Ch 5 Supplemental

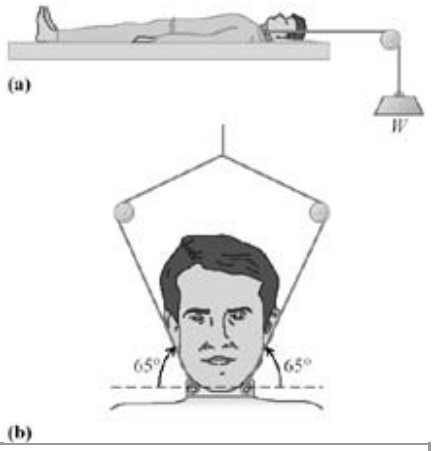
Due: 1:09pm on Sunday, October 16, 2011

Note: To understand how points are awarded, read your instructor's Grading Policy.

Exercise 5.4

Description: In treating spinal injuries, it is often necessary to provide some tension along the spinal column to stretch the backbone. One device for doing this is the Stryker frame, illustrated in part (a) of the figure. A weight W is attached to the patient...

In treating spinal injuries, it is often necessary to provide some tension along the spinal column to stretch the backbone. One device for doing this is the Stryker frame, illustrated in part (a) of the figure. A weight W is attached to the patient (sometimes around a neck collar, as shown in part (b) of the figure), and friction between the person's body and the bed prevents sliding.



Part A

If the coefficient of static friction between a 92.5 kg patient's body and the bed is 0.775, what is the maximum traction force along the spinal column that W can provide without causing the patient to slide?

ANSWER: $T = mgfs$ N

Part B

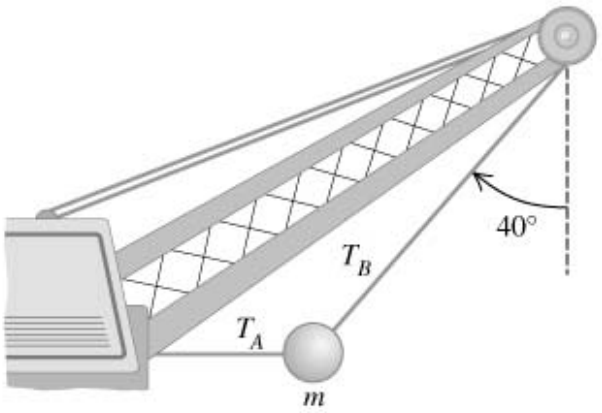
Under the conditions of maximum traction, what is the tension in each cable attached to the neck collar?

ANSWER: $T = \dfrac{\frac{mgfs}{2}}{\sin\left(\frac{65\pi}{180}\right)}$ N

Exercise 5.6

Description: A large wrecking ball is held in place by two light steel cables . (a) If the mass m of the wrecking ball is m, what is the tension T_B in the cable that makes an angle of theta with the vertical? (b) If the mass m of the wrecking ball is m, what is ...

A large wrecking ball is held in place by two light steel cables .



Part A

If the mass m of the wrecking ball is 4030 kg, what is the tension T_B in the cable that makes an angle of 40° with the vertical?

Express your answer using two significant figures.

ANSWER: $\frac{mg}{\cos(\theta)}$ N

Part B

If the mass m of the wrecking ball is 4030 kg, what is the tension T_A in the horizontal cable?

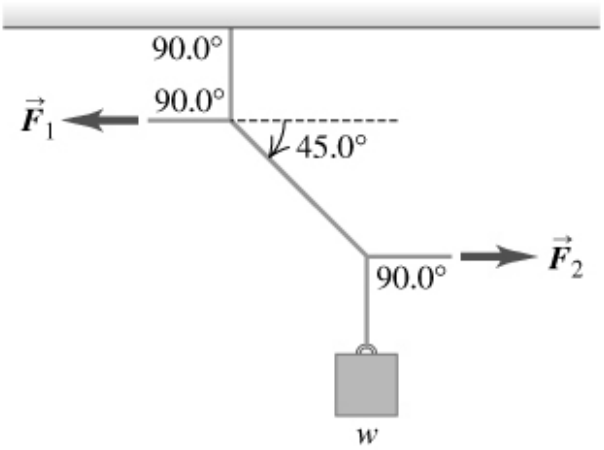
Express your answer using two significant figures.

