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Section 4-1

HOLT PHYSICS

Diagram Skills

Changes in Motion

A large, square box of exercise equipment sits on a storeroom floor. A rope is tied around the box. Assume that if the box moves along the floor, there is a backward force that resists its motion.

1. Suppose that the box remains at rest. In the space provided, draw a free-body diagram for the box. Label each force involved in the diagram.

1.

2. Suppose a warehouse worker moves the box by pulling the rope to the right horizontal to the ground. In the space provided, draw a free-body diagram for the box. Label each force involved in the diagram.

2.

3. Suppose the warehouse worker moves the box by pulling the rope to the right at a 50° angle to the ground. In the space provided, draw a free-body diagram for the box. Label each force involved in the diagram.

3.

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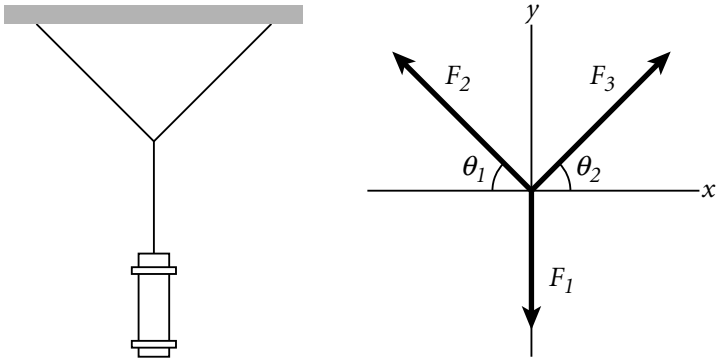
Section 4-2

HOLT PHYSICS

Diagram Skills

Newton's First Law

A lantern of mass *m* is suspended by a string that is tied to two other strings, as shown in the figure below. The free-body diagram shows the forces exerted by the three strings on the knot.



1. In terms of $\mathbf{F_1}$, $\mathbf{F_2}$, and $\mathbf{F_3}$, what is the net force acting on the knot? (Hint: The lantern is in equilibrium.)

_____

2. Find the magnitudes of the *x* and *y* components for each force acting on the knot. (Assume the positive directions are to the right and up.)

String 1 (F_1) *x* component _____ *y* component _____

String 2 (F_2) *x* component _____ *y* component _____

String 3 (F_3) *x* component _____ *y* component _____

3. In terms of F_1, F_2, and F_3, what is the magnitudes of the net force acting on the knot in the *x* direction? in the *y* direction?

$F_{x\,net}$ = _____

$F_{y\,net}$ = _____

4. Assume that $\theta_1 = 30°$, $\theta_2 = 60°$, and the mass of the lantern is 2.1 kg. Find F_1, F_2, and F_3.

F_1 = _____

F_2 = _____

F_3 = _____

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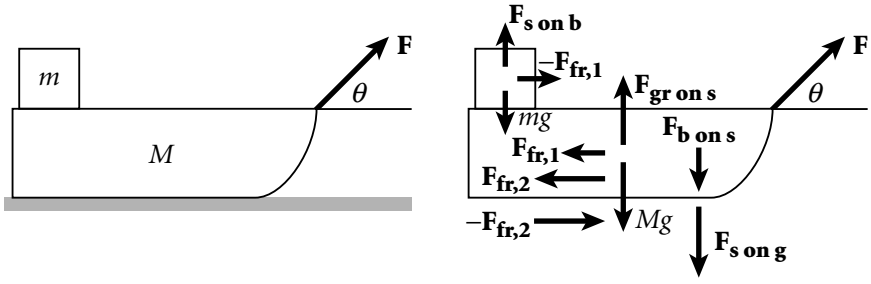
Section 4-3

HOLT PHYSICS

Diagram Skills

Newton's Second and Third Laws

The figure on the left below illustrates a sled with a mass of *M* pulled horizontally along the ground by a force with a magnitude of *F*. A box with a mass of *m* lies on the sled and remains at rest relative to the sled. Assume there is friction between the surface of the sled and the box and between the surface of the ground and the sled. The figure on the right below shows the *force* diagram for this situation.



