11-0) What defines static equilibrium?

I. The sum of all forces on an object is zero
II. The sum of all torques on an object (around an axis) is zero
III. The object is not translating
IV. The object is not rotating

A) None of these are true
B) One of these is true
C) Two of these are true
D) Three of these are true
E) All of these are true

I think the pace of this course (covering a chapter a week) is…

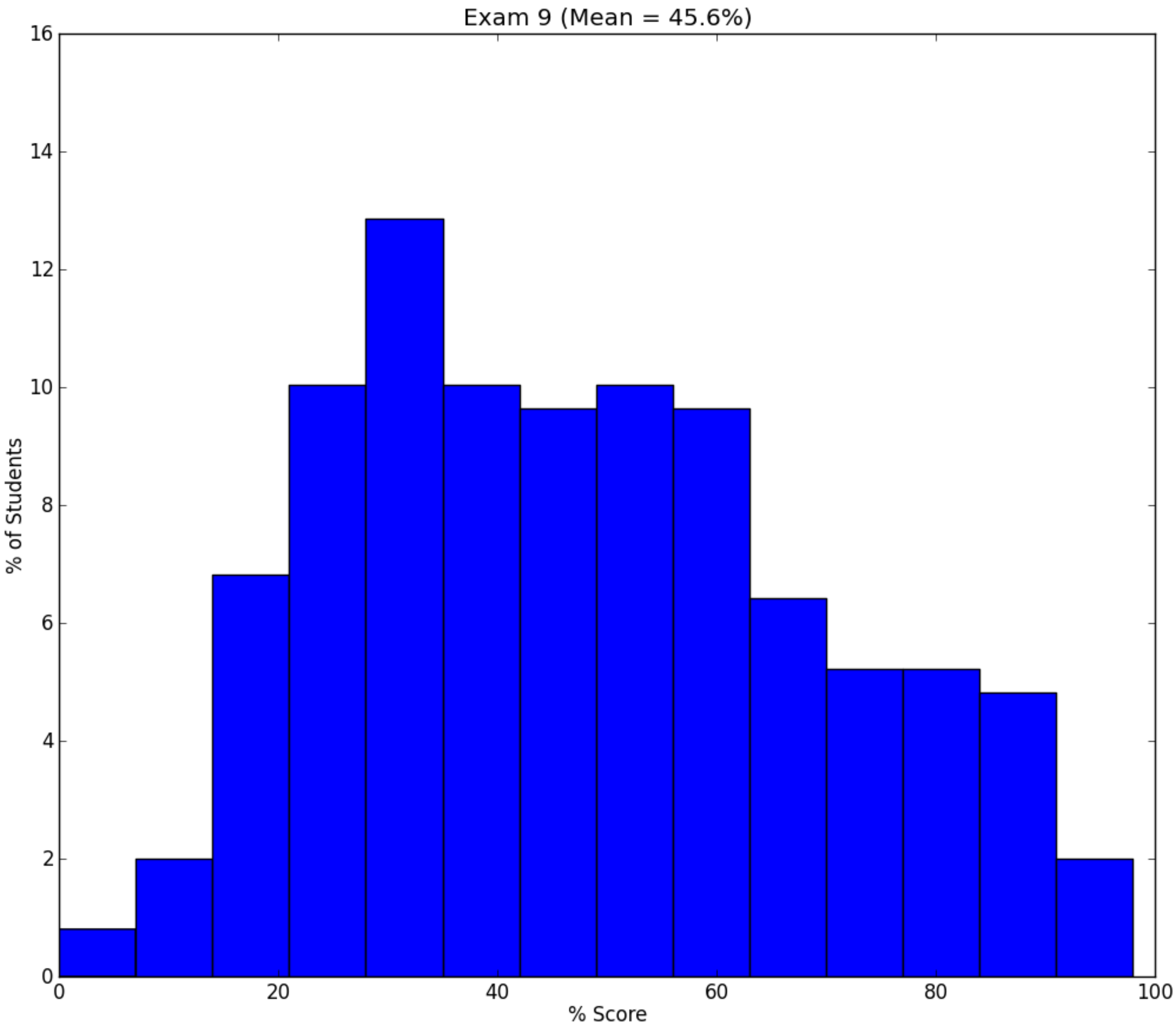
A) Way too fast
B) Too fast
C) Just right
D) Too slow
E) Way too slow

I would prefer to cover fewer topics in more depth than we do now.

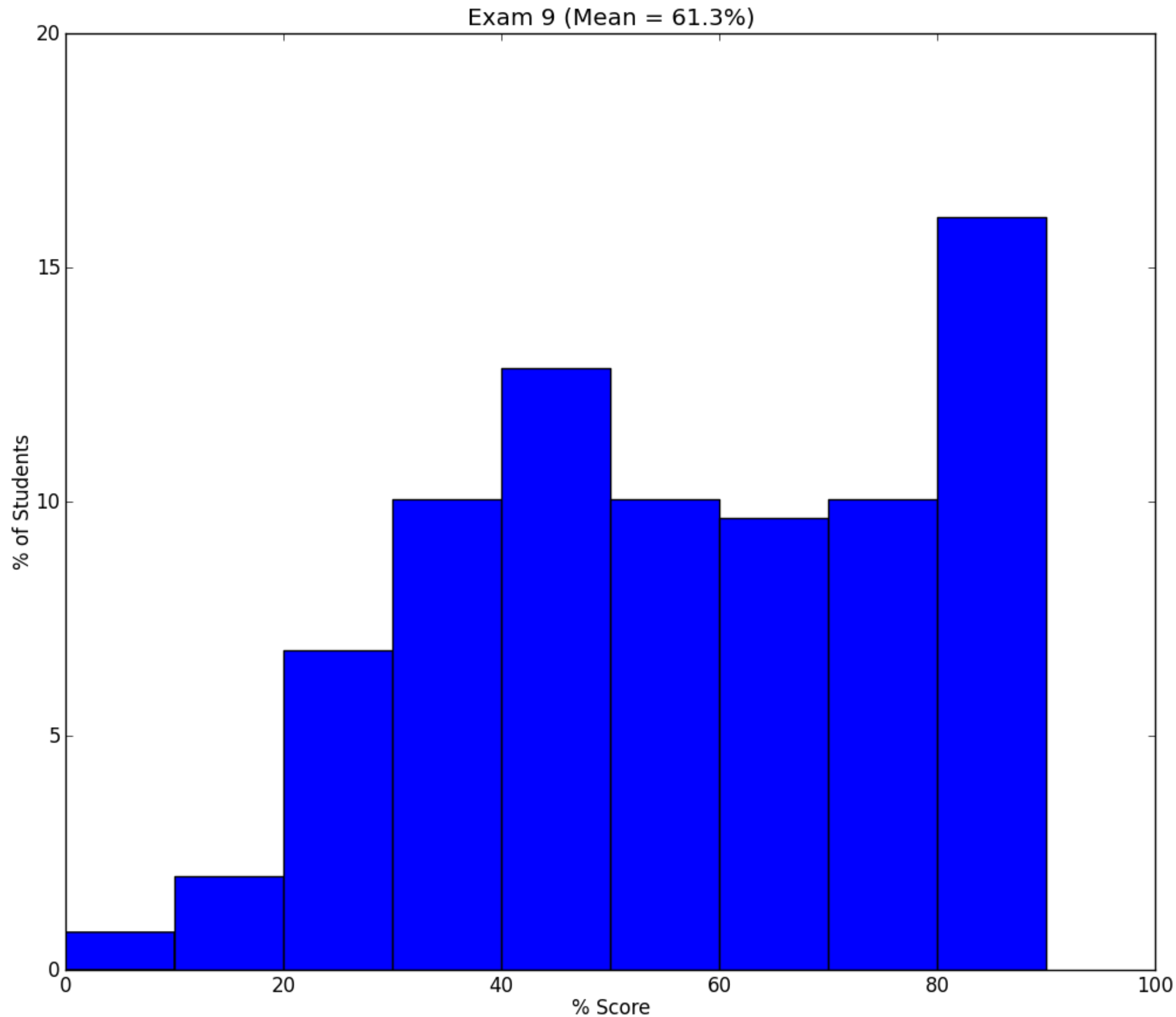
A) Strongly agree
B) Agree
C) Neutral/Meh
D) Disagree
E) Strongly disagree

