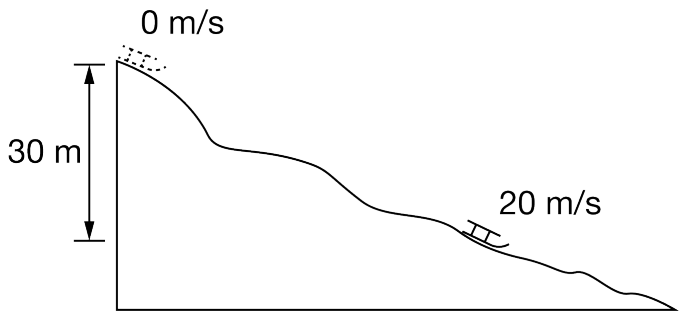
CHAPTER4PARTB

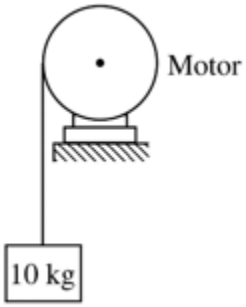
1.



A $6\ \text{kg}$ sled starts from rest at the top of a hill and slides down the hill, as shown above. As the sled passes through a point that is $30\ \text{m}$ vertically below its starting point, it has a speed of $20\ \text{m/s}$. How much mechanical energy was dissipated by frictional forces during the interval shown?

(A) $0\ \text{J}$
(B) $600\ \text{J}$
(C) $1200\ \text{J}$
(D) $1800\ \text{J}$

2.



A 10 kg block is attached to a light cord that is wrapped around the pulley of an electric motor, as shown above. At what rate is the motor doing work when it is pulling the block upward with an instantaneous speed of 3 m/s and an upward acceleration of 2 m/s^2 ?

(A) 120 W
(B) 240 W
(C) 300 W
(D) 360 W
(E) 600 W

3. A ball is dropped from rest and falls to the floor. The initial gravitational potential energy of the ball-Earth-floor system is 10 J. The ball then bounces back up to a height where the gravitational potential energy is 7 J. What was the mechanical energy of the ball-Earth-floor system the instant the ball left the floor?

(A) 0 J
(B) 3 J
(C) 7 J
(D) 10 J

CHAPTER4PARTB

4. A ball is tossed straight up and later returns to the point from which it was launched. If the ball is subject to air resistance as well as gravity, which of the following statements is correct?

(A) The speed at which the ball returns to the point of launch is less than its speed when it was initially launched.

(B) The time for the ball to fall is the same as the time for the ball to rise.

(C) The force of air resistance is directed down-ward both when the ball is rising and when it is falling.

(D) The net work done by air resistance on the ball during its flight is zero.

(E) The net work done by gravity on the ball during its flight is greater than zero.

5. An automobile traveling on a straight, level road has an initial speed *v* when the brakes are applied. In coming to rest with a constant acceleration, it travels a distance *x*. How far would the automobile travel in coming to rest if it had the same acceleration but an initial speed 2*v* ?

(A) $\frac{1}{4}x$

(B) $\frac{1}{2}x$

(C) x

(D) $2x$

(E) $4x$

6. A simple pendulum consists of a sphere tied to the end of a string of negligible mass. The sphere is pulled back until the string is horizontal and then released from rest. Assume gravitational potential energy is zero when the sphere is at its lowest point. What angle will the string make with the horizontal when the kinetic energy and the potential energy of the sphere-Earth system are equal?

(A) Greater than 45°

(B) Equal to 45°

(C) Less than 45°

(D) It cannot be determined without knowing the mass of the sphere.

7. A nonrotating spherical planet with no atmosphere has mass *M* and radius *R*. A projectile of mass *m* is launched radially from the surface of the planet with initial speed $v = \sqrt{GM/2R}$. The potential energy of the projectile-planet system, as a function of the projectile's distance *r* from the center of the planet, is given by *U* = - *GMm/ r*. The greatest distance from the center of the planet that the projectile reaches is

(A) infinity

(B) R

(C) $\frac{7}{5}R$

(D) $\frac{4}{3}R$

(E) $\sqrt{2}R$

8. A rocket is continuously firing its engines as it accelerates away from Earth. For the first kilometer of its ascent, the mass of fuel ejected is small compared to the mass of the rocket. For this distance, which of the following indicates the changes, if any, in the kinetic energy of the rocket, the gravitational potential energy of the Earth-rocket system, and the mechanical energy of the Earth-rocket system?

