CHAPTER 6: Work and Energy

Problems

6–1 Work, Constant Force

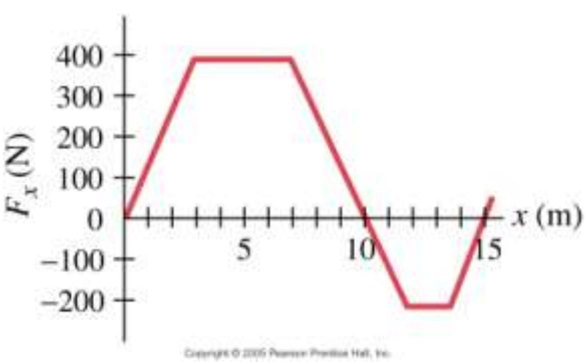
1. (I) How much work is done by the gravitational force when a 265-kg pile driver falls 2.80 m?

4. (I) How much work did the movers do (horizontally) pushing a 160-kg crate 10.3 m across a rough floor without acceleration, if the effective coefficient of friction was 0.50?

8. (II) A 330-kg piano slides 3.6 m down a 28º incline and is kept from accelerating by a man who is pushing back on it *parallel to the incline* (Fig. 6–36). The effective coefficient of kinetic friction is 0.40. Calculate: *(a)* the force exerted by the man, *(b)* the work done by the man on the piano, *(c)* the work done by the friction force, *(d)* the work done by the force of gravity, and *(e)* the net work done on the piano.

*6–2 Work, Varying Force

***12.** (II) The force on an object, acting along the x axis, varies as shown in Fig. 6–37. Determine the work done by this force to move the object (a) from $x = 0.0$ to $x = 10.0\,\text{m}$, and (b) from $x = 0.0$ to $x = 15.0\,\text{m}$.



6–3 Kinetic Energy; Work-Energy Principle

16. (I) (a) If the KE of an arrow is doubled, by what factor has its speed increased? (b) If its speed is doubled, by what factor does its KE increase?

18. (I) How much work must be done to stop a 1250-kg car traveling at $105\,\text{km/h}$?

19. (II) An 88-g arrow is fired from a bow whose string exerts an average force of 110 N on the arrow over a distance of 78 cm. What is the speed of the arrow as it leaves the bow?

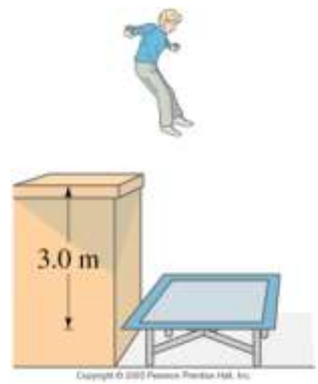
6–4 and 6–5 Potential Energy

29. (II) A 1200-kg car rolling on a horizontal surface has speed $v = 65\,\text{km/h}$ 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?

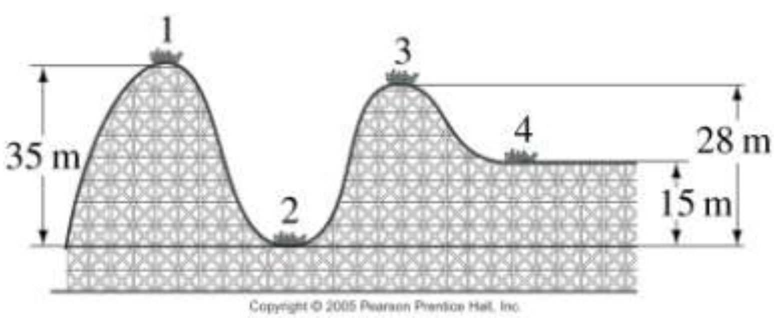
31. (II) A 55-kg hiker starts at an elevation of 1600 m and climbs to the top of a 3300-m peak. (*a*) What is the hiker's change in potential energy? (*b*) What is the minimum work required of the hiker? (*c*) Can the actual work done be more than this? Explain why.

