

Tutorial 05 Work and Energy [[Edit](#)][Overview](#)[Summary View](#)[Diagnostics View](#)[Print View with Answers](#)

Tutorial 05 Work and Energy

Due: --

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Exercise 6.10

Description: An ## kg package in a mail-sorting room slides ## m down a chute that is inclined at ## degree(s) below the horizontal. The coefficient of kinetic friction between the package and the chute's surface is ##. (a) Calculate the work done on the package ...

An 8.00 kg package in a mail-sorting room slides 2.00 m down a chute that is inclined at 53.0° below the horizontal. The coefficient of kinetic friction between the package and the chute's surface is 0.400.

Part A

Calculate the work done on the package by friction.

ANSWER:

$$W_{\text{friction}} = -37.7 \text{ J}$$

Part B

Calculate the work done on the package by gravity.

ANSWER:

$$W_{\text{gravity}} = 125 \text{ J}$$

Part C

Calculate the work done on the package by the normal force.

ANSWER:

$$W_{\text{N}} = 0 \text{ J}$$

Part D

What is the net work done on the package?

ANSWER:

$$W_{\text{net}} = 87.5 \text{ J}$$

Exercise 6.12

Description: You apply a constant force $F_{\text{vec}} = (-68.0 \text{ N})\mathbf{i}_{\text{unit}} + (36.0 \text{ N})\mathbf{j}_{\text{unit}}$ to a m car as the car travels s in a direction that is 240.0 degree(s) counterclockwise from the +x-axis. (a) How much work does

the force you apply do on the car?

You apply a constant force $\vec{F} = (-68.0 \text{ N})\hat{i} + (36.0 \text{ N})\hat{j}$ to a 430 kg car as the car travels 54.0 m in a direction that is 240.0° counterclockwise from the $+x$ -axis.

Part A

How much work does the force you apply do on the car?

Express your answer to three significant figures and include the appropriate units.

ANSWER:

$$W = -68.0 \text{scos}\left(\frac{4\pi}{3}\right) + 36.0 \text{sigdig}\left(\text{ssin}\left(\frac{4\pi}{3}\right), 4\right) = 152 \text{J}$$

Exercise 6.27

Description: A little red wagon with mass m moves in a straight line on a frictionless horizontal surface. It has an initial speed of v and then is pushed s in the direction of the initial velocity by a force with a magnitude of 10.0 N . (a) Use the work-energy...

A little red wagon with mass 7.30 kg moves in a straight line on a frictionless horizontal surface. It has an initial speed of 3.60 m/s and then is pushed 4.1 m in the direction of the initial velocity by a force with a magnitude of 10.0 N .

Part A

Use the work-energy theorem to calculate the wagon's final speed.

Express your answer using two significant figures.

ANSWER:

$$v_2 = \frac{\text{round}\left(\sqrt{v^2 + \frac{20.0\text{s}}{m} \cdot 10}\right)}{10} = 4.9 \text{ m/s}$$

Part B

Calculate the acceleration produced by the force.

Express your answer using two significant figures.

ANSWER:

$$a = \text{round}\left(\frac{10.0}{m}, -1\right) = 1.4 \text{ m/s}^2$$

Part C

Use this acceleration in the kinematic relationship $v_x^2 = v_{0x}^2 + 2a_x(x - x_0)$ to calculate the wagon's final speed.

Express your answer using two significant figures.

ANSWER:

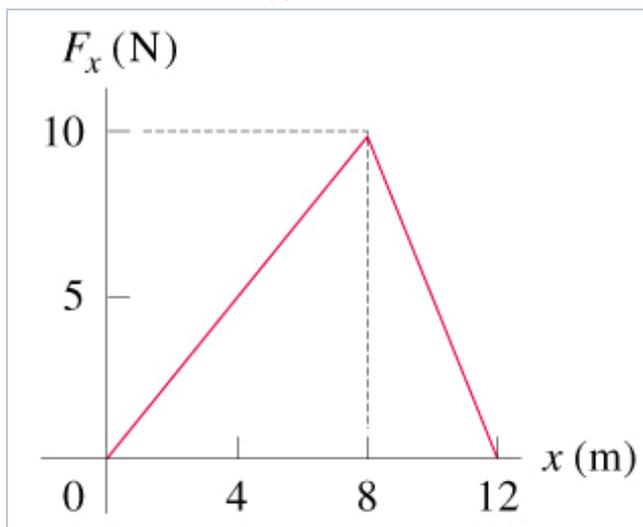
$$v_2 = \text{round}\left(\sqrt{v^2 + \frac{20.0s}{m}}, -1\right) = 4.9 \text{ m/s}$$

