Name _____ Class _____ Date _____

SKills Worksheet

Math Skills

Work

After you study each sample problem and solution work out the practice problems on a separate sheet of paper. Write your answers in the spaces provided.

Problem

A car has run out of gas. Fortunately, there is a gas station nearby. You must exert a force of 715 N on the car in order to move it. By the time you reach the station, you have done 2.72×10^4 J of work. How far have you pushed the car?

Solution

Step 1: List the given and unknown values.

Given: *force*, $F = 715$ N

work, $W = 2.72 \times 10^4$ J

Unknown: *distance*, $d = ?$ m

Step 2: Rearrange the work equation to solve for distance.

$$work = force \times distance \qquad W = F \times d$$

$$\frac{W}{F} = \frac{F \times d}{F} = d$$

Step 3: Insert the known values into the equation, and solve.

$$d = \frac{2.72 \times 10^4 \text{ J}}{715 \text{ N}} = \frac{2.72 \times 10^4 \text{ N} \cdot \text{m}}{715 \text{ N}}$$

$$d = 38.0 \text{ m}$$

Practice

1. You must exert a force of 4.5 N on a book to slide it across a table. If you do 2.7 J of work in the process, how far have you moved the book?

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2. A catcher picks up a baseball from the ground. If the unbalanced force on the ball is 7.25×10^{-2} N and 4.35×10^{-2} J of work is done to lift the ball, how far does the catcher lift the ball?

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3. The smallest bird is the Cuban bee hummingbird, which has a mass of only 1.7 g. If this bird did 8.8×10^{-4} J of work by exerting an upward force of 3.4×10^{-4} N, how far did it fly?

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Problem

A building under construction requires building materials to be raised to the upper floors by cranes or elevators. A quantity of cement is lifted 76.2 m by a crane, which exerts a force on the cement that is slightly larger than the weight of the cement. If the work done in excess of the work done against gravity is 1.31×10^3 J, what is the unbalanced, overall force exerted on the cement?

Solution

Step 1: List the given and unknown values.

Given: *distance*, $d = 76.2$ m

work, $W = 1.31 \times 10^3$ J

Unknown: *force*, $F = ?$ N

Step 2: Rearrange the work equation to solve for force.

$$work = force \times distance \qquad W = F \times d$$

$$\frac{W}{d} = \frac{F \times \cancel{d}}{\cancel{d}} = F$$

Step 3: Insert the known values into the equation, and solve.

$$F = \frac{1.31 \times 10^3 \text{ J}}{76.2 \text{ m}} = \frac{1.31 \times 10^3 \text{ N} \cdot \text{m}}{76.2 \text{ m}}$$

$$F = 17.2 \text{ N}$$

Practice

4. The world's most powerful tugboats are built in Finland. One of these boats can do 9.8×10^7 J of work through a distance of 35 m. What is the force exerted by the tugboat?

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5. A child pulls a sled up a snow-covered hill. In the process, the child does 405 J of work on the sled. If she walks a distance of 15 m up the hill, how large a force does she exert on the sled?

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6. One of the most powerful forklifts was built in Sweden in 1991. The lift is capable of lifting a 9.0×10^4 kg mass a distance of 2.0 m above the ground. If the work done by the forklift on the mass is 1.8×10^6 J, what is the force that the lift exerts on the mass?

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Problem

An old house is being lifted by a type of crane from its foundation and moved by truck to another location. If the house, which weighs just under 1.50×10^4 N, is lifted 1.52 m from the foundation to the bed of the truck, what is the minimum amount of work done by the crane on the house?

Solution

Step 1: List the given and unknown values.

Given: *force*, $F = 1.50 \times 10^4$ N

distance, $d = 1.52$ m

Unknown: *work*, $W = ?$ J

Step 2: Write out the equation for work.

$$work = force \times distance \qquad W = F \times d$$

Step 3: Substitute force and distance values into the work equation, and solve.

$$W = (1.50 \times 10^4 \text{ N}) \times 1.52 \text{ m} = 2.28 \times 10^4 \text{ N} \cdot \text{m}$$

$$W = 2.28 \times 10^4 \text{ J}$$

Practice

7. After the house in the sample problem has been set on the truck bed, the truck accelerates until it reaches a constant speed. If the force required to move the house horizontally a distance of 75.5 m is 3150 N, how much work has been done on the house?

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8. The largest passenger ship still in service is the SS *Norway*, which has a mass of 7.6×10^7 kg. The force required to accelerate the SS *Norway* from rest to its top cruising speed of 33 km/h is 1.6×10^6 N, assuming that this acceleration takes place over a distance of 2.0 km. How much work must be done on the ship during this period of acceleration?

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9. Suppose an adult blue whale is stranded on a beach. The whale, which lies parallel to the shore, is 15 m from water deep enough for it to swim away in. A group of people line up along the side of the whale to push it back into the ocean. If the whale's weight is 1.5×10^6 N, and the force of friction that must be overcome by the people is 0.25 times the whale's weight, how much work must the people do on the whale in order to return it to the ocean?

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