Ch 4 Supplemental [Edit]

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Ch 4 Supplemental

Due: 6:59pm on Wednesday, October 26, 2016

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

Exercise 4.7

Description: In outer space, a constant net force of magnitude ## N is exerted on a ## kg probe initially at rest. (a) What acceleration does this force produce? (b) How far does the probe travel in ## s?

In outer space, a constant net force of magnitude 141 N is exerted on a 30.1 kg probe initially at rest.

Part A

What acceleration does this force produce?

ANSWER:

$a = \frac{F}{m} = 4.68 \ \mathrm{m/s^2}$

Part B

How far does the probe travel in 5.00 s ?

ANSWER:

$l = \frac{t^2 F}{2m} = 58.6 \ \mathrm{m}$

Exercise 4.8

Description: You walk into an elevator, step onto a scale, and push the "up" button. You recall that your normal weight is ## N. (a) Draw a free-body diagram for you. (b) When the elevator has an upward acceleration of magnitude a, what does the scale...

You walk into an elevator, step onto a scale, and push the "up" button. You recall that your normal weight is 625 N .

Part A

Draw a free-body diagram for you.

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

When the elevator has an upward acceleration of magnitude 2.90 $\mathrm{m/s^2}$, what does the scale read?

Express your answer with the appropriate units.

ANSWER:

F = $w+\frac{w}{9.8}a$ = 810 N

Also accepted: $w+\frac{w}{9.81}a$ = 810 N, $w+\frac{w}{9.8}a$ = 810 N

Part C

If you hold a 3.61-kg package by a light vertical string, what will be the tension in this string when the elevator accelerates as in the previous part?

Express your answer with the appropriate units.

ANSWER:

T = $m\left(9.80+a\right)$ = 45.8 N

Also accepted: $m\left(9.81+a\right)$ = 45.9 N, $m\left(9.80+a\right)$ = 45.8 N

Exercise 4.10

Description: A dockworker applies a constant horizontal force of F to a block of ice on a smooth horizontal floor. The frictional force is negligible. The block starts from rest and moves a distance x in a time t_1. (a) What is the mass of the block of ice? (b)...

A dockworker applies a constant horizontal force of 85.0 N to a block of ice on a smooth horizontal floor. The frictional force is negligible. The block starts from rest and moves a distance 12.0 m in a time 4.90 s .

Part A

What is the mass of the block of ice?

ANSWER:

$m = \frac{F{t_1}^2}{2x}$ = 85.0 kg

Part B

If the worker stops pushing at the end of 4.90 s , how far does the block move in the next 4.80 s ?

ANSWER:

$x = \frac{2x}{t_1}t_2$ = 23.5 m

Exercise 4.19

Description: At the surface of Jupiter's moon Io, the acceleration due to gravity is g_I. A watermelon has a weight of w at the surface of the earth. In this problem, use g for the acceleration due to gravity on earth. (a) What is its mass on the earth's surface? ...

At the surface of Jupiter's moon Io, the acceleration due to gravity is 1.81 $\mathrm{m/s^2}$. A watermelon has a weight of 44.0 N at the surface of the earth. In this problem, use 9.81 $\mathrm{m/s^2}$ for the acceleration due to gravity on earth.

Part A

What is its mass on the earth's surface?

ANSWER:

$m = \frac{w}{g}$ = 4.49 kg

Part B

What is its mass on the surface of Io?

ANSWER:

$m = \frac{w}{g} = 4.49 \ \mathrm{kg}$

Part C

What is its weight on the surface of Io?

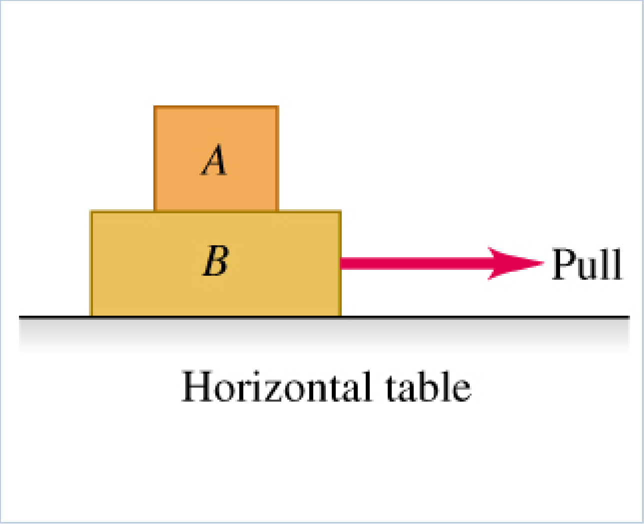
ANSWER:

$w = \frac{g_I w}{g} = 8.12 \ \mathrm{N}$

Exercise 4.26

Description: A person pulls horizontally on block B in the figure , causing both blocks to move together as a unit. (a) While this system is moving, make a carefully labeled free-body diagram of block A if the table is frictionless. (b) While this system is...

