NAME ______________________ DATE ____________ CLASS ____________

Holt Physics

Problem 5A

WORK AND ENERGY

PROBLEM

The largest palace in the world is the Imperial Palace in Beijing, China. Suppose you were to push a lawn mower around the perimeter of a rectangular area identical to that of the palace, applying a constant horizontal force of 60.0 N. If you did 2.05×10^5 J of work, how far would you have pushed the lawn mower? If the Imperial Palace is 9.60×10^2 m long, how wide is it?

SOLUTION

Given:

$F = 60.0$ N

$W = 2.05 \times 10^5$ J

$x = 9.60 \times 10^2$ m

Unknown:

$d = ?$

$y = ?$

Use the equation for net work done by a constant force.

$$W = Fd(\cos \theta)$$

To calculate the width, y, recall that the perimeter of an area equals the sum of twice its width and twice its length.

$$d = 2x + 2y$$

Rearrange the equations to solve for d and y. Note that the force is applied in the direction of the displacement, so $\theta = 0$.

$$d = \frac{W}{F(\cos \theta)} = \frac{2.05 \times 10^5 \text{ J}}{(60.0 \text{ N})(\cos 0\ )}$$

$$d = \boxed{3.42 \times 10^3 \text{ m}}$$

$$y = \frac{d - 2x}{2} = \frac{3.42 \times 10^3 \text{ m} - (2)(9.60 \times 10^2 \text{ m})}{2}$$

$$y = \frac{3.42 \times 10^3 \text{m} - 1.92 \times 10^3 \text{ m}}{2} = \frac{1.50 \times 10^3 \text{ m}}{2}$$

$$y = \boxed{7.50 \times 10^2 \text{ m}}$$

ADDITIONAL PRACTICE

1. Lake Point Tower in Chicago is the tallest apartment building in the United States (although not the tallest building in which there are apartments). Suppose you take the elevator from street level to the roof of the building. The elevator moves almost the entire distance at constant speed, so that it does 1.15×10^5 J of work on you as it lifts the en-

tire distance. If your mass is 60.0 kg, how tall is the building? Ignore the effects of friction.

2. In 1985 in San Antonio, Texas, an entire hotel building was moved several blocks on 36 dollies. The mass of the building was about 1.45×10^6 kg. If 1.00×10^2 MJ of work was done to overcome the force of resistance that was just 2.00 percent of the building's weight, how far was the building moved?

3. A hummingbird has a mass of about 1.7 g. Suppose a hummingbird does 0.15 J of work against gravity, so that it ascends straight up with a net acceleration of 1.2 m/s^2. How far up does it move?

4. In 1453, during the siege of Constantinople, the Turks used a cannon capable of launching a stone cannonball with a mass of 5.40×10^2 kg. Suppose a soldier dropped a cannonball with this mass while trying to load it into the cannon. The cannonball rolled down a hill that made an angle of 30.0° with the horizontal. If 5.30×10^4 J of work was done by gravity on the cannonball as it rolled down a hill, how far did it roll?

5. The largest turtle ever caught in the United States had a mass of over 800 kg. Suppose this turtle were raised 5.45 m onto the deck of a research ship. If it takes 4.60×10^4 J of work to lift the turtle this distance at a constant velocity, what is the turtle's weight?

6. During World War II, 16 huge wooden hangers were built for United States Navy airships. The hangars were over 300 m long and had a maximum height of 52.0 m. Imagine a 40.0 kg block being lifted by a winch from the ground to the top of the hangar's ceiling. If the winch does 2.08×10^4 J of work in lifting the block, what force is exerted on the block?

7. The *Warszawa Radio* mast in Warsaw, Poland, is 646 m tall, making it the tallest human-built structure. Suppose a worker raises some tools to the top of the tower by means of a small elevator. If 2.15×10^5 J of work is done in lifting the tools, what is the force exerted on them?

8. The largest mincemeat pie ever created had a mass of 1.02×10^3 kg. Suppose that a pie with this mass slides down a ramp that is 18.0 m long and is inclined to the ground by 10.0°. If the coefficient of kinetic friction is 0.13, what is the net work done on the pie during its descent?

9. The longest shish kebab ever made was 881.0 m long. Suppose the meat and vegetables need to be delivered in a cart from one end of this shish kebab's skewer to the other end. A cook pulls the cart by applying a force of 40.00 N at an angle of 45.00° above the horizontal. If the force of friction acting on the cart is 28.00 N, what is the net work done on the cart and its contents during the delivery?

