Hewitt 11th edition
Ch. 7 Review Questions p. 117

2. What do we call the quantity force x distance, and what quantity does it change?
Ans. Work by definition equals Force x displacement. When work is done to an object, the object gains some form of energy.

3. Cite an example where a force is exerted on and object without doing work on the object.
Ans. If the object is not displaced, then no work is done to it**.** An example would be you pushing on a wall that does not move. Although you applied a force, there was zero displacement and therefore no work was done to the wall.

4. 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.
Ans. First note that kilograms are not units of force. The 50-kg sack actually weighs 500 newtons, therefor the force required to lift it will be 500 newtons. Likewise, the force required to lift the 25-kg sack will be 250 newtons.

The work done lifting the 50-kg sack will be: W=FΔX= 500n x 2m= 1000joules
The work done lifting the 25-kg sack 4 m will be: W= FΔX = 250m x 4m = 1000 joules.
Equal amounts of work are done in both cases.

7. A car is lifted a certain distance in a service station and therefore has potential energy with respect to the floor. If it were lifted twice as high, how much potential energy would it have?
Ans. G.P.E. = mgh. Because you doubled the height h, you must also have doubled the gravitational potential energy of the car.

8. Two cars are lifted to the same height in a service station. If one car is twice as massive as the other, how do their gravitational potential energies compare?
Ans. **G.P.E. = mgh** . **The car that is twice as massive must also gain twice as much gravitational potential energy as the other one. This must be true because G.P.E. is directly proportional to the mass of the object.**

10. A moving car has kinetic energy. a) If it speeds up until it is going four times as fast, how much kinetic energy does it have in comparison? b) Compared to its original speed, how much work must the brakes supply to stop the four-times-as-fast car?
Ans. a. It will have 16 times as much kinetic energy as it originally had.
b. The breaks will have to do 16 times as much work. Ask in class about this.

11. Compared to some original speed, a) how much work must the brakes of a car supply to stop a four-times-as-fast car? b) How will the stopping distance compare?
Ans. a) Looking at the equation: $KE = \frac{1}{2}mv^2$ we see that the kinetic energy is proportional to the velocity squared. Since the car is going 4 times faster, it will have 4^2 = 16 times more kinetic energy and therefore, the brakes will have to do 16 times more work.
b) Since work = FΔX were ΔX is the displacement, in order to do 16 times as much work the car will have to go 16 times further. We are assuming that the force is constant.

Ch. 7 Review Questions; 11th edition
continued

17 a) Can a machine multiply input force?
Ans. Yes it can.
b) Can a machine multiply input distance?
Ans. Yes it can.
c) Can a machine multiply input energy?
Ans. No. No. No. A machine will never, ever produce more energy than is supplied to it.

25. If a moving object doubles its speed, how much more momentum does it have?
Ans. Since momentum is directly proportional to velocity, it will have twice as much momentum as it originally had.

26. If a moving object doubles its speed, how much more impulse does it provide to whatever it bumps into?
Ans. Double.
How much more work does it do as it is stopped?
Ans. Kinetic energy is proportional to velocity squared. Doubling the objects velocity will increase its kinetic energy four times so it will have to do four times as much work in order to stop.

Extra: What will be the kinetic energy of an arrow shot from a bow having a potential energy of 40 joules?
Ans. If the bow transfers all of its energy to the arrow, the arrow will have 40 joules of kinetic energy as it leaves the bow. The total energy of the arrow will continue to be 40 joules for the entire flight.

Extra: If a man uses a pulley to pull 1 meter of rope downward with a force of 100 newtons, and the load rises 1/7 as high, what is the maximum load that can be lifted?
Ans. $Work_{in} = Work_{out}$. $Work = F\Delta X$

Since the distance out is $1/7^{th}$ of the distance in, the force out will be 7 times larger than the force in. Therefore the force out will be 700 newtons. Ask about this one in class.

Chapter 7; 11th edition
Plug and Chug pg. 118

1. How many joules of work are done when a force of 2 N moves a book 2 meters.
Ans. Since work = force x displacement, 2 N x 2 meters = **4 joules** of work.

