Announcements

1. Prepare equation sheet for Second Hour Exam,
   Wed. Oct 16th

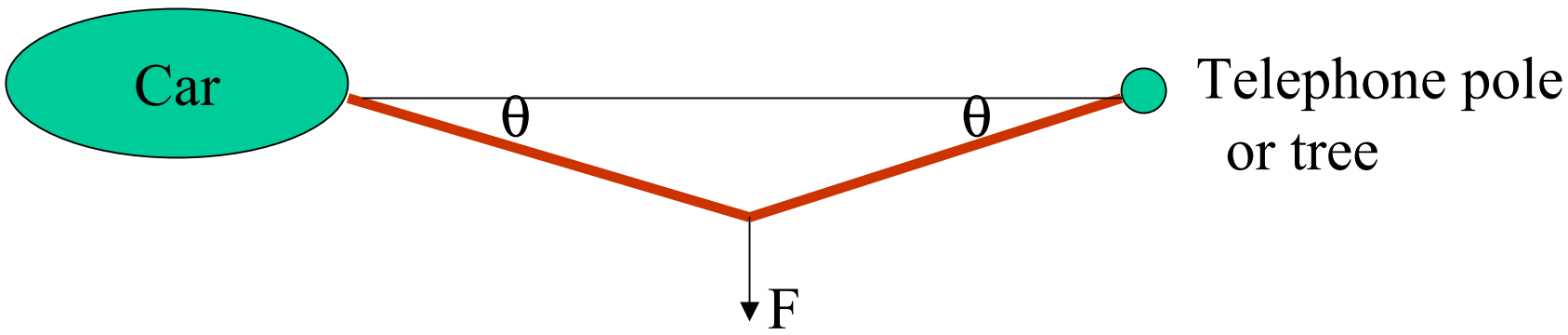
2. Review session – Monday at 5 PM ?

   -- Tuesday at 5 PM ?

3. Topics for today -- center of attention on
   the “center-of-mass”

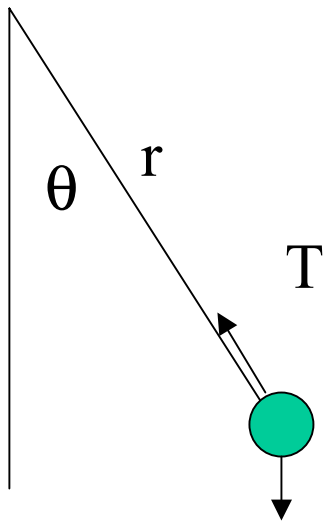
   -- equilibrium and stability

Pulling car out of the mud. Bird's eye view:



Notion of equilibrium: $\sum_i \mathbf{F}_i = 0$ $\sum_i \boldsymbol{\tau}_i = 0$

Notion of stability:



$\mathbf{F}=m\mathbf{a}$ ➔ $T - mg\cos\theta = 0$

$-mg\sin\theta = -ma_\theta$

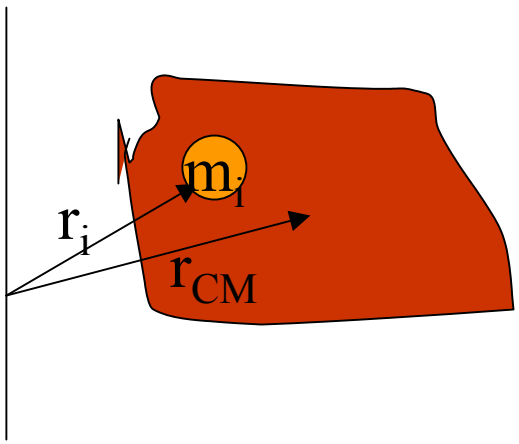
$\tau = I\alpha$ ➔ $r\,mg\sin\theta = mr^2\alpha = mra_\theta$

Example of stable equilibrium.

$mg(-\mathbf{j})$

Center-of-mass $$\mathbf{r}_{CM} \equiv \frac{\sum_i m_i \mathbf{r}_i}{\sum_i m_i}$$

Torque on an extended object due to gravity (near surface of the earth) is the same as the torque on a point mass M located at the center of mass.

