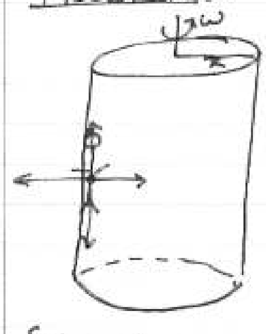
CAVEAT: THESE ARE WRITTEN SIMPLY AS MY NOTES TO DISCUSS SO DON'T EXPECT FULL SOLUTIONS OR EVEN FULL QUESTIONS. I WOULD RECOMMEND THAT YOU USE THESE ONLY AFTER WE DISCUSS THEM (i.e. DON'T COME TO PROBLEM SESSION ~~ALREADY~~ KNOWING THE ANSWERS, THAT DEFEATS THE PURPOSE)

10/17/07

PROBLEMS:



NORMAL FORCE = $\frac{mv^2}{R} = m\omega^2 R$

$F_s = \mu_s N = mg \Rightarrow \mu_s m\omega^2 R = mg$

$\mu_s \omega^2 R = g$

MINIMUM

{(0) WHICH DIRECTION IS THE NORMAL FORCE?}

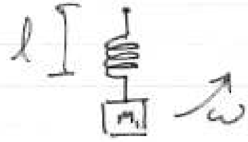
→ WHY CAN THIS SPIN AT ONLY 1 FREQUENCY? WHY DON'T WE NEED TO SPIN IT FASTER FOR HEAVIER PEOPLE?

↳ IT'S TRUE THE FRICTIONAL FORCES MUST BE GREATER, BUT BY SPINNING THEM AT THE SAME VELOCITY, HEAVIER PEOPLE HAVE A LARGER NORMAL FORCE WHICH EXACTLY CANCEL

WHAT IS THE COEFFICIENT (MIN) OF STATIC FRICTION BETWEEN THE PERSON & WALL NEEDED SUCH THAT THEY DON'T FALL?

$\boxed{\mu_s = g/\omega^2 R}$ THEORETICALLY A WAY TO CALCULATE μ_s

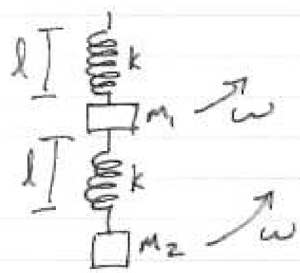
2) a)



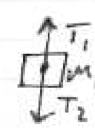
HOW MUCH DOES THE SPRING STRETCH (WHAT IS IT'S FINAL LENGTH?)

$$T = m_1 \omega^2 R = k \Delta l$$
$$= m_1 \omega^2 (l + \Delta l) = k \Delta l$$
$$\Rightarrow m_1 \omega^2 l + m_1 \omega^2 \Delta l = k \Delta l \Rightarrow$$
$$m_1 \omega^2 l = \Delta l (k - m_1 \omega^2) \Rightarrow \boxed{\Delta l = \frac{m_1 \omega^2 l}{k - m_1 \omega^2}}$$

b) WHAT IF WE ADD A SECOND MASS?



<u>STEP 1:</u> LOOK AT TOP MASS



$$T_1 - T_2 = m_1 \omega^2 R_1$$

<u>STEP 2:</u> LOOK AT BOTTOM

$$T_2 = m_2 \omega^2 R_2$$

$$T_1 - T_2 = m_1\omega^2 R_1 \quad ; \quad T_2 = m_2\omega^2 R_2$$

$$\Rightarrow T_1 = m_1\omega^2 R_1 + m_2\omega^2 R_2 \quad , \quad T_1 = k(R_1 - l)$$

$$\cancel{k(R_1-l) = m_1\omega^2 R_1 + m_2\omega^2 R_2}$$

$$T_2 = m_2\omega^2 R_2 = k(R_2 - R_1 - l) \Rightarrow$$

$$R_2(m_2\omega^2 - k) = -k(R_1 + l) \Rightarrow \boxed{R_2 = \frac{k(R_1+l)}{k - m_2\omega^2}}$$

