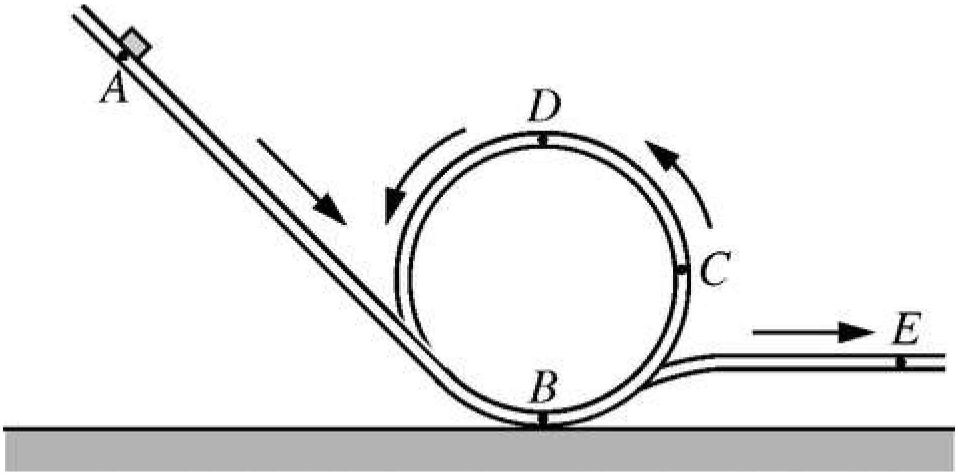
Conservation of energy

Name



A block released from rest at position *A* slides with negligible friction down an inclined track, around a vertical loop, and then along a horizontal portion of the track, as shown above. The block never leaves the track.

1. After the block is released, in which of the following sequences of positions is the speed of the block ordered from fastest to slowest?

(A) *B C D E*

(B) *B E C D*

(C) *D C E B*

(D) *E B C D*

(E) *E D C B*

2. The gravitational potential energy and the kinetic energy of the block are most nearly equal at which position? (Consider the potential energy to be zero at position *B*.)

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(A) *A*

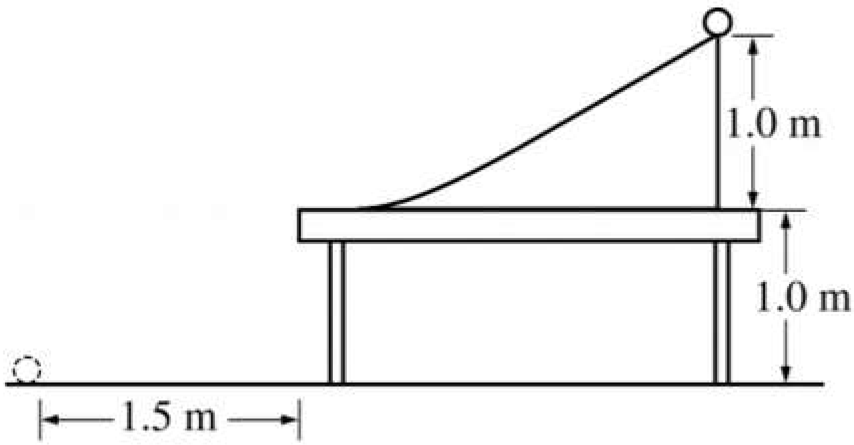
(B) *B*

(C) *C*

(D) *D*

(E) *E*

Questions 12-14 refer to the following material.



A cylinder at rest is released from the top of a ramp, as shown above. The ramp is 1.0 m high, and the cylinder rolls down the ramp without slipping. At the bottom of the ramp, the cylinder makes a smooth transition to a small section of a horizontal table and then travels over the edge at a height of 1.0 m above the floor, eventually landing on the floor at a horizontal distance of 1.5 m from the table.

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3. As the cylinder rolls down the ramp, how do the potential energy of the cylinder-Earth system and the kinetic energy of the cylinder change, if at all?

