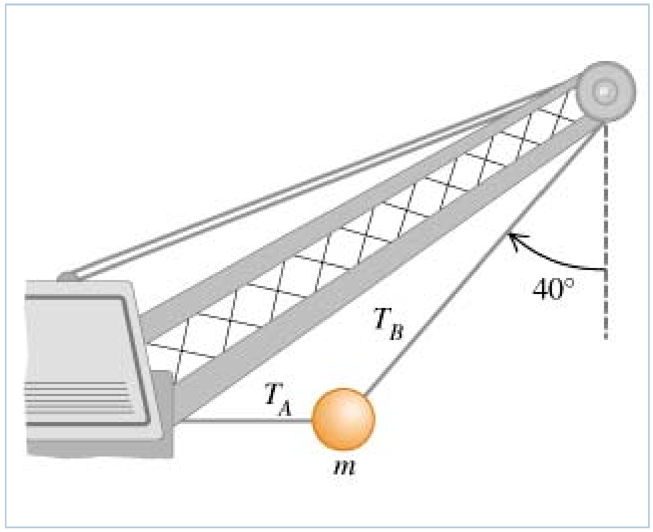
Description: A large wrecking ball is held in place by two light steel cables . (a) If the mass m of the wrecking ball is m, what is the tension T_B in the cable that makes an angle of 40 degree(s) with the vertical? (b) What is the tension T_A in the...

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



Part A

If the mass m of the wrecking ball is 3700 kg , what is the tension T_B in the cable that makes an angle of 40° with the vertical?

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

ANSWER:

T_B = $\frac{m\cdot 9.80}{\cos(40)}$ = $4.7\times10^4 \mathrm{N}$

Also accepted: $\frac{m\cdot 9.80}{\cos(40)}$ = $4.73\times10^4 \mathrm{N}$, $\frac{m\cdot 9.81}{\cos(40)}$ = $4.74\times10^4 \mathrm{N}$, $\frac{m\cdot 9.80}{\cos(40)}$ = $4.7\times10^4 \mathrm{N}$

Part B

What is the tension T_A in the horizontal cable?

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

ANSWER:

T_A = $m\cdot 9.80\tan(40)$ = $3.0\times10^4 \mathrm{N}$

Also accepted: $m\cdot 9.80\tan(40)$ = $3.04\times10^4 \mathrm{N}$, $m\cdot 9.81\tan(40)$ = $3.05\times10^4 \mathrm{N}$, $m\cdot 9.80\tan(40)$ = $3.0\times10^4 \mathrm{N}$

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 2120-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 1.30 $\mathrm{m/s^2}$ and 1.10 s later an upward velocity of 1.95 $\mathrm{m/s}$.

Part A

Determine A.

ANSWER:

A = a = 1.30 $\mathrm{m/s^2}$

Part B

Determine B.

ANSWER:

B = $\frac{v - at}{t^2}$ = 0.430 $\mathrm{m/s^3}$

Part C

At 3.20 s after fuel ignition, what is the acceleration of the rocket?

ANSWER:

a = $a + \frac{2(v - at)}{t^2} t2$ = 4.05 $\mathrm{m/s^2}$

Part D

At 3.20 s after fuel ignition,what thrust force does the burning fuel exert on it, assume no air resistance? Express the thrust in newtons.

ANSWER:

T = $m\left(9.8 + a + \frac{2(v - at)}{t^2} t2\right)$ = 2.94×10^4 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 = $\frac{\frac{m\left(9.8+a+\frac{2(v-at)}{t^2}t2\right)}{m}}{9.8}$ = 1.41 w

Part F

What was the initial thrust due to the fuel?

ANSWER:

T_i = $m\left(9.8+a\right)$ = 2.35×10^4 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 coeflficient of kinetic friction between the box and the surface is mu_k. (a) What horizontal force must the worker apply to maintain the...

A stockroom worker pushes a box with mass 11.2 kg on a horizontal surface with a constant speed of 3.70 $\mathrm{m/s}$. The coeflficient of kinetic friction between the box and the surface is 0.16.

Part A

What horizontal force must the worker apply to maintain the motion?

Express your answer with the appropriate units.

ANSWER:

F = $\mu_k m\cdot 9.80$ = 18N

Also accepted: $\mu_k m\cdot 9.80$ = 17.6N, $\mu_k m\cdot 9.81$ = 17.6N, $\mu_k m\cdot 9.80$ = 18N

Part B

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

Express your answer with the appropriate units.