I like the being given an exam a week, and would not prefer fewer exams in this course.

A) Strongly agree
B) Agree
C) Neutral
D) Disagree
E) Strongly disagree



Exam 9 (Mean = 45.6%)
% of Students
% Score
0
2
4
6
8
10
12
14
16
0
20
40
60
80
100



Exam 9 (Mean = 61.3%)
% of Students
% Score
0
5
10
15
20
0
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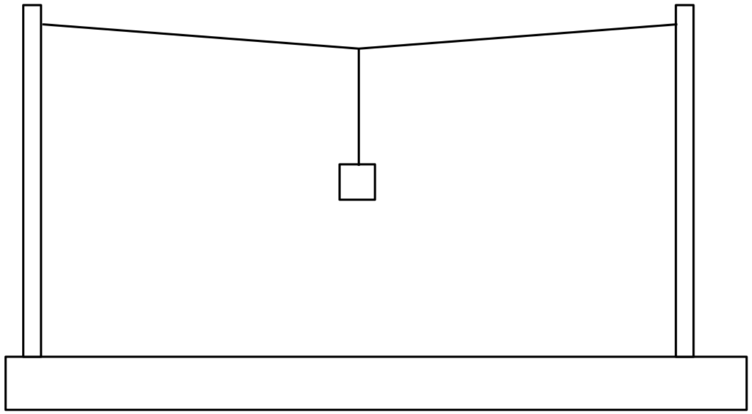
40
60
80
100

Static Equilibrium

11-1) A mass m is hung from a clothesline stretched between two poles as shown. As a result, the clothesline sags very slightly as shown.



The tension T in the clothesline has magnitude…

A) mg

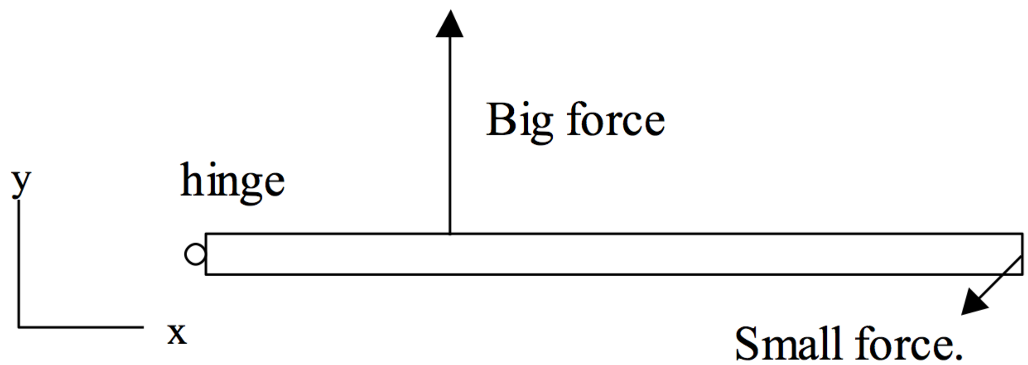
B) mg/2

C) a little more than mg/2

D) much more than mg/2

E) much less than mg/2

11-2) A door is pushed on by two forces, a smaller force at the door knob AND a larger force nearer the hinge as shown. The door does not move.

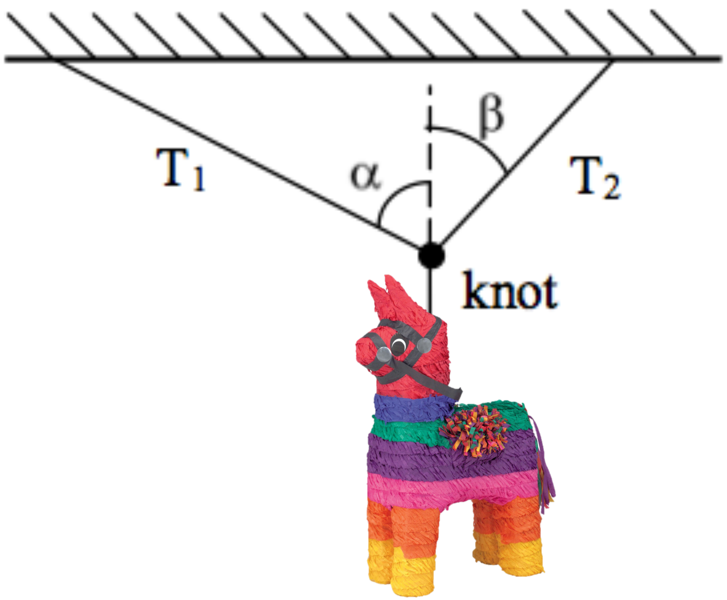


The force exerted on the door by the hinge…

A) is zero
B) points along +y
C) points along –y
D) points lower right
E) points upper right