10. The world's largest chandelier was created by a company in South Korea and hangs in one of the department stores in Seoul, South Korea. The chandelier's mass is about 9.7×10^3 kg. Consider a situation in which this chandelier is placed in a wooden crate whose mass is negligible. The chandelier is then pulled along a smooth horizontal surface by two forces that are parallel to the smooth surface, are at right angles to each other, and are applied 45° to either side of the direction in which the chandelier is moving. If each of these forces is 1.2×10^3 N, how much work must be done on the chandelier to pull it 12 m?

11. The world's largest flag, which was manufactured in Pennsylvania, has a length of 154 m and a width of 78 m. The flag's mass is 1.24×10^3 kg, which may explain why the flag has never been flown from a flagpole. Suppose this flag is being pulled by two forces: a force of 8.00×10^3 N to the east and a force of 5.00×10^3 N that is directed 30.0° south of east. How much work is done in moving the flag 20.0 m directly south?

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Holt Physics

Problem 5B

KINETIC ENERGY

PROBLEM

Silvana Cruciata from Italy set a record in one-hour running by running 18.084 km in 1.000 h. If Cruciata's kinetic energy was 694 J, what was her mass?

SOLUTION

1. DEFINE **Given:** $\Delta x = 18.084\ \text{km} = 1.8084 \times 10^4\ \text{m}$

$\Delta t = 1.000\ \text{h} = 3.600 \times 10^3\ \text{s}$

$KE = 694\ \text{J}$

Unknown: $m = ?$

2. PLAN **Choose the equation(s) or situation:** Use the definition of average velocity to calculate Cruciata's speed.

$$v_{avg} = \frac{\Delta x}{\Delta t}$$

Use the equation for kinetic energy, using v_{avg} for the velocity term, to solve for m.

$$KE = \frac{1}{2} m {v_{avg}}^2$$

Rearrange the equation(s) to isolate the unknown(s): Substitute the average velocity equation into the equation for kinetic energy and solve for m.

$$m = \frac{2KE}{{v_{avg}}^2} = \frac{2KE}{\left(\frac{\Delta x}{\Delta t}\right)^2} = \frac{2KE\Delta t^2}{\Delta x^2}$$

3. CALCULATE **Substitute the values into the equation(s) and solve:**

$$m = \frac{(2)(694\ \text{J})(3.600 \times 10^3\ \text{s})^2}{(1.8084 \times 10^4\ \text{m})^2} = \boxed{55.0\ \text{kg}}$$

4. EVALUATE If the average speed is rounded to 5.0 m/s, and the kinetic energy is rounded to 700 J, the estimated mass is 56 kg, which is close to the calculated value.

ADDITIONAL PRACTICE

1. In 1994, Leroy Burrell of the United States set what was then a new world record for the men's 100 m run. He ran the 1.00×10^2 m distance in 9.85 s. Assuming that he ran with a constant speed equal to his average speed, and his kinetic energy was 3.40×10^3 J, what was Burrell's mass?
2. The fastest helicopter, the Westland Lynx, has a top speed of 4.00×10^2 km/h. If its kinetic energy at this speed is 2.10×10^7 J, what is the helicopter's mass?

3. Dan Jansen of the United States won a speed-skating competition at the 1994 Winter Olympics in Lillehammer, Norway. He did this by skating 500 m with an average speed of 50.3 km/h. If his kinetic energy was 6.54×10^3 J, what was his mass?

4. In 1987, the fastest auto race in the United States was the Busch Clash in Daytona, Florida. That year, the winner's average speed was about 318 km/h. Suppose the kinetic energy of the winning car was 3.80 MJ. What was the mass of the car and its driver?

5. In 1995, Karine Dubouchet of France reached a record speed in downhill skiing. If Dubouchet's mass was 51.0 kg, her kinetic energy would have been 9.96×10^4 J. What was her speed?

6. Susie Maroney from Australia set a women's record in long-distance swimming by swimming 93.625 km in 24.00 h.

- **a.** What was Maroney's average speed?
- **b.** If Maroney's mass was 55 kg, what was her kinetic energy?

7. The brightest, hottest, and most massive stars are the brilliant blue stars designated as spectral class O. If a class O star with a mass of 3.38×10^{31} kg has a kinetic energy of 1.10×10^{42} J, what is its speed? Express your answer in km/s (a typical unit for describing the speed of stars).

