

**Chapter 8 Energy, Work, and Power**

**Example Problems**

**8.1 Work**

**E1.** While driving home from work a monkey runs out of gas. The monkey decides to push the car to the nearest gas station some 218 meters away. The monkey applies a average force of 543 N to the back of the car while pushing it. Calculate the work done by the monkey in pushing the car to the gas station.

*Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve*

$W =$

$F =$

$d =$

a) \_\_\_\_\_ ← units

**E2.** A 900 N crate is at rest on a horizontal floor. There is force of friction that acts against the crate when it is in motion. If the force of friction is 180 N, calculate the work needed to push the crate 6.0 meters.

*Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve*

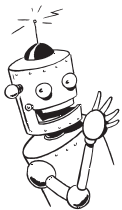
$W =$

$F =$

$d =$

a) \_\_\_\_\_ ← units

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**E3.** A half-pound burger weighs 2.22 N, calculate how much work is done raising the hamburger 0.3 meters from the table to your mouth.

*Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve*

$W =$

$F =$

$d =$

a) \_\_\_\_\_ ← units

**E4.** A monkey lifts a 98 N sack of coconuts with a hoisted up to his tree house some 50 meters above the ground. Calculate how much work is done by the monkey in lifting the coconuts to his tree house.

*Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve*

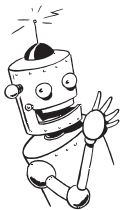
$W =$

$F =$

$d =$

a) \_\_\_\_\_ ← units

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**E5.** A monkey does 150 J of work pushing a crate filled with bananas 2.0 meters across the floor, calculate the magnitude of the force applied by the monkey.

*Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve*

$W =$

$F =$

$d =$

a) \_\_\_\_\_ ← units

**E6.** A monkey does 148 J of work lifting a box of books. If the monkey applies an average force of 185 N, calculate how high the monkey lifted the book.

*Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve*

$W =$

$F =$

$d =$

a) \_\_\_\_\_ ← units

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**E7.** A 50 kg crate is pulled 40 meters along a friction free horizontal surface by a constant force of 100 N at an angle of  $37^\circ$  to horizontal. Determine the work done on the crate.

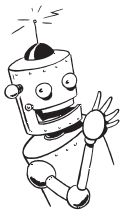
*Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve*

a) \_\_\_\_\_ ← units

**E8.** A 60 kg crate is pulled 3 meters across a frictionless floor by a monkey applying a force of 210 N directed  $20^\circ$  above horizontal. Calculate the work done on the crate.

*Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve*

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a) \_\_\_\_\_ ← units

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# Example Problems

## 8.1 Gravitational Potential Energy

E9. Calculate how much work a monkey does lifting a 1.44 kg coconut 2.00 meters above its starting point.

*Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve*

$PE =$

$m =$

$g =$

$h =$

a) \_\_\_\_\_ ← units

E10. A monkey places a 2.0 kg hammer on the edge of a table that is 0.40 meters above the floor. If the hammer should fall, and just by chance land on top of a loose nail, how much work would the hammer do to the nail?

*Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve*

$PE =$

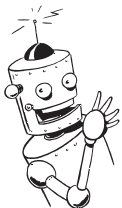
$m =$

$g =$

$h =$

a) \_\_\_\_\_ ← units

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**E11.** A monkey lifts a 50 N sack of coconuts 1.5 meters onto the back of his truck. Calculate the change in potential energy of the sack of coconuts.

*Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve*

$PE =$

$m =$

$g =$

$h =$

a) \_\_\_\_\_ ← units

**E12.** A monkey throws a 0.325 kg rock straight up into the air. If the change in potential energy of the rock is 115 J, calculate how high the rock traveled.

*Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve*

$PE =$

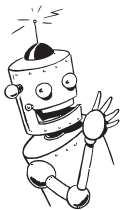
$m =$

$g =$

$h =$

a) \_\_\_\_\_ ← units

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**E13.** Several monkeys pull on a rope to lift a crate of bananas 3.00 meters up. If the change in potential energy of the crate is 2,822.40 J, calculate the mass of the crate.

*Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve*

$PE =$

$m =$

$g =$

$h =$

a) \_\_\_\_\_ ← units

**E14.** A 15 kg crate is pulled at a constant speed 5.7 meters along a frictionless ramp, to a height of 2.5 meters above its starting point. Calculate the work done on the crate.

*Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve*

$PE =$

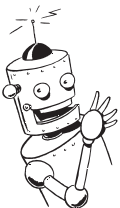
$m =$

$g =$

$h =$

a) \_\_\_\_\_ ← units

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**E15.** On a ski weekend in Colorado, a monkey, whose mass is 75.0 kg, skis down a hill that is inclined at an angle of  $15.0^\circ$  to the horizontal and has a vertical rise of 25.0 m. How much work is done by gravity on monkey as he goes down the hill?

*Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve*

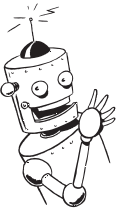
a) \_\_\_\_\_ ← units

**E16.** A 100 kg crate is pushed up a frictionless  $30^\circ$  inclined plane. If the crate is pushed a total of 3 meters along the incline, calculate how much work is done in the process.

*Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve*

a) \_\_\_\_\_ ← units

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# Example Problems

## 8.1 Elastic Potential Energy

E17. A monkey compresses a spring 0.53 meters in order to launch a coconut at a gorilla. If the spring has a spring constant of 219 N/m, calculate the potential energy stored in the spring.

*Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve*

$PE =$

$k =$

$x =$

a) \_\_\_\_\_ ← units

E18. A monkey stretches a spring 0.23 meters from equilibrium. What is the potential energy of the spring if the spring has a constant of 12 N/m?

*Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve*

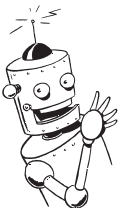
$PE =$

$k =$

$x =$

a) \_\_\_\_\_ ← units

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**E19.** A monkey compresses a spring that has a spring constant of 12.5 N/m in order to launch a coconut through the air at a gorilla. If 127 J of energy is stored in the spring, calculate how far the spring is displaced from its equilibrium position.

*Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve*

$PE =$

$k =$

$x =$

a) \_\_\_\_\_ ← units

**E20.** A spring is stretched 1.23 meters and has 93 J of energy, calculate the spring constant.

*Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve*

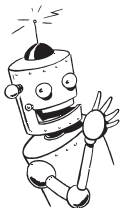
$PE =$

$k =$

$x =$

a) \_\_\_\_\_ ← units

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# Example Problems

## 8.1 Kinetic Energy

E21. What is the kinetic energy of an 80 kg football player running at 8 m/s.

*Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve*

$KE =$

$m =$

$v =$

a) \_\_\_\_\_ ← units

E22. How fast would you have to throw a 0.43 kg football so that it had the same energy as 80 kg football player running at 8 m/s?

*Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve*

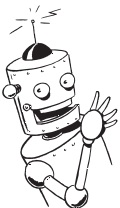
$KE =$

$m =$

$v =$

a) \_\_\_\_\_ ← units

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**E23.** A gorilla is riding his bike at a velocity of 8.5 m/s. If the gorilla and bike have a total kinetic energy of 3,100 J, calculate the combined mass of the gorilla and the bike.

*Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve*

$KE =$

$m =$

$v =$

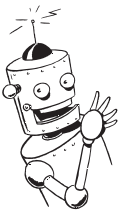
a) \_\_\_\_\_ ← units

**E24.** By how much does the kinetic energy of an object change if the objects velocity is doubled? By how much if the objects velocity is tripled? By how much if the objects velocity is Quadrupled?

*Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve*

a) \_\_\_\_\_ ← units

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# Student Problems

## 8.1 Work and Energy

1. A monkey pulls a 40 kg wagon with a horizontal force of 300 N over a horizontal distance of 50 meters. Calculate the work done by the monkey.

*Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve*

$W =$

$F =$

$d =$

a) \_\_\_\_\_ ← units

2. A monkey lifts a box of bananas that weighs 185 N 0.800 meters and places it on a shelf. How much work does the monkey do lifting the box of bananas?

*Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve*

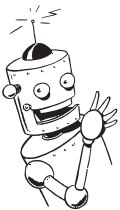
$W =$

$F =$

$d =$

a) \_\_\_\_\_ ← units

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3. A runner does 2000 J of work running 50 meters. Calculate the average force the runner exert on the ground.

*Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve*

$W =$

$F =$

$d =$

a) \_\_\_\_\_ ← units

4. A monkey does 300 J of work pushing a chair across the room. If the monkey applies and average force of 60 N, calualte how far did the monkey pushes the chair.

*Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve*

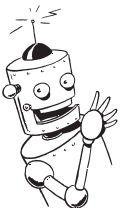
$W =$

$F =$

$d =$

a) \_\_\_\_\_ ← units

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5. A model rocket does 1200 J of work as it travels to its highest point. If the average force the rocket exerts during its climb is 2 N, calculate the height the rocket travels.

*Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve*

$W =$

$F =$

$d =$

a) \_\_\_\_\_ ← units

6. A weight lifter lifts a 180 kg barbell to a height of 1.95 meters from the ground to above his head. Calculate the change in the potential energy of the barbell.

*Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve*

$PE =$

$m =$

$g =$

$h =$

a) \_\_\_\_\_ ← units

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7. A 60 kg monkey climbs a 4 meter high flight of stairs. Calculate the change in energy of the monkey.

*Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve*

$PE =$

$m =$

$g =$

$h =$

a) \_\_\_\_\_ ← units

8. A monkey drops a 0.180 kg coconut on top of a gorilla standing beneath him. If the change in energy of the falling coconut is 4.41 J, how far did the coconut fall?

*Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve*

$PE =$

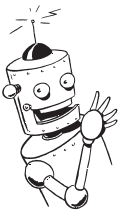
$m =$

$g =$

$h =$

a) \_\_\_\_\_ ← units

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9. A gorilla carries his new refrigerator up a flight of stairs to his apartment. If the gorilla does 11,760 J of work carrying the refrigerator 8 meters above street level, calculate the mass of the refrigerator.

*Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve*

$PE =$

$m =$

$g =$

$h =$

a) \_\_\_\_\_ ← units

10. A dart is pushed into a toy dart gun compressing the gun's spring 0.06 meters. If the spring has a spring constant of 250 N/m, how much energy is stored in the gun?

*Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve*

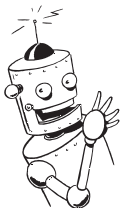
$PE =$

$k =$

$x =$

a) \_\_\_\_\_ ← units

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11. How far would you have to stretch a spring with constant of 1,400 N/m in order to have 210 J of energy?

*Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve*

$PE =$

$k =$

$x =$

a) \_\_\_\_\_ ← units

12. A monkey compresses a spring so he can launch a coconut at a gorilla. If the monkey compress the spring 0.337 meters and store 25 J of energy in the spring, calculate the spring constant.

*Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve*

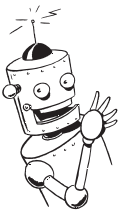
$PE =$

$k =$

$x =$

a) \_\_\_\_\_ ← units

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13. Jamaican sprinter Usain Bolt shocked the world by running the 100 meter dash in 9.58 seconds at an average speed of 10.44 m/s. If Usain’s weight was 190 lbs (86 kg), calculate Usain’s kinetic energy as he set this world record.

*Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve*

$KE =$

$m =$

$v =$

a) \_\_\_\_\_ ← units

14. A top tennis player can hits a serve at 130 mph (58.12 m/s). If the tennis ball has a mass of 0.0585 kg, calculate the kinetic energy of the tennis ball.

*Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve*

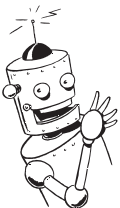
$KE =$

$m =$

$v =$

a) \_\_\_\_\_ ← units

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15. The average speed of a ping-pong ball in a table tennis match is 25 mph (11.18 m/s). If the mass of a ping-pong ball is 0.0027 kg, calculate the kinetic energy of the ball.

*Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve*

$KE =$

$m =$

$v =$

a) \_\_\_\_\_ ← units

16. A Porsche Boxster has a mass of 2,855 lb (1,295 kg). How fast would a 132.28 lb (60 kg) person have to run in order to have the same kinetic energy as a Porsche Boxster traveling at 30 mph (13.41 m/s)?

*Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve*

$KE =$

$m =$

$v =$

a) \_\_\_\_\_ ← units

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