CHAPTER4PARTB

(A)

Rocket Kinetic Energy	System Gravitational Potential Energy	System Mechanical Energy
Increasing	Increasing	Increasing

(B)

Rocket Kinetic Energy	System Gravitational Potential Energy	System Mechanical Energy
Increasing	Increasing	Constant

(C)

Rocket Kinetic Energy	System Gravitational Potential Energy	System Mechanical Energy
Increasing	Decreasing	Decreasing

(D)

Rocket Kinetic Energy	System Gravitational Potential Energy	System Mechanical Energy
Decreasing	Increasing	Constant

9. A sled slides down a hill with friction between the sled and hill but negligible air resistance. Which of the following must be correct about the resulting change in energy of the sled-Earth system?

(A) The sum of the kinetic energy and the gravitational potential energy changes by an amount equal to the energy dissipated by friction.

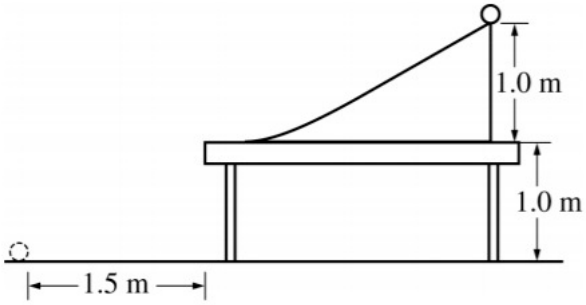
(B) The gravitational potential energy decreases and the kinetic energy is constant.

(C) The decrease in the gravitational potential energy is equal to the increase in kinetic energy.

(D) The gravitational potential energy and the kinetic energy must both decrease.

CHAPTER4PARTB

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.

10. A sphere with the same mass and radius as the original cylinder, but a smaller rotational inertia, is released from rest from the top of the ramp. K_S and K_C are the sphere's and the cylinder's total kinetic energy at the bottom of the ramp, respectively. How do K_S and K_C compare, and why?

(A) $K_S < K_C$, because the sphere will gain less rotational kinetic energy.

(B) $K_S < K_C$, because the sphere has a greater acceleration and therefore has less time to gain kinetic energy.

(C) $K_S = K_C$, because both objects accelerate at the same rate.

(D) $K_S = K_C$, because the gravitational force does equal work on each object as it rolls down the ramp.

11. 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?

CHAPTER4PARTB

(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

---

12. An asteroid orbits the Sun in a highly elliptical orbit. As the asteroid gets closer to the Sun, how are the total mechanical energy and the gravitational potential energy of the asteroid-Sun system changing, if at all?

CHAPTER4PARTB

(A)

Total Mechanical Energy	Gravitational Potential Energy
Not changing	Not changing

(B)

Total Mechanical Energy	Gravitational Potential Energy
Not changing	Decreasing

(C)

Total Mechanical Energy	Gravitational Potential Energy
Increasing	Not changing

(D)

Total Mechanical Energy	Gravitational Potential Energy
Increasing	Decreasing

13. A student is asked to determine the work done on a block of wood when the block is pulled horizontally using an attached string. The student is supplied with a spring scale, a stopwatch, and a meterstick. Which of the following graphical analysis techniques will allow the student to determine the work done on the block by the string?

(A) Graphing the force as a function of time and calculating the slope

(B) Graphing the force as a function of time and calculating the area under the curve

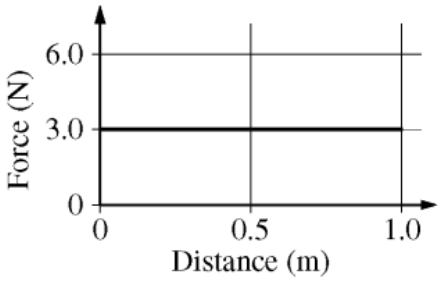
(C) Graphing the force as a function of distance and calculating the slope

(D) Graphing the force as a function of distance and calculating the area under the curve

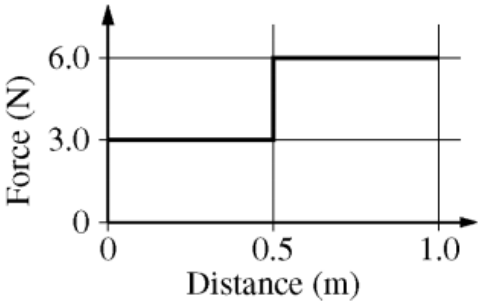
14. A student uses a spring scale to exert a horizontal force on a block, pulling the block over a smooth floor. The student repeats the procedure several times, each time pulling the block from rest through a distance of 1.0 m. For which of the following graphs of force as a function of distance will the block be moving the fastest at the end of the 1.0 m?