8. The male polar bear is the largest land-going predator. Its height when standing on its hind legs is over 3 m and its mass, which is usually around 500 kg, can be as large as 680 kg. In spite of this bulk, a running polar bear can reach speeds of 56.0 km/h.

- **a.** Determine the kinetic energy of a running polar bear, using the maximum values for its mass and speed.
- **b.** What is the ratio of the polar bear's kinetic energy to the kinetic energy of Leroy Burrell, as given in item 1?

9. Escape speed is the speed required for an object to leave Earth's orbit. It is also the minimum speed an incoming object must have to avoid being captured and pulled into an orbit around Earth. The escape speed for a projectile launched from Earth's surface is 11.2 km/s. Suppose a meteor is pulled toward Earth's surface and, as a meteorite, strikes the ground with a speed equal to this escape speed. If the meteorite has a diameter of about 3 m and a mass of 2.3×10^5 kg, what is its kinetic energy at the instant it collides with Earth's surface?

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Holt Physics

Problem 5C

WORK-KINETIC ENERGY THEOREM

PROBLEM

The Great Pyramid of Khufu in Egypt, used to have a height of 147 m and sides that sloped at an angle of 52.0° with respect to the ground. Stone blocks with masses of 1.37×10^4 kg were used to construct the pyramid. Suppose that a block with this mass at rest on top of the pyramid begins to slide down the side. Calculate the block's kinetic energy at ground level if the coefficient of kinetic friction is 0.45.

SOLUTION

1. DEFINE **Given:**

$m = 1.37 \times 10^4$ kg

$h = 147$ m

$g = 9.81$ m/s^2

$\theta = 52.0$

$\mu_k = 0.45$

$v_i = 0$ m/s

Unknown: $KE_f = ?$

2. PLAN **Choose the equation(s) or situation:** The net work done by the block as it slides down the side of the pyramid can be expressed by using the definition of work in terms of net force. Because the net force is parallel to the displacement, the net work is simply the net force multiplied by the displacement. It can also be expressed in terms of changing kinetic energy by using the work–kinetic energy theorem.

$$W_{net} = F_{net}d$$
$$W_{net} = \Delta KE$$

The net force on the block equals the difference between the component of the force due to free-fall acceleration along the side of the pyramid and the frictional force resisting the downward motion of the block.

$$F_{net} = mg(\sin\theta) - F_k = mg(\sin\theta) - \mu_k mg(\cos\theta)$$

The distance the block travels along the side of the pyramid equals the height of the pyramid divided by the sine of the angle of the side's slope.

$$h = d(\sin\theta)$$
$$d = \frac{h}{\sin\theta}$$

Because the block is initially at rest, its initial kinetic energy is zero, and the change in kinetic energy equals the final kinetic energy.

$$\Delta KE = KE_f - KE_i = KE_f$$

Rearrange the equation(s) to isolate the unknown(s): Combining these equations yields the following expression for the final kinetic energy.

$$KE_f = F_{net}d = mg(\sin\theta - \mu_k\cos\theta)\left(\frac{h}{\sin\theta}\right)$$

$$KE_f = mgh\left(1 - \frac{\mu_k}{\tan\theta}\right)$$

3. CALCULATE **Substitute the values into the equation(s) and solve:**

$$KE_f = (1.37 \times 10^4\ \text{kg})(9.81\ \text{m/s}^2)(147\ \text{m})\left(1 - \frac{0.45}{\tan 52.0}\right)$$

$$KE_f = (1.37 \times 10^4\ \text{kg})(9.81\ \text{m/s}^2)(147\ \text{m})(1.00 - 0.35)$$

$$KE_f = (1.37 \times 10^4\ \text{kg})(9.81\ \text{m/s}^2)(147\ \text{m})(0.65)$$

$$KE_f = \boxed{1.3 \times 10^7\ \text{J}}$$

4. EVALUATE Note that the net force, and thus the final kinetic energy, is about two-thirds of what it would be if the side of the pyramid were frictionless.

ADDITIONAL PRACTICE

1. The tops of the towers of the Golden Gate Bridge, in San Francisco, are 227 m above the water. Suppose a worker drops a 655 g wrench from the top of a tower. If the average force of air resistance is 2.20 percent of the force of free fall, what will the kinetic energy of the wrench be when it hits the water?

2. Bonny Blair of the United States set a world record in speed skating when she skated 5.00×10^2 m with an average speed of 12.92 m/s. Suppose Blair crossed the finish line at this speed and then skated to a stop. If the work done by friction over a certain distance was −2830 J, what would Blair's kinetic energy be, assuming her mass to be 55.0 kg.

