Name _____ Period _____ Date _____

Example Problems

8.4 Conservation of Energy

E1. A monkey does 0.45 joule of work compressing the spring in a pop-up toy. If the mass of the toy is 0.020 kilogram, calculate the maximum vertical height that the toy can reach after the spring is released.

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

$$PE_o = mgh_o =$$

$$KE_o = \frac{mv_o^2}{2} =$$

$$PE_f = mgh_f =$$

$$KE_f = \frac{mv_f^2}{2} =$$

a) _____ ← units

E2. A 1.44 kg coconut is dropped 5 meters from a tree by a monkey, calculate the speed of the coconut as it hits the ground.

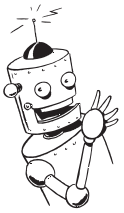
Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve

$$PE_o = mgh_o =$$

$$KE_o = \frac{mv_o^2}{2} =$$

$$PE_f = mgh_f =$$

$$KE_f = \frac{mv_f^2}{2} =$$



a) _____ ← units

Chapter 8 Energy, Work, and Power

E3. A roller-coaster is loaded with a bunch of supper large gorillas. Assuming the height of the first hill is 40 meters, calculate how fast the roller-coaster will be going at the bottom of the first hill.

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

$PE_o = mgh_o =$

$KE_o = \frac{mv_o^2}{2} =$

$PE_f = mgh_f =$

$KE_f = \frac{mv_f^2}{2} =$

a) _____ ← units

E4. A 70 kg pole vaulter is running at a speed of 8.9 m/s just before he plants the pole and begins the vault. Calculate the maximum height the pole vaulter could reach assuming a perfect vault.

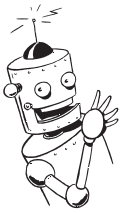
Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve

$PE_o = mgh_o =$

$KE_o = \frac{mv_o^2}{2} =$

$PE_f = mgh_f =$

$KE_f = \frac{mv_f^2}{2} =$



a) _____ ← units

Chapter 8 Energy, Work, and Power

E5. A monkey is running at a speed of 5.6 m/s when he grabs a vine that is hanging vertically from a tall tree in the middle of the jungle. After the monkey grabs hold of the vine he begins to swing upward, calculate the maximum height the monkey can swing.

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

$PE_o = mgh_o =$

$KE_o = \frac{mv_o^2}{2} =$

$PE_f = mgh_f =$

$KE_f = \frac{mv_f^2}{2} =$

a) _____ ← units

E6. A monkey throws a 0.5 kg banana from the roof of a 30 meter tall building with an initial speed of 10 m/s. Calculate how much mechanical energy the banana has on release and the speed of the banana as it hits the ground. Damn monkey

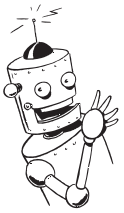
Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve

$PE_o = mgh_o =$

$KE_o = \frac{mv_o^2}{2} =$

$PE_f = mgh_f =$

$KE_f = \frac{mv_f^2}{2} =$



a) _____ ← units b) _____ ← units

Chapter 8 Energy, Work, and Power

E7. An object is projected horizontally from a bridge that is 20 meters above a river. The initial speed of the object is 30 m/s. Calculate the speed of the stone at the moment it hits the surface of the water 20 meters below the bridge.

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

$PE_o = mgh_o =$

$KE_o = \frac{mv_o^2}{2} =$

$PE_f = mgh_f =$

$KE_f = \frac{mv_f^2}{2} =$

a) _____ ← units

E8. A tire starts from rest and is given a push down a big hill. When the tire is 5 meters above the bottom of the hill it is moving at 7 m/s, calculate the height of the hill.

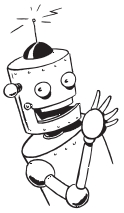
Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve

$PE_o = mgh_o =$

$KE_o = \frac{mv_o^2}{2} =$

$PE_f = mgh_f =$

$KE_f = \frac{mv_f^2}{2} =$



a) _____ ← units

Chapter 8 Energy, Work, and Power

E9. A block whose mass is 5.7 kg if moving along a frictionless tabletop at a constant speed of 1.2 m/s. The block is brought to rest by compressing a spring that is positioned in its path. If the spring has a constant of 1500 N/m, calculate how far the spring is compressed.

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

$PE_o = mgh_o =$

$KE_o = \frac{mv_o^2}{2} =$

$PE_f = mgh_f =$

$KE_f = \frac{mv_f^2}{2} =$

a) _____ ← units

E10. A dart of mass 0.100 kg is pushed against a spring in a toy dart gun. The spring has a spring constant of 250 N/m and is compressed 0.06 meters. Calculate the speed of the dart as it leaves the gun.