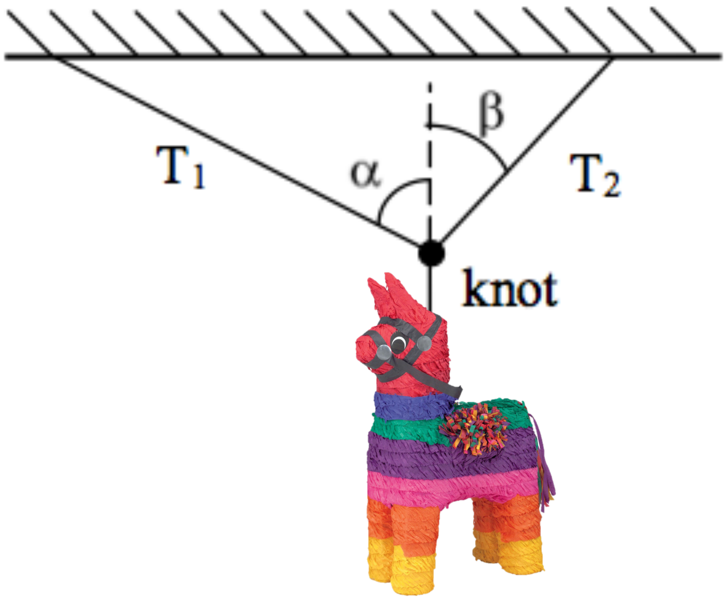
Example: Hanging a piñata

You are hanging a very large piñata for a totally sweet party. But, you are concerned about breaking the ropes. Luckily, you can whip out your mad physics skills to check if the ropes will hold.



Example: Hanging a piñata

11-10a) Which of the following is the correct expression for the sum of all forces in the x-direction?



A) $T_2 \cos\beta - T_1 \cos\alpha = 0$

B) $T_2 \sin\beta - T_1 \sin\alpha = 0$

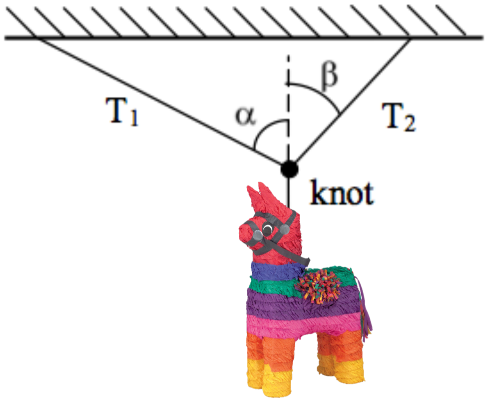
C) $T_2 \cos\beta - T_1 \sin\alpha = 0$

D) $T_2 \sin\beta - T_1 \cos\alpha = 0$

E) None of these

Example: Hanging a piñata

11-10b) Which of the following is the correct expression for the sum of all forces in the y-direction?



A) $T_2 \cos \beta - T_1 \cos \alpha - mg = 0$

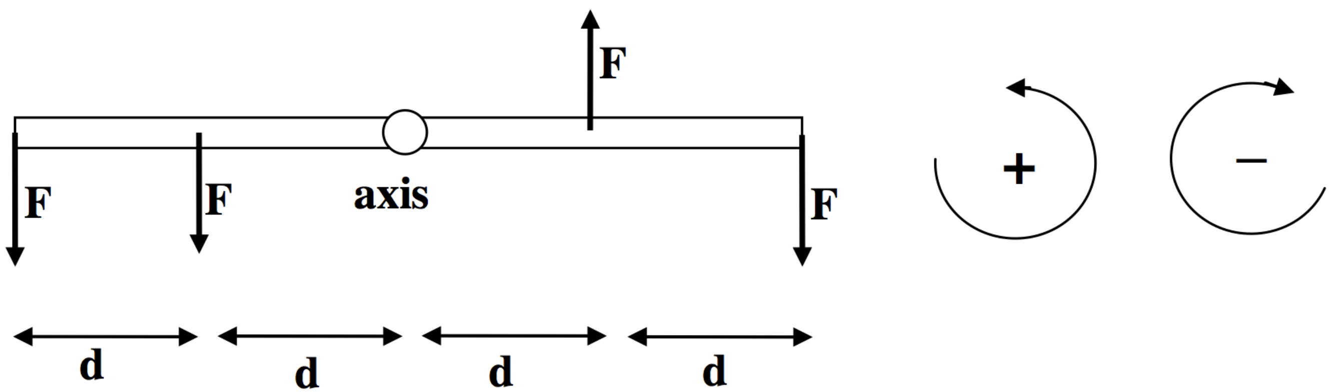
B) $T_2 \cos \beta + T_1 \cos \alpha + mg = 0$

C) $-T_2 \cos \beta + T_1 \cos \alpha + mg = 0$

D) $T_2 \cos \beta + T_1 \cos \alpha - mg = 0$

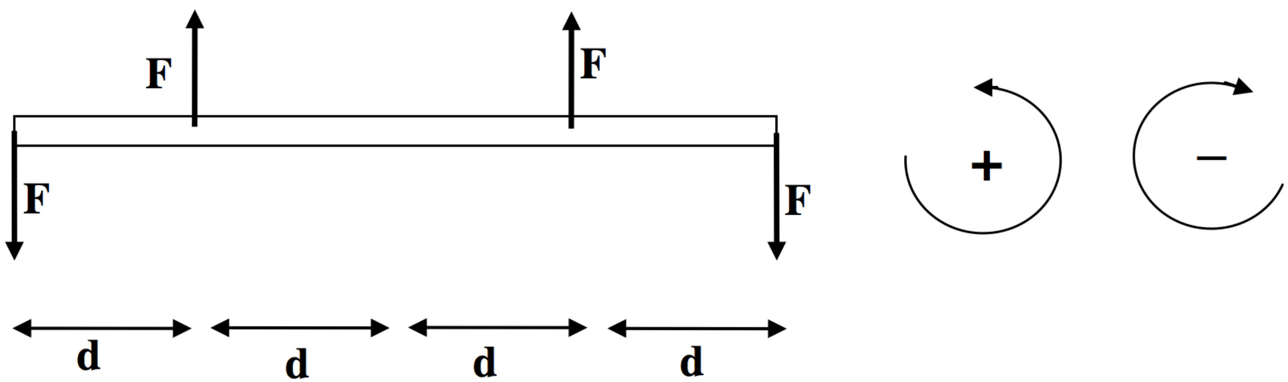
E) None of these

11-3) A bar has four forces, all of the same magnitude, exerted on it, as shown. What is the sign of the net torque about the axis of rotation? Use the sign convention shown.



A) torque is zero   B) positive (+) C) negative (-)

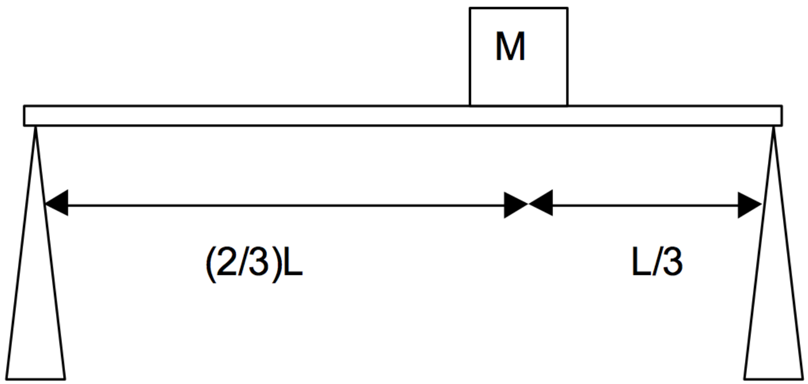
11-4) A light board of length 4d is stationary. Four forces, all of the same magnitude F, are being applied as shown.