3. The CN Tower in Toronto, Canada, is 553 m tall, making it the tallest free-standing structure in the world. Suppose a chunk of ice with a mass of 25.0 g falls from the top of the tower. The speed of the ice is 30.0 m/s as it passes the restaurant, which is located 353 m above the ground. What is the magnitude of the average force due to air resistance?

4. In 1979, Dr. Hans Liebold of Germany drove a race car 12.6 km with an average speed of 404 km/h. Suppose Liebold applied the brakes to reduce his speed. What was the car's final speed if −3.00 MJ of work was done by the brakes? Assume the combined mass of the car and driver to be 1.00×10^3 kg.

5. The summit of Mount Everest is 8848.0 m above sea level, making it the highest summit on Earth. In 1953, Edmund Hillary was the first person to reach the summit. Suppose upon reaching there, Hillary slid a rock with a 45.0 g mass down the side of the mountain. If the rock's speed is

27.0 m/s when it is 8806.0 m above sea level, how much work was done on the rock by air resistance?

6. In 1990, Roger Hickey of California reached a speed 35.0 m/s on his skateboard. Suppose it took 21 kJ of work for Roger to reach this speed from a speed of 25.0 m/s. Calculate Hickey's mass.

7. At the 1984 Winter Olympics, William Johnson of the United States reached a speed of 104.5 km/h in the downhill skiing competition. Suppose Johnson left the slope at that speed and then slid freely along a horizontal surface. If the coefficient of kinetic friction between the skis and the snow was 0.120 and his final speed was half of his initial speed, find the distance William traveled.

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Holt Physics

Problem 5D

POTENTIAL ENERGY

PROBLEM

In 1993, Javier Sotomayor from Cuba set a record in the high jump by clearing a vertical distance of 2.45 m. If the gravitational potential energy associated with Sotomayor at the top point of his trajectory was 1.59×10^3 J, what was his mass?

SOLUTION

Given: $h = 2.45$ m

$g = 9.81$ m/s^2

$PE_g = 1.59 \times 10^3$ J

Unknown: $m = ?$

Use the equation for gravitational potential energy, and rearrange it to solve for m.

$$PE_g = mgh$$

$$m = \frac{PE_g}{gh}$$

$$m = \frac{(1.59 \times 10^3 \text{ J})}{\left(9.81 \frac{\text{m}}{\text{s}^2}\right)(2.45 \text{ m})} = \boxed{66.2 \text{ kg}}$$

ADDITIONAL PRACTICE

1. In 1992, Ukrainian Sergei Bubka used a short pole to jump to a height of 6.13 m. If the maximum potential energy associated with Bubka was 4.80 kJ at the midpoint of his jump, what was his mass?
2. Naim Suleimanoglu of Turkey has a mass of about 62 kg, yet he can lift nearly 3 times this mass. (This feat has earned Suleimanoglu the nick-name of "Pocket Hercules.") If the potential energy associated with a barbell lifted 1.70 m above the floor by Suleimanoglu is 3.04×10^3 J, what is the barbell's mass?
3. In 1966, a special research cannon built in Arizona shot a projectile to a height of 180 km above Earth's surface. The potential energy associated with the projectile when its altitude was 10.0 percent of the maximum height was 1.48×10^7J. What was the projectile's mass? Assume that constant free-fall acceleration at this altitude is the same as at sea level.
4. The highest-caliber cannon ever built (though never used) is located in Moscow, Russia. The diameter of the cannon's barrel is about 89 cm, and the cannon's mass is 3.6×10^4 kg. Suppose this cannon were lifted by airplane. If the potential energy associated with this cannon were

8.88×10^8 J, what would be its height above sea level? Assume that constant free-fall acceleration at this altitude is the same as at sea level.

5. In 1987, Stefka Kostadinova from Bulgaria set a new women's record in high jump. It is known that the ratio of the potential energy associated with Kostadinova at the top of her jump to her mass was 20.482 m^2/s^2. What was the height of her record jump?

6. In 1992, David Engwall of California used a slingshot to launch a dart with a mass of 62 g. The dart traveled a horizontal distance of 477 m. Suppose the slingshot had a spring constant of 3.0×10^4 N/m. If the elastic potential energy stored in the slingshot just before the dart was launched was 1.4×10^2 J, how far was the slingshot stretched?