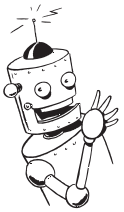
Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve

$PE_o = mgh_o =$

$KE_o = \frac{mv_o^2}{2} =$

$PE_f = mgh_f =$

$KE_f = \frac{mv_f^2}{2} =$



a) _____ ← units

Name _____ Period _____ Date _____

Chapter 8 Energy, Work, and Power

E11. A 2.60 kg ball is dropped form rest. The ball falls a vertical distance of 0.55 meters before landing on a spring causing the spring to be compressed 0.15 meters. Assume the spring has negligible mass, calculate the spring's spring constant.

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

$$PE_o = mgh_o =$$

$$KE_o = \frac{mv_o^2}{2} =$$

$$PE_f = mgh_f =$$

$$KE_f = \frac{mv_f^2}{2} =$$

a) _____ ← units

E12. A monkey jumps off a bridge with a bungee cord tied to his ankle. He falls 15 meters before the bungee cord begins to stretch. The monkey's mass is 75 kg and we assume the cord obeys Hooke's law with a constant of 50 N/m. If we neglect air resistance, how far below the bridge will the monkey fall before coming to rest?

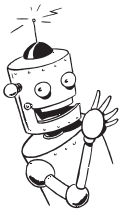
Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve

$$PE_o = mgh_o =$$

$$KE_o = \frac{mv_o^2}{2} =$$

$$PE_f = mgh_f =$$

$$KE_f = \frac{mv_f^2}{2} =$$



a) _____ ← units

Name _____ Period _____ Date _____

Student Problems

8.4 Conservation of Energy

1. A 50 kg monkey stands on a tree limb holding a vine. The monkey jumps from the tree limb and begins swinging down like a pendulum. At the bottom of his swing the monkey has dropped 7 meters vertically. Calculate the monkey's speed at the bottom of his swing.

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

$$PE_o = mgh_o =$$

$$KE_o = \frac{mv_o^2}{2} =$$

$$PE_f = mgh_f =$$

$$KE_f = \frac{mv_f^2}{2} =$$

a) _____ ← units

2. A monkey drops a 2.0 kg physics book from the balcony of his apartment to a gorilla standing below. If the gorilla stands 8.5 meters below the balcony and catches the book, calculate how fast the book was moving when it was caught by the gorilla.

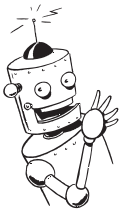
Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve

$$PE_o = mgh_o =$$

$$KE_o = \frac{mv_o^2}{2} =$$

$$PE_f = mgh_f =$$

$$KE_f = \frac{mv_f^2}{2} =$$



a) _____ ← units

3. A 15 meter long rope is suspended vertically from the branch of a tree. Suppose you wish to raise yourself above ground by running along, grabbing hold of the rope, and swing up like a pendulum. Calculate how fast you need to be running as you grab the rope in order to raise yourself 2 meters above the ground.

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

$$PE_o = mgh_o =$$

$$KE_o = \frac{mv_o^2}{2} =$$

$$PE_f = mgh_f =$$

$$KE_f = \frac{mv_f^2}{2} =$$

a) _____ ⟵ units

4. A monkey is swinging on a garden swing. At the lowest point of his swing the monkey is traveling at 4 m/s. If the combined mass of the monkey and swing is 40 kg, calculate how high from the lowest point the monkey will rise.

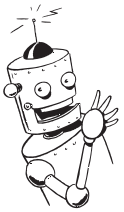
Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve

$$PE_o = mgh_o =$$

$$KE_o = \frac{mv_o^2}{2} =$$

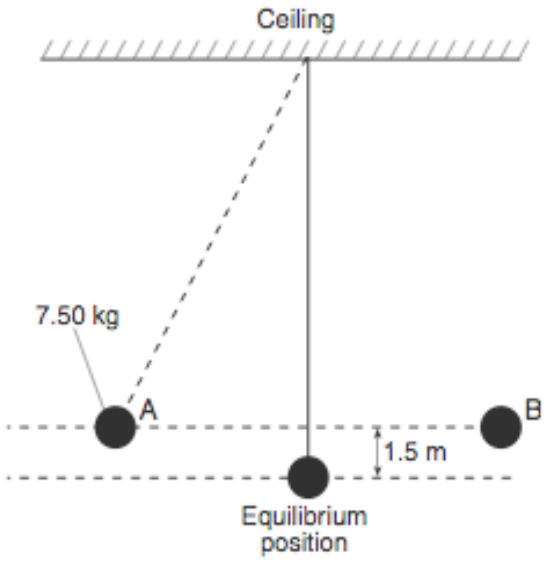
$$PE_f = mgh_f =$$

$$KE_f = \frac{mv_f^2}{2} =$$



a) _____ ⟵ units

5. A pendulum has a mass of 7.50 kg and is attached by a rope to the ceiling of a science classroom. The mass is pulled to one side until it is 1.5 meters higher than its equilibrium position. After it is released from rest, the pendulum moves freely back and forth between positions A and B as shown in the diagram below.



