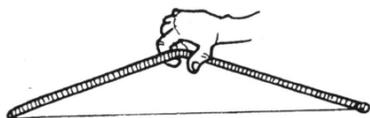


Questions on Energy and Power *

Mechanical Energy (work, kinetic, gravitational potential, spring potential, heat)

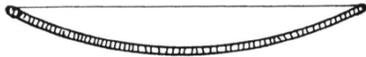
1. Why is it harder to stop a bowling ball compared to a tennis ball if they are traveling at the same speed?
2. Does a baseball pitcher do any work on a baseball as they throw a ball (before release)?
3. Does a baseball pitcher do any work on a baseball after they release the ball?
4. Suppose you are hired to stand and push on a sheet of plywood to keep it stationary while other workers paint it. Are you doing any work in the physics sense?
5. Bullets leaving a rifle typically are traveling at a much higher velocity (more kinetic energy) than bullets leaving the barrel of a pistol. This has something to do with the length of the barrels. Explain.
6. What is the difference between “conserving energy” (i.e. turning off lights, turning the thermostat down) and conservation of energy (a law of physics)?
7. Suppose a 10kg mass is held at a height of one meter so that it has a potential energy of 100J. Answer the following:
 - a) If it is released, how much kinetic energy does it have right before it hits the floor?
 - b) How much kinetic energy does it have when it is half way down?
 - c) What happens to this energy after the mass comes to rest on the floor?
8. A simple pendulum consists of a mass swinging back and forth at the end of a long string or rope. When is the gravitational potential energy a maximum? When is the kinetic energy a maximum? What is the relationship between the kinetic energy and the gravitational potential energy?
9. Describe the changes in types of energy when you throw a ball up into the air during each of the following steps:
 - a) You apply a force over a distance to get the ball started;
 - b) You release the ball and it starts upward;
 - c) The ball slows at it goes upwards until it reaches its highest point;
 - d) The ball turns around and begins increasing speed on the way down;
 - e) Just before the ball reaches the ground it has its maximum speed;
 - f) The ball hits the ground and comes to rest.
10. Does the force of gravity do any work on a ball rolling across the floor? What about a satellite in orbit around the earth?
11. We know that for every force on an object there is an equal force in the opposite direction (Newton’s third law). So if you push a filing cabinet across the floor and there is an equal force pushing back on you, does this mean you do no work on the cabinet? Explain.
12. A kid reaches the bottom of a slide in the playground with 1200J of kinetic energy. Based on the height of the slide he had 1400J of potential energy at the top. What happened to the missing 200J?
13. Years ago the Wham-O company sold a “superball” with the claim that it would bounce higher than the height at which it was dropped. Is this possible? Explain.
14. Is it possible to build a rollercoaster that has peaks that are higher than the starting point without using any motors? Explain.
15. A Ping-Pong ball and a golf ball have the same kinetic energy. Which has the higher speed?
16. Helium molecules are lighter than oxygen molecules. In a mixture of these gasses at the same temperature they have the same kinetic energy. Which type of molecule is moving faster?
17. Suppose you do 25 J of work on a guitar string by stretching the middle it to some maximum position. Then you let it go.



a) How much kinetic energy does the string have when it passes through its equilibrium (straight) position?



b) How much potential energy does the string have when it reaches the maximum in the other direction?



c) What happens to the energy when, after a while, the string comes to rest?

18. Why do the brakes on your car get hot when you stop?
19. Does a car burn more gasoline if the lights are on? What about if the engine is off? Does the gas mileage change in either case? Explain.
20. A gasoline engine only converts about 20% of the energy in the gasoline into useful mechanical energy (making the car go, running the lights, etc.). What happens to the rest of the energy?
21. If a car engine could be 100% efficient (it cannot), would it give off heat? What about sound? What about vibrations?
22. Calories are another unit for energy (a food calorie, like is listed on a soft drink can is actually 1000 calories). We need energy to generate body heat and to move around. What happens over time to someone if input calories (what you eat) is less than the output calories (body heat and movement)? What happens if someone takes in more calories than they burn?
23. Why would you expect the temperature of a jar of water to increase when shaken vigorously?
24. The temperature of the water at the bottom of a waterfall is slightly higher than at the top. Explain why.
25. Suppose there is a sudden loud sound in a closed room. Eventually the sound dies away. What happened to the energy in the sound waves that were produced? What can you say about the temperature of the walls of the room after the sound has died away?

Power

1. If the power company can't provide enough electricity fast enough, is this a power crisis or an energy crisis? Explain.
2. When you reach the top of a hill, have you used more power if you go straight up versus if you take a zigzag path (Hint; it takes more time to walk the zigzag path)?
3. Betty and Bob have the same mass and race up the stairs. Betty gets there first. Who does more work? Who uses more power?
4. Use a calculator to find out how many horsepower a 100 Watt light bulb is capable of putting out. (1 hp = 746 Watts)
5. Use a calculator to find out how many Watts a 250 hp car motor is capable of putting out.

Thermodynamics

1. An inventor claims to have the following new system. An engine runs by burning hydrogen. The engine turns a generator that makes electricity. The electricity runs through water to make hydrogen. The hydrogen is used in the engine. The inventor claims the system produces more energy than it uses. Should you invest in this new system? Why not (name the law which is broken)?
2. An inventor claims to have invented a motor that is 100% efficient. Would you invest in this device? Why not?
3. Why can't a gasoline car engine be 100% efficient?
4. The actual upper limit of efficiency for a gasoline engine is probably something less than 45%. Where does this limit come from?
5. Why do amplifier circuits for electric guitars generate heat?
6. Many instruments (violins and guitars for example) have to be retuned after they have been played for a few minutes. This is because they get warmer. One source of the heat that causes them to warm up is heat from the hands of the performer. What other source of heat is involved?

* Many of these ideas came from *Conceptual Physics* 11th Ed. by Paul Hewitt (Addison Wesley, 2011).