6–6 and 6–7 Conservation of Mechanical Energy

37. (II) A 65-kg trampoline artist jumps vertically upward from the top of a platform with a speed of $5.0\,\text{m/s}$. (*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 $6.2\times10^4\ \text{N/m}$, how far does he depress it?



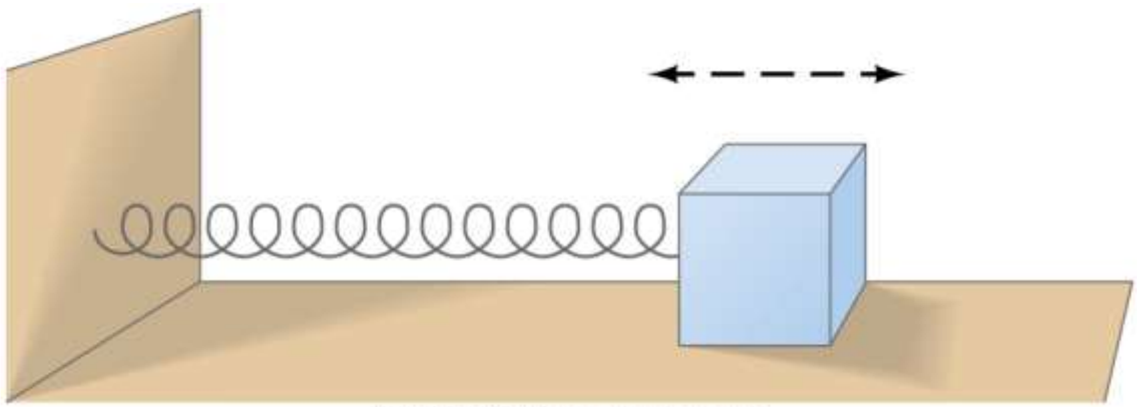
43. (II) The roller-coaster car shown in Fig. 6–41 is dragged up to point 1 where it is released from rest. Assuming no friction, calculate the speed at points 2, 3, and 4.



6–8 and 6–9 Law of Conservation of Energy

49. (II) A ski starts from rest and slides down a 22º incline 75 m long. (*a*) If the coefficient of friction is 0.090, what is the ski's speed at the base of the incline? (*b*) If the snow is level at the foot of the incline and has the same coefficient of friction, how far will the ski travel along the level? Use energy methods.

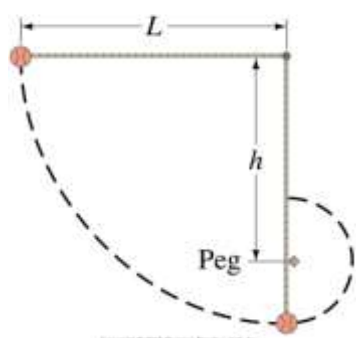
55. (III) A 0.620-kg wood block is firmly attached to a very light horizontal spring $(k = 180\ \mathrm{N/m})$ as shown in Fig. 6–40. It is noted that the block–spring system, when compressed 5.0 cm and released, stretches out 2.3 cm beyond the equilibrium position before stopping and turning back. What is the coefficient of kinetic friction between the block and the table?



6–10 Power

65. (II) A shot-putter accelerates a 7.3-kg shot from rest to $14\ \mathrm{m/s}$. If this motion takes 1.5 s, what average power was developed?

77. A ball is attached to a horizontal cord of length L whose other end is fixed (Fig. 6–43). (*a*) If the ball is released, what will be its speed at the lowest point of its path? (*b*) A peg is located a distance h directly below the point of attachment of the cord. If $h = 0.80L$, what will be the speed of the ball when it reaches the top of its circular path about the peg?



90. A 6.0-kg block is pushed 8.0 m up a rough 37º inclined plane by a horizontal force of 75 N. If the initial speed of the block is $2.2\ \mathrm{m/s}$ 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.