ANSWER: $mg\tan(\theta)$ N

Exercise 5.10

Description: In the figure the weight w is w. (a) What is the tension in the diagonal string? (b) Find the magnitudes of the horizontal forces F_vec_1 and F_vec_2 that must be applied to hold the system in the position shown.

In the figure the weight w is 68.3 N.



Part A

What is the tension in the diagonal string?

ANSWER: $T = w\sqrt{2}$ N

Part B

Find the magnitudes of the horizontal forces $\vec{F}_1$ and $\vec{F}_2$ that must be applied to hold the system in the position shown.

[Print]

ANSWER: $\vec{F}_1, \vec{F}_2 = \begin{matrix} w \\ w \end{matrix}$ N

Exercise 5.22

Description: A m-kg test rocket is launched vertically from the launch pad. Its fuel (of negligible mass) provides a thrust force so that its vertical velocity as a function of time is given by v(t) = At + Bt^2, where A and B are constants and time is measured...

A 2700-kg test rocket is launched vertically from the launch pad. Its fuel (of negligible mass) provides a thrust force so that its vertical velocity as a function of time is given by $v(t) = At + Bt^2$, where A and B are constants and time is measured from the instant the fuel is ignited. At the instant of ignition, the rocket has an upward acceleration of 1.80 $\mathrm{m/s^2}$ and 1.50 s later an upward velocity of 1.79 $\mathrm{m/s}$.

Part A

Determine A.

ANSWER: $A = a \quad \mathrm{m/s^2}$

Part B

Determine B.

ANSWER: $B = \dfrac{v - at}{t^2} \quad \mathrm{m/s^3}$

Part C

At 5.00 s after fuel ignition, what is the acceleration of the rocket?

ANSWER: $a = a + \dfrac{2\,(v - at)}{t^2} t2 \quad \mathrm{m/s^2}$

Part D

What thrust force does the burning fuel exert on it, assume no air resistance? Express the thrust in newtons.

ANSWER: $T = m\left(9.8 + a + \dfrac{2\,(v - at)}{t^2} t2\right) \quad \mathrm{N}$

Part E

What thrust force does the burning fuel exert on it, assume no air resistance? Express the thrust as a multiple of the rocket's weight.

ANSWER: $T = \dfrac{\frac{m\left(9.8 + a + \frac{2(v - at)}{t^2} t2\right)}{m}}{9.8} \quad w$

Part F

What was the initial thrust due to the fuel?

ANSWER: $T_i = m\,(9.8 + a) \quad \mathrm{N}$

Exercise 5.27

Description: A stockroom worker pushes a box with mass m on a horizontal surface with a constant speed of v. The coeffficient of kinetic friction between the box and the surface is mu_k. (a) What horizontal force must be applied by the worker to maintain the...

A stockroom worker pushes a box with mass 11.2 kg on a horizontal surface with a constant speed of 3.00 $\mathrm{m/s}$. The coeffficient of kinetic friction between the box and the surface is 0.180.

Part A

What horizontal force must be applied by the worker to maintain the motion?

ANSWER: $\mu_k m \cdot 9.80$ N

Part B

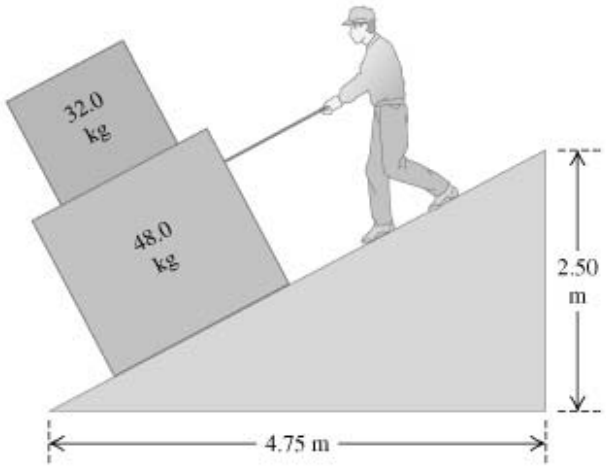
If the force calculated in part A is removed, how far does the box slide before coming to rest?