4. How many watts of power are expended when a force of 2 newton moves a book 2 meters in a time interval of 1 second?
Ans.

$$Power = \frac{work}{time} = \frac{2N(2m)}{1\,second} = \frac{4\,joules}{second} = 4\,watts$$

7. How many joules of potential energy does a 1-kg book gain when it is elevated 4 m? When it is elevated 8 m?
Ans. **G.P.E. = mgh = 1 kg x 10 m/s/s x 4 m = 40 joules**.
G.P.E. = mgh = 1 kg x 10 m/s/s x 8 m = 80 joules

10 Calculate the number of joules of kinetic energy does a 1-kg book have when it is tossed across the room at speed of 2m/s?
Ans. $K.E. = \frac{1}{2}mv^2 = \frac{1}{2}1kg(2\frac{m}{s})^2 = 2\frac{kg \bullet m^2}{\sec^2}$ = 2 joules

Chapter 7, Exercises (pg. 119); 11th edition

9. When a rifle with a longer barrel is fired, the force of the expanding gas pushes the bullet for a longer distance. What effect does this have on the velocity of the emerging bullet? Why?
Ans. The bullet will be moving faster than it would if fired from a gun with a shorter barrel. Since the work done on the bullet equals the force applied multiplied by the displacement, a longer barrel means that more work is done to the bullet. The kinetic energy gained by the bullet equals the work done to it.
Work = $F\Delta X = \Delta K.E. = 1/2\ mv^2$
More work done to the bullet means that it gains more kinetic energy. When an object gains kinetic energy, it gains velocity.

15. a. At what point in its motion is the KE of a pendulum bob or a child's swing, at maximum?

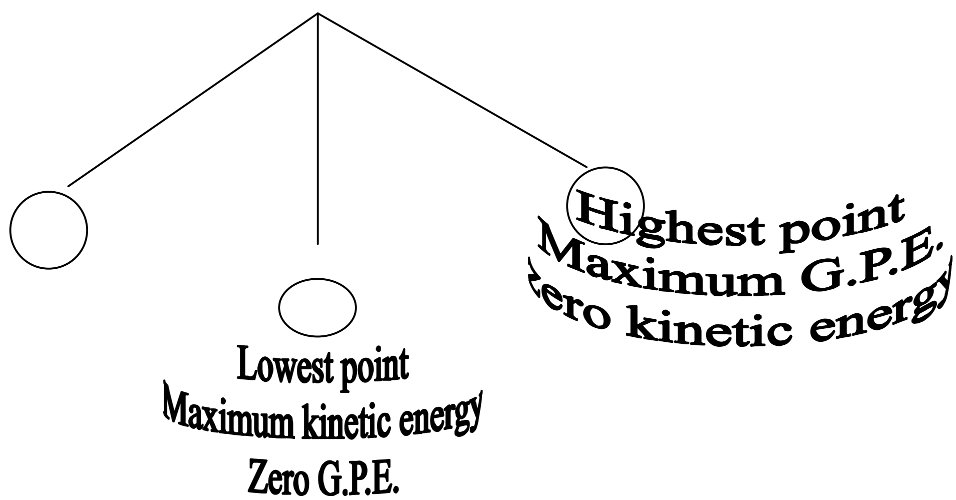
Ans. At the bottom of its path. Can you explain why? If you can't, ask in class.

b. At what point is its PE at maximum?

Ans. At the top of its swing.

c. When is KE half of its maximum value and what percentage of its PE does it have?

Ans. When the center of mass of the swing is half way between the highest and lowest points, one-half of its energy will be in the form of gravitational potential energy and the other half of its energy will be in the form of kinetic energy.



Chapter 7; 11th edition
Exercises continued

16. A physics instructor demonstrates energy conservation by releasing a heavy pendulum bob, allowing it to swing out and back. What would happen if in his exuberance he gave the bob a slight shove as it left his nose? Explain.

Ans. If he pushes the bob away, he will do work to the system and put extra energy into it. The pendulum bob would swing out and back higher than the release point and would hit his nose, if he didn't move out of the way.

24. On a slide a child has potential energy that decreases by 1000 joules while its kinetic energy increase by 900 joules. What other form of energy is involved, and how much?