7. Suppose a 51 kg bungee jumper steps off the Royal Gorge Bridge, in Colorado. The bridge is situated 321 m above the Arkansas River. The bungee cord's spring constant is 32 N/m, the cord's relaxed length is 104 m, and its length is 179 m when the jumper stops falling. What is the total potential energy associated with the jumper at the end of his fall? Assume that the bungee cord has negligible mass.

8. Situated 4080 m above sea level, La Paz, Bolivia, is the highest capital in the world. If a car with a mass of 905 kg is driven to La Paz from a location that is 1860 m above sea level, what is the increase in potential energy?

9. In 1872, a huge gold nugget with a mass of 286 kg was discovered in Australia. The nugget was displayed for the public before it was melted down to extract pure gold. Suppose this nugget is attached to the ceiling by a spring with a spring constant of 9.50×10^3 N/m. The nugget is released from a height of 1.70 m above the floor, and is caught when it is no longer moving downward and is about to be pulled back up by the elastic force of the spring.

- **a.** If the spring stretches a total amount of 59.0 cm, what is the elastic potential energy associated with the spring-nugget system?
- **b.** What is the gravitational potential energy associated with the nugget just before it is dropped?
- **c.** What is the gravitational potential energy associated with the nugget after the spring has stretched 59.0 cm?
- **d.** What is the difference between the gravitational potential energy values in parts (b) and (c)? How does this compare with your answer for part (a)?

10. When April Moon set a record for flight shooting in 1981, the arrow traveled a distance of 9.50×10^2 m. Suppose the arrow had a mass of 65.0 g, and that the angle at which the arrow was launched was 45.0° above the horizontal.

- **a.** What was the kinetic energy of the arrow at the instant it left the bowstring? (Hint: Review Section 3E to determine the initial speed of the arrow.)

b. If the bowstring was pulled back 55.0 cm from its relaxed position, what was the spring constant of the bowstring? (Hint: Assume that all of the elastic potential energy stored in the bowstring is converted to the arrow's initial kinetic energy.)

c. Assuming that air resistance is negligible, determine the maximum height that the arrow reaches. (Hint: Equate the arrow's initial kinetic energy to the sum of the maximum gravitational potential energy associated with the arrow and the arrow's kinetic energy at maximum height.)

Holt Physics

Problem 5E

CONSERVATION OF MECHANICAL ENERGY

PROBLEM

The largest apple ever grown had a mass of about 1.47 kg. Suppose you hold such an apple in your hand. You accidentally drop the apple, then manage to catch it just before it hits the ground. If the speed of the apple at that moment is 5.42 m/s, what is the kinetic energy of the apple? From what height did you drop it?

SOLUTION

1. DEFINE **Given:**

$m = 1.47$ kg

$g = 9.81$ m/s^2

$v = 5.42$ m/s

Unknown: $KE = ?$ $h = ?$

2. PLAN **Choose the equation(s) or situation:** Use the equations for kinetic and gravitational potential energy.

$$KE = \frac{1}{2}mv^2$$

$$PE_g = mgh$$

The zero level for gravitational potential energy is the ground. Because the apple ends its fall at the zero level, the final gravitational potential energy is zero.

$$PE_{g,f} = 0$$

The initial gravitational potential energy is measured at the point from which the apple is released.

$$PE_{g,i} = mgh$$

The apple is initially at rest, so the initial kinetic energy is zero.

$$KE_i = 0$$

The final kinetic energy is therefore:

$$KE_f = \frac{1}{2}mv^2$$

3. CALCULATE **Substitute the values into the equation(s) and solve:**

$$PE_{g,i} = (1.47\text{ kg})(9.81\ \frac{\text{m}}{\text{s}^2})h$$

$$KE_f = \frac{1}{2}(1.47\text{ kg})\left(5.42\ \frac{\text{m}}{\text{s}}\right)^2$$

Solving for KE yields the following result:

$$KE = KE_f = \frac{1}{2}(1.47\text{ kg})\left(5.42\ \frac{\text{m}}{\text{s}}\right)^2 = \boxed{21.6\text{ J}}$$

Now use the principle of conservation for mechanical energy and the calculated quantity for KE_f to evaluate h.

$$ME_i = ME_f$$

$$PE_i + KE_i = PE_f + KE_f$$

$$PE_i + 0 \text{ J} = 0 \text{ J} + 21.6 \text{ J}$$

$$mgh = 21.6 \text{ J}$$

$$h = \frac{21.6 \text{ J}}{(1.47 \text{ kg})\left(9.81 \frac{\text{m}}{\text{s}^2}\right)} = \boxed{1.50 \text{ m}}$$

4. EVALUATE Note that the height of the apple can be determined without knowing the apple's mass. This is because the conservation equation reduces to the equation relating speed, acceleration, and displacement: $v^2 = 2gh$.

