83. (*a*) If the human body could convert a candy bar directly into work, how high could an 82-kg man climb a ladder if he were fueled by one bar (= 1100 kJ)? (*b*) If the man then jumped off the ladder, what will be his speed when he reaches the bottom?

84. A projectile is fired at an upward angle of 45.0° from the top of a 165-m cliff with a speed of 175 m/s. What will be its speed when it strikes the ground below? (Use conservation of energy and neglect air resistance.)

85. If you stand on a bathroom scale, the spring inside the scale compresses 0.60 mm, and it tells you your weight is 710 N. Now if you jump on the scale from a height of 1.0 m, what does the scale read at its peak?

86. A 65-kg student runs at 5.0 m/s, grabs a rope, and swings out over a lake (Fig. 6–45). He releases the rope when his velocity is zero. (*a*) What is the angle θ when he releases the rope? (*b*) What is the tension in the rope just before he releases it? (*c*) What is the maximum tension in the rope?

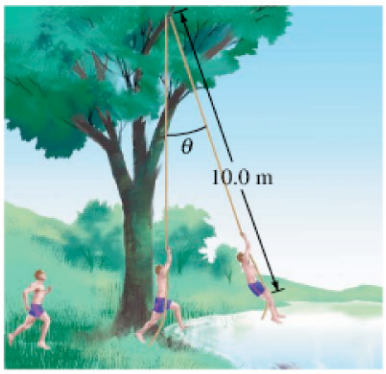

FIGURE 6–45 Problem 86.

87. In the rope climb, a 72-kg athlete climbs a vertical distance of 5.0 m in 9.0 s. What minimum power output was used to accomplish this feat?

88. Some electric-power companies use water to store energy. Water is pumped by reversible turbine pumps from a low to a high reservoir. To store the energy produced in 1.0 hour by a 120-MW $(120 \times 10^6\,\mathrm{W})$ electric-power plant, how many cubic meters of water will have to be pumped from the lower to the upper reservoir? Assume the upper reservoir is 520 m above the lower and we can neglect the small change in depths within each. Water has a mass of 1000 kg for every 1.0 m^3.

89. A spring with spring stiffness constant k is cut in half. What is the spring stiffness constant for each of the two resulting springs?

90. A 6.0-kg block is pushed 8.0 m up a rough 37° inclined plane by a horizontal force of 75 N. If the initial speed of the block is 2.2 m/s up the plane and a constant kinetic friction force of 25 N opposes the motion, calculate (*a*) the initial kinetic energy of the block; (*b*) the work done by the 75-N force; (*c*) the work done by the friction force; (*d*) the work done by gravity; (*e*) the work done by the normal force; (*f*) the final kinetic energy of the block.

91. If a 1500-kg car can accelerate from 35 km/h to 55 km/h in 3.2 s, how long will it take to accelerate from 55 km/h to 75 km/h? Assume the power stays the same, and neglect frictional losses.

92. In a common test for cardiac function (the "stress test"), the patient walks on an inclined treadmill (Fig. 6–46). Estimate the power required from a 75-kg patient when the treadmill is sloping at an angle of 15° and the velocity is 3.3 km/h. (How does this power compare to the power rating of a lightbulb?)

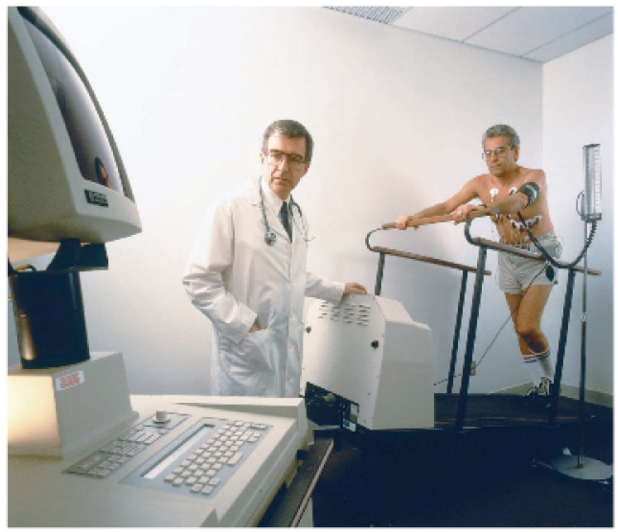

FIGURE 6–46 Problem 92.

93. (*a*) If a volcano spews a 500-kg rock vertically upward a distance of 500 m, what was its velocity when it left the volcano? (*b*) If the volcano spews the equivalent of 1000 rocks of this size every minute, what is its power output?

94. Water falls onto a water wheel from a height of 2.0 m at a rate of 95 kg/s. (*a*) If this water wheel is set up to provide electricity output, what is its maximum power output? (*b*) What is the speed of the water as it hits the wheel?

Answers to Exercises

A: (*c*).

B: No, because the speed v would be the square root of a negative number, which is not real.

C: It is nonconservative, because for a conservative force $W = 0$ in a round trip.

D: $W_{\text{net}} = \Delta\text{KE}$, where $W_{\text{net}} = mg(y_1 - y_2)$ and $\Delta\text{KE} = \frac{1}{2}mv_2^2 - \frac{1}{2}mv_1^2 = \frac{1}{2}mv_2^2$. Then $v_2^2 = 2g(y_1 - y_2)$.

E: Equal speeds.