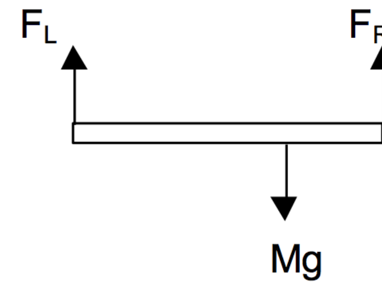


If we choose the left end of the board as the axis of rotation, then the net torque about that axis is

A) torque is zero
B) positive (+)
C) negative (–)

11-5a) A mass M is placed on a very light board supported at the ends, as shown. The free-body diagram shows directions of the forces, but not their correct relative sizes.

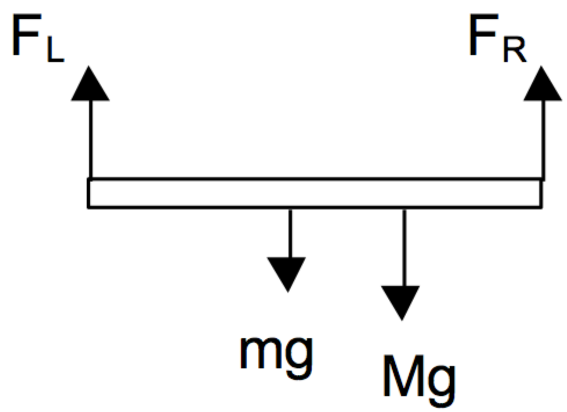




What is the ratio F_R/F_L?
(Hint: consider the torque about the mass M)

A) 2/3 B) 1/3 C) 1/2 D) 2 E) None of these

11-5b) Suppose now the board has mass m, so the free-body diagram is now…

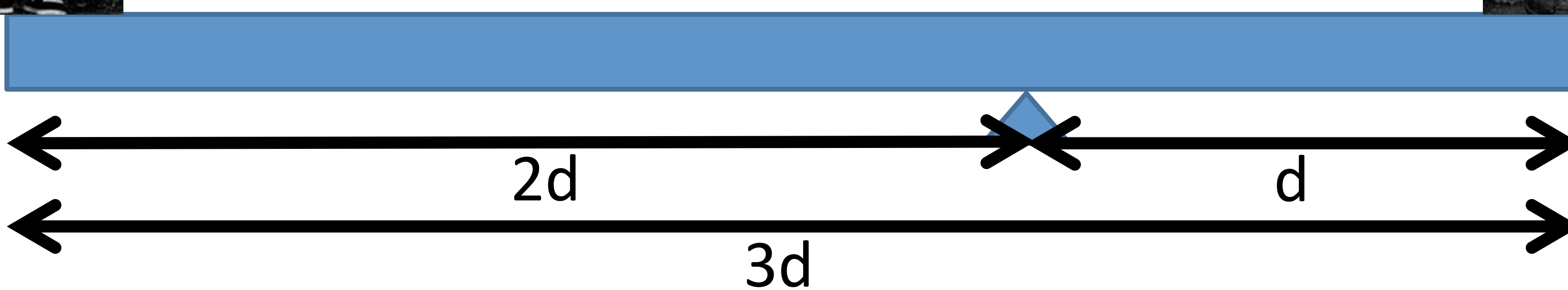


Compared to when the board had no mass, the force F_R is now…

A) greater
B) less
C) the same.

Example: Jay and Silent Bob on a seesaw

Jay and Silent Bob are on standing on a very large seesaw (length, L; mass, m_p) that is not rotating. Knowing Jay's mass (m_2), can we determine Silent Bob's (m_1)?



Example: Jay and Silent Bob on a seesaw

11-11) Which of the following is the relationship for the torques about the pivot point?

A) $2d\,(m_2 g) + d/2\,(m_p g) - d\,(m_1 g) = 0$

B) $-2d\,(m_2 g) + d/2\,(m_p g) + d\,(m_1 g) = 0$

C) $2d\,(m_2 g) - d/2\,(m_p g) - d\,(m_1 g) = 0$

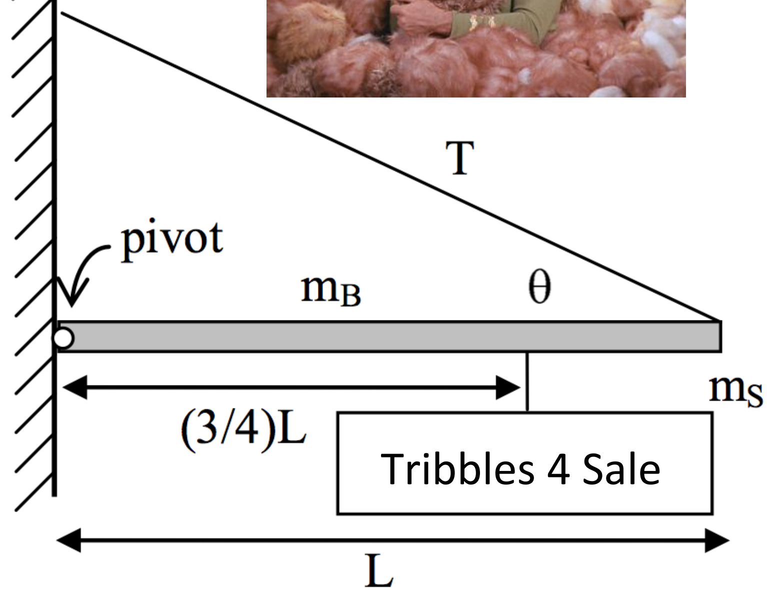
D) $2d\,(m_2 g) + d/2\,(m_p g) + d\,(m_1 g) = 0$

E) None of these

Example: Hanging a sign

You are hanging a sign for your new business venture. You need to use the right wire to hold it.

Determine the force the wire must withstand.