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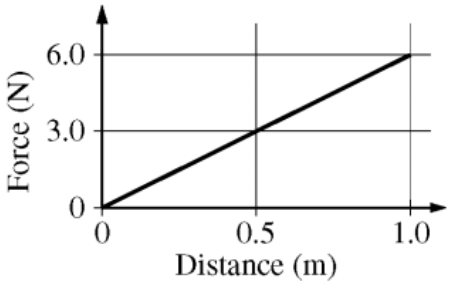
(A)



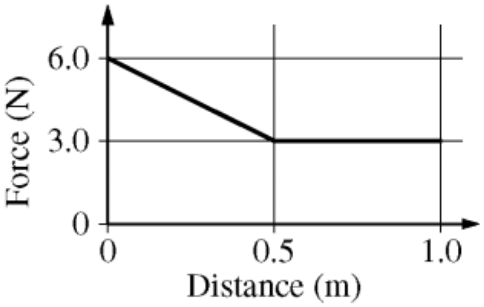
(B)



(C)

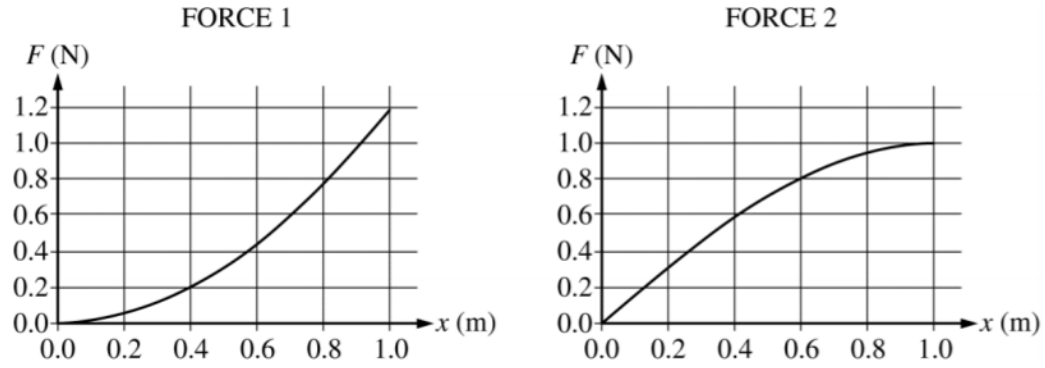


(D)



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15.



The graphs above show the magnitude F of a force exerted on an object as a function of the object's position x for two trials in an experiment. W_1 and W_2 are the work done on the object by force 1 and force 2, respectively. How do W_1 and W_2 compare, and why?

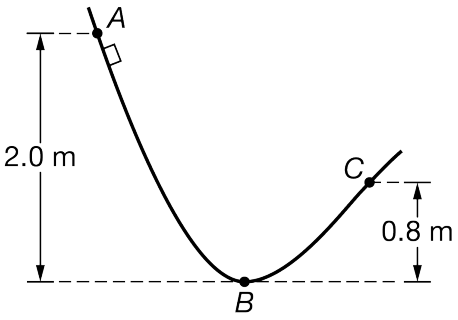
(A) $W_1 > W_2$, because the maximum value of force 1 is greater than the maximum value of force 2.

(B) $W_1 > W_2$, because the slope of force 1's graph increases, while the slope of force 2's graph decreases.

(C) $W_1 < W_2$, because the average value of force 1 is smaller than the average value of force 2.

(D) $W_1 < W_2$, because at the midpoint, $x = 0.5$ m , the value of force 1 is less than the value of force 2.

16.