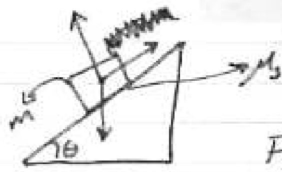
$$T_1 = m_1\omega^2 R_1 + m_2\omega^2 R_2 = k(R_1 - l)$$

$$k(R_1 - l) - m_1\omega^2 R_1 = m_2\omega^2 \frac{k(R_1+l)}{k - m_2\omega^2}$$

$$kR_1 - m_1\omega^2 R_1 - \frac{m_2\omega^2 k R_1}{k - m\omega^2} = \frac{m_2\omega^2 l}{k - m_2\omega^2} + kl$$

$$\boxed{R_1 = \frac{\left(\frac{m_2\omega^2 l}{k - m_2\omega^2}\right) + kl}{k - m_1\omega^2 - \frac{m_2\omega^2}{k - m_2\omega^2}}}$$

3)



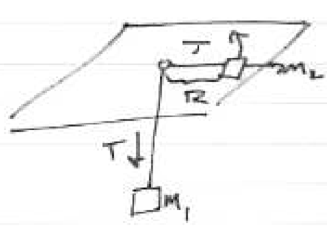
FIND MAXIMUM ANGLE BEFORE THIS BEGINS TO SLIDE.

$$\vec{N} + \vec{F}_g + \vec{F}_s = 0$$

<u>IN X:</u> $N \sin\theta = -F_s \cos\theta \qquad F_s = \mu_s N$

$$\tan\theta = -\mu_s \qquad \boxed{\theta = \tan^{-1}(-\mu_s) = -\tan^{-1}(\mu_s)}$$

4



NO FRICTION

$$T = m_1 g = m_2 \omega^2 R$$

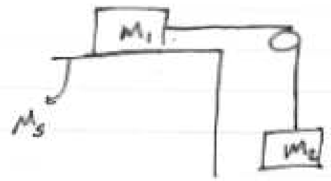
$$\omega = \sqrt{\frac{m_1 g}{m_2 R}}$$

FIND ω SUCH THAT m_1 IS STATIONARY.

NOW WHAT IF THERE WAS FRICTION? WHAT WOULD HAVE TO DO TO MAINTAIN ~~THE~~ MASS 1'S HEIGHT?

PUT A LITTLE MOTOR ON IT WHICH EXERTS A FORCE $F = \mu_k m_2 g$

5)

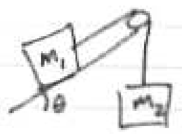


HOW ~~BIG~~ MUCH CAN M_2 BE SUCH THAT M_1 WON'T MOVE?

→ TRICK QUESTION

$m_2 g = \mu_s m_1 g$ $\boxed{m_2 = \mu_s m_1}$

→ TABLE LEG BREAKS.



HOW DOES THIS CHANGE?

NOT EXACTLY CORRECT

$$N_x + F_{sx} + T_x = 0$$
$$-N\sin\theta \mp \mu_s N\cos\theta + T\cos\theta = 0$$
$$-N(\sin\theta + \mu_s\cos\theta) + m_2 g\cos\theta = 0$$
$$-m_1 g(\sin\theta + \mu_s\cos\theta) + m_2 g\cos\theta = 0$$
$$m_1 g(1 + \mu_s\tan\theta) + m_2 g = 0$$
$$m_1 g(1 + \mu_s\tan\theta) = +m_2 g \Rightarrow$$
$$1 + \mu_s\tan\theta = \frac{+m_2}{m_1} \qquad 1 - \frac{m_2}{m_1} = \mu_s\tan\theta$$
$$\tan\theta = \frac{1}{\mu_s} - \frac{m_2}{m_1\mu_s}$$
$$\boxed{\theta = \tan^{-1}\left(\frac{1}{\mu_s} - \frac{m_2}{m_1\mu_s}\right)}$$