FORCES AND NEWTON'S FIRST LAW

Review Questions

1. Is it possible for an object to be in motion if no net force is acting on it? Explain.
2. If an object is at rest, can we conclude that no external forces are acting on it?
3. An object thrown into the air stops at the highest point in its path. Is it in equilibrium at this point? Explain.
4. What physical quantity is a measure of the amount of inertia an object has?

Conceptual Questions

5. A beach ball is left in the bed of a pickup truck. Describe what happens to the ball when the truck accelerates forward.
6. A large crate is placed on the bed of a truck but is not tied down.
   a. As the truck accelerates forward, the crate slides across the bed until it hits the tailgate. Explain what causes this.
   b. If the driver slammed on the brakes, what could happen to the crate?

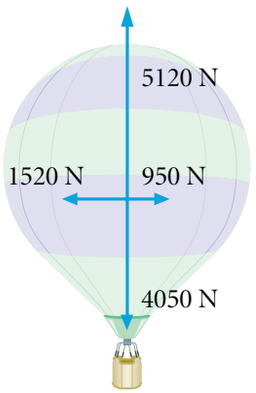
Practice Problems

For problems 7–9, see Sample Problem A.

7. Earth exerts a downward gravitational force of 8.9 N on a cake that is resting on a plate. The plate exerts a force of 11.0 N upward on the cake, and a knife exerts a downward force of 2.1 N on the cake. Draw a free-body diagram of the cake.
8. A chair is pushed forward with a force of 185 N. The gravitational force of Earth on the chair is 155 N downward, and the floor exerts a force of 155 N upward on the chair. Draw a free-body diagram showing the forces acting on the chair.
9. Draw a free-body diagram representing each of the following objects:
   a. a ball falling in the presence of air resistance
   b. a helicopter lifting off a landing pad
   c. an athlete running along a horizontal track

For problems 10–12, see Sample Problem B.

10. Four forces act on a hot-air balloon, shown from the side in the figure below. Find the magnitude and direction of the resultant force on the balloon.



11. Two lifeguards pull on ropes attached to a raft. If they pull in the same direction, the raft experiences a net force of 334 N to the right. If they pull in opposite directions, the raft experiences a net force of 106 N to the left.
    a. Draw a free-body diagram representing the raft for each situation.
    b. Find the force exerted by each lifeguard on the raft for each situation. (Disregard any other forces acting on the raft.)
12. A dog pulls on a pillow with a force of 5 N at an angle of 37° above the horizontal. Find the x and y components of this force.

ANSWERS

1. yes; The object could move at a constant velocity.
2. no, just that the net force equals zero
3. no; It has a net force downward (gravitational force).
4. mass
5. The ball moves toward the back of the truck because inertia keeps it in place relative to the ground.
6. **a.** the inertia of the crate
   b. It could continue forward by inertia and hit the cab.
7. $\mathbf{F_g}$ (8.9 N) and $\mathbf{F_{applied}}$ (2.1 N) point downward, and $\mathbf{F_n}$ (11.0 N) points upward.
8. $\mathbf{F_{applied}}$ (185 N) points forward, $\mathbf{F_g}$ (155 N) points downward, and $\mathbf{F_n}$ (155 N) points upward. The diagram may also include $\mathbf{F_{friction}}$ backward.
9. a. $\mathbf{F_g}$ points down, and $\mathbf{F_R}$ points up.
   b. $\mathbf{F_{rotors}}$ points up, and $\mathbf{F_g}$ points down.
   c. $\mathbf{F_g}$ points down, $\mathbf{F_{track}}$ points in the direction of motion, and $\mathbf{F_n}$ points up.
10. 1210 N at 62° above the 1520 N force
11. a. $\mathbf{F_1}$ (220 N) and $\mathbf{F_2}$ (114 N) both point right; $\mathbf{F_1}$ (220 N) points left, and $\mathbf{F_2}$ (114 N) points right.
    b. first situation: 220 N to the right, 114 N to the right; second situation: 220 N to the left, 114 N to the right
12. 4 N; 3 N