Name:

In science, work is defined as the force needed to move an object a certain distance. Suppose that you and a friend needed to move two 500-newton piles of potting soil to a garden that was 100 meters away. You accomplished this task in 10 minutes while your friend took 30 minutes. Both of you did the same amount of work (force × distance), but you did the work in a shorter amount of time. The amount of work done per unit of time is called power. In this example, you had more power than your friend. This skill sheet will give you practice with how to calculate power.

1. What is power?

Both you and your friend did the same amount of work.

$$W = F \times d$$

$$W = 500 \text{ N} \times 100 \text{ m} = 50,000 \text{ N-m} = 50,000 \text{ joules}$$

However, you had more power than your friend.

$$\text{Power (watts)} = \frac{\text{Work (joules)}}{\text{Time (seconds)}}$$

Let's do the math to see how this is possible.

Step one: Convert minutes to seconds.

$$10 \text{ minutes} \times \frac{60 \text{ seconds}}{\text{minute}} = 600 \text{ seconds (You)}$$

$$30 \text{ minutes} \times \frac{60 \text{ seconds}}{\text{minute}} = 1,800 \text{ seconds (Friend)}$$

Step two: Find power.

$$\frac{50,000 \text{ joules}}{600 \text{ seconds}} = 83.3 \text{ watts (You)}$$

$$\frac{50,000 \text{ joules}}{1,800 \text{ seconds}} = 27.8 \text{ watts (Friend)}$$

As you can see, the same amount of work that is done in less time produces more power. You are familiar with the word *watt* from a light bulb. Now you see why a 100-watt bulb is more powerful than a 40-watt bulb. Time for you to practice solving some problems involving work and power.

2. Solving problems

Solve the following problems using the power and work equations. The first problem is done for you.

1. A motor does 5,000 joules of work in 20 seconds. What is the power of the motor?

$$\text{power} = \frac{\text{work}}{\text{time}} = \frac{5000 \text{ joules}}{20 \text{ sec}} = \frac{250 \text{ joules}}{\text{sec}} = 250 \text{ watts}$$

2. A machine does 1,500 joules of work in 30 seconds. What is the power of this machine?

3. A sleigh weighing 2,000 newtons is pulled by a horse a distance of 1.0 kilometer (or 1,000 meters) in 45 minutes. What is the power of the horse? (HINT: Convert time to seconds.)

4. A wagon weighing 1,800 newtons is pulled by a horse at a speed of 0.40 m/sec. What is the power of this horse?

5. Suppose a force of 100 newtons is used to push an object a distance of 5 meters in 15 seconds. Find the work done and the power for this situation.

6. A force of 100 newtons is used to move an object a distance of 15 meters with a power of 25 watts. Find the work done and the time it takes to do the work.

7. If a small machine does 2,500 joules of work on an object to move it a distance of 100 meters in 10 seconds, what is the force needed to do the work? What is the power of the machine doing the work?

8. A machine uses a force of 200 newtons to do 20,000 joules of work in 20 seconds. Find the distance the object moved and the power of the machine.(HINT: A joule is the same as a newton-meter.)

9. A machine that uses 200 watts of power moves an object a distance of 15 meters in 25 seconds. Find the force needed and the work done by this machine.