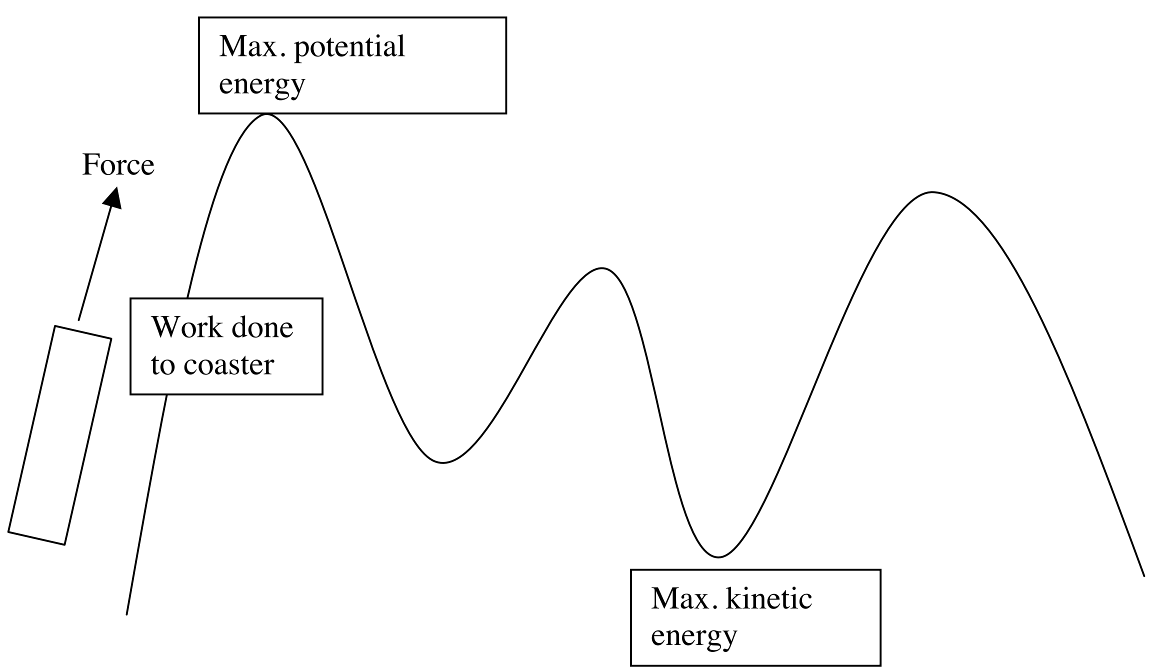
Ans. 100 joules of energy are 'missing'. The 100 joules of energy were used to do work against the force of friction.

29. Someone wants to sell you a superball and claims that it will bounce to a height greater than the height at which it was dropped. Can this be?

Ans. No, it is not possible. Conservation of energy would not allow it. I do believe in the conservation of energy- I do believe.

28 + 29. Discuss the design of a roller coaster in terms of work, gravitational potential energy and kinetic energy. Does each hill have to be lower than the preceding hill? Can the coaster ever go higher than the first hill?

Ans. Work is done to the coaster when it is pulled up the first hill. That is where the coaster gets all of its energy. At the top of the first hill, the energy is mainly in the form of gravitational potential energy. This is where the 'h' in mgh is the largest. As the coaster goes down a hill, its gravitational potential energy decreases and its kinetic energy increases. The kinetic energy is at maximum when the coaster is at its lowest point. This is also where the coaster must be moving the fastest.



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Exercises pg. 119

Ans. exercises 28+29 continued

The total energy would remain constant. If there were no friction, the total energy would always be equal to the work done on the coaster. Because we believe in the conservation of energy, we know that when the coaster goes up a hill and its GPE increases, its kinetic energy must decrease. When a coaster goes down a hill, its GPE will decrease and its kinetic energy must increase. The hills can have any height less than that of the first hill. The coaster will not be able to go up a hill that is higher than the first without having extra energy added somehow. This would violate the law of conservation of energy.

41. In the absence of air resistance, a ball thrown vertically upward with a certain initial velocity and kinetic energy, will return to its original position with the same speed and kinetic energy. When air resistance is considered, will it return to its original level with the same, less, or more kinetic energy? Are any laws of physics violated?

Ans. When we consider air resistance, the ball will return to its original height moving slower than when it was thrown upward. This is caused by the fact that the ball did work when it pushed air molecules out of its way. Because it did work, it used up some of its energy and therefore has less kinetic energy than when it started. All is as it should be.

47. When the mass of a moving object is doubled with no change in speed, a) by what factor does its momentum change? b) By what factor is its kinetic energy changed?

Ans. **a)** momentum is doubled. **b)** kinetic energy is doubled.
You should have the definitions memorized by now.

$$P \equiv m \bullet v; \qquad K.E. \equiv \frac{1}{2}mv^2$$

48. When the velocity of a moving object is doubled with no change in mass, a) by what factor does its momentum change? b) By what factor is its kinetic energy changed?

Ans. **a)** Momentum is doubled. **b)** Kinetic energy is four times larger than its original value.

Extra. An exciting demonstration involves a physics instructor lying on a bed of nails with a cinder block on his chest. The block is then smashed with a sledge hammer and the teacher is unharmed. Why must the teacher make sure that he is lying on a lot of nails and that the block is massive and will break fairly easily?

