1. You jump out of a second-story window that is a distance \( h \) above the top of your dorm room couch. The couch cushions your fall, causing you to stop in a distance \( d \) after first hitting it. (a) Find your acceleration (assumed constant) for the time interval between when you first hit the couch and you come to rest. (b) What is the stopping force exerted by the couch. (c) What is the force that you exert on the couch?

2. The 2 masses, \( m_a \) and \( m_b \), are pushed by a horizontal force of magnitude \( F \) on a frictionless plane inclined by an angle \( \theta \) from the horizontal. Find the magnitude of the contact force between the 2 masses if (a) \( m_a \) is the lower of the 2 masses, as drawn, and (b) if, instead, \( m_b \) is the lower of the 2 masses.

3. A cube with mass \( m_c \) lies atop a wedge of mass \( m_w \) that sits on a frictionless horizontal surface. There is no friction between the cube and the wedge. Find the horizontal force that is applied to the wedge so that the cube does not slide on the wedge.

4. A 200-m-wide river has a uniform flow speed of 1.1 m/s through a jungle and toward the east. An explorer wishes to leave a small clearing on the south bank and cross the river in a powerboat that moves at a constant speed of 4.0 m/s with respect to the water. There is a clearing on the north bank 82 m upstream from a point directly opposite the clearing on the south bank. (a) In what direction must the boat be pointed in order to travel in a straight line and land in the clearing on the north bank? (b) How long will the boat take to cross the river and land in the clearing?

5. A wooden boxcar is moving along a straight railroad track at speed \( v_1 \). A sniper fires a bullet (initial speed \( v_2 \)) at it from a high-powered rifle. The bullet passes through both lengthwise walls of the car, its entrance and exit holes being exactly opposite each other as viewed from within the car. From what direction, relative to the track, is the bullet fired? Assume that the bullet is not deflected upon entering the car, but that its speed
decreases by 20%. Take \( v_1 = 85 \text{ km/h} \) and \( v_2 = 650 \text{ m/s} \). (Why don't you need to know the width of the boxcar?)

6. Some insects can walk below a thin rod (such as a twig) by hanging from it. Suppose that such an insect has mass \( m \) and hangs from a horizontal rod as shown in the picture, with angle \( \theta = 40^\circ \). Its six legs are all under the same tension, and the leg sections nearest the body are horizontal. (a) What is the ratio of the tension in each tibia (forepart of a leg) to the insect's weight? (b) If the insect straightens out its legs somewhat, does the tension in each tibia increase, decrease, or stay the same?

7. The picture shows three blocks attached by cords that loop over massless, frictionless pulleys. Block \( B \) lies on a frictionless table; the masses are \( m_A = 6.00 \text{ kg} \), \( m_B = 8.00 \text{ kg} \), and \( m_C = 10.0 \text{ kg} \). When the blocks are released, what is the tension in the cord at the right?

8. In the figure, elevator cabs \( A \) and \( B \) are connected by a short cable and can be pulled upward or lowered by the cable above cab \( A \). Cab \( A \) has mass 1700 kg; cab \( B \) has mass 1300 kg. A 12.0 kg box lies on the floor of cab \( A \). The tension in the cable connecting the cabs is \( 1.91 \times 10^4 \text{ N} \). What is the magnitude of the normal force on the box from the floor?

9. The picture shows a box of mass \( m_2 = 1.0 \text{ kg} \) on a frictionless plane inclined at angle \( \theta = 30^\circ \). It is connected by a cord of negligible mass to a box of mass \( m_1 = 3.0 \text{ kg} \) on a horizontal frictionless surface. The pulley is frictionless and massless. (a) If the magnitude of horizontal force \( \vec{F} \) is 2.3 N, what is the tension in the connecting cord? (b) What is the largest value the magnitude of \( \vec{F} \) may have without the cord becoming slack?

10. You pull a short refrigerator with a constant force \( \vec{F} \) across a greased (frictionless) floor, either with \( \vec{F} \) horizontal (case 1) or with \( \vec{F} \) tilted upward at an angle \( \theta \) (case 2). (a) What is the ratio of the refrigerator's speed in case 2 to its speed in case 1 if you pull for a certain time \( t \)? (b) What is this ratio if you pull for a certain distance \( d \)?