Ch 11 Supplemental [Edit]

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Ch 11 Supplemental

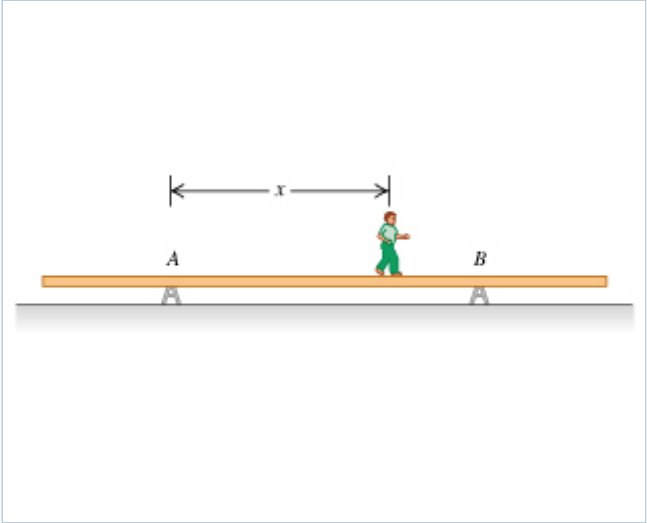
Due: 11:00pm on Thursday, December 1, 2016

To understand how points are awarded, read the Grading Policy for this assignment.

Exercise 11.12

Description: A uniform, aluminum beam 9.00 m long, weighting 300 N, rests symmetrically on two supports 5.00 m apart. A boy weighing 600 N starts at point A and walks toward the right. (a) How far beyond point B can the boy walk before the beam tips? (b)...

A uniform, aluminum beam 9.00 m long, weighting 300 N, rests symmetrically on two supports 5.00 m apart. A boy weighing 600 N starts at point *A* and walks toward the right.



Part A

How far beyond point *B* can the boy walk before the beam tips?

ANSWER:

l = 1.25 m

Part B

How far from the right end of the beam should support *B* be placed so that the boy can walk just to the end of the beam without causing it to tip?

ANSWER:

l = 1.50 m

Exercise 11.19

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e zoo is held in a horizontal position by two ropes at its ends in . The left rope makes an angle of 150 degree(s) with the rod and the right rope makes an angle theta with the horizontal. A w2-

N howler...

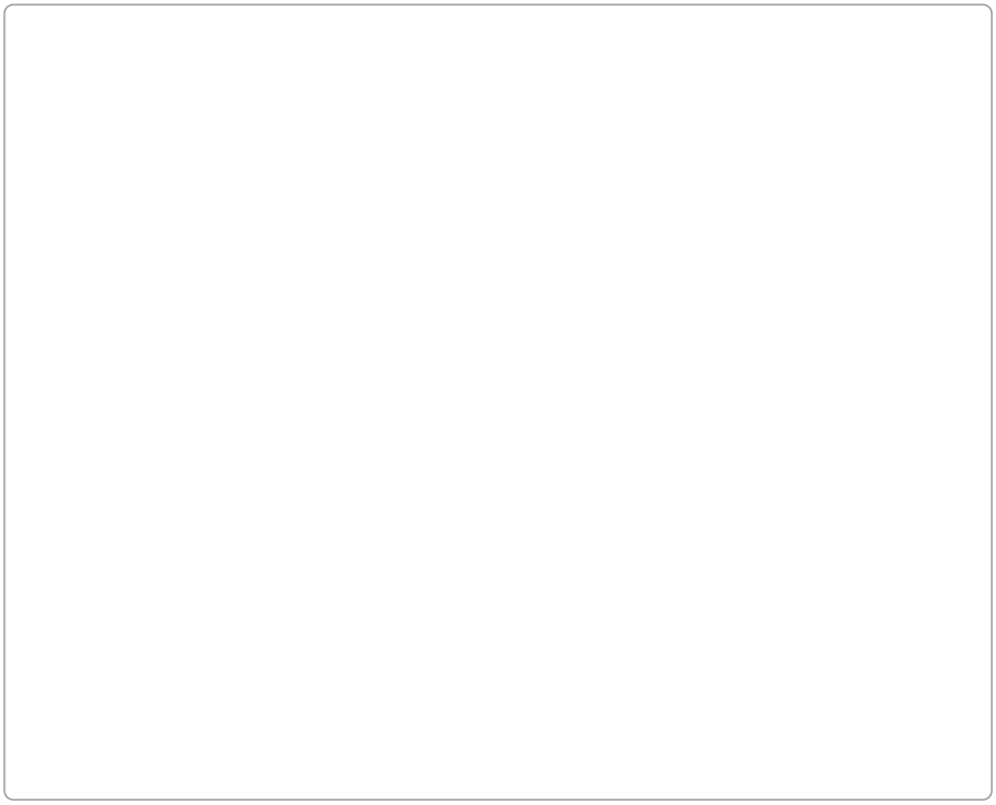
A 3.00-m-long, 170-N, uniform rod at the zoo is held in a horizontal position by two ropes at its ends in . The left rope makes an angle of 150° with the rod and the right rope makes an angle θ with the horizontal. A 90-N howler monkey (*Alouatta seniculus*) hangs motionless 0.50 m from the right end of the rod as he carefully studies you.

