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?
2. (I) A 65.0-kg firefighter climbs a flight of stairs 20.0 m high. How much work is required?
3. (I) A 1300-N crate rests on the floor. How much work is required to move it at constant speed (*a*) 4.0 m along the floor against a friction force of 230 N, and (*b*) 4.0 m vertically?
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?
5. (II) A box of mass 5.0 kg is accelerated from rest across a floor at a rate of 2.0 m/s^2 for 7.0 s. Find the net work done on the box.
6. (II) Eight books, each 4.3 cm thick with mass 1.7 kg, lie flat on a table. How much work is required to stack them one on top of another?
7. (II) A lever such as that shown in Fig. 6–35 can be used to lift objects we might not otherwise be able to lift. Show that the ratio of output force, F_O, to input force, F_I, is related to the lengths l_I and l_O from the pivot point by $F_O/F_I = l_I/l_O$ (ignoring friction and the mass of the lever), given that the work output equals work input.

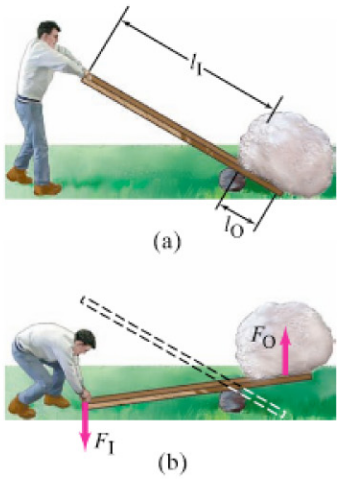

FIGURE 6–35
Problem 7.
A simple lever.

8. (II) A 330-kg piano slides 3.6 m down a 28° 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.

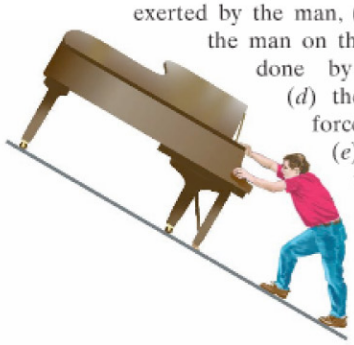

FIGURE 6–36
Problem 8.

9. (II) (*a*) Find the force required to give a helicopter of mass M an acceleration of $0.10g$ upward. (*b*) Find the work done by this force as the helicopter moves a distance h upward.
10. (II) What is the minimum work needed to push a 950-kg car 810 m up along a 9.0° incline? (*a*) Ignore friction. (*b*) Assume the effective coefficient of friction retarding the car is 0.25.

* 6–2 Work, Varying Force

* 11. (II) In Fig. 6–6a, assume the distance axis is linear and that $d_A = 10.0$ m and $d_B = 35.0$ m. Estimate the work done by force F in moving a 2.80-kg object from d_A to d_B.
* 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 $x = 10.0$ m, and (*b*) from $x = 0.0$ to $x = 15.0$ m.

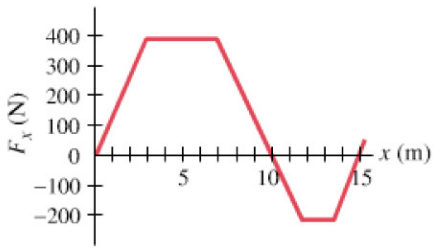

FIGURE 6–37
Problem 12.

* 13. (II) A spring has $k = 88$ N/m. Use a graph to determine the work needed to stretch it from $x = 3.8$ cm to $x = 5.8$ cm, where x is the displacement from its unstretched length.
* 14. (II) The net force exerted on a particle acts in the $+x$ direction. Its magnitude increases linearly from zero at $x = 0$, to 24.0 N at $x = 3.0$ m. It remains constant at 24.0 N from $x = 3.0$ m to $x = 8.0$ m, and then decreases linearly to zero at $x = 13.0$ m. Determine the work done to move the particle from $x = 0$ to $x = 13.0$ m graphically by determining the area under the F_x vs. x graph.

6–3 Kinetic Energy; Work-Energy Principle

15. (I) At room temperature, an oxygen molecule, with mass of 5.31×10^{-26} kg, typically has a KE of about 6.21×10^{-21} J. How fast is the molecule moving?
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?
17. (I) How much work is required to stop an electron ($m = 9.11 \times 10^{-31}$ kg) which is moving with a speed of 1.90×10^6 m/s?
18. (I) How much work must be done to stop a 1250-kg car traveling at 105 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?
20. (II) A baseball ($m = 140$ g) traveling 32 m/s moves a fielder's glove backward 25 cm when the ball is caught. What was the average force exerted by the ball on the glove?
21. (II) If the speed of a car is increased by 50%, by what factor will its minimum braking distance be increased, assuming all else is the same? Ignore the driver's reaction time.