

62. (III) Boxes are moved on a conveyor belt from where they are filled to the packing station 11.0 m away. The belt is initially stationary and must finish with zero speed. The most rapid transit is accomplished if the belt accelerates for half the distance, then decelerates for the final half of the trip. If the coefficient of static friction between a box and the belt is 0.60, what is the minimum transit time for each box?
63. (III) A block (mass  $m_1$ ) lying on a frictionless inclined plane is connected to a mass  $m_2$  by a massless cord passing over a pulley, as shown in Fig. 4–57. (a) Determine a formula for the acceleration of the system of the two blocks in terms of  $m_1$ ,  $m_2$ ,  $\theta$  and  $g$ . (b) What conditions apply to masses  $m_1$  and  $m_2$  for the acceleration to be in one direction (say,  $m_1$  down the plane), or in the opposite direction?

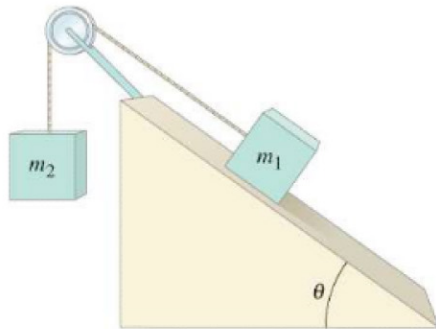


FIGURE 4–57  
Problems 63  
and 64.

## General Problems

66. According to a simplified model of a mammalian heart, at each pulse approximately 20 g of blood is accelerated from 0.25 m/s to 0.35 m/s during a period of 0.10 s. What is the magnitude of the force exerted by the heart muscle?
67. A person has a reasonable chance of surviving an automobile crash if the deceleration is no more than 30 “g’s.” Calculate the force on a 70-kg person undergoing this acceleration. What distance is traveled if the person is brought to rest at this rate from 100 km/h?
68. (a) If the horizontal acceleration produced by an earthquake is  $a$ , and if an object is going to “hold its place” on the ground, show that the coefficient of static friction with the ground must be at least  $\mu_s = a/g$ . (b) The famous Loma Prieta earthquake that stopped the 1989 World Series produced ground accelerations of up to  $4.0 \text{ m/s}^2$  in the San Francisco Bay Area. Would a chair have started to slide on a linoleum floor with coefficient of static friction 0.25?
69. An 1150-kg car pulls a 450-kg trailer. The car exerts a horizontal force of  $3.8 \times 10^3 \text{ N}$  against the ground in order to accelerate. What force does the car exert on the trailer? Assume an effective friction coefficient of 0.15 for the trailer.
70. Police investigators, examining the scene of an accident involving two cars, measure 72-m-long skid marks of one of the cars, which nearly came to a stop before colliding. The coefficient of kinetic friction between rubber and the pavement is about 0.80. Estimate the initial speed of that car assuming a level road.
71. A car starts rolling down a 1-in-4 hill (1-in-4 means that for each 4 m traveled along the road, the elevation change is 1 m). How fast is it going when it reaches the bottom after traveling 55 m? (a) Ignore friction. (b) Assume an effective coefficient of friction equal to 0.10.
72. A 2.0-kg purse is dropped from the top of the Leaning Tower of Pisa and falls 55 m before reaching the ground with a speed of 29 m/s. What was the average force of air resistance?
73. A cyclist is coasting at a steady speed of 12 m/s but enters a muddy stretch where the effective coefficient of friction is 0.60. Will the cyclist emerge from the muddy stretch without having to pedal if the mud lasts for 11 m? If so, what will be the speed upon emerging?
74. A city planner is working on the redesign of a hilly portion of a city. An important consideration is how steep the roads can be so that even low-powered cars can get up the hills without slowing down. A particular small car, with a mass of 1100 kg, can accelerate on a level road from rest to 21 m/s (75 km/h) in 14.0 s. Using these data, calculate the maximum steepness of a hill.
75. Francesca, who likes physics experiments, dangles her watch from a thin piece of string while the jetliner she is in takes off from JFK Airport (Fig. 4–58). She notices that the string makes an angle of  $25^\circ$  with respect to the vertical as the aircraft accelerates for takeoff, which takes about 18 s. Estimate the takeoff speed of the aircraft.

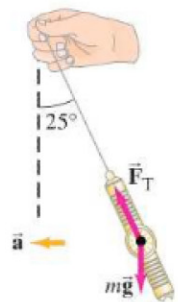


FIGURE 4–58  
Problem 75.