Part A

Make a free-body diagram of the rod.

Draw the vectors starting at the black dots. The location and orientation of the vectors will be graded. The length of the vectors will not be graded.

ANSWER:



Part B

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Calculate the tension in the left rope.

Express your answer to two significant figures and include the appropriate units.

ANSWER:

T_L = $\frac{1.5w + w2 \cdot 0.5}{3\sin(150)}$ = 200 N

Also accepted: $\frac{1.5w + w2 \cdot 0.5}{3\sin(150)}$ = 200 N, $\frac{1.5w + w2 \cdot 0.5}{3\sin(150)}$ = 200 N

Part C

Calculate the tension in the right rope.

Express your answer to two significant figures and include the appropriate units.

ANSWER:

T_R = $\sqrt{\left((w + w2) - \frac{\frac{1.5w + w2 \cdot 0.5}{3\sin(150)}}{2}\right)^2 + \left(\frac{1.5w + w2 \cdot 0.5}{3\sin(150)}\cos(150)\right)^2}$ = 240 N

Also accepted: $\sqrt{\left((w + w2) - \frac{\frac{1.5w + w2 \cdot 0.5}{3\sin(150)}}{2}\right)^2 + \left(\frac{1.5w + w2 \cdot 0.5}{3\sin(150)}\cos(150)\right)^2}$ = 236 N,

$\sqrt{\left((w + w2) - \frac{\frac{1.5w + w2 \cdot 0.5}{3\sin(150)}}{2}\right)^2 + \left(\frac{1.5w + w2 \cdot 0.5}{3\sin(150)}\cos(150)\right)^2}$ = 240 N

Part D

Calculate the angle θ.

Express your answer using two significant figures.

ANSWER:

θ = = 43 °

Also accepted: = 42.7, = 43

Exercise 11.21

Description: Two forces equal in magnitude and opposite in direction, acting on an object at two different points, form what is called a couple. Two antiparallel forces with equal magnitudes F_1 = F_2 =F are applied to a rod as shown in the figure . (a) What...

Two forces equal in magnitude and opposite in direction, acting on an object at two different points, form what is called a *couple*. Two antiparallel forces with equal magnitudes $F_1 = F_2 =$7.30 N are applied to a rod as shown in the figure .

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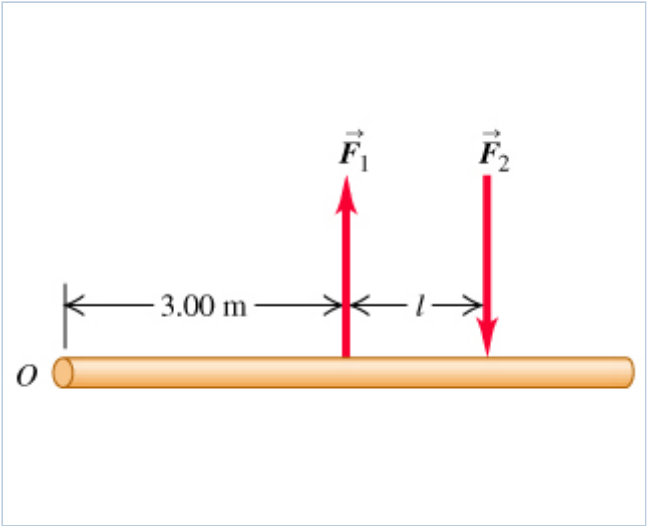

Part A

What should the distance l between the forces be if they are to provide a net torque of 6.30 $\mathrm{N \cdot m}$ about the left end of the rod?