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(A)

Potential Energy of Cylinder-Earth System	Kinetic Energy of Cylinder
Stays the same	Increases

(B)

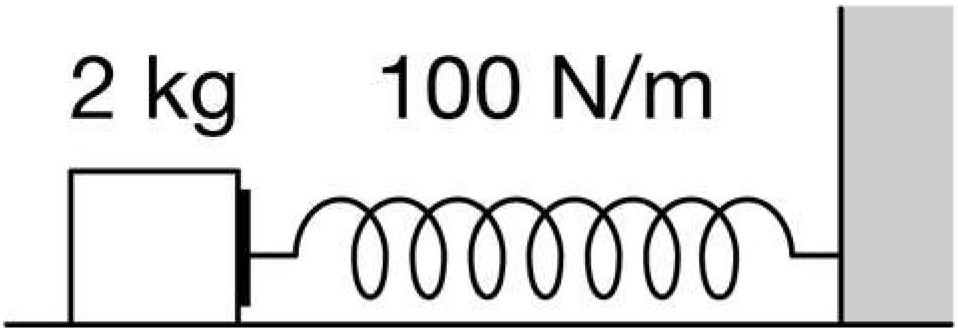
Potential Energy of Cylinder-Earth System	Kinetic Energy of Cylinder
Stays the same	Decreases

(C)

Potential Energy of Cylinder-Earth System	Kinetic Energy of Cylinder
Decreases	Increases

(D)

Potential Energy of Cylinder-Earth System	Kinetic Energy of Cylinder
Decreases	Decreases



A student is conducting an experiment to analyze the mechanical energy of a block-spring system. The student places a block of mass 2kg on a horizontal surface and attaches the block to a horizontal spring of negligible mass and spring constant 100N/m, as shown in the figure. There is negligible friction between the block and the horizontal surface. The other end of the spring is attached to a wall. The block-spring system is initially at the spring's equilibrium position.

4. The student wants to collect data of the block-spring system that can be used to determine the work done on the spring by the block when the spring is compressed. Which of the following includes only the measuring devices that the student will need in order to collect the data?

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(A) Force probe and meterstick

(B) Stopwatch and meterstick

(C) Stopwatch and force probe

(D) Force probe, stopwatch, and meterstick

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5.