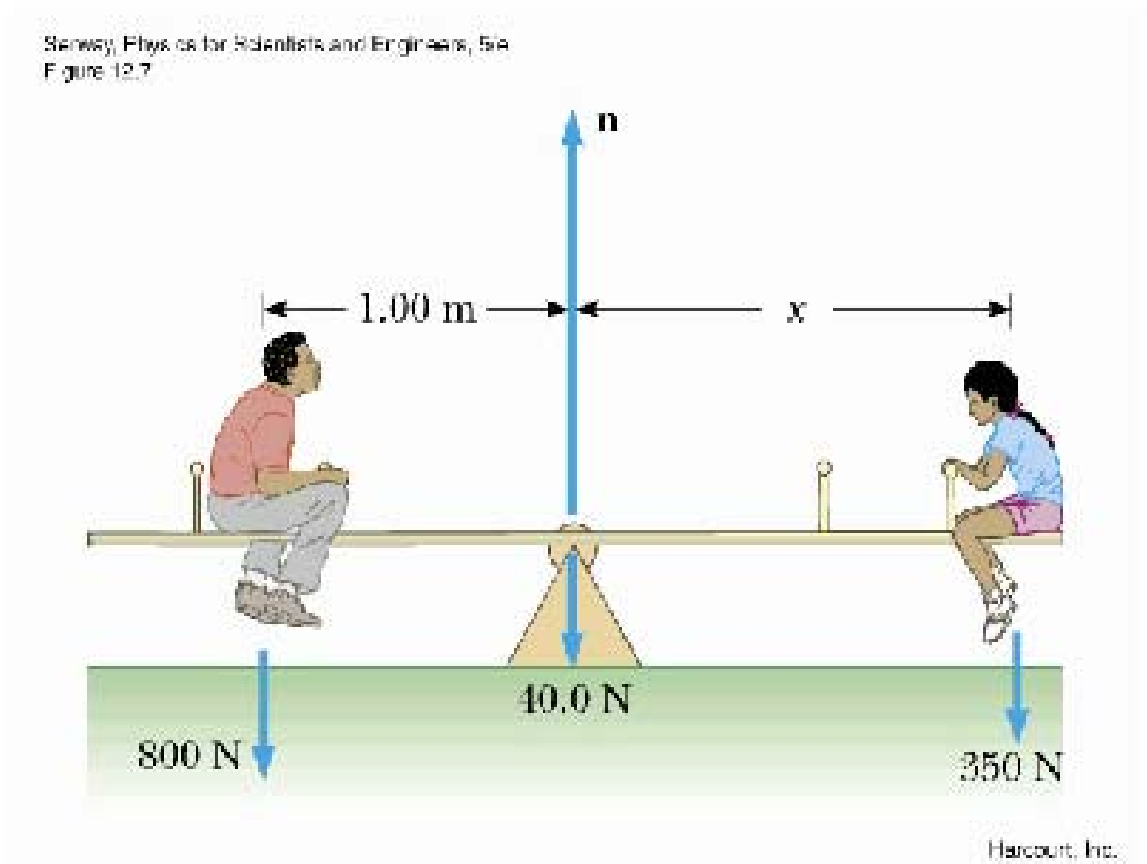


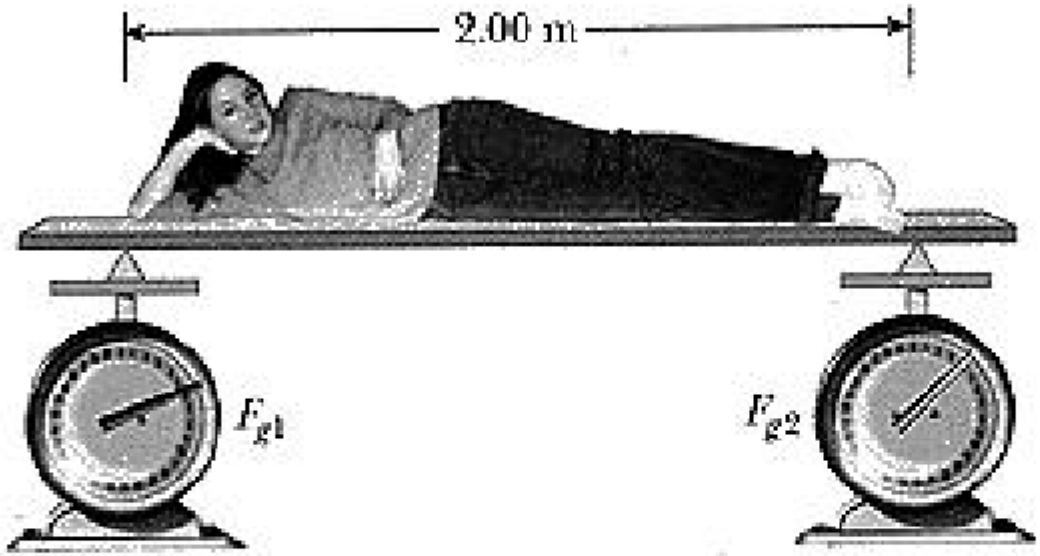
$$\boldsymbol{\tau} = \sum_i \mathbf{r}_i \times m_i g(-\mathbf{j}) = \mathbf{r}_{CM} \times Mg(-\mathbf{j})$$

Analysis of stability:

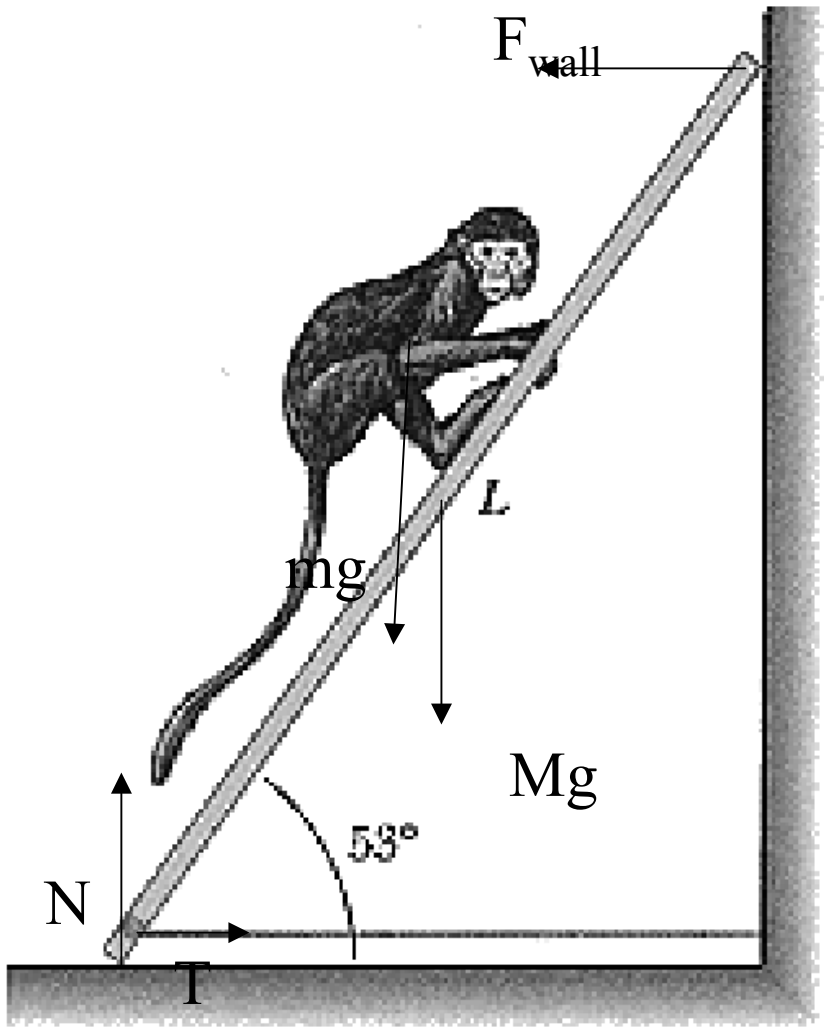
$$\sum_i \mathbf{F}_i = 0 \qquad \sum_i \boldsymbol{\tau}_i = 0$$

Online Quiz for Lecture 18
Equilibrium -- Oct. 11, 2002





A student takes a nap on a massless plank which is supported by two scales as shown. If the left and right scale readings are $F_{g1} = 350$ N and $F_{g2} = 300$ N, respectively, what is her total weight and where is her center of mass located? (Please indicate whether you are measuring her center of mass from her feet or head.)

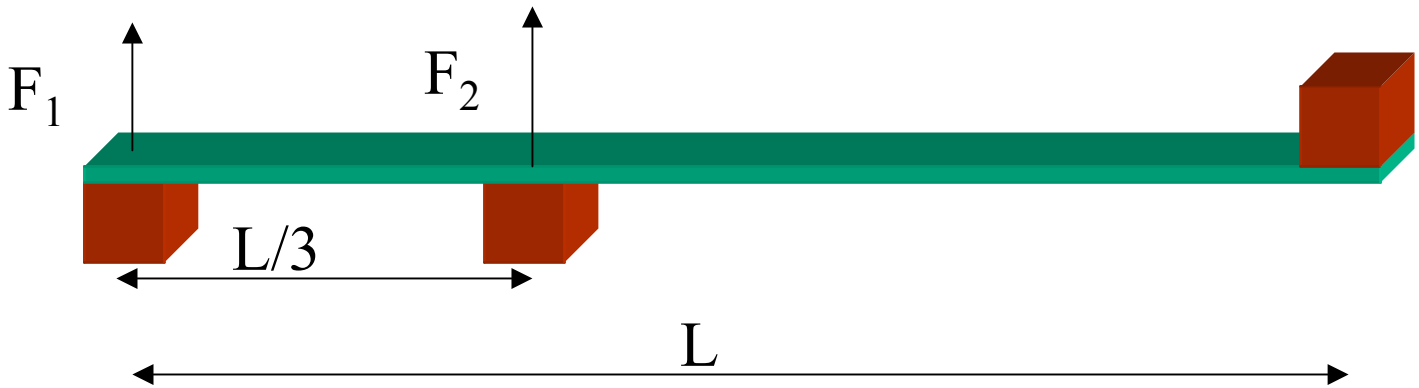


Mg = 120 N

mg = 98 N

T < 110 N

Peer instruction question



Consider the above drawing of the two supports for a uniform plank which has a total weight Mg and has a weight mg at its end. What can you say about F_1 and F_2?

(a) F_1 and F_2 are both up as shown.

(b) F_1 is up but F_2 is down.

(c) F_1 is down but F_2 is up.