A 1.0 kg block can slide along the frictionless track shown above. A student moves the block along the track so that the block has the same speed at point A, point B, and point C. The work done by the student on the block as it moves from A to C is most nearly

(A) $+28$ J

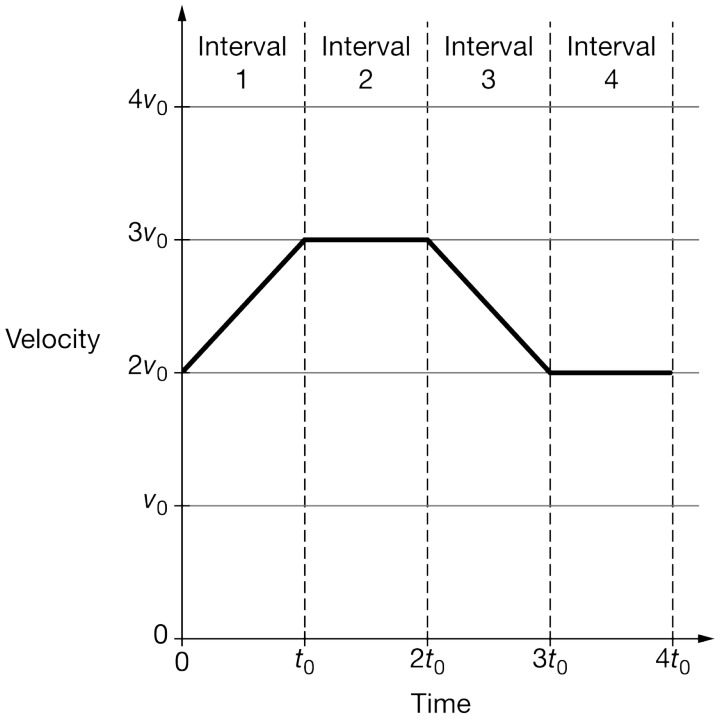
(B) $+8$ J

(C) -12 J

(D) -20 J

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17.



Interval	Mechanical Energy Dissipated due to Friction
1	0
2	W_2
3	W_3
4	W_4

A block slides down an inclined plane whose roughness varies. Only during time interval 1 does the block slide with negligible friction. The coefficient of kinetic friction during time interval 3 is twice the coefficient of kinetic friction during time interval 2. The graph shows the block's velocity as a function of time. The table lists the mechanical energy dissipated due to friction over the different time intervals. Which of the following claims is true?

(A) $|W_4| > |W_3| > |W_2|$

(B) $|W_2| = |W_3| = |W_4|$

(C) $|W_3| > |W_2| > |W_4|$

(D) $(|W_2| = |W_4|) > |W_3|$

18. A block of unknown mass on a horizontal table is held at rest against a compressed horizontal spring. The block is launched by the spring and slides a short distance before coming to rest. Which of the following quantities can be used together to determine the amount of mechanical energy dissipated by friction after the block is released from rest? Select two answers.

CHAPTER4PARTB

A The spring constant of the spring

B The frictional force exerted by the table on the block

C The speed of the block after it loses contact with the spring

D The total distance that the block moves



Figure 1

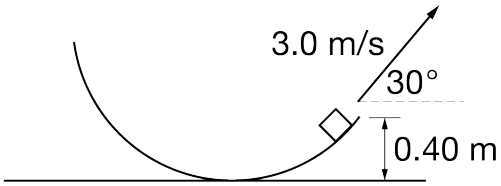


Figure 2

Note: Figures not drawn to scale.

The figures above show a small block of mass $0.20\ \text{kg}$ on a track in the shape of a circular arc. The block is released from rest at a height H above the floor, as shown in Figure 1. The block slides along the track with negligible friction and leaves it at a height of $0.40\ \text{m}$ above the floor and a speed of $3.0\ \text{m/s}$ at a 30° angle, as shown in Figure 2.

19. The height H is most nearly

(A) $0.45\ \text{m}$

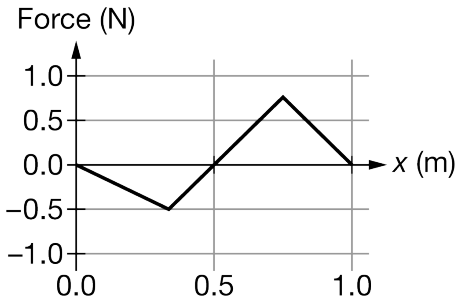
(B) $0.51\ \text{m}$

(C) $0.86\ \text{m}$

(D) $1.7\ \text{m}$

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20.



