22. (II) At an accident scene on a level road, investigators measure a car's skid mark to be 88 m long. The accident occurred on a rainy day, and the coefficient of kinetic friction was estimated to be 0.42. Use these data to determine the speed of the car when the driver slammed on (and locked) the brakes. (Why does the car's mass not matter?)

23. (II) A softball having a mass of 0.25 kg is pitched at 95 km/h. By the time it reaches the plate, it may have slowed by 10%. Neglecting gravity, estimate the average force of air resistance during a pitch, if the distance between the plate and the pitcher is about 15 m.

24. (II) How high will a 1.85-kg rock go if thrown straight up by someone who does 80.0 J of work on it? Neglect air resistance.

25. (III) A 285-kg load is lifted 22.0 m vertically with an acceleration $a = 0.160\,g$ by a single cable. Determine (*a*) the tension in the cable, (*b*) the net work done on the load, (*c*) the work done by the cable on the load, (*d*) the work done by gravity on the load, and (*e*) the final speed of the load assuming it started from rest.

6–4 and 6–5 Potential Energy

26. (I) A spring has a spring stiffness constant, k, of 440 N/m. How much must this spring be stretched to store 25 J of potential energy?

27. (I) A 7.0-kg monkey swings from one branch to another 1.2 m higher. What is the change in potential energy?

28. (I) By how much does the gravitational potential energy of a 64-kg pole vaulter change if his center of mass rises about 4.0 m during the jump?

29. (II) A 1200-kg car rolling on a horizontal surface has speed $v = 65$ km/h when it strikes a horizontal coiled spring and is brought to rest in a distance of 2.2 m. What is the spring stiffness constant of the spring?

30. (II) A 1.60-m tall person lifts a 2.10-kg book from the ground so it is 2.20 m above the ground. What is the potential energy of the book relative to (*a*) the ground, and (*b*) the top of the person's head? (*c*) How is the work done by the person related to the answers in parts (*a*) and (*b*)?

31. (II) A 55-kg hiker starts at an elevation of 1600 m and climbs to the top of a 3300-m peak. (*a*) What is the hiker's change in potential energy? (*b*) What is the minimum work required of the hiker? (*c*) Can the actual work done be more than this? Explain why.

32. (II) A spring with $k = 53$ N/m hangs vertically next to a ruler. The end of the spring is next to the 15-cm mark on the ruler. If a 2.5-kg mass is now attached to the end of the spring, where will the end of the spring line up with the ruler marks?

6–6 and 6–7 Conservation of Mechanical Energy

33. (I) Jane, looking for Tarzan, is running at top speed (5.3 m/s) and grabs a vine hanging vertically from a tall tree in the jungle. How high can she swing upward? Does the length of the vine affect your answer?

34. (I) A novice skier, starting from rest, slides down a frictionless 35.0° incline whose vertical height is 185 m. How fast is she going when she reaches the bottom?

35. (I) A sled is initially given a shove up a frictionless 28.0° incline. It reaches a maximum vertical height 1.35 m higher than where it started. What was its initial speed?

36. (II) In the high jump, Fran's kinetic energy is transformed into gravitational potential energy without the aid of a pole. With what minimum speed must Fran leave the ground in order to lift her center of mass 2.10 m and cross the bar with a speed of 0.70 m/s?

37. (II) A 65-kg trampoline artist jumps vertically upward from the top of a platform with a speed of 5.0 m/s. (*a*) How fast is he going as he lands on the trampoline, 3.0 m below (Fig. 6–38)? (*b*) If the trampoline behaves like a spring with spring stiffness constant 6.2×10^4 N/m, how far does he depress it?

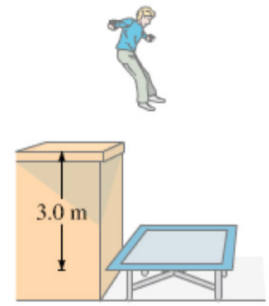

FIGURE 6–38 Problem 37.

38. (II) A projectile is fired at an upward angle of 45.0° from the top of a 265-m cliff with a speed of 185 m/s. What will be its speed when it strikes the ground below? (Use conservation of energy.)

39. (II) A vertical spring (ignore its mass), whose spring stiffness constant is 950 N/m, is attached to a table and is compressed down 0.150 m. (*a*) What upward speed can it give to a 0.30-kg ball when released? (*b*) How high above its original position (spring compressed) will the ball fly?

40. (II) A block of mass m slides without friction along the looped track shown in Fig. 6–39. If the block is to remain on the track, even at the top of the circle (whose radius is r), from what minimum height h must it be released?

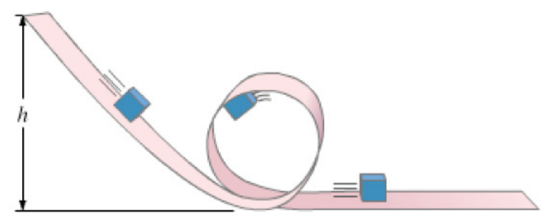

FIGURE 6–39 Problems 40 and 75.

41. (II) A block of mass m is attached to the end of a spring (spring stiffness constant k), Fig. 6–40. The block is given an initial displacement x_0, after which it oscillates back and forth. Write a formula for the total mechanical energy (ignore friction and the mass of the spring) in terms of x_0, position x, and speed v.

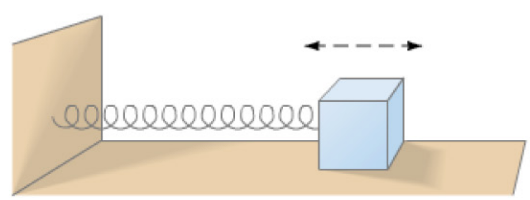

FIGURE 6–40 Problems 41, 55, and 56.

42. (II) A 62-kg bungee jumper jumps from a bridge. She is tied to a bungee cord whose unstretched length is 12 m, and falls a total of 31 m. (*a*) Calculate the spring stiffness constant k of the bungee cord, assuming Hooke's law applies. (*b*) Calculate the maximum acceleration she experiences.