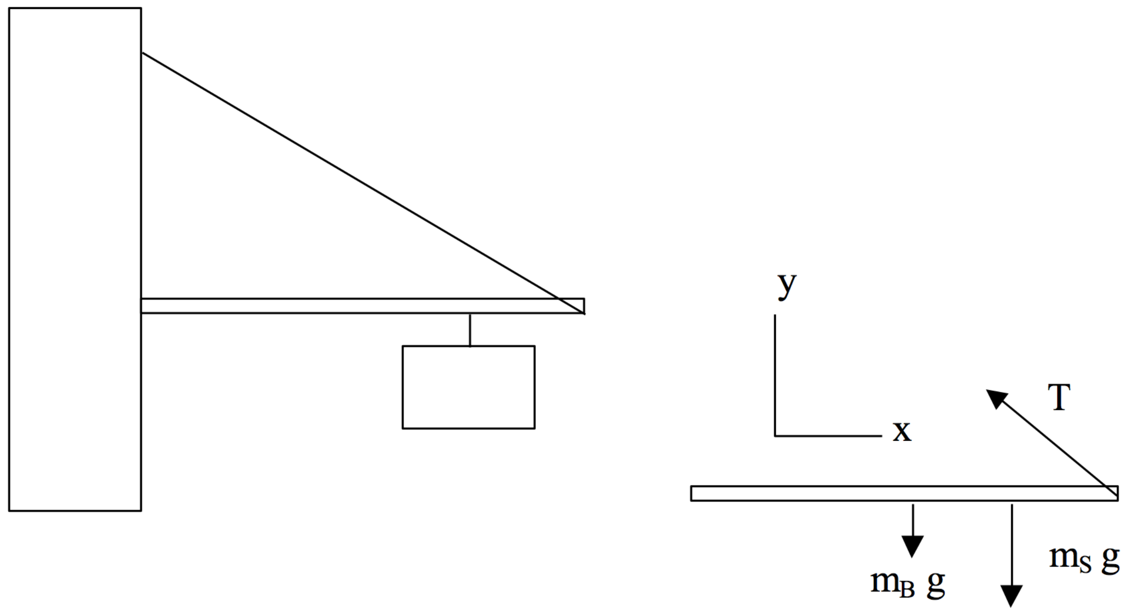


Example: Hanging a sign

11-12) Which is the appropriate relationship for the torques about the pivot point?

A) $- L (F_R \sin\theta) - 3L/4 (m_g g) - L/2(m_b g) = 0$
B) $L (F_R \sin\theta) + 3L/4 (m_g g) + L/2(m_b g) = 0$
C) $L (F_R \sin\theta) + 3L/4 (m_g g) - L/2(m_b g) = 0$
D) $L (F_R \sin\theta) - 3L/4 (m_g g) + L/2(m_b g) = 0$
E) None of these

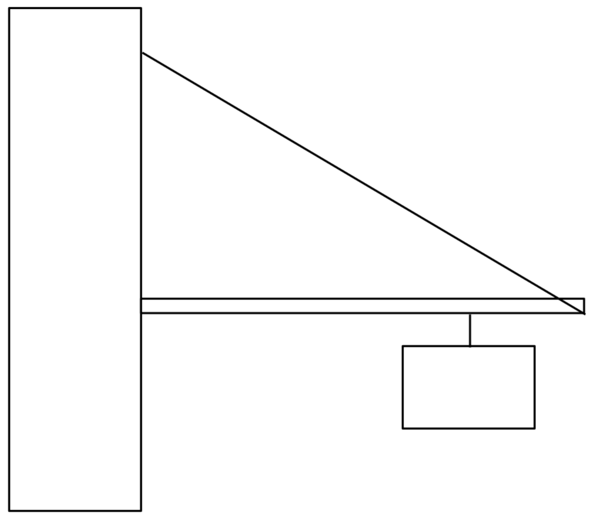
11-7a) A sign of mass m_s is hung from a uniform horizontal bar of mass m_B as shown.

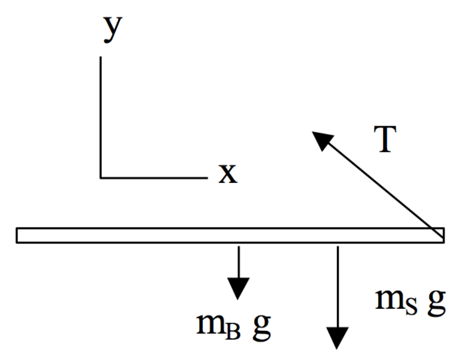


What is the sign of the x-component of the force exerted on the bar by the wall?

A) Positive B) Negative C) $F_{WX} = 0$

11-7b) A sign of mass m_s is hung from a uniform horizontal bar of mass m_B as shown.



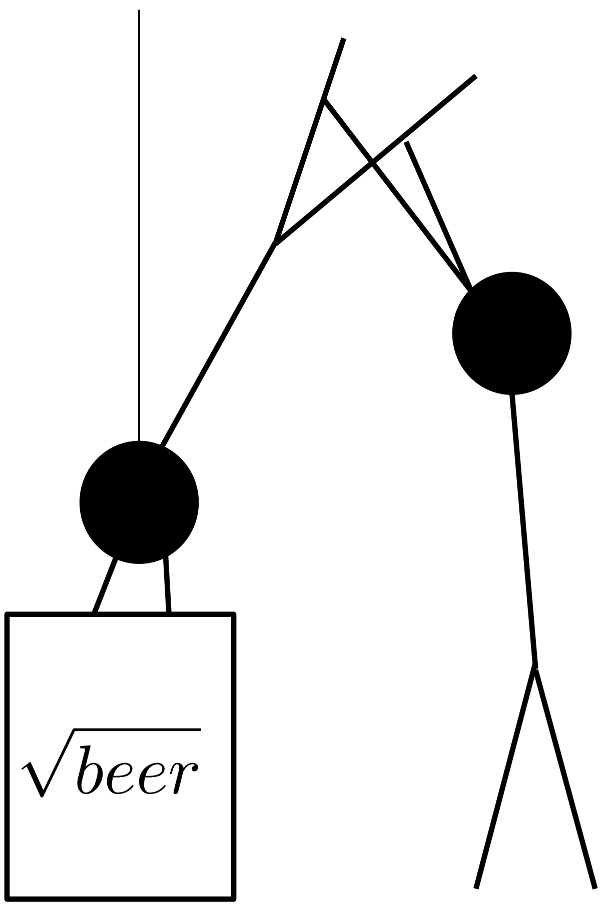


What is the sign of the y-component of the force exerted on the bar by the wall?

A) Positive B) Negative C) $F_{WY} = 0$.

(HINT: consider the torques about the right end of the bar.)

Example: Doing a kegstand



You are doing a kegstand with your favorite tasty beverage (root beer for the young-un's).

If your mass is m, and height is h, with what force does your friend push up to keep you from tipping over?