ANSWER:

l = = 0.863 m

Part B

Is the sense of this torque clockwise or counterclockwise?

ANSWER:

- (•) clockwise
- ( ) counterclockwise

Part C

Repeat part A for a pivot at the point on the rod where $\vec{F}_2$ is applied.

ANSWER:

l = = 0.863 m

Part D

Repeat part B for a pivot at the point on the rod where $\vec{F}_2$ is applied.

ANSWER:

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- (•) clockwise
- ( ) counterclockwise

Problem 11.43

Description: A box of negligible mass rests at the left end of a l-m, m-kg plank (the figure). The width of the box is w, and sand is to be distributed uniformly throughout it. The center of gravity of the nonuniform plank is d from the right end. (a) What mass...

A box of negligible mass rests at the left end of a 2.10-m, 22.5-kg plank (the figure). The width of the box is 75.0 cm , and sand is to be distributed uniformly throughout it. The center of gravity of the nonuniform plank is 50.0 cm from the right end.

Part A

What mass of sand should be put into the box so that the plank balances horizontally on a fulcrum placed just below its midpoint?

ANSWER:

m_{sand} = = 18.3 kg

Problem 11.46

Description: A uniform ## m, ##-kg beam is hinged to a wall and supported by a thin cable attached ## m from the free end of the beam . The beam is supported at an angle of ## degree(s) above the horizontal. (a) Draw a free-body diagram of the beam. ...

A uniform 5.0 m , 1150-kg beam is hinged to a wall and supported by a thin cable attached 2.0 m from the free end of the beam . The beam is supported at an angle of 30.0 $^\circ$ above the horizontal.

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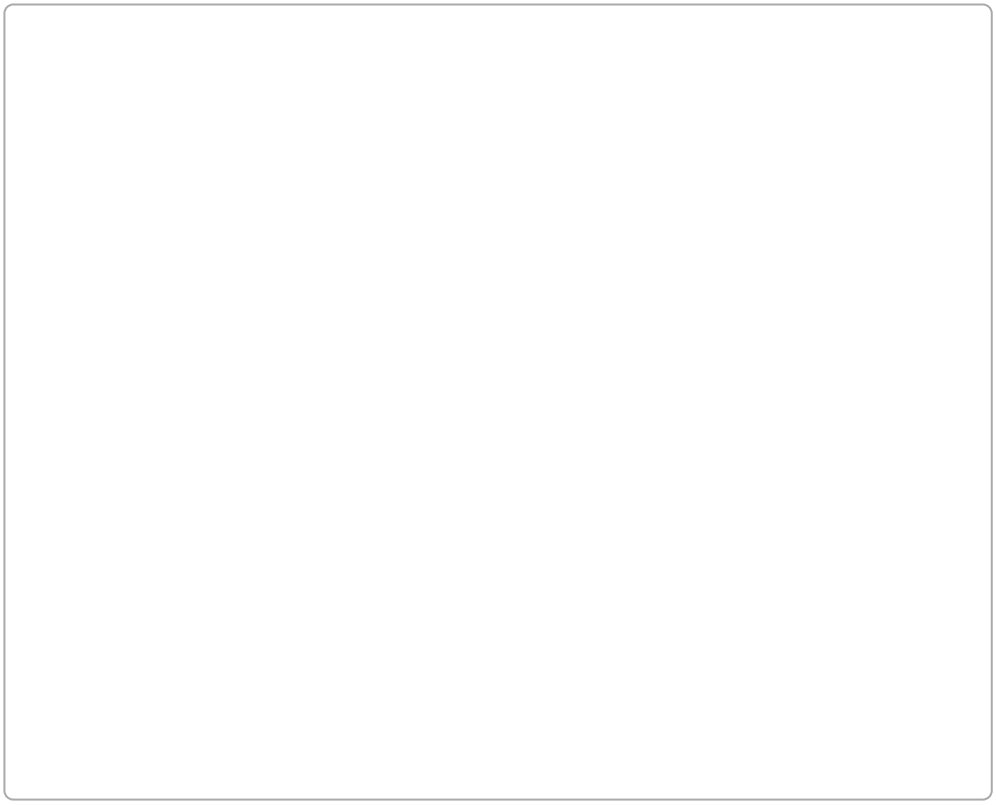
Part A

Draw a free-body diagram of the beam.