ANSWER: $\dfrac{v^2}{2\mu_k \cdot 9.80}$ m

Exercise 5.31

Description: You are lowering two boxes, one on top of the other, down the ramp shown in the figure by pulling on a rope parallel to the surface of the ramp. Both boxes move together at a constant speed of v. The coefficient of kinetic friction between the ramp...

You are lowering two boxes, one on top of the other, down the ramp shown in the figure by pulling on a rope parallel to the surface of the ramp. Both boxes move together at a constant speed of 18.0 $\mathrm{cm/s}$. The coefficient of kinetic friction between the ramp and the lower box is 0.441, and the coefficient of static friction between the two boxes is 0.772.



Part A

What force do you need to exert to accomplish this?

ANSWER: $T = \left(\sin\left(\frac{27.76}{180}\pi\right) - \mu 1 \cos\left(\frac{27.76}{180}\pi\right)\right) \cdot 80 \cdot 9.8$ N

Part B

What is the magnitude of the friction force on the upper box?

ANSWER: $f = 146$ N

Part C

What is the direction of the friction force on the upper box?

ANSWER:
- (●) **up the ramp**
- ( ) **down the ramp**

Exercise 5.38

Description: A box with mass m is dragged across a level floor having a coefficient of kinetic friction mu_k by a rope that is pulled upward at an angle theta above the horizontal with a force of magnitude F. (a) In terms of m, mu_k, theta, and g, obtain an...

A box with mass m is dragged across a level floor having a coefficient of kinetic friction μ_k by a rope that is pulled upward at an angle θ above the horizontal with a force of magnitude F.

Part A

In terms of m, μ_k, θ, and g, obtain an expression for the magnitude of force required to move the box with constant speed.

ANSWER: $\frac{\mu_k m g}{\cos(\theta) + \mu_k \sin(\theta)}$

Part B

Knowing that you are studying physics, a CPR instructor asks you how much force it would take to slide a 90-kg patient across a floor at constant speed by pulling on him at an angle of 25° above the horizontal. By dragging some weights wrapped in an old pair of pants down the hall with a spring balance, you find that $\mu_k = 0.35$. Use the result of part A to answer the instructor's question.

ANSWER:

$$\frac{0.35 \cdot 90 \cdot 9.80}{\cos\left(\frac{25\pi}{180}\right) + 0.35\sin\left(\frac{25\pi}{180}\right)} \quad \text{N}$$

Exercise 5.45

Description: A m1-kg car and a m2-kg pickup truck approach a curve on the expressway that has a radius of R. (a) At what angle should the highway engineer bank this curve so that vehicles traveling at v can safely round it regardless of the condition of their...

A 1166-kg car and a 2280-kg pickup truck approach a curve on the expressway that has a radius of 279 m.

Part A

At what angle should the highway engineer bank this curve so that vehicles traveling at 68.5 $\mathrm{mi/h}$ can safely round it regardless of the condition of their tires?

ANSWER:

$$\phi = \frac{\operatorname{atan}\left(\frac{v^2}{\frac{9.8}{R}}\right)}{\pi} \cdot 180 \quad ^\circ$$

Part B

Should the heavy truck go slower than the lighter car?

ANSWER:

- yes
- no

Part C

As the car and truck round the curve at 68.5 $\mathrm{mi/h}$, find the normal force on the car to the highway surface.

