Chapter 4: Work, Energy & Power
End of Chapter Questions

1. Which produces the greater change in kinetic energy: exerting a 10-N force for a distance of 5 m, or exerting a 20-N force over a distance of 2 m? Assume that all of the work goes into KE.

2. This question is typical on some driver's license exams: A car moving at 50 km/h skids 15 m with locked brakes. How far will the car skid with locked brakes at 150 km/h?

3. A 60-kg skydiver moving at terminal speed falls 50 m in 1 second. What power is the skydiver expending on the air?

4. How many joules of work are done when a force of 1 N moves a book 2 m?

5. Which requires more work–lifting a 50-kg sack a vertical distance of 2 m or lifting a 25-kg sack a vertical distance of 4 m?

6. If both sacks in the preceding question are lifted their respective distances in the same time, how does the power required for each compare? How about for the case where the lighter sack is moved its distance in half the time?

7. How many watts of power are expended when a force of 1 N moves a book 2 m in a time interval of 1 second?

8. Exactly what is it that a body having energy is capable of doing?

9. A car is lifted a certain distance in a service station and therefore has potential energy relative to the floor. If it were lifted twice as high, how much potential energy would it have?

10. Two cars are lifted to the same elevation in a service station. If one car is twice as massive as the other, how do their potential energies compare?

11. How many joules of potential energy does a 1-kg book gain when it is elevated 4 m? When it is elevated 8 m?

12. When is the potential energy of something important?

13. How many joules of kinetic energy does a 1-kg book have when it is tossed across the room at a speed of 2 m/s?

14. A moving car has kinetic energy. If it speeds up until it is going four times as fast, how much kinetic energy does it have in comparison?

15. Compared to some original speed, how much work must the brakes of a car supply to stop a four-times-as-fast car? How will the stopping distance compare?

16. (a) How much work do you do when you push a crate horizontally with 100 N across a 10-m factory floor? (b) If the force of friction between the crate and floor is a steady 70 N, how much KE is gained by the crate after sliding 10 m? (c) How much of the work you do converts to heat?

17. How does speed affect the friction between a road and a skidding tire?

18. What will be the kinetic energy of a pile driver ram when it undergoes a 10-kJ decrease in potential energy?

19. An apple hanging from a limb has potential energy because of its height. If it falls, what becomes of this energy just before it hits the ground? When it hits the ground?

Answers:

1. The work done by 10 N over a distance of 5 m = 50 J. That by 20 N over 2 m = 40 J. So the 10-N force over 5 m does more work and could produce a greater change in KE.
2. At three times the speed, it has 9 times the KE and will skid 9 times as far – 135 m. Since the frictional force is about the same in both cases, the distance has to be 9 times as great for 9 times as much work done by the pavement on the car.
3. The force exerted by the skydiver on the air is equal to her weight, $W = mg$ = (60 kg)(10 m/s^2) = 600 N. Power is work per second, so $P = F \times d/t$ = (600 N)(50 m)/(1 s) = 30,000 J/s = 30 kW.
4. Work = Fd = 1 N x 2 m = 2 Joules.
5. Both require the same work because the force x distance is the same for each.
6. Power for each is the same because the same work is done in the same time. Twice the power is required to do the same work on the lighter sack in half the time.
7. Power = Fd/t = 2J/1s = 2 Watts.
8. Work.
9. Twice.
10. The twice-as-massive car has twice the PE.
11. PE = mgh = 1 kg x 10 m/s^2 x 4 m = 40 J. At 8 m the PE = 80 J.
12. PE is important only when it *changes*, either in amount or into another form of
13. KE = 1/2 mv^2 = 1/2 (1 kg)(2 m/s)^2 = 2 J.
14. A four-times-as-fast car has 4^2 or 16 times the KE.
15. A four-times-as-fast car has 16 times as much KE and will require 16 times as much work to stop, and 16 times as much stopping distance.
16. You do F x d = 100 N x 10 m = 1000 J of work. Because of friction, net work on the crate is less. DKE = Net work = net force x distance = (100 N — 70 N)(10 m) = 300 J. So the rest, 700 J, goes into heating the crate and floor.
17. Speed doesn't affect the force of friction. Fast or slow, the friction force is the same.
18. If none of this PE is converted to heat, the KE will be 10 kJ.
19. PE turns to KE in falling; when it hits the ground it goes into deformation and heating the apple and ground.