Example: Doing a kegstand

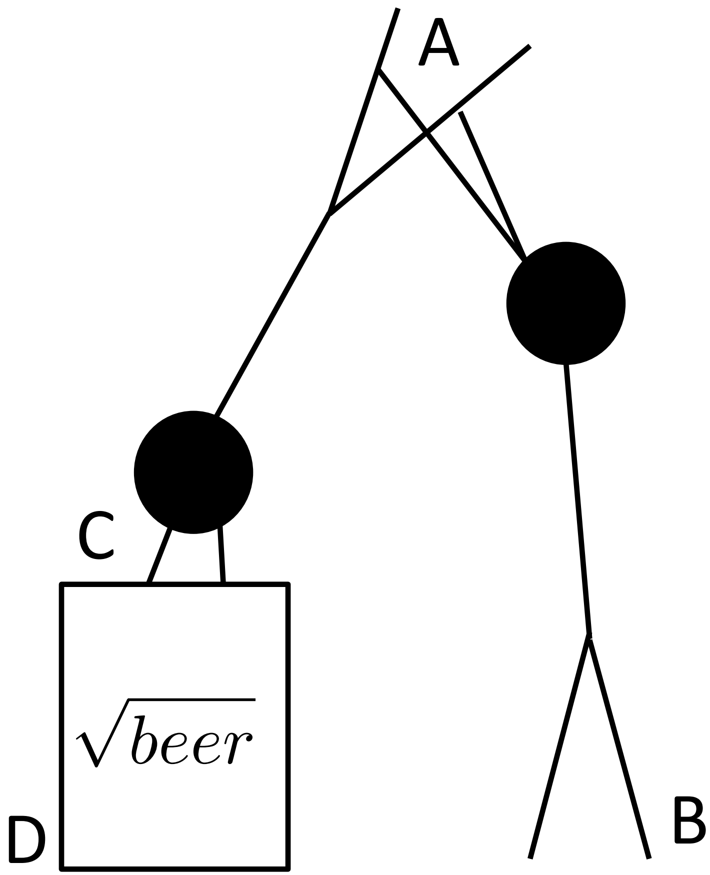
11-12a) We've done a few of these now. What's the best approach for this problem?

A) No net torque

B) No net force

C) Apply both?

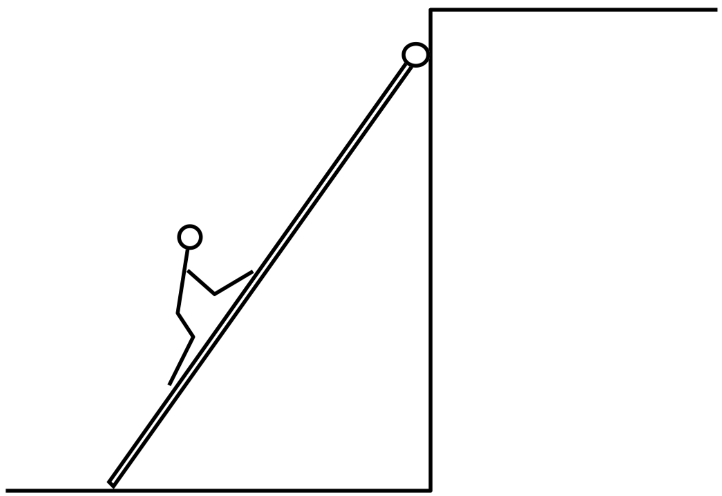
Example: Doing a kegstand

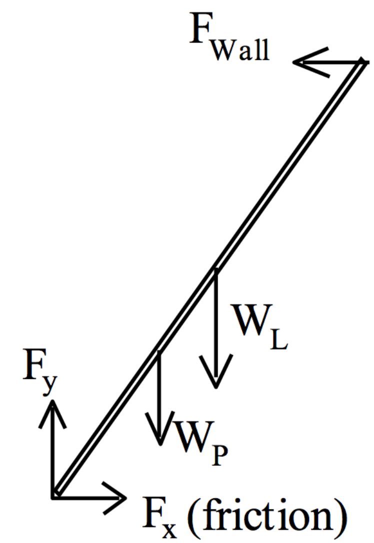


11-12b) About which point should apply our torque equation?
That is, where's the pivot point that helps us solve our problem?

E) Somewhere else

11-6a) A ladder of weight W_L leans against a wall. The ladder has rollers at the top so that the wall exerts a normal force only on the top of the ladder. A person of weight W_P slowly climbs the ladder. A free-body diagram for the ladder is shown.





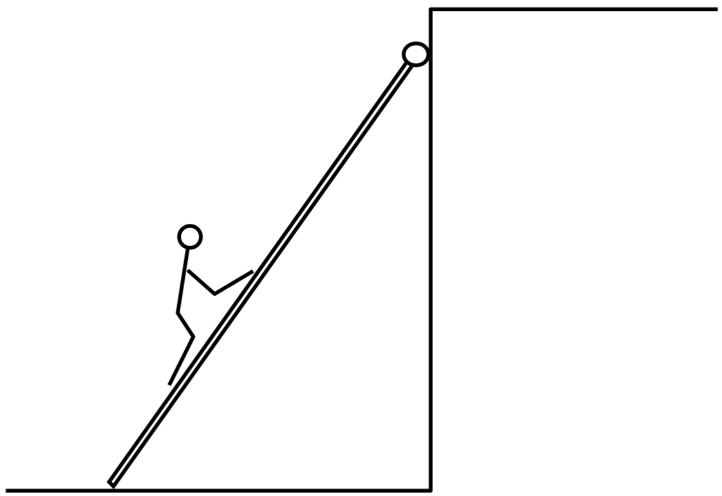
As the person ascends the ladder, the force from the wall (F_{wall})

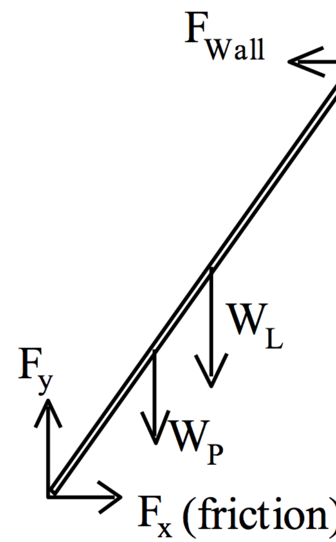
A) increases B) decreases C) stays the same

(Hint: Consider the torque about the point where the ladder touches the ground.)