ADDITIONAL PRACTICE

1. The largest watermelon ever grown had a mass of 118 kg. Suppose this watermelon were exhibited on a platform 5.00 m above the ground. After the exhibition, the watermelon is allowed to slide along to the ground along a smooth ramp. How high above the ground is the watermelon at the moment its kinetic energy is 4.61 kJ?

2. One species of eucalyptus tree, *Eucalyptus regnens,* grows to heights similar to those attained by California redwoods. Suppose a bird sitting on top of one specimen of eucalyptus tree drops a nut. If the speed of the falling nut at the moment it is 50.0 m above the ground is 42.7 m/s, how tall is the tree? Do you need to know the mass of the nut to solve this problem? Disregard air resistance.

3. In 1989, Michel Menin of France walked on a tightrope suspended under a balloon nearly at an altitude of 3150 m above the ground. Suppose a coin falls from Menin's pocket during his walk. How high above the ground is the coin when its speed is 60.0 m/s?

4. In 1936, Col. Harry Froboess of Switzerland jumped into the ocean from the airship *Graf Hindenburg,* which was 1.20×10^2 m above the water's surface. Assuming Froboess had a mass of 72.0 kg, what was his kinetic energy at the moment he was 30.0 m from the water's surface? What was his speed at that moment? Neglect the air resistance.

5. Suppose a motorcyclist rides a certain high-speed motorcycle. He reaches top speed and then coasts up a hill. The maximum height reached by the motorcyclist is 250.0 m. If 2.55×10^5 J of kinetic energy is dissipated by friction, what was the initial speed of the motorcycle? The combined mass of the motorcycle and motorcyclist is 250.0 kg.

6. The deepest mine ever drilled has a depth of 12.3 km (by contrast, Mount Everest has height of 8.8 km). Suppose you drop a rock with a mass of 120.0 g down the shaft of this mine. What would the rock's kinetic energy be after falling 3.2 km? What would the potential energy associated with the rock be at that same moment? Assume no air resistance and a constant free-fall acceleration.

7. *Desperado,* a roller coaster built in Nevada, has a vertical drop of 68.6 m. The roller coaster is designed so that the speed of the cars at the end of this drop is 35.6 m/s. Assume the cars are at rest at the start of the drop. What percent of the initial mechanical energy is dissipated by friction?

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Holt Physics

Problem 5F

POWER

PROBLEM

Martinus Kuiper of the Netherlands ice skated for 24 h with an average speed of 6.3 m/s. Suppose Kuiper's mass was 65 kg. If Kuiper provided 520 W of power to accelerate for 2.5 s, how much work did he do?

SOLUTION

Given: $P = 520$ W

$\Delta t = 2.5$ s

Unknown: $W = ?$

Use the equation for power and rearrange it to solve for work.

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

$$W = P\Delta t = (520 \text{ W})(2.5 \text{ s}) = \boxed{1300 \text{ J}}$$

ADDITIONAL PRACTICE

1. The most powerful ice breaker in the world was built in the former Soviet Union. The ship is almost 150 m long, and its nuclear engine generates 56 MW of power. How much work can this engine do in 1.0 h?
2. Reginald Esuke from Cameroon ran over 3 km down a mountain slope in just 62.25 min. How much work was done if the power developed during Esuke's descent was 585.0 W?
3. The world's tallest lighthouse is located in Japan and is 106 m tall. A winch that provides 3.00×10^2 W of power is used to raise 14.0 kg of equipment to the lighthouse top at a constant velocity. How long does it take the equipment to reach the lighthouse top?
4. The first practical car to use a gasoline engine was built in London in 1826. The power generated by the engine was just 2984 W. How long would this engine have to run to produce 3.60×10^4 J of work?
5. Dennis Joyce of the United States threw a boomerang and caught it at the same location 3.0 min later. Suppose Joyce decided to work out while waiting for the boomerang to return. If he expended 54 kJ of work, what was his average power output during the workout?
6. In 1984, Don Cain threw a flying disk that stayed aloft for 16.7 s. Suppose Cain ran up a staircase during this time, reaching a height of 18.4 m. If his mass was 72.0 kg, how much power was needed for Cain's ascent.