ANSWER:

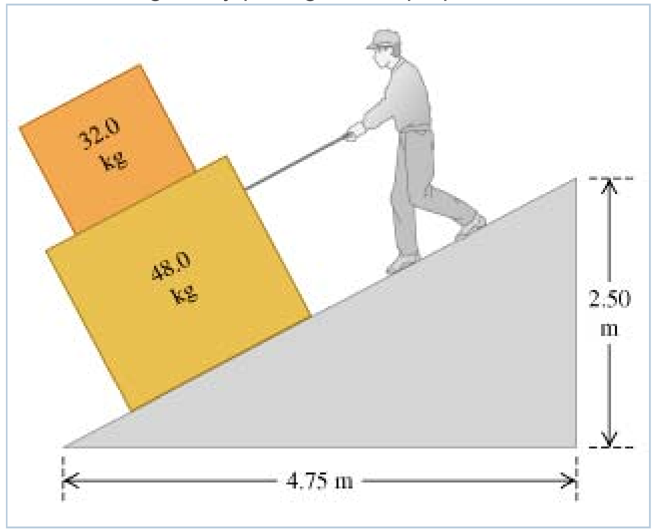
l = $\frac{v^2}{2\mu_k\cdot 9.80}$ = 4.4m

Also accepted: $\frac{v^2}{2\mu_k\cdot 9.80}$ = 4.37m, $\frac{v^2}{2\mu_k\cdot 9.81}$ = 4.36m, $\frac{v^2}{2\mu_k\cdot 9.80}$ = 4.4m

Exercise 5.33

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 10.0 $\mathrm{cm/s}$. The coefficient of kinetic friction between the ramp and the lower box is 0.435, and the coefficient of static friction between the two boxes is 0.785.



Part A

What force do you need to exert to accomplish this?

ANSWER:

T = $\left(\sin\left(\frac{27.76}{180}\pi\right) - \mu 1\cos\left(\frac{27.76}{180}\pi\right)\right)\cdot 80\cdot 9.8$ = 63.4 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:

- (selected) 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 $\mu_{\rm k}$ 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, $\mu_{\rm k}$, 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-$\rm kg$ 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:

293 N

Exercise 5.49

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 1193-$\rm kg$ car and a 2270-$\rm kg$ pickup truck approach a curve on the expressway that has a radius of 224 $\rm m$.

Part A

At what angle should the highway engineer bank this curve so that vehicles traveling at 60.4 $\rm mi/h$ can safely round it regardless of the condition of their tires?

ANSWER:

ϕ = $\frac{\operatorname{atan}\left(\frac{\frac{v^2}{9.8}}{R}\right)}{\pi} \cdot 180$ = 18.4 $^\circ$

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 60.4 $\mathrm{mi/h}$, find the normal force on the car to the highway surface.

ANSWER:

$$N_{\mathrm{car}} = \frac{m1 \cdot 9.8}{\cos\left(\mathrm{atan}\left(\frac{\frac{v^2}{9.8}}{R}\right)\right)} = 1.23\times10^{4} \ \mathrm{N}$$

Part D

As the car and truck round the curve at 60.4 $\mathrm{mi/h}$, find the normal force on the truck to the highway surface.

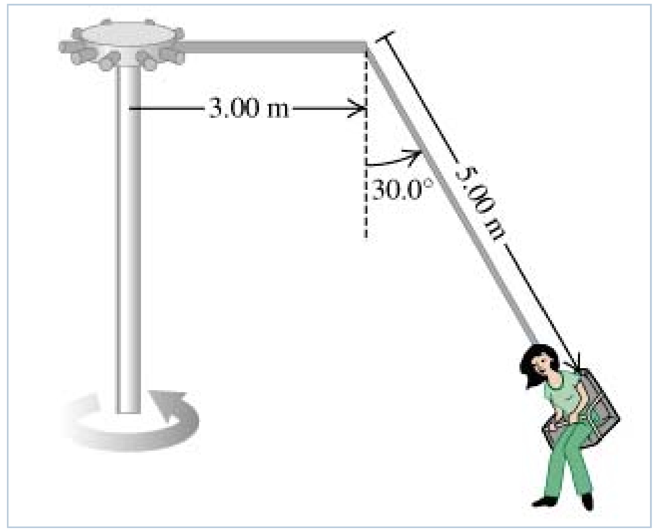
ANSWER:

$$N_{\mathrm{truck}} = \frac{m2 \cdot 9.8}{\cos\left(\mathrm{atan}\left(\frac{\frac{v^2}{9.8}}{R}\right)\right)} = 2.34\times10^{4} \ \mathrm{N}$$

Exercise 5.50

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. (selected)