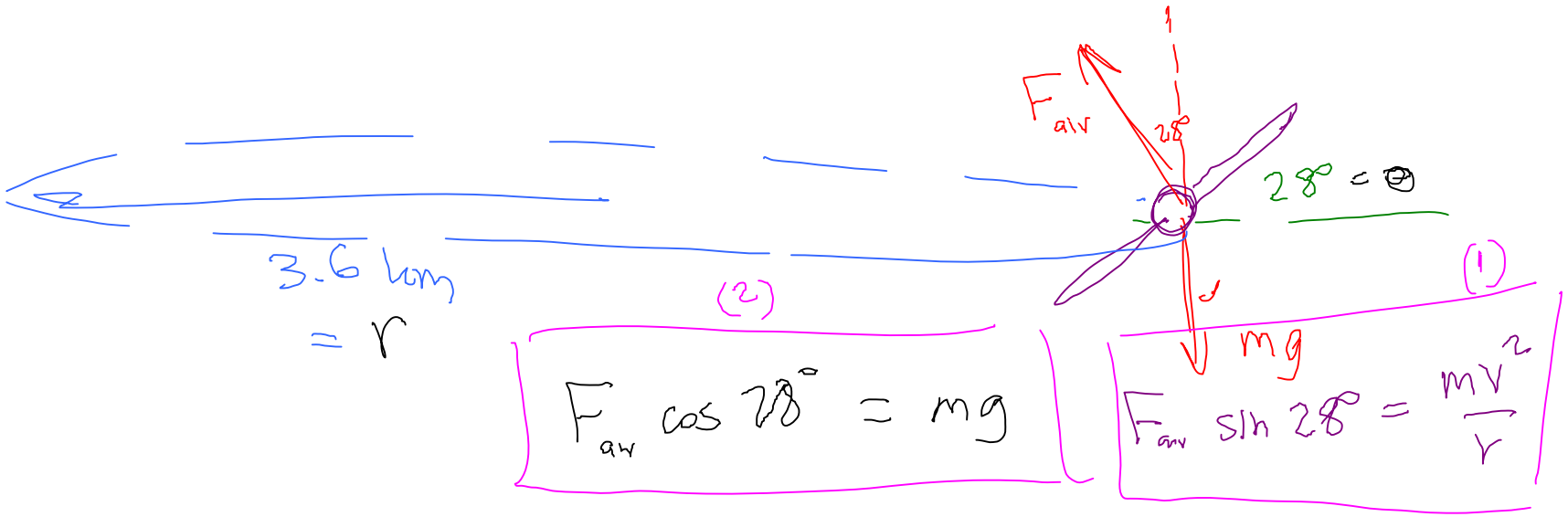

$$\text{Inward force} = \frac{mv^2}{r}$$

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

$$v^2 = r\frac{T\cos\theta}{m}$$

I set $12.8\ \frac{m}{s}$

5.27 An airplane goes into a turn 3.6 km in radius. If the banking angle required is 28° from the horizontal what's the plane's speed.



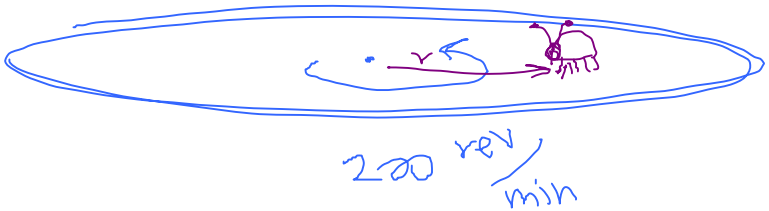
Divide (1) by (2)

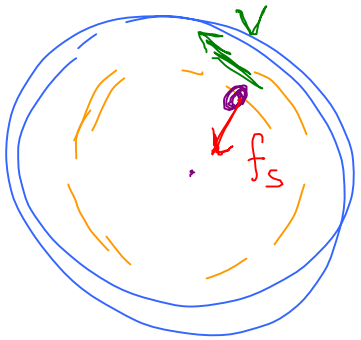
$$\frac{\sin 28}{\cos 28} = \frac{mv^2/r}{mg} = \frac{v^2}{gr}$$

$$= \tan 28$$

$$v^2 = gr\tan 28 = 137 \frac{m}{s} = 490 \frac{km}{hr}$$

5.48 A bug crawls outward from center of a CD spinning at 200 rev/min. Coefficient of static friction between bug & surface is 1.2. How far does the bug get from center before slipping?

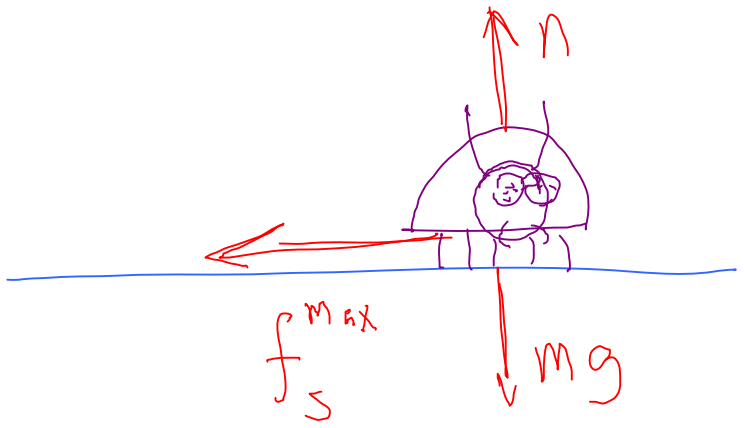



About to slip

$f_s = f_s^{Max}$

$= \mu_s n$




$$f_s = \mu_s mg$$

$$F_c = f_s = \frac{mv^2}{r}$$

They're equal, so

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

$$\mu_s g = \frac{v^2}{r} = \frac{1}{r}\left(\frac{2\pi r}{T}\right)^2$$

Want r

Give us rotation Period

$$T = \frac{60\ \text{sec}}{200\ \text{rot}} = 0.30\ \text{sec}$$

$$v = \frac{2\pi r}{T}$$

solve for r

I got 2.7 cm