ANSWER:

$$N_{\text{car}} = \frac{m1 \cdot 9.8}{\cos\left(\operatorname{atan}\left(\frac{v^2}{\frac{9.8}{R}}\right)\right)} \quad \text{N}$$

Part D

As the car and truck round the curve at 68.5 $\mathrm{mi/h}$, find the normal force on the truck to the highway surface.

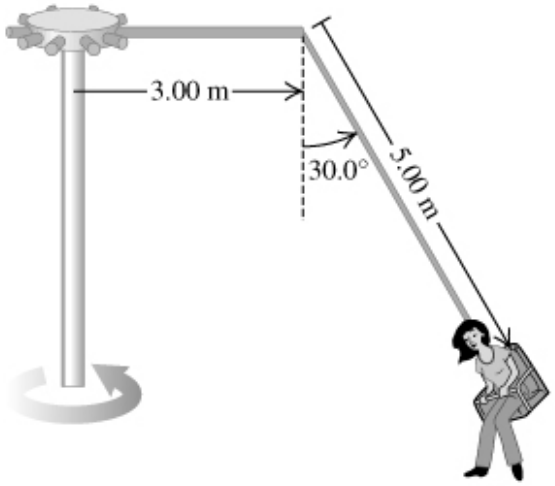
ANSWER:

$$N_{\text{truck}} = \frac{m2{\cdot}9.8}{\cos\left(\operatorname{atan}\left(\frac{\frac{v^2}{9.8}}{R}\right)\right)} \quad \mathrm{N}$$

Exercise 5.46

Description: The "Giant Swing" at a county fair consists of a vertical central shaft with a number of horizontal arms attached at its upper end. Each arm supports a seat suspended from a cable 5.00 m long, the upper end of the cable being fastened to the arm at a...

The "Giant Swing" at a county fair consists of a vertical central shaft with a number of horizontal arms attached at its upper end. Each arm supports a seat suspended from a cable 5.00 m long, the upper end of the cable being fastened to the arm at a point 3.00 m from the central shaft.



Part A

Find the time of one revolution of the swing if the cable supporting a seat makes an angle of $30.0°$ with the vertical.

ANSWER:

T = 6.19 s

Part B

Does the angle depend on the weight of the passenger for a given rate of revolution?

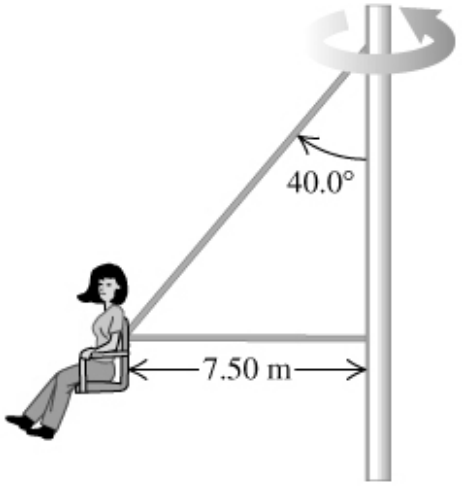
ANSWER:

- Yes.
- **No.**

Exercise 5.47

Description: In another version of the "Giant Swing", the seat is connected to two cables as shown in the figure , one of which is horizontal. The seat swings in a horizontal circle at a rate of f. (a) If the seat weighs w1 and a w2-N person is sitting in it,...

In another version of the "Giant Swing", the seat is connected to two cables as shown in the figure , one of which is horizontal. The seat swings in a horizontal circle at a rate of 38.8 rev/min.



Part A

If the seat weighs 298 N and a 842-N person is sitting in it, find the tension in the horizontal cable.

ANSWER:

$$T_1 = \frac{w1+w2}{9.8}\cdot 4\pi^2 \cdot 7.5 f^2 - (w1+w2)\tan\left(\frac{40}{180}\pi\right) \quad \text{N}$$

Part B

If the seat weighs 298 N and a 842-N person is sitting in it, find the tension in the inclined cable.

ANSWER:

$$T_2 = \frac{w1+w2}{\cos\left(\frac{40}{180}\pi\right)} \quad \text{N}$$