Find the total amount of kinetic energy that the mass has as it swings freely through its equilibrium position and how fast is it moving. [Neglect friction.]

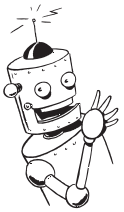
Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve

$PE_o = mgh_o =$

$KE_o = \frac{mv_o^2}{2} =$

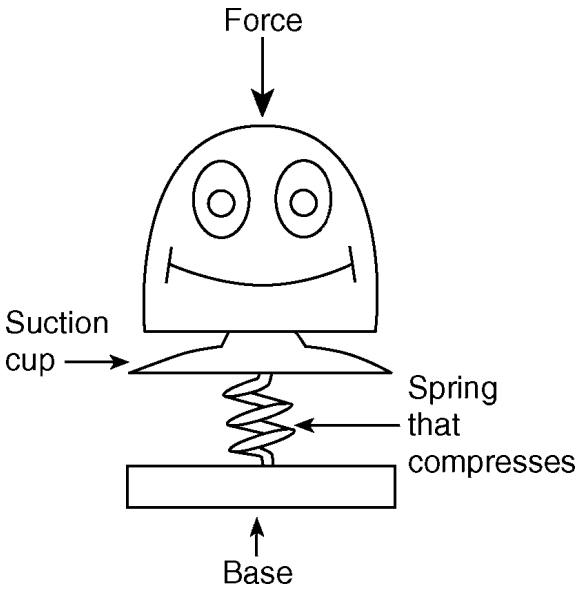
$PE_f = mgh_f =$

$KE_f = \frac{mv_f^2}{2} =$



a) _____ ← units b) _____ ← units

6. A monkey does 0.20 joule of work to compress the spring in a pop-up toy. If the mass of the toy is 0.010 kg, find the maximum vertical height that the toy can reach after the spring is released and find how fast it will be moving when it leaves the table.



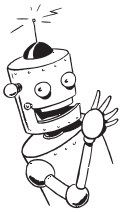
Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve

$PE_o = mgh_o =$

$KE_o = \frac{mv_o^2}{2} =$

$PE_f = mgh_f =$

$KE_f = \frac{mv_f^2}{2} =$



a) _____ ← units b) _____ ← units

7. A monkey jumps off the 10 meter high diving board with an initial speed of 3 m/s. Calculate the monkey's speed as he enters the water.

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

$PE_o = mgh_o =$

$KE_o = \frac{mv_o^2}{2} =$

$PE_f = mgh_f =$

$KE_f = \frac{mv_f^2}{2} =$

a) _____ ⟵ units

8. A monkey throws a 0.01 kg ball towards the ground from a height of 2.0 meters. If the ball strikes the floor at a speed of 7.5 m/s, what was the initial speed of the ball?

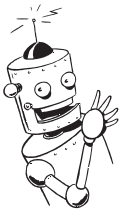
Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve

$PE_o = mgh_o =$

$KE_o = \frac{mv_o^2}{2} =$

$PE_f = mgh_f =$

$KE_f = \frac{mv_f^2}{2} =$



a) _____ ⟵ units

9. A ball starts from rest and rolls down a hill. When the ball is 3 meters above the ground it is moving at 5 m/s. Calculate the balls total mechanical energy and calculate the height of the hill.

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

$PE_o = mgh_o =$

$KE_o = \frac{mv_o^2}{2} =$

$PE_f = mgh_f =$

$KE_f = \frac{mv_f^2}{2} =$

a) _____ ⟵ units

10. A monkey makes his living selling hot dogs on the streets of Austin, Texas. One day the monkey pushes his 300 kg hot dog cart to the top of a 50 meter hill, he then trips and accidently lets go of the cart, sending the cart down the other side of the hill. The cart travels all the way down the first hill and then up a second hill. The initial velocity of the cart as it was released by the monkey was 4.0 m/s and at the top of the second hill the cart is traveling at 21.5 m/s, calculate the height of the second hill.