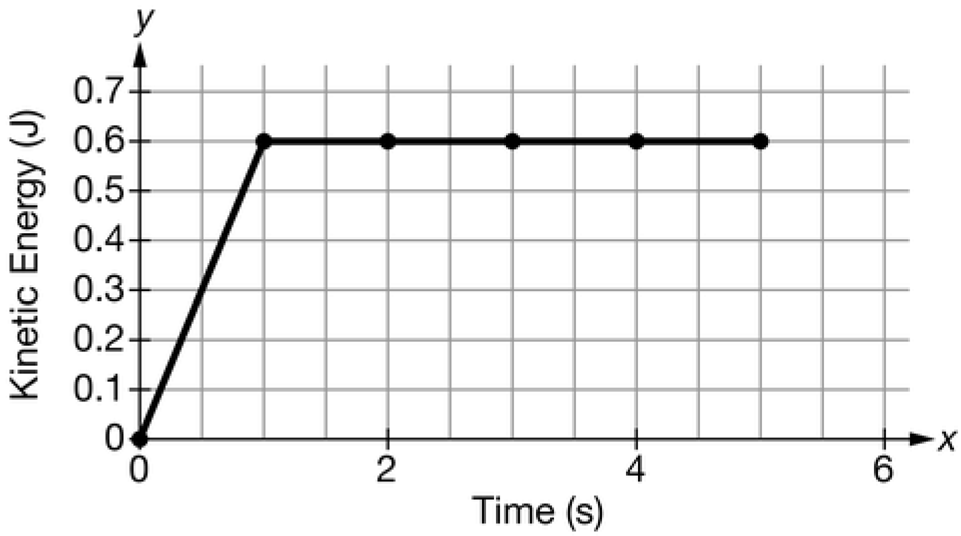

Figure 1

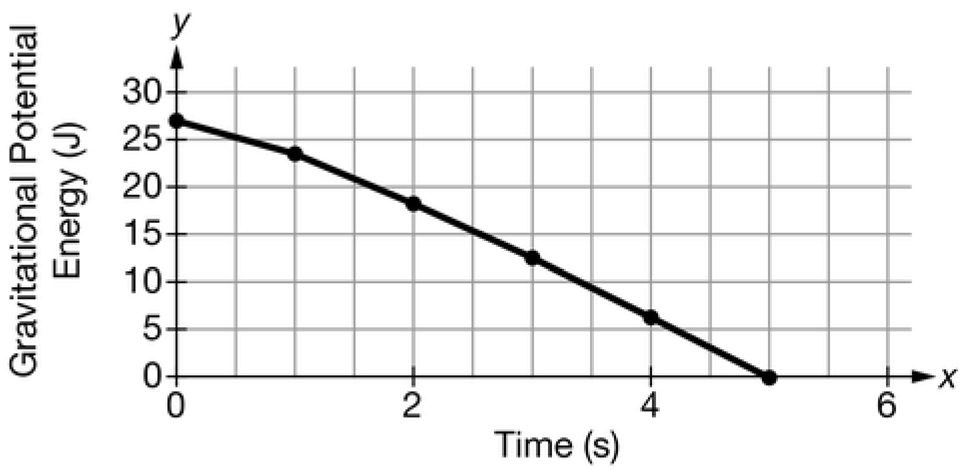

Figure 2

A student conducts an experiment in which an object is released from rest and falls to the floor. In the experiment, frictional forces CANNOT be neglected. The student uses experimental data to create two graphs. Figure 1 is a graph of kinetic energy of the object as a function of time. Figure 2 is a graph of the object-Earth system's gravitational potential energy as a function of time. How should the student use one or both graphs to determine how much the total mechanical energy changes after $5\ \mathrm{s}$?

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(A) Calculate the magnitude of the difference between the final kinetic energy of the object and the final kinetic energy of the object by using the graph in Figure 1.

(B) Calculate the magnitude of the difference between the final gravitational potential energy of the system and the initial gravitational potential energy of the system by using the graph in Figure 2.

(C) Calculate the magnitude of the difference between the final kinetic energy of the object found from the graph in Figure 1 and the final gravitational potential energy of the object-Earth system found from the graph in Figure 2.

(D) Calculate the magnitude of the difference between the final kinetic energy of the object found from the graph in Figure 1 and the initial gravitational potential energy of the object-Earth system found from the graph in Figure 2.

A ball is dropped and bounces off the floor. Its speed is the same immediately before and immediately after the collision.

6. How does the height to which the ball bounces compare to the height from which it was dropped?

(A) It is less.

(B) It is the same.

(C) It is greater.

(D) It cannot be determined without knowing the value of the height from which the ball was dropped.

(E) It cannot be determined without knowing the value of the ball's speed as it hits the floor.

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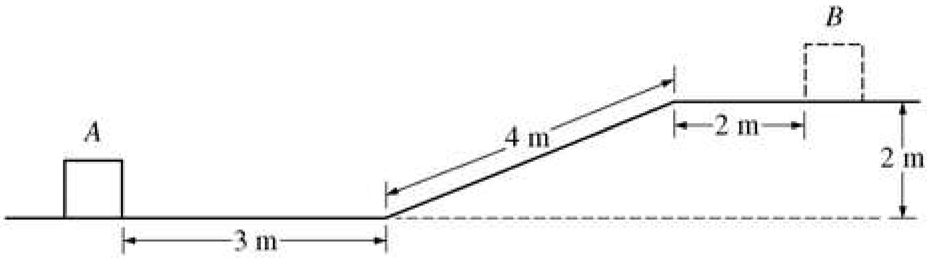
7.



A block of mass 10 kg moves from position *A* to position *B* shown in the figure above. The speed of the block is 10 m/s at *A* and 4.0 m/s at *B*. The work done by friction on the block as it moves from *A* to *B* is most nearly

