Conceptual Questions

7.1 Work

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.

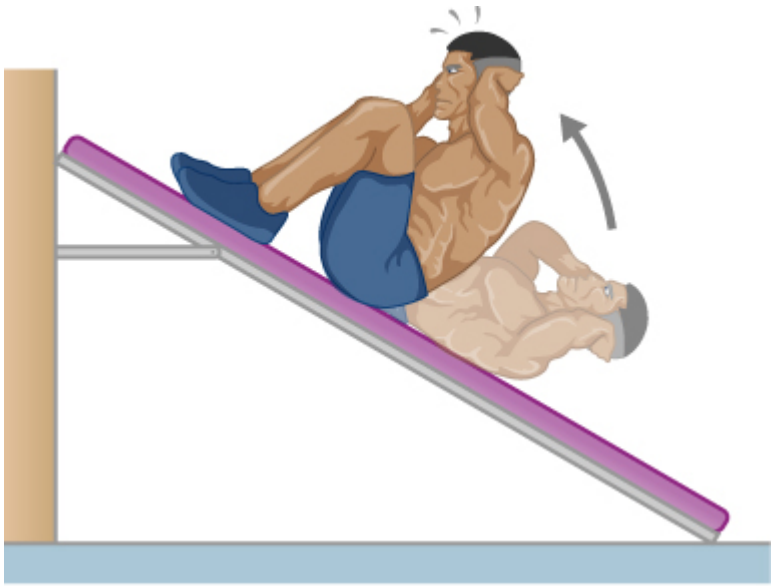
2 . Give an example of a situation in which there is a force and a displacement, but the force does no work. Explain why it does no work.

3 . Describe a situation in which a force is exerted for a long time but does no work. Explain.

4 . A body moves in a circle at constant speed. Does the centripetal force that accelerates the body do any work? Explain.

5 . Suppose you throw a ball upward and catch it when it returns at the same height. How much work does the gravitational force do on the ball over its entire trip?

6 . Why is it more difficult to do sit-ups while on a slant board than on a horizontal surface? (See below.)



7 . As a young man, Tarzan climbed up a vine to reach his tree house. As he got older, he decided to build and use a staircase instead. Since the work of the gravitational force *mg* is path independent, what did the King of the Apes gain in using stairs?

7.2 Kinetic Energy

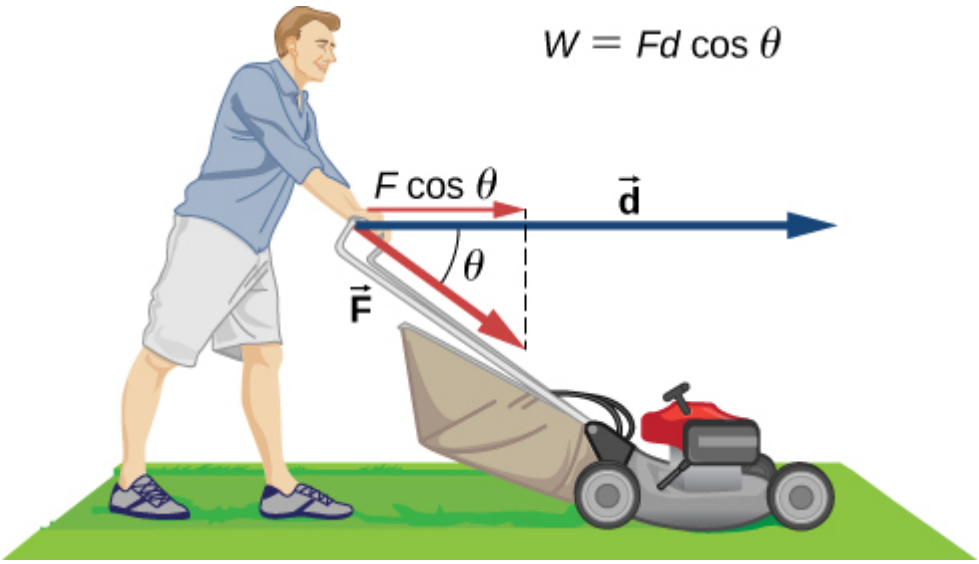
8 . A particle of *m* has a velocity of $v_x\hat{\mathbf{i}} + v_y\hat{\mathbf{j}} + v_z\hat{\mathbf{k}}$. Is its kinetic energy given by $m({v_x}^2\hat{\mathbf{i}} + {v_y}^2\hat{\mathbf{j}} + {v_z}^2\hat{\mathbf{k}})/2$? If not, what is the correct expression?

9 . One particle has mass *m* and a second particle has mass 2*m*. The second particle is moving with speed *v* and the first with speed 2*v*. How do their kinetic energies compare?

10 . A person drops a pebble of mass m_1 from a height *h*, and it hits the floor with kinetic energy *K*. The person drops another pebble of mass m_2 from a height of 2*h*, and it hits the floor with the same kinetic energy *K*. How do the masses of the pebbles compare?

7.3 Work-Energy Theorem

11 . The person shown below does work on the lawn mower. Under what conditions would the mower gain energy from the person pushing the mower? Under what conditions would it lose energy?



12 . Work done on a system puts energy into it. Work done by a system removes energy from it. Give an example for each statement.

13 . Two marbles of masses *m* and 2*m* are dropped from a height *h*. Compare their kinetic energies when they reach the ground.

14 . Compare the work required to accelerate a car of mass 2000 kg from 30.0 to 40.0 km/h with that required for an acceleration from 50.0 to 60.0 km/h.

15 . Suppose you are jogging at constant velocity. Are you doing any work on the environment and vice versa?

16 . Two forces act to double the speed of a particle, initially moving with kinetic energy of 1 J. One of the forces does 4 J of work. How much work does the other force do?

7.4 Power

17 . 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.

18 . 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?

19 . 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.

20 . Does the work done in lifting an object depend on how fast it is lifted? Does the power expended depend on how fast it is lifted?

21 . Can the power expended by a force be negative?

22 . How can a 50-W light bulb use more energy than a 1000-W oven?