Exercise 6.35

Description: A child applies a force F_{vec} parallel to the x -axis to a m -kg sled moving on the frozen surface of a small pond. As the child controls the speed of the sled, the x -component of the force she applies varies with the x -coordinate of the sled as shown...

A child applies a force \vec{F} parallel to the x -axis to a 6.00-kg sled moving on the frozen surface of a small pond.

As the child controls the speed of the sled, the x -component of the force she applies varies with the x -coordinate of the sled as shown in figure . Suppose the sled is initially at rest at $x=0$. You can ignore friction between the sled and the surface of the pond.



Part A

Use the work-energy theorem to find the speed of the sled at 8.0m .

ANSWER:

$$v = \sqrt{\frac{5x_1^2}{m}} = 3.65 \text{ m/s}$$

Part B

Use the work-energy theorem to find the speed of the sled at 9.0m .

ANSWER:

$$v = \sqrt{\frac{120.0 - (12 - x_2) \left(30 - \frac{5}{2}x_2\right)}{m}} = 4.03 \text{ m/s}$$

Exercise 6.56

Description: An elevator has mass 600 kg, not including passengers. The elevator is designed to ascend, at constant speed, a vertical distance of 20.0 m (five floors) in 16.0 s, and it is driven by a motor that can provide up to 40 hp to the elevator. (a) What is ...

An elevator has mass 600 **kg**, not including passengers. The elevator is designed to ascend, at constant speed, a vertical distance of 20.0 **m** (five floors) in 16.0 **s**, and it is driven by a motor that can provide up to 40 **hp** to the elevator.

Part A

What is the maximum number of passengers that can ride in the elevator? Assume that an average passenger has mass 65.0 **kg**.

Express your answer using two significant figures.

ANSWER:

$$n = 28$$

Conceptual Question 7.04

Description: (a) Two identical balls are thrown directly upward, ball A at speed v and ball B at speed $2v$, and they feel no air resistance. Which statement about these balls is correct?

Part A

Two identical balls are thrown directly upward, ball A at speed v and ball B at speed $2v$, and they feel no air resistance. Which statement about these balls is correct?

ANSWER:

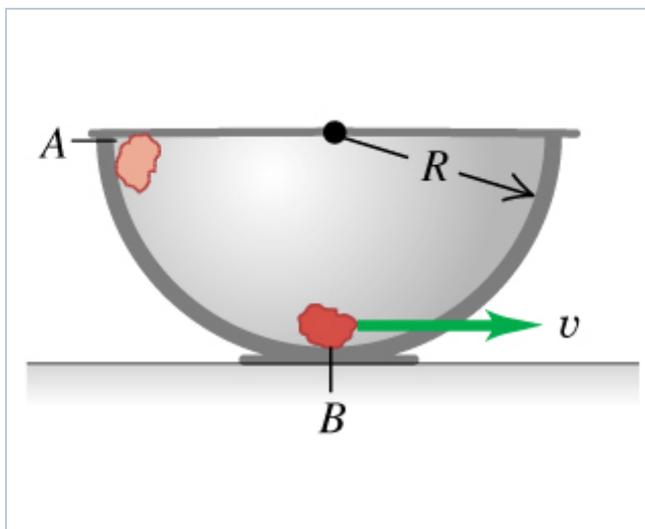
- Ball B will go twice as high as ball A because it had twice the initial speed.
- At its highest point, ball B will have twice as much gravitational potential energy as ball A because it started out moving twice as fast.
- Ball B will go four times as high as ball A because it had four times the initial kinetic energy.
- At their highest point, the acceleration of each ball is instantaneously equal to zero because they stop for an instant.
- The balls will reach the same height because they have the same mass and the same acceleration.

Exercise 7.9

Description: A small rock with mass m is released from rest at point A, which is at the top edge of a large, hemispherical bowl with radius $R = \text{##} m$ (the figure). Assume that the size of the rock is small compared to R , so that the rock can be treated as a...