A person pulls horizontally on block B in the figure , causing both blocks to move together as a unit.



Part A

While this system is moving, make a carefully labeled free-body diagram of block A if the table is frictionless.

Draw all relevant force vectors with their tails at the dot. The orientation of your vectors will be graded. The exact length of your vectors will not be graded but the relative length of one to the other will be graded.

ANSWER:

Part B

While this system is moving, make a carefully labeled free-body diagram of block A if there is friction between block B and the table and the pull is equal to the friction force on block B due to the table.

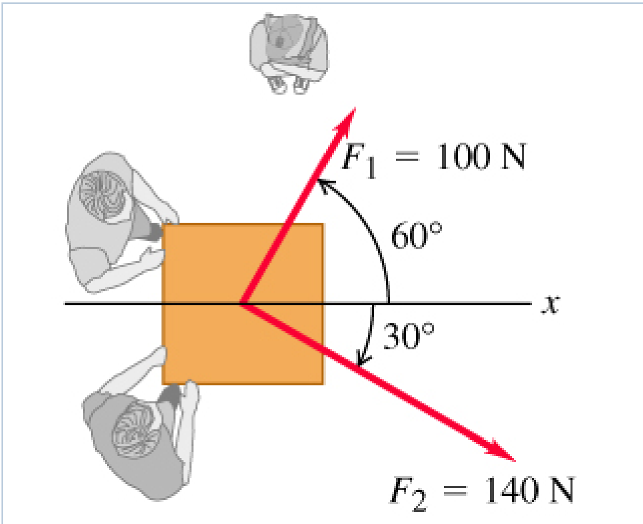
Draw all relevant force vectors with their tails at the dot. The orientation of your vectors will be graded. The exact length of your vectors will not be graded but the relative length of one to the other will be graded.

ANSWER:

Problem 4.33

Description: Two adults and a child want to push a wheeled cart in the direction marked x in the figure . The two adults push with horizontal forces F_1_vec and F_2_vec as shown in the figure. (a) Find the magnitude of the smallest force that the child should...

Two adults and a child want to push a wheeled cart in the direction marked x in the figure . The two adults push with horizontal forces $\vec{F_1}$ and $\vec{F_2}$ as shown in the figure.



Part A

Find the magnitude of the *smallest* force that the child should exert. You can ignore the effects of friction.

ANSWER:

F = 16.6 N

Part B

Find the angle that the force makes with the +*x*-direction. Take angles measured counterclockwise from the +*x*-direction to be positive.

ANSWER:

θ = 270 $^\circ$

Also accepted: -90

Part C

If the child exerts the minimum force found in part (A) and in part (B) , the cart accelerates at 2.00 $\mathrm{m/s^2}$ in the +*x* -direction. What is the weight of the cart?

ANSWER:

W = 840 N

Problem 4.43

Description: The froghopper (Philaenus spumarius), the champion leaper of the insect world, has a mass of ## mg and leaves the ground (in the most energetic jumps) at ## m/s from a vertical start. The jump itself lasts a mere ## ms before the insect is clear of...

The froghopper (*Philaenus spumarius*), the champion leaper of the insect world, has a mass of 12.3 mg and leaves the ground (in the most energetic jumps) at 4.00 $\mathrm{m/s}$ from a vertical start. The jump itself lasts a mere 1.00 ms before the insect is clear of the ground.

Part A

Assuming constant acceleration, make a free-body diagram of this mighty leaper while the jump is taking place.

Draw the force vectors with their tails at the origin of the dot. The orientation of your vectors will be graded. The exact lengths of your vectors will not be graded but the relative length of one to the other will be graded.

ANSWER:

Part B

Find the force that the ground exerts on the froghopper during its jump.

ANSWER:

F = 4.92×10^{-2} N

Part C

Express the force in part B in terms of the froghopper's weight.

ANSWER:

F = 408 $w_{\mathrm{froghopper}}$

Problem 4.46

Description: A 4.9-N hammer head is stopped from an initial downward velocity of 3.2 m/s in a distance of 0.45 cm by a nail in a pine board. In addition to its weight, there is a 15-N downward force on the hammer head applied by the person using the hammer. Assume ...

A 4.9-N hammer head is stopped from an initial downward velocity of 3.2 $\mathrm{m/s}$ in a distance of 0.45 cm by a nail in a pine board. In addition to its weight, there is a 15-N downward force on the hammer head applied by the person using the hammer. Assume that the acceleration of the hammer head is constant while it is in contact with the nail and moving downward.

Part A

Calculate the downward force $\vec{F}$ exerted by the hammer head on the nail while the hammer head is in contact with the nail and moving downward.

