

## **Chapter 12: Work and Energy**

### **Section 1: Work, Power and Machines**

#### **Review**

1. Define work and power. How are work and power related to each other?
2. Determine if work is being done in these situations:
  - (a) lifting a spoonful of soup to your mouth
  - (b) holding a stack of books motionless over your head
  - (c) letting a pencil fall to the ground
3. Describe how a ramp can make lifting a box easier without changing the amount of work needed to move the box.
4. A short ramp and a long ramp both reach a height of 1 m. Which has a greater mechanical advantage?

#### **Math Skills**

5. How much work is done by a person who uses a force of 25 N to move a desk 3.0 m?
6. A bus driver applies a force of 55.0 N to the steering wheel which applies 132 N of force on the steering column. What is the mechanical advantage of the steering wheel?
7. A student who weighs 400 N climbs a 3 m ladder in 4s.
  - (a) How much work does the student do?
  - (b) What is the student's power output?
8. An outboard engine on a boat can do  $1.0 \times 10^6$  J of work in 50.0 s. Calculate its power in watts.

### **Section 2: Simple Machines**

1. List the 6 types of simple machines.
2. Identify which simple machine the following represent:
  - (a) a drill bit
  - (b) a skateboard ramp
  - (c) a boat oar
3. Describe how a lever can increase the force without changing the amount of work being done.
4. Explain why pulleys are in the lever family.
5. Compare the mechanical advantage of a long thin wedge with a short, wide wedge.

6. Can an inclined plane have a mechanical advantage of less than 1?
7. Using the lever, explain why it is easier to open a door by pushing near the knob rather than by the hinges.
8. Choose a compound machine that you use every day and identify the simple machines it contains.

### **Section 3: What is Energy?**

#### **Review**

1. List three different forms of energy.
2. Explain how energy is different from work.
3. Explain the difference between potential and kinetic energy.
4. What form or forms of energy apply to each of the following?
  - (a) a Frisbee flying through the air
  - (b) a hot cup of soup
  - (c) a wound clock spring
  - (d) sunlight
  - (e) a boulder sitting at the top of a cliff
5. Water storage tanks are usually built on towers or on hilltops. Why?
6. Name one situation in which gravitational potential energy might be useful, and name one situation where it might be dangerous.

#### **Math Skills**

7. Calculate the gravitational potential energy of a 93.0 kg sky diver who is 550 meters above the ground.
8. What is the kinetic energy of a .02 kg bullet traveling 300 m/s?
9. Calculate the kinetic or potential energy of each of the following:
  - (a) a 2.5 kg book held 2.0 m above the ground
  - (b) a 15 g snowball thrown at 3.5 m/s
  - (c) a 35 kg child sitting at the top of a slide that is 3.5m tall
  - (d) an 8500 kg airplane moving at 220 km/hr

### **Section 4: Conservation of Energy**

### **Review**

1. List three situations in which potential energy becomes kinetic energy and three situations in which kinetic energy becomes potential energy.
2. State the law of conservation of energy and give an example.
3. Describe the rise and fall of a basketball using the concepts of potential and kinetic energy.
4. Explain why machines are not 100% efficient.
5. Use the concepts of kinetic and potential energy to describe the motion of a child on a swing.
6. Why does a driver have to keep applying gas to keep the speed of a car constant while on a flat road?

### **Math Skills**

7. When you do 100 J of work on the handle of a bicycle pump, it does 40 J of work compressing air. What is the efficiency of the pump?
8. A river does 6500 J of work on a water wheel every second. The wheel's efficiency is 12%.
  - (a) How much work in joules does the wheel output every second?
  - (b) What is the power output of the wheel?
9. John is using a pulley to lift the sail of a sailboat. The sail weighs 150 N and he must lift it 4.0 m.
  - (a) How much work must be done to lift the sail?
  - (b) If the pulley is 50% efficient, how much work must be done to lift the sail?