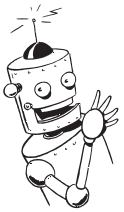
Record all givens, draw a picture, arrow all vectors, write the formula, substitute and solve

$PE_o = mgh_o =$

$KE_o = \frac{mv_o^2}{2} =$

$PE_f = mgh_f =$

$KE_f = \frac{mv_f^2}{2} =$



a) _____ ⟵ units

Name _____ Period _____ Date _____

Student Problems

8.4 Conservation of Energy (with friction)

1. A roller coaster has a potential energy of 588,240 J at the top of the first hill. If 20,000 J of energy is consumed overcoming friction on the way to the top of the second hill, calculate the maximum height of the second hill on the track so that the roller coaster can just make it to the top.

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

$PE_o = mgh_o =$

$KE_o = \frac{mv_o^2}{2} =$

$PE_f = mgh_f =$

$KE_f = \frac{mv_f^2}{2} =$

$W = Fd =$

a) _____ ← units

2. An 800 kg roller coaster starts from rest at the top of a 30 meter hill. If the height of second hill is 21 meters and the roller coaster just barely makes it to the top, calculate the amount of energy lost to friction along the way.

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

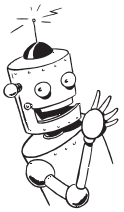
$PE_o = mgh_o =$

$KE_o = \frac{mv_o^2}{2} =$

$PE_f = mgh_f =$

$KE_f = \frac{mv_f^2}{2} =$

$W = Fd =$



a) _____ ← units

3. A monkey throws a 0.0585 kg tennis ball vertically into the air. The ball leave the monkey's hand traveling at 26 m/s but when the ball returns to the monkey's hand it is only traveling at 19 m/s. Calculate the amount of work done by friction on the tennis ball as it was in the air.

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

$PE_o = mgh_o =$

$KE_o = \frac{mv_o^2}{2} =$

$PE_f = mgh_f =$

$KE_f = \frac{mv_f^2}{2} =$

$W = Fd =$

a) _____ ← units

4. A 30 kg monkey is sliding down a playground slide that is 2.5 meter high. If the monkey reaches the bottom of the slide and is only traveling at a speed of 2.0 m/s, how much energy was dissipated as heat?

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

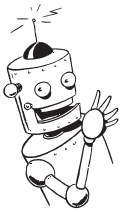
$PE_o = mgh_o =$

$KE_o = \frac{mv_o^2}{2} =$

$PE_f = mgh_f =$

$KE_f = \frac{mv_f^2}{2} =$

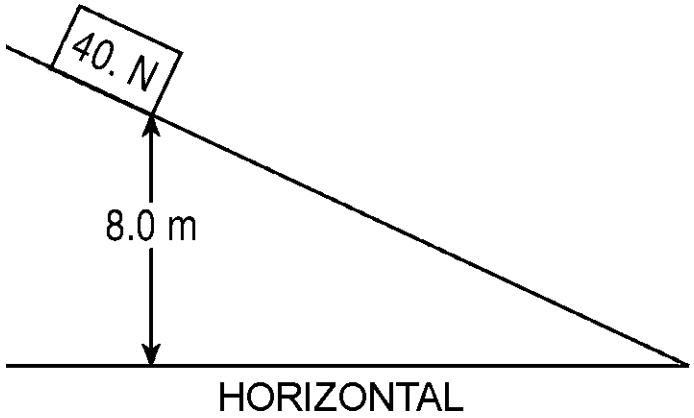
$W = Fd =$



a) _____ ← units

Chapter 8 Energy, Work, and Power

5. A block weighing 40 N is released from rest on an incline 8.0 meters above the horizontal, as shown in the diagram below.



If 50 J of heat is generated as the block slides down the incline, what is the maximum kinetic energy of the block at the bottom of the incline?

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

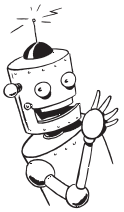
$PE_o = mgh_o =$

$KE_o = \frac{mv_o^2}{2} =$

$PE_f = mgh_f =$

$KE_f = \frac{mv_f^2}{2} =$

$W = Fd =$



a) _____ ← units

6. An electric motor lifts a 55 N block a distance of 9.5 meters. If the total amount of energy used by the motor is 788 J, how much energy was transformed into to heat?

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

$PE_o = mgh_o =$

$KE_o = \frac{mv_o^2}{2} =$

$PE_f = mgh_f =$

$KE_f = \frac{mv_f^2}{2} =$

$W = Fd =$

a) _____ ← units

7. A motor is used as an elevator to lift a 1.25 kg mass to a height of 4.5 meters. If the total amount of energy used by the motor is 60 J, how much energy was converted to heat and sound?

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

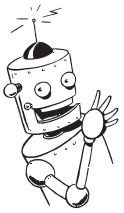
$PE_o = mgh_o =$

$KE_o = \frac{mv_o^2}{2} =$

$PE_f = mgh_f =$

$KE_f = \frac{mv_f^2}{2} =$

$W = Fd =$



a) _____ ← units