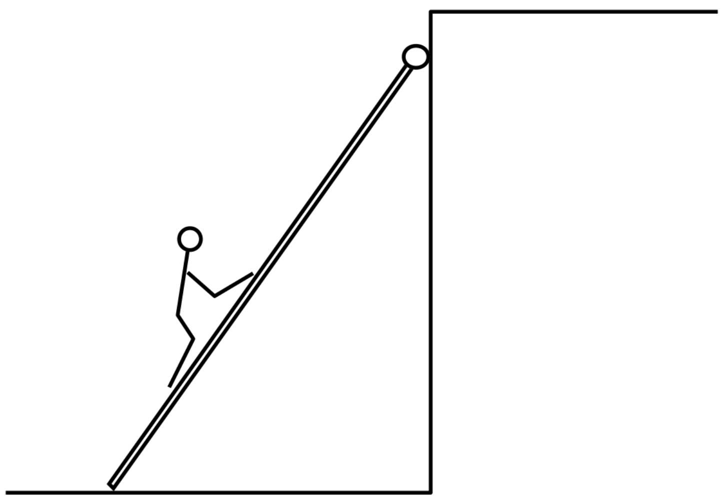
11-6b) As the person ascends the ladder the force of friction F_x, between the ladder and the ground …

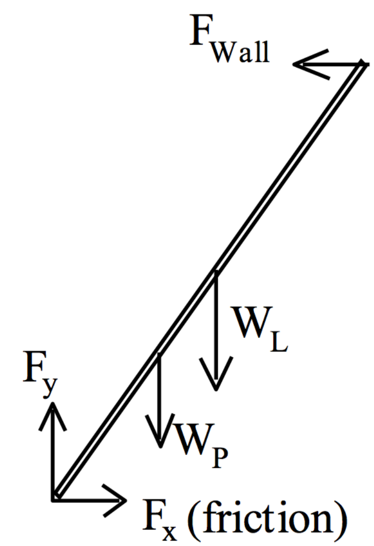
A) increases B) decreases C) stays the same





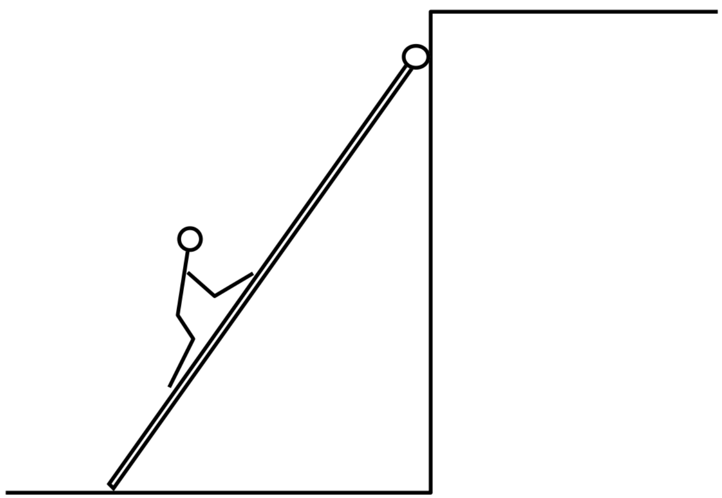
11-6c) The ladder is more likely to slip when the person is...
A) lower   B) higher   C) doesn't matter.

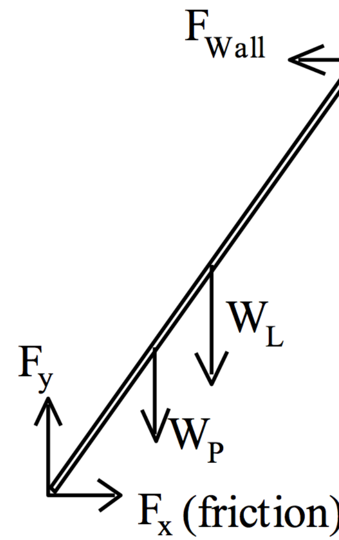




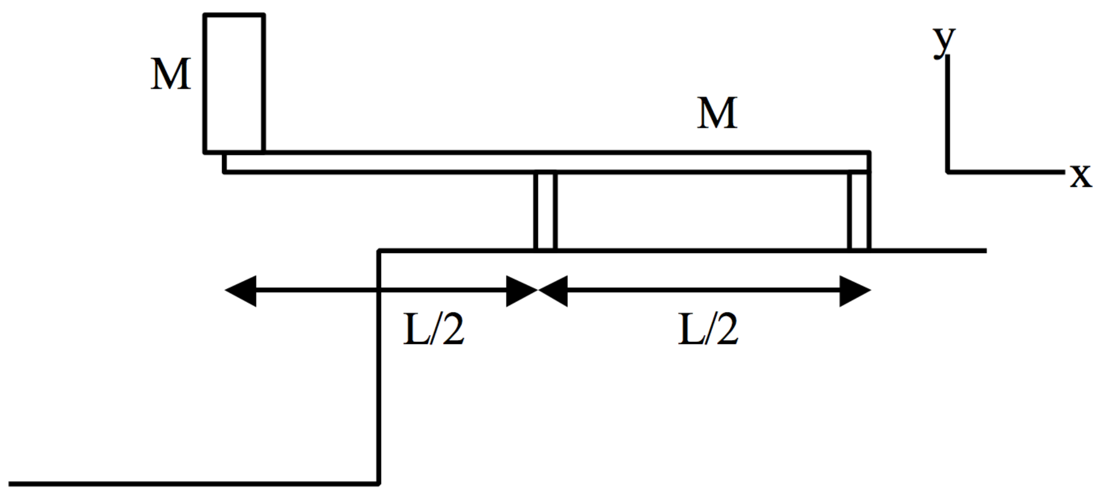
11-6d) All during the time that the person ascends, but before the ladder slips, is it true that $F_{fric} = \mu_S N$?

A) Yes B) No



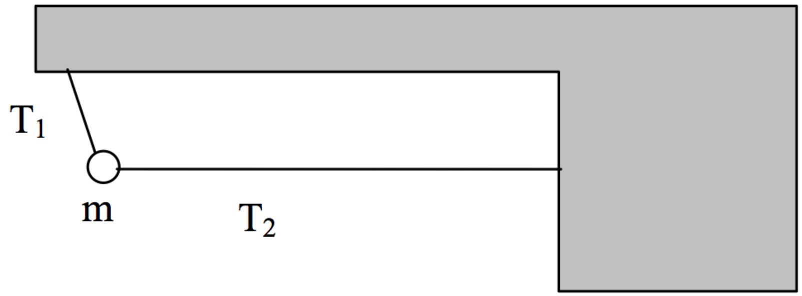


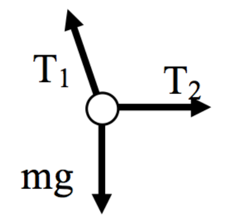
11-8) A box of mass M is sitting at the edge of a diving board of the same mass M, total length L. The board has two supports: one in the middle, one on the end, as shown. What is the y-component of the force on the board F_Y from the right support? (Hint: consider the torque about the C.M. of the board.)



A) Mg B) –Mg C) 2Mg D) -2Mg E) None of these

11-9) A mass M is supported by two threads as shown. The free-body diagram correctly shows the directions of the forces but does not correctly show their magnitudes.





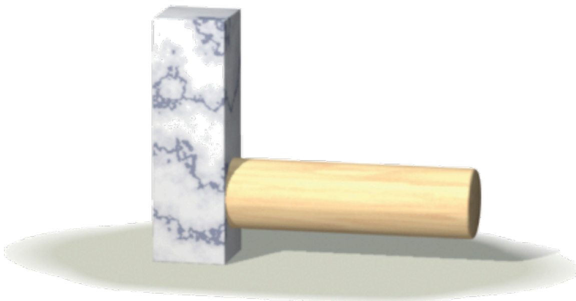
Which tension is larger: T_1 or T_2?