Draw the vectors starting at the black dots. The location and orientation of the vectors will be graded. The length of the vectors will not be graded.

ANSWER:



Part B

Find the tension in the cable.

Express your answer with the appropriate units.

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T = = 1.3×10^4 N

Also accepted: = 1.27×10^4 N, = 1.27×10^4 N, = 1.3×10^4 N

Part C

How hard does the beam push inward on the wall? That is, find only the horizontal component of the force.

Express your answer with the appropriate units.

ANSWER:

H_h = = 1.2×10^4 N

Also accepted: = 1.25×10^4 N, = 1.25×10^4 N, = 1.2×10^4 N

Problem 11.47

Description: A uniform, w0-N rod that is l long carries a 225-N weight at its right end and an unknown weight W toward the left end (see the figure). When W is placed x from the left end of the rod, the system just balances horizontally when the fulcrum is...

A uniform, 237-N rod that is 2.05 m long carries a 225-N weight at its right end and an unknown weight W toward the left end (see the figure). When W is placed 44.7 cm from the left end of the rod, the system just balances horizontally when the fulcrum is located 76.1 cm from the right end.

Part A

Find W.

ANSWER:

W = = 129 {\rm N}

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If W is now moved 24.1 {\rm {\rm cm}} to the right, how far must the fulcrum be moved to restore balance?

ANSWER:

\Delta x = $= 5.26\times10^{-2}$ {\rm m}

Part C

If W is now moved 24.1 {\rm {\rm cm}} to the right, in what direction must the fulcrum be moved to restore balance?

ANSWER:

- to the left
- to the right

Problem 11.49

Description: You open a restaurant and hope to entice customers by hanging out a sign . The uniform horizontal beam supporting the sign is l long, has a mass of m_1 , and is hinged to the wall. The sign itself is uniform with a mass of m_2 and...

You open a restaurant and hope to entice customers by hanging out a sign . The uniform horizontal beam supporting the sign is 1.50 {\rm {\;\rm m}} long, has a mass of 18.0 {\rm {\;\rm kg}} , and is hinged to the wall. The sign itself is uniform with a mass of 32.0 {\rm {\;\rm kg}} and overall length of 1.20 {\rm {\;\rm m}} . The two wires supporting the sign are each 36.0 {\rm {\;\rm cm}} long, are 90.0 {\rm {\;\rm cm}} apart, and are equally spaced from the middle of the sign. The cable supporting the beam is 2.00 {\rm {\;\rm m}} long.

Part A

What minimum tension must your cable be able to support without having your sign come crashing down?

Express your answer with the appropriate units.

ANSWER:

T_{\rm min} = $= 465\,\mathrm{N}$

Also accepted: $= 466\,\mathrm{N}$, $= 465\,\mathrm{N}$

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Part B

What minimum vertical force must the hinge be able to support without pulling out of the wall?

Express your answer with the appropriate units.

ANSWER:

F_{v\;\rm min} = = 182 N

Also accepted: = 182 (Missing units), = 182 (Missing units)

Problem 11.58

Description: A uniform drawbridge must be held at a 37 degree(s) angle above the horizontal to allow ships to pass underneath. The drawbridge weighs 45,000 N and is 14.0 m long. A cable is connected 3.5 m from the hinge where the bridge pivots (measured along the ...

A uniform drawbridge must be held at a 37 ^\circ angle above the horizontal to allow ships to pass underneath. The drawbridge weighs 45,000 {\rm N} and is 14.0 {\rm m} long. A cable is connected 3.5 {\rm m} from the hinge where the bridge pivots (measured along the bridge) and pulls horizontally on the bridge to hold it in place.

Part A

What is the tension in the cable?

ANSWER:

T = 1.19×10^5 {\rm N}

Part B

Find the magnitude of the force the hinge exerts on the bridge.

ANSWER:

N = 1.27×10^5 {\rm N}

Also accepted: 1.28×10^5

Part C

Find the direction of the force the hinge exerts on the bridge.

