

## 3.E: Work and Energy (Exercise)

### Conceptual Questions

#### 4.1: Work- The Scientific Definition

1. Give an example of something we think of as work in everyday circumstances that is not work in the scientific sense. Is energy transferred or changed in form in your example? If so, explain how this is accomplished without doing work.
2. Give an example of a situation in which there is a force and a displacement, but the force does no work. Explain why it does no work.
3. Describe a situation in which a force is exerted for a long time but does no work. Explain.

#### 4.2: Kinetic Energy and the Work-Energy Theorem

4. The person in [Figure 3.E. 1](#) does work on the lawn mower. Under what conditions would the mower gain energy? Under what conditions would it lose energy?

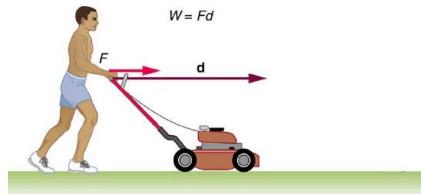


Figure 3.E. 1

5. Work done on a system puts energy into it. Work done by a system removes energy from it. Give an example for each statement.
6. When solving for speed in [Example 4.2.3](#), we kept only the positive root. Why?

#### 4.3: Gravitational Potential Energy

7. In [Example 4.3.2](#), we calculated the final speed of a roller coaster that descended 20 m in height and had an initial speed of 5 m/s downhill. Suppose the roller coaster had had an initial speed of 5 m/s *uphill* instead, and it coasted uphill, stopped, and then rolled back down to a final point 20 m below the start. We would find in that case that it had the same final speed. Explain in terms of conservation of energy.
8. Does the work you do on a book when you lift it onto a shelf depend on the path taken? On the time taken? On the height of the shelf? On the mass of the book?

#### 4.4: Conservative Forces, Potential Energy, and Conservation of Energy

9. What is a conservative force?
10. The force exerted by a diving board is conservative, provided the internal friction is negligible. Assuming friction is negligible, describe changes in the potential energy of a diving board as a swimmer dives from it, starting just before the swimmer steps on the board until just after his feet leave it.
11. Define mechanical energy. What is the relationship of mechanical energy to nonconservative forces? What happens to mechanical energy if only conservative forces act?
12. What is the relationship of potential energy to conservative force?
13. Consider the following scenario. A car for which friction is *not* negligible accelerates from rest down a hill, running out of gasoline after a short distance. The driver lets the car coast farther down the hill, then up and over a small crest. He then coasts down that hill into a gas station, where he brakes to a stop and fills the tank with gasoline. Identify the forms of energy the car has, and how they are changed and transferred in this series of events. (See [Figure 3.E. 2](#).)

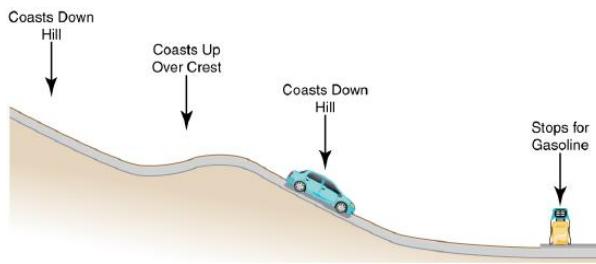


Figure 3.E. 2: A car experiencing non-negligible friction coasts down a hill, over a small crest, then downhill again, and comes to a stop at a gas station.

14. Describe the energy transfers and transformations for a javelin, starting from the point at which an athlete picks up the javelin and ending when the javelin is stuck into the ground after being thrown
15. List four different forms or types of energy. Give one example of a conversion from each of these forms to another form.
16. List the energy conversions that occur when riding a bicycle.

#### 4.5: Spring Potential Energy

17. Describe a system in which elastic potential energy is stored.

#### 4.6: Power

18. Most electrical appliances are rated in watts. Does this rating depend on how long the appliance is on? (When off, it is a zero-watt device.) Explain in terms of the definition of power.
19. Explain, in terms of the definition of power, why energy consumption is sometimes listed in kilowatt-hours rather than joules. What is the relationship between these two energy units?
20. A spark of static electricity, such as that you might receive from a doorknob on a cold dry day, may carry a few hundred watts of power. Explain why you are not injured by such a spark.

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