Ans. The nails will puncture the teacher's skin if the pressure is too great. Since pressure is Force/Area, the larger the area of contact is the smaller the pressure will be. More nails mean more area, which means smaller pressure. Work is done to the block when it is broken. This uses up some of the energy in the sledge-hammer. Also, if the block is massive, it will have a lot of inertia and will not be driven into the teacher’s chest. That would be a bad thing-ouch. Mommy, mommy.

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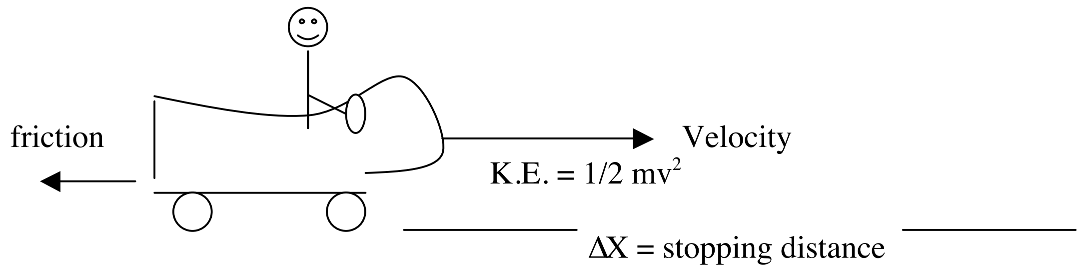
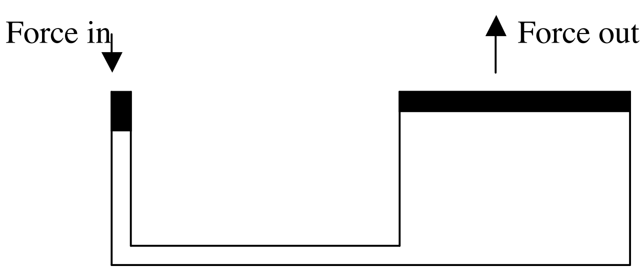
pg 121

3. A car moving at 50 km/hr requires15 meters of stopping distance. Predict the stopping distance for the same car, with identical road conditions, if it is moving at 150 miles/hr. Use the concept of conservation of energy to answer this question.



Ans. The car's velocity has tripled. From KE = 1/2 mv^2 we see that its kinetic energy is 9 times its original value. It must do 9 times as much work in stopping.
Work = $F\Delta X$ and since F is constant, the stopping distance must be 9 times further.
9(15m)= 135 meters

8. In the hydraulic machine shown, the small piston is pushed down 10 cm while the large piston only rises 1 cm. If the small piston is pushed down with a force of 100 N, how much force will the large piston exert?



Ans. Because we believe in the conservation of energy, we know that the work done to the machine will equal the work that we get out of the machine. $F\Delta X$ in = $F\Delta X$ out. Since the distance out is 1/10 the distance in, the force out must be 10 times the force in.

Work in = Work out Force in x Distance in = Force out x Distance out

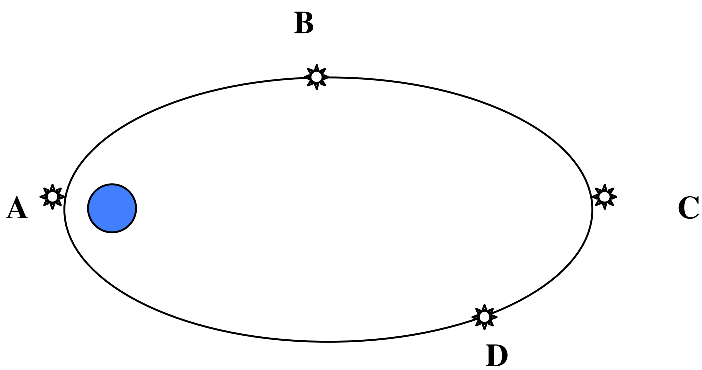
$$\text{Force out} = \frac{\text{Force in x Distance in}}{\text{Distance out}} = \frac{100 \text{ N x } 10 \text{ cm}}{1 \text{ cm}} = 1000 \text{ Newtons}$$

If this confuses you, ask in class.

p191 Exercise.58; 11th edition

At which of the indicated positions does the satellite in elliptical orbit experience the greatest:

a) gravitational force
b) speed
c) velocity
d) momentum
e) kinetic energy
f) gravitational potential energy
g) total energy
h) acceleration



Ask and answer in class for + 4 points