ANSWER:

\phi = 20.7 ^\circ above the horizontal

Part D

Loading [MathJax]/jax/output/HTML-CSS/autoload/maction.js ude of the angular acceleration of the drawbridge just after the cable breaks?

ANSWER:

\alpha = 0.839 {\rm rad/s^2}

Part E

What is the angular speed of the drawbridge as it becomes horizontal?

ANSWER:

\omega = 1.12 {\rm rad/s}

Problem 11.72

Description: You are trying to raise a bicycle wheel of mass m and radius R up over a curb of height h. To do this, you apply a horizontal force F_vec. (a) What is the least magnitude of the force F_vec that will succeed in raising the wheel onto the curb when...

You are trying to raise a bicycle wheel of mass \texttip{m}{m} and radius \texttip{R}{R} up over a curb of height \texttip{h}{h}. To do this, you apply a horizontal force \texttip{\vec{F}}{F_vec}.

Part A

What is the least magnitude of the force \texttip{\vec{F}}{F_vec} that will succeed in raising the wheel onto the curb when the force is applied at the center of the wheel?

ANSWER:

F =

Part B

What is the least magnitude of the force \texttip{\vec{F}}{F_vec} that will succeed in raising the wheel onto the curb when the force is applied at the top of the wheel?

ANSWER:

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F =

Also accepted:

Part C

In which case is less force required?

ANSWER:

- case A
- case B

Problem 11.74

Description: If you put a uniform block at the edge of a table, the center of the block must be over the table for the block not to fall off. (a) If you stack two identical blocks at the table edge, the center of the top block must be over the bottom block, and...

If you put a uniform block at the edge of a table, the center of the block must be over the table for the block not to fall off.

Part A

If you stack two identical blocks at the table edge, the center of the top block must be over the bottom block, and the center of gravity of the two blocks together must be over the table. In terms of the length \texttip{L}{L} of each block, what is the maximum overhang possible?

ANSWER:

Part B

Repeat part (A) for three identical blocks.

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ANSWER:

Part C

Repeat part (A) for four identical blocks.

ANSWER:

Part D

Is it possible to make a stack of blocks such that the uppermost block is not directly over the table at all?

ANSWER:

- (•) yes
- ( ) no

Part E

How many blocks would it take to do this? (Try this with your friends using copies of this book.)

ANSWER:

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Problem 11.75

Description: Two uniform m-g marbles d in diameter are stacked as shown in the figure in a container that is l wide. (a) Find the force that the container exerts on the marble at the point of contact A. (b) Find the force that the container exerts on the marble ...

Two uniform 69.9-{\rm g} marbles 1.77 {\rm {\rm cm}} in diameter are stacked as shown in the figure in a container that is 2.81 {\rm {\rm cm}} wide.

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Part A

Find the force that the container exerts on the marble at the point of contact *A*.

ANSWER:

N_A = = 0.497 {\rm N}

Part B

Find the force that the container exerts on the marble at the point of contact *B*.

ANSWER:

N_B = = 1.37 {\rm N}

Part C

Find the force that the container exerts on the marble at the point of contact *C*.

ANSWER:

N_C = = 0.497 {\rm N}

Part D

What force does each marble exert on the other?

ANSWER:

N = = 0.847 {\rm N}

Problem 11.90

Description: One end of a post weighing 400 N and with height h rests on a rough horizontal surface with mu_s=0.30. The upper end is held by a rope fastened to the surface and making an angle of 36.9 degree(s) with the post. A horizontal force F_vec is...

One end of a post weighing 400 {\rm N} and with height \texttip{h}{h} rests on a rough horizontal surface with \mu_s=0.30. The upper end is held by a rope fastened to the surface and making an angle of 36.9^\circ with the post. A horizontal force \texttip{\vec{F}}{F_vec} is exerted on the post as shown.

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Part A

If the force \texttip{\vec{F}}{F_vec} is applied at the midpoint of the post, what is the largest value it can have without causing the post to slip?

Express your answer using two significant figures.

ANSWER:

$F_{\rm max} = 400 \ {\rm N}$

Part B

How large can the force be without causing the post to slip if its point of application is \large{{\frac{6}{10}}} of the way from the ground to the top of the post?

Express your answer using two significant figures.

ANSWER:

$F_{\rm max} = 750 \ {\rm N}$

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