(A) -280 J

(B) -220 J

(C) -200 J

(D) 0 J

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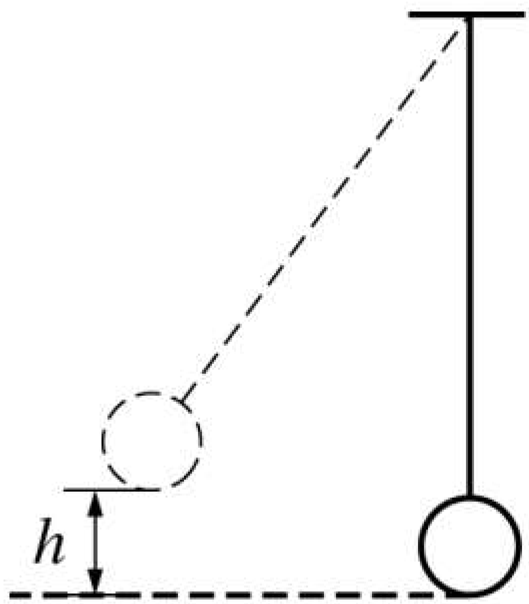
8.



The pendulum shown in the figure above reaches a maximum height h above the equilibrium position as it oscillates. Assuming friction and air resistance are negligible, which of the following is true about the total energy of the Earth-pendulum system as the pendulum oscillates?

(A) It is at a maximum when the pendulum is at its lowest position.

(B) It is at a maximum when the pendulum is at its maximum height h.

(C) It is constant throughout the pendulum's motion.

(D) It is at a minimum when the pendulum is somewhere between its lowest and highest positions.

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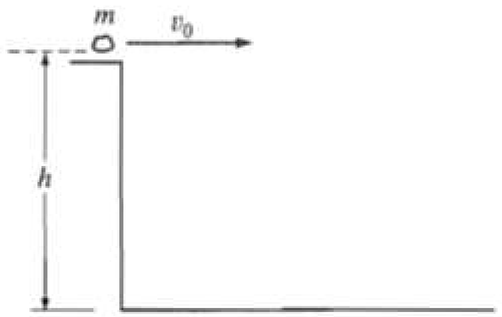

A rock of mass *m* is thrown horizontally off a building from a height *h,* as shown above. The speed of the rock as it leaves the thrower's hand at the edge of the building is v_o

9. What is the kinetic energy of the rock just before it hits the ground?

(A) *mgh*

(B) $\frac{1}{2}mv_0^2$

(C) $\frac{1}{2}mv_0^2 - mgh$

(D) $\frac{1}{2}mv_0^2 + mgh$

(E) $mgh - \frac{1}{2}mv_0^2$

Refer to the following material to give answers to the group of questions.

Three identical blocks each take a different path from a height *h* to the ground. Block *A* is released from rest and falls vertically. Block *B* is released from rest and slides down a frictionless incline. Block *C* is projected horizontally with an initial speed *v*.

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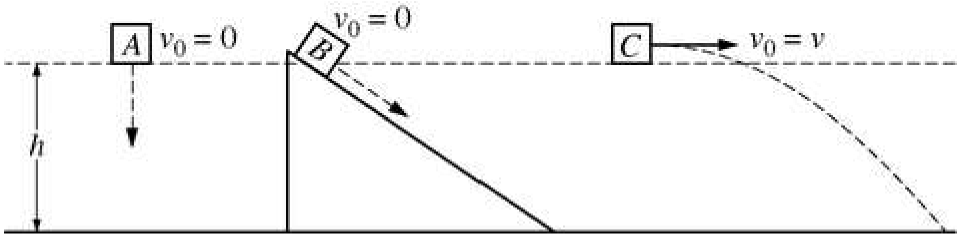

10. Which block has the greatest speed just before hitting the ground?

(A) A

(B) B

(C) C

(D) The blocks reach the ground with the same speed.

11. While traveling in its elliptical orbit around the Sun, Mars gains speed during the part of the orbit where it is getting closer to the Sun. Which of the following can be used to explain this gain in speed?

(A) As Mars gets closer to the Sun, the Mars–Sun system loses potential energy and Mars gains kinetic energy.

(B) A component of the gravitational force exerted on Mars is perpendicular to the direction of motion, causing an acceleration and hence a gain in speed along that direction.

(C) The torque exerted on Mars by the Sun during this segment of the orbit increases the Mars–Sun system's angular momentum.

(D) The centripetal force exerted on Mars is greater than the gravitational force during this segment of the orbit, causing Mars to gain speed as it gets closer to the Sun.