Express your answer using two significant figures.

ANSWER:

590 N

Part B

Suppose the nail is in hardwood and the distance the hammer head travels in coming to rest is only 0.12 cm. The downward forces on the hammer head are the same as on part A. What then is the force $\vec{F}$ exerted by the hammer head on the nail while the hammer head is in contact with the nail and moving downward?

Express your answer using two significant figures.

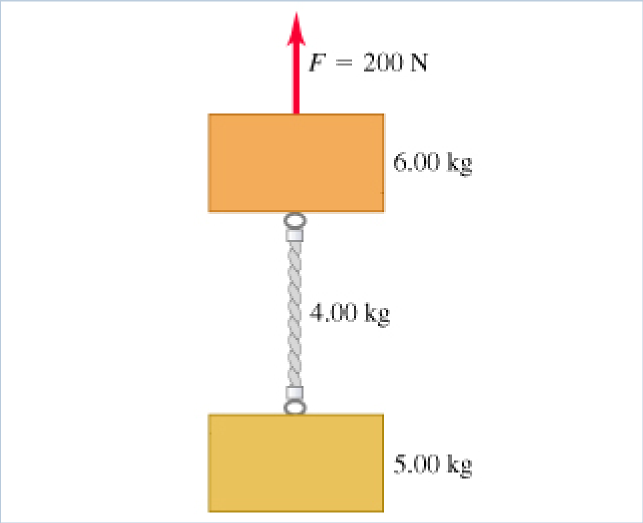
ANSWER:

2200 N

Problem 4.48

Description: The two blocks in the figure are connected by a heavy uniform rope with a mass of 4.00 kg . An upward force of 200 N is applied as shown. (a) What is the acceleration of the system? (b) What is the tension at the top of the heavy rope? (c)...

The two blocks in the figure are connected by a heavy uniform rope with a mass of 4.00 kg . An upward force of 200 N is applied as shown.



Part A

What is the acceleration of the system?

ANSWER:

a = 3.53 $\mathrm{m/s^2}$

Part B

What is the tension at the top of the heavy rope?

ANSWER:

T = 120 N

Part C

What is the tension at the midpoint of the rope?

ANSWER:

T = 93.3 N

Problem 4.54

Description: An 8.00-kg box sits on a level floor. You give the box a sharp push and find that it travels 8.22 m in 2.8 s before coming to rest again. (a) You measure that with a different push the box traveled 4.20 m in 2.0 s. Do you think the...

An 8.00-kg box sits on a level floor. You give the box a sharp push and find that it travels 8.22 m in 2.8 s before coming to rest again.

Part A

You measure that with a different push the box traveled 4.20 m in 2.0 s. Do you think the box has a constant acceleration as it slows down?

ANSWER:

- (selected) Yes, the acceleration is constant and has a magnitude of 2.1 $\mathrm{m/s^2}$.
- Yes, the acceleration is constant and has a magnitude of 4.2 $\mathrm{m/s^2}$.
- Yes, the acceleration is constant and has a magnitude of 1.1 $\mathrm{m/s^2}$.
- No, the acceleration is not constant.

Part B

You add books to the box to increase its mass. Repeating the experiment, you give the box a push and measure how long it takes the box to come to rest and how far the box travels. The results, including the initial experiment with no added mass, are given in the table below.

Added Mass (kg)	**Distance** (m)	**Time** (s)
0	8.22	2.8
3.00	10.75	3.2
7.00	9.45	3.0
12.0	7.10	2.6

In each case, did your push give the box the same initial speed?

ANSWER:

- Yes, in each case initial speed is the same and equals 6.3 $\mathrm{m/s}$.
- Yes, in each case initial speed is the same and equals 6.7 $\mathrm{m/s}$.
- Yes, in each case initial speed is the same and equals 5.9 $\mathrm{m/s}$.
- (selected) No, in each case initial speed is not the same.

Part C

What is the ratio between the greatest initial speed and the smallest initial speed for these four cases?

ANSWER:

$\frac{v_{0,\mathrm{max}}}{v_{0,\mathrm{min}}}$ = 1.2

Also accepted: 1.23, 1.2

Part D

Is the average horizontal force f exerted on the box by the floor the same in each case?

ANSWER:

- Yes, in each case horizontal force f is the same and equals 23 N.
- Yes, in each case horizontal force f is the same and equals 46 N.
- Yes, in each case horizontal force f is the same and equals 92 N.
- (selected) No, in each case horizontal force f is not the same.

Part E

Graph the magnitude of force f versus the total mass m of the box plus its contents.

ANSWER:

Part F

Use your graph to determine an equation for f as a function of m, where m is in kg.

Express your answer in terms of m.

ANSWER:

f = $2.1m$ N