A cart is traveling in the positive direction with speed v_0 on a horizontal, frictionless track when it reaches position $x = 0$. The graph above shows the net horizontal force exerted on the cart as a function of position between $x = 0$ and $x = 1\ \text{m}$. The cart's speed at $x = 1\ \text{m}$ is v_f.

How does v_f compare to v_0 ?

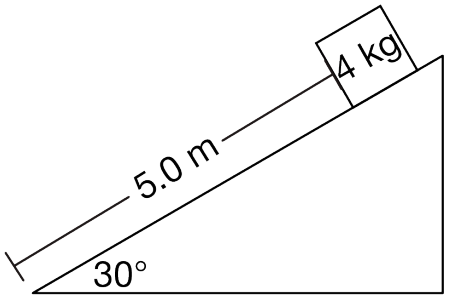
(A) $v_f > v_0$

(B) $v_f = v_0$

(C) $v_f < v_0$

(D) The relationship cannot be determined without knowing the numerical value of v_0.

21.



A $4\,\text{kg}$ block is pushed up an incline that makes a 30^o angle with the horizontal, as shown in the figure. Once the block is pushed a distance of $d = 5.0\ \text{m}$ up the incline, the block remains at rest. What is the approximate change in the gravitational potential energy of the block-Earth system when the block is held at rest compared to its original location at the bottom of the incline?

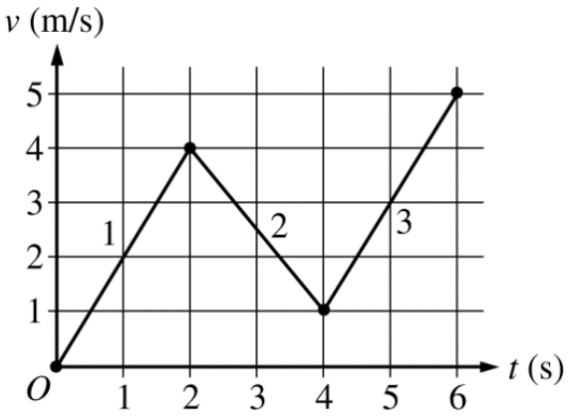
(A) $0\ \text{J}$

(B) $100\ \text{J}$

(C) $100\sqrt{3}\ \text{J}$

(D) $200\ \text{J}$

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The graph above shows velocity v as a function of time t for a 0.50 kg object traveling along a straight line. The graph has three segments labeled 1, 2, and 3. A rope exerts a constant force of magnitude F_T on the object along its direction of motion the whole time. During segment 2 only, a frictional force of magnitude F_f is also exerted on the object.

22. For another identical object initially at rest, no frictional force is exerted during segment 2 (between $t = 2$ s and $t = 4$ s). A rope exerts the same constant force of magnitude F_T as in the previous scenario. What is the change in the object's kinetic energy during segment 2?

(A) 3.75 J

(B) 4.00 J

(C) 12.0 J

(D) 16.0 J

23.

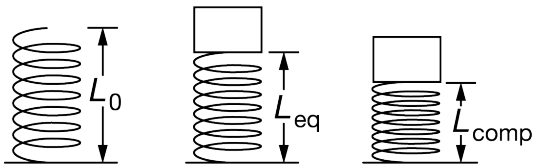


Figure 1 Figure 2 Figure 3

A vertical spring has unstretched length L_0, as shown in Figure 1. A block is attached to the top of the spring and slowly lowered until it is at rest and the spring has length L_{eq}, as shown in Figure 2. The block is then pushed down until the spring is compressed to length L_{comp}, as shown in Figure 3, and then released. After release, at what height will the kinetic energy of the block be maximum?

(A) L_0

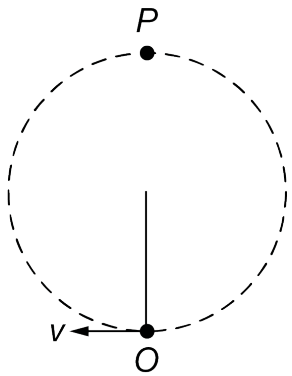
(B) L_{eq}

(C) L_{comp}

(D) $\frac{(L_{eq}+L_{comp})}{2}$

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24.