A small rock with mass 0.20**kg** is released from rest at point **A**, which is at the top edge of a large, hemispherical bowl with radius $R = 0.42\text{m}$ (the figure). Assume that the size of the rock is small compared to

R , so that the rock can be treated as a particle, and assume that the rock slides rather than rolls. The work done by friction on the rock when it moves from point A to point B at the bottom of the bowl has magnitude 0.22 J .



Part A

Between points A and B , how much work is done on the rock by the normal force?

Express your answer using two significant figures.

ANSWER:

$$W = 0 \text{ J}$$

Part B

Between points A and B , how much work is done on the rock by gravity?

Express your answer using two significant figures.

ANSWER:

$$W = 9.8mR = 0.82 \text{ J}$$

Part C

What is the speed of the rock as it reaches point B ?

Express your answer using two significant figures.

ANSWER:

$$v = \sqrt{\frac{2(9.8mR - .22)}{m}} = 2.5 \text{ m/s}$$

Part D

Of the three forces acting on the rock as it slides down the bowl, which (if any) are constant and which are not? Explain.

ANSWER:

3663 Character(s) remaining

Gravity is constant and equal to mg . n is not constant; it is zero at A and not zero at B. Therefore, $f_k = \mu_k n$ is also not constant.

Part E

Just as the rock reaches point **B**, what is the normal force on it due to the bottom of the bowl?

Express your answer using two significant figures.

ANSWER:

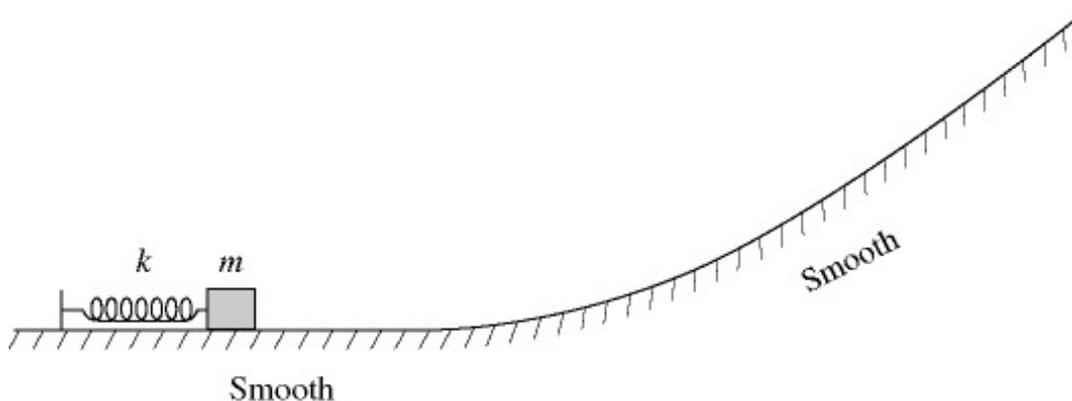
$$n = m \left(9.8 + \frac{2(9.8mR - .22)}{R} \right) = 4.8 \text{ N}$$

Conceptual Question 7.06

Description: (a) A box of mass m is pressed against (but is not attached to) an ideal spring of force constant k and negligible mass, compressing the spring a distance x . After it is released, the box slides up a frictionless incline as shown in the figure and...

Part A

A box of mass m is pressed against (but is not attached to) an ideal spring of force constant k and negligible mass, compressing the spring a distance x . After it is released, the box slides up a frictionless incline as shown in the figure and eventually stops. If we repeat this experiment but instead compress the spring a distance of $2x$



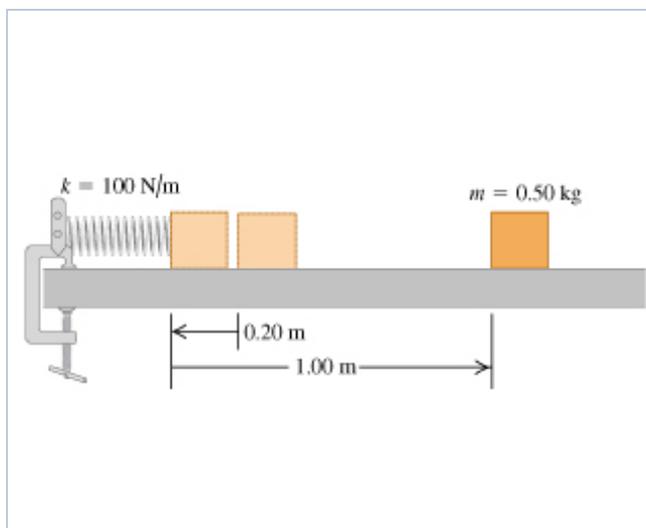
ANSWER:

- just as it moves free of the spring, the box will be traveling twice as fast as before.
- just as it moves free of the spring, the box will be traveling four times as fast as before.
- the box will go up the incline twice as high as before.
- just as it moves free of the spring, the box will have twice as much kinetic energy as before.
- just before it is released, the box has twice as much elastic potential energy as before.

Problem 7.43

Description: A block with mass 0.50 kg is forced against a horizontal spring of negligible mass, compressing the spring a distance of 0.20 m (the figure). When released, the block moves on a horizontal tabletop for 1.00 m before coming to rest. The spring...

A block with mass 0.50 kg is forced against a horizontal spring of negligible mass, compressing the spring a distance of 0.20 m (the figure). When released, the block moves on a horizontal tabletop for 1.00 m before coming to rest. The spring constant k is 100 N/m .



Part A

What is the coefficient of kinetic friction μ_k between the block and the tabletop?

Express your answer using two significant figures.

ANSWER:

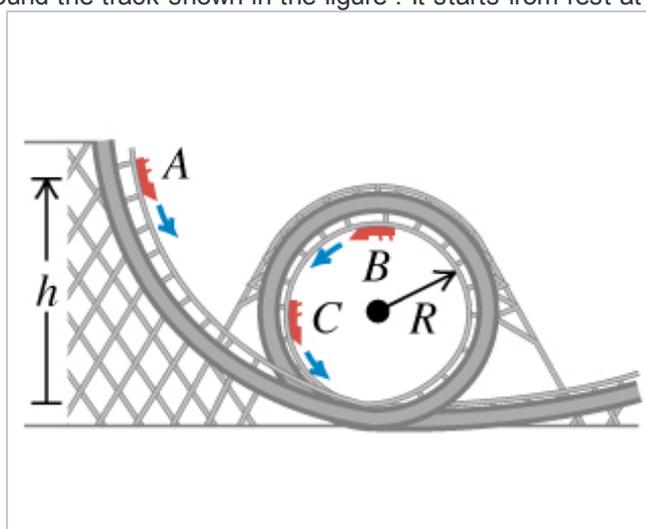
$$\mu_k = 0.41$$

Problem 7.46

Description: A car in an amusement park ride rolls without friction around the track shown in the figure. It starts from rest at point A at a height h above the bottom of the loop. Treat the car as a particle. (a) What is the minimum value of h (in terms of R)...

A car in an amusement park ride rolls without friction around the track shown in the figure. It starts from rest at point A at a height h above the bottom of the loop.

Treat the car as a particle.



Part A

What is the minimum value of h (in terms of R) such that the car moves around the loop without falling off at the top (point B)?

ANSWER:

$$h_{\min} = \frac{5R}{2} = 3.73$$

Also accepted: $2.5R = 0.891$

Part B

If the car starts at height $h = 3.50 R$ and the radius is $R = 15.0\text{m}$, compute the speed of the passengers when the car is at point C , which is at the end of a horizontal diameter.

ANSWER:

$$v_C = \sqrt{2(kR_1 - R_1)g} = 27.1 \text{ m/s}$$

Part C

If the car starts at height $h = 3.50 R$ and the radius is $R = 15.0\text{m}$, compute the radial acceleration of the passengers when the car is at point C , which is at the end of a horizontal diameter.

ANSWER:

$$a_{\text{rad}} = 2(k - 1)g = 49.0 \text{ m/s}^2$$

Part D

If the car starts at height $h = 3.50 R$ and the radius is $R = 15.0\text{m}$, compute the tangential acceleration of the passengers when the car is at point C , which is at the end of a horizontal diameter.

ANSWER:

$$|a_{\text{tan}}| = 9.80 \text{ m/s}^2$$