Name _____ Date _____ Class _____

WORKSHEET 51 **MATH IN SCIENCE: PHYSICAL SCIENCE**

MATH SKILLS USED
Addition
Multiplication
Division
Decimals
Scientific Notation

Work and Power

Use the equations for work and power.

Part 1: An Equation for Work

As you sit and read this worksheet, are you doing work? You might say, "Yes, of course." But are you doing work in the scientific sense? Scientists use the word *work* to describe a very specific concept. In physics, **work** is a force applied over a distance.

EQUATION:

$$\text{work} = \text{Force} \times \text{distance}$$
$$W = F \times d$$

The SI unit for work is the newton-meter (N · m), also known as a **joule (J).** You can calculate the amount of work accomplished with the equation above. Let's see how it's done!

SAMPLE PROBLEM: How much work is done on a 16 N sack of potatoes when you lift the sack 1.5 m?

$$W = 16 \text{ N} \times 1.5 \text{ m}$$
$$W = \mathbf{24\ J}$$

Work It Out!

Based on what you know about work, answer the following questions. Be sure to show your work.

1. A deflated hot-air balloon weighs a total of 8000 N. Filled with hot air, the balloon rises to a height of 1000 m. How much work is accomplished by the hot air?

_____

_____

2. A rope is thrown over a beam, and one end is tied to a 300 N bundle of lumber. You pull the free end of the rope 2 m with a force of 400 N to lift the lumber off the ground. How much work have you done?

_____

_____

3. A 150 N boy rides a 60 N bicycle a total of 200 m at a constant speed. The frictional force against the forward motion of the bicycle equals 35 N. How much work does the boy do? Explain your answer. (Hint: Remember that work is only done when the motion is in the same direction that the force is applied.)

_____

_____

_____

_____

Part 2: Work and Power

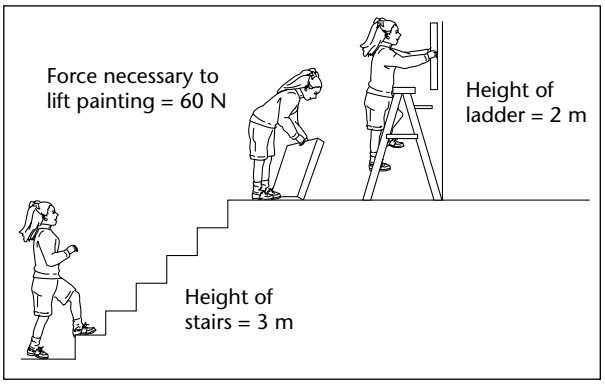
Work is closely related to the concept of power. **Power** is a measure of how much work is done in a certain time. The faster work is done, the more power is produced.

EQUATION:

$$\text{power} = \frac{\text{work}}{\text{time}}$$

$$P = \frac{W}{t}$$

The unit for power is the **watt (W).** One watt (W) is equal to 1 J of work done for 1 second. Use the data given in the diagram below to determine how much work and power are involved in each step. Remember to show your work.



Step 1: A 50 N girl climbs the flight of stairs in 3 seconds.

Work = _____

_____

Power = _____

_____

Step 2: The girl lifts a painting to a height of 0.5 m in 0.75 seconds.

Work= _____

_____

Power= _____

_____

Step 3: The girl climbs the ladder with the painting in 5 seconds.

Work= _____

_____

Power= _____

_____

Challenge Yourself!

4. A crane lifts a load of steel that weighs 9.3×10^5 N a distance of 100 m. It takes 5 minutes to complete the task.

a. How much work is done by the crane?

_____

b. How much power does the crane produce?

_____

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$$W = \mathbf{24\ J}$$

Work It Out!

Based on what you know about work, answer the following questions. Be sure to show your work.

1. A deflated hot-air balloon weighs a total of 8000 N. Filled with hot air, the balloon rises to a height of 1000 m. How much work is accomplished by the hot air?

8000 N × 1000 m = 8,000,000 J

2. A rope is thrown over a beam, and one end is tied to a 300 N bundle of lumber. You pull the free end of the rope 2 m with a force of 400 N to lift the lumber off the ground. How much work have you done?

400 N × 2 m = 800 J

3. A 150 N boy rides a 60 N bicycle a total of 200 m at a constant speed. The frictional force against the forward motion of the bicycle equals 35 N. How much work does the boy do? Explain your answer. (Hint: Remember that work is only done when the motion is in the same direction that the force is applied.)

35 N × 200 m = 7000 J; The weights of the boy and the bicycle are not used to calculate the work done because the direction of their forces (downward) is different than the direction of the motion (forward).

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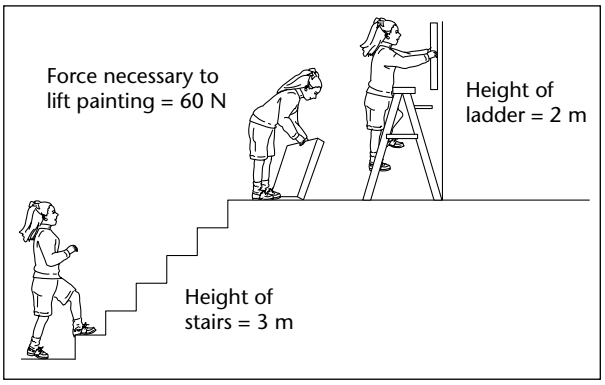

Step 1: A 50 N girl climbs the flight of stairs in 3 seconds.

Work = 50 N × 3 m = 150 J

Power = 150 J ÷ 3 s = 50 W

Step 2: The girl lifts a painting to a height of 0.5 m in 0.75 seconds.

Work= 60 N × 0.5 m = 30 J

Power= 30 J ÷ 0.75 seconds = 40 W

Step 3: The girl climbs the ladder with the painting in 5 seconds.

Work= 50 N + 60 N = 110 N

110 N × 2 m = 220 J

Power= 220 J ÷ 5 seconds = 44 W

Challenge Yourself!

4. A crane lifts a load of steel that weighs 9.3×10^5 N a distance of 100 m. It takes 5 minutes to complete the task.

a. How much work is done by the crane?

$(9.3 \times 10^5\ \text{N}) \times 100\ \text{m} = 9.3 \times 10^7\ \text{J}$, or 93,000,000 J

b. How much power does the crane produce?

$(9.3 \times 10^7\ \text{J}) \div 300\ \text{seconds} = 3.1 \times 10^5\ \text{W}$, or 310,000 W