Side View

An object of mass M is attached to a string of negligible mass and spun in a vertical circle of radius R, as shown in the figure above. As the object's height increases, its speed decreases such that the object-Earth system's total mechanical energy remains constant. By how much does the object's kinetic energy decrease in moving from point O, the lowest point on the circle, to point P, the highest point on the circle?

(A) $\frac{1}{2}MgR$

(B) MgR

(C) $\sqrt{2}MgR$

(D) $2MgR$

25. An object is released from rest near and above Earth's surface from a distance of $10\ \text{m}$. After applying the appropriate kinematic equation, a student predicts that it will take $1.43\ \text{s}$ for the object to reach the ground with a speed of $14.3\ \text{m/s}$. After performing the experiment, it is found that the object reaches the ground after a time of $3.2\ \text{s}$. How should the student determine the actual speed of the object when it reaches the ground? Assume that the acceleration of the object is constant as it falls.

(A) Use $v_y = v_{y0} + a_y t$ but use the new time rather than $1.43\ \text{s}$ and the vertical acceleration equal to g since all other quantities are known. Solve for v_y .

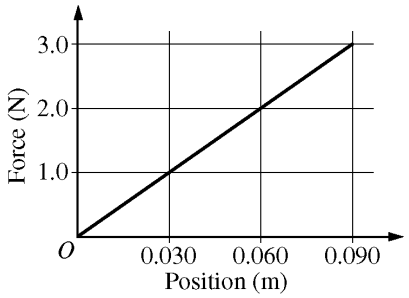
(B) Use $v_y^2 = v_{y0}^2 + 2a_y(y - y_0)$ with the vertical acceleration equal to g since all other quantities are known. Solve for v_y .

(C) Use $mgy_0 = \frac{1}{2}mv_f^2$ since the conservation of mechanical energy applies in this scenario, and the initial height above the ground is known. Solve for v_y .

(D) Use $y = y_0 + v_{y0}t + \frac{1}{2}a_y t^2$ to determine the acceleration of the object as it falls since all other quantities are known. Then use $mgy_0 - W_{\text{External}} = \frac{1}{2}mv_f^2$ with $W_{\text{External}} = ma_y(y_f - y_0)$ since all other quantities are known. Solve for v_y .

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26.



The figure above shows the net force exerted on an object as a function of the position of the object. The object starts from rest at position $x = 0$ m and acquires a speed of 3.0 m / s after traveling a distance of 0.090 m. What is the mass of the object?

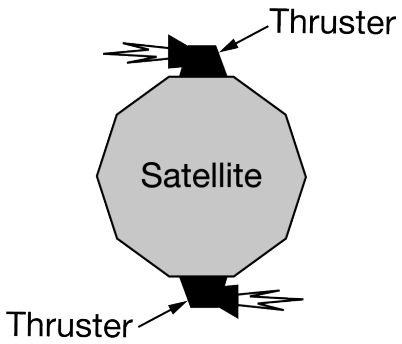
(A) 0.015 kg

(B) 0.030 kg

(C) 0.045 kg

(D) 0.060 kg

27.



A satellite in a circular orbit around Earth is initially not rotating with respect to its center of mass. Two identical thrusters on opposite sides of the satellite fire in opposite directions over the same 10-minute time interval, as shown above, and then turn off. How does the firing of the thrusters affect the mechanical energy of the satellite-Earth system and the shape of the satellite's orbit, if at all?

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(A)

Mechanical Energy of Satellite-Earth System	Shape of Orbit
No effect	No effect

(B)

Mechanical Energy of Satellite-Earth System	Shape of Orbit
No effect	Would change

(C)

Mechanical Energy of Satellite-Earth System	Shape of Orbit
Increases	No effect

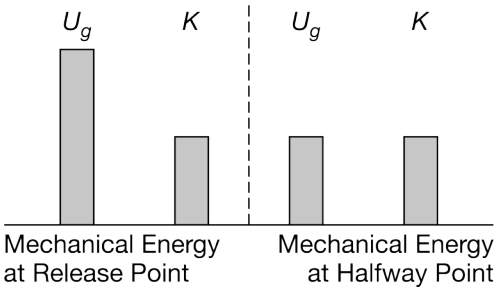
(D)

Mechanical Energy of Satellite-Earth System	Shape of Orbit
Increases	Would change

