Practice with Forces in 1 Dimension
(up & down, left & right)

Conceptual Questions

3. If the acceleration of an object is zero, are no forces acting on it? Explain.

5. When a golf ball is dropped to the pavement, it bounces back up. (*a*) Is a force needed to make it bounce back up? (*b*) If so, what exerts the force?

9. A stone hangs by a fine thread from the ceiling, and a section of the same thread dangles from the bottom of the stone (Fig. 4–36). If a person gives a sharp pull on the dangling thread, where is the thread likely to break: below the stone or above it? What if the person gives a slow and steady pull? Explain your answers.
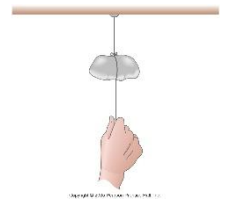
10. In the absence of air resistance, all objects fall at the same rate. The force of gravity on a 2-kg rock is twice as great as that on a 1-kg rock. Why then doesn't the heavier rock fall faster?

13. When an object falls freely under the influence of gravity there is a net force mg exerted on it by the Earth. Yet by Newton's third law the object exerts an equal and opposite force on the Earth. Why doesn't the Earth move?

15. According to Newton's third law, each team in a tug of war (Fig. 4–37) pulls with equal force on the other team. What, then, determines which team will win?

Problems

1. (I) What force is needed to accelerate a child on a sled $(\text{total mass} = 60.0 \text{ kg})$ at 1.25 m/s^2 ?

2. (I) A net force of 265 N accelerates a bike and rider at 2.30 m/s^2. What is the mass of the bike and rider together?

4. (I) What is the weight of a 76-kg astronaut (*a*) on Earth, (*b*) on the Moon $\left(g = 1.7 \text{ m/s}^2 \right)$, (*c*) on Mars $\left(g = 3.7 \text{ m/s}^2 \right)$, (*d*) in outer space traveling with constant velocity?

6. (II) What average force is required to stop an 1100-kg car in 8.0 s if the car is traveling at 95 km/h ?

9. (II) A 0.140-kg baseball traveling 35.0 m/s strikes the catcher's mitt, which, in bringing the ball to rest, recoils backward 11.0 cm. What was the average force applied by the ball on the glove?

10. (II) How much tension must a rope withstand if it is used to accelerate a 1200-kg car vertically upward at $0.80 \, \text{m/s}^2$?

13. (II) An elevator (mass 4850 kg) is to be designed so that the maximum acceleration is 0.0680g. What are the maximum and minimum forces the motor should exert on the supporting cable?

14. (II) A 75-kg petty thief wants to escape from a third-story jail window. Unfortunately, a makeshift rope made of sheets tied together can support a mass of only 58 kg. How might the thief use this "rope" to escape? Give a quantitative answer.

15. (II) A person stands on a bathroom scale in a motionless elevator. When the elevator begins to move, the scale briefly reads only 0.75 of the person's regular weight. Calculate the acceleration of the elevator, and find the direction of acceleration.

36. (I) If the coefficient of kinetic friction between a 35-kg crate and the floor is 0.30, what horizontal force is required to move the crate at a steady speed across the floor? What horizontal force is required if μ_k is zero?

37. (I) A force of 48.0 N is required to start a 5.0-kg box moving across a horizontal concrete floor. (*a*) What is the coefficient of static friction between the box and the floor? (*b*) If the 48.0-N force continues, the box accelerates at $0.70 \, \text{m/s}^2$. What is the coefficient of kinetic friction?

38. (I) Suppose that you are standing on a train accelerating at 0.20*g*. What minimum coefficient of static friction must exist between your feet and the floor if you are not to slide?

44. (II) Drag-race tires in contact with an asphalt surface have a very high coefficient of static friction. Assuming a constant acceleration and no slipping of tires, estimate the coefficient of static friction needed for a drag racer to cover 1.0 km in 12 s, starting from rest.

47. (II) A box is given a push so that it slides across the floor. How far will it go, given that the coefficient of kinetic friction is 0.20 and the push imparts an initial speed of $4.0\,\mathrm{m/s}$?