A) T_1 B) T_2 C) Both have the same magnitude

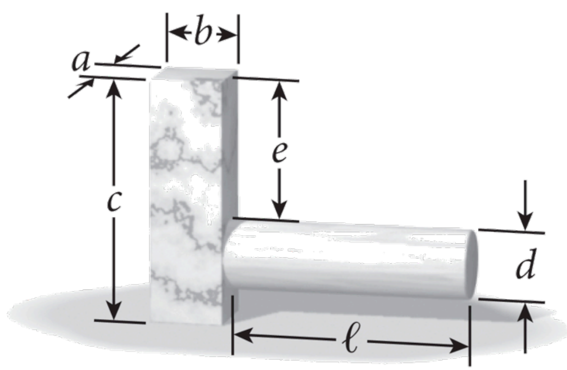
Stability

http://www.youtube.com/watch?v=pch3hoUtfJ0

Example: Abstract sculpture



(a)

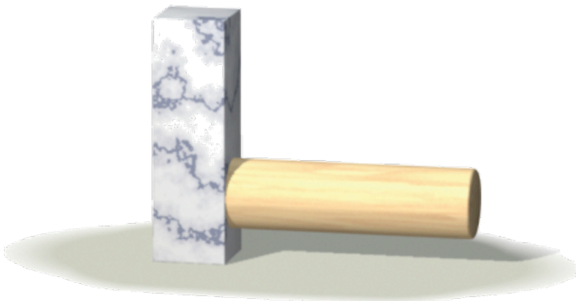


(b)

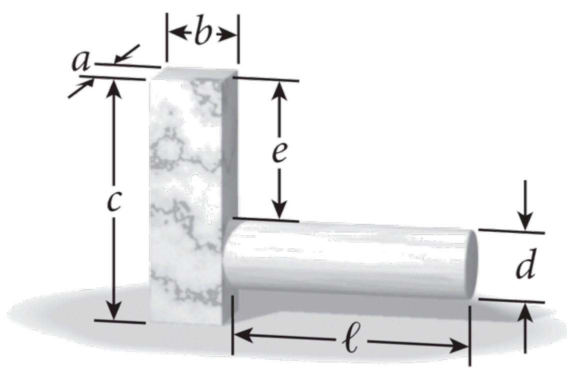
Can this thing stand up on its own or does it need a brace?

Ideas: How could you tell?

Example: Abstract sculpture



(a)

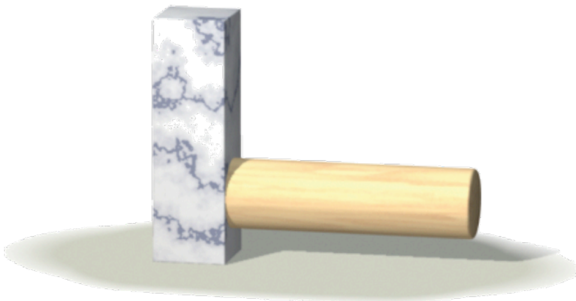


(b)

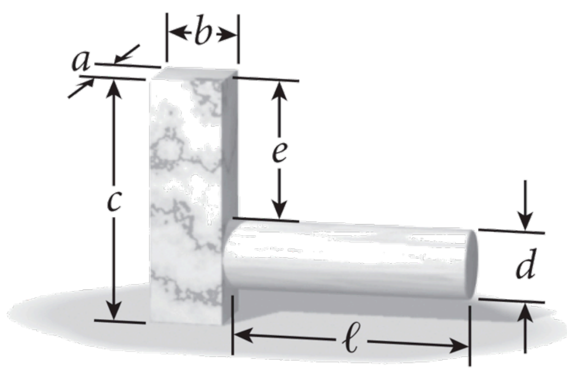
Ok, for the sake of argument, let's work through the details.

Perhaps, you have to prepare the space before it gets there (or something).

Example: Abstract sculpture



(a)

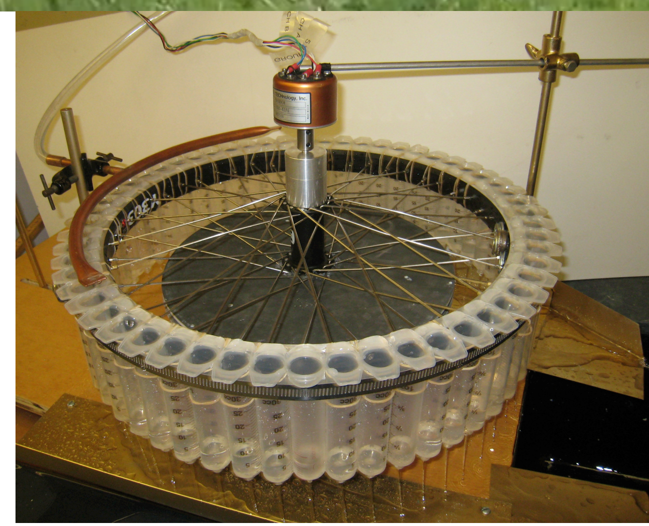


(b)

11-13) How would we find the center of mass of each object?

A) Using a sophisticated calculation (integrals!)
B) Just look at it
C) Something else

Stability Analysis

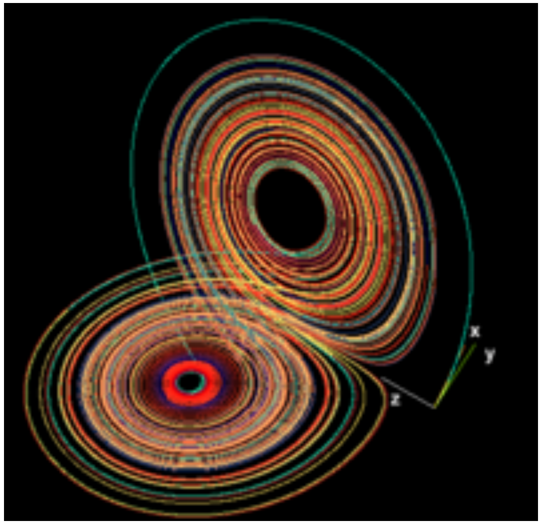


Zombies vs Humans

- Low Number Density, Low Noise http://www.youtube.com/watch?v=1ZfGxTwMT94
- Moderate Number Density, Moderate Noise http://www.youtube.com/watch?v=vEFOuUU7IPY
- High Number Density, Low Noise http://www.youtube.com/watch?v=KYGKwiMTxJo

Chaotic Waterwheel

- http://www.youtube.com/watch?v=HH2jPq9g6CI



Model of atmospheric convection