1. Identify any action-reaction pairs in the force diagram.

_____

2. Which of the forces shown would be included in the free-body diagram of the box?

_____

3. Which of the forces shown would be included in the free-body diagram of the sled?

_____

4. What is the net force on the box in the horizontal direction? _____

5. What is the net force on the box in the vertical direction? _____

6. What is the net force on the sled in the horizontal direction? _____

7. What is the net force on the sled in the vertical direction? _____

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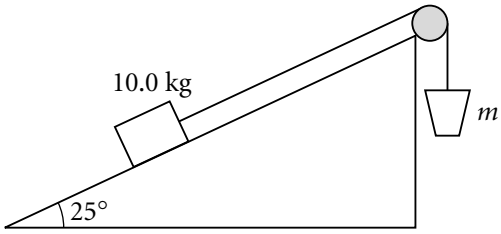
Section 4-4

HOLT PHYSICS

Concept Review

Everyday Forces

A wooden box with a mass of 10.0 kg rests on a ramp that is inclined at an angle of 25° to the horizontal. A rope attached to the box runs parallel to the ramp and then passes over a frictionless pulley. A bucket with a mass of *m* hangs from the end of the rope. The coefficient of static friction between the ramp and the box is 0.50. The coefficient of kinetic friction between the ramp and the box is 0.35.



1. Suppose the box remains at rest relative to the ramp. What is the maximum magnitude of the friction force exerted on the box by the ramp?

_____

2. Suppose the box slides along the ramp. What is the maximum magnitude of the friction force exerted on the box by the ramp?

_____

3. Suppose the bucket has a mass of 2.0 kg.

a. What is the friction force exerted on the box by the ramp?

_____

b. Does the box remain at rest relative to the ramp?

_____

4. Suppose water is added to the bucket so that the total mass of the bucket and its contents is 6.0 kg.

a. What is the friction force exerted on the box by the ramp?

_____

b. Does the box remain at rest relative to the ramp?

_____

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Chapter 4

HOLT PHYSICS

Mixed Review

Forces and the Laws of Motion

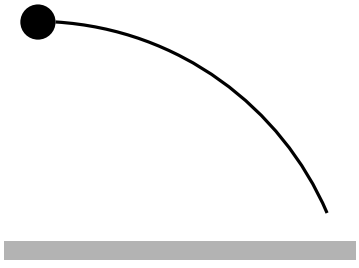
1. A crate rests on the horizontal bed of a pickup truck. For each situation described below, indicate the motion of the crate relative to the ground, the motion of the crate relative to the truck, and whether the crate will hit the front wall of the truck bed, the back wall, or neither. Disregard friction.

a. Starting at rest, the truck *accelerates* to the right.

b. The crate is at rest relative to the truck while the truck moves to the right with a constant velocity.

c. The truck in item b slows down.

2. A ball with a mass of m is thrown through the air, as shown in the figure.



a. What is the gravitational force exerted on the ball by Earth?

b. What is the force exerted on Earth by the ball?

c. If the surrounding air exerts a force on the ball that resists its motion, is the *total* force on the ball the same as the force calculated in part a?

d. If the surrounding air exerts a force on the ball that resists its motion, is the *gravitational* force on the ball the same as the force calculated in part a?

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Chapter 4

HOLT PHYSICS

Mixed Review *continued*

3. Two blocks of masses m_1 and m_2, respectively, are placed in contact with each other on a smooth, horizontal surface. A constant horizontal force F to the right is applied to m_1. Answer the following questions in terms of F, m_1, and m_2.

a. What is the acceleration of the two blocks?

_____

b. What are the horizontal forces acting on m_2?

_____

c. What are the horizontal forces acting on m_1?

_____

d. What is the magnitude of the contact force between the two blocks?

_____

4. Assume you have the same situation as described in item 3, only this time there is a frictional force, F_k, between the blocks and the surface. Answer the following questions in terms of F, F_k, m_1, and m_2.

a. What is the acceleration of the two blocks?

_____

b. What are the horizontal forces acting on m_2?

_____

c. What are the horizontal forces acting on m_1?

_____

d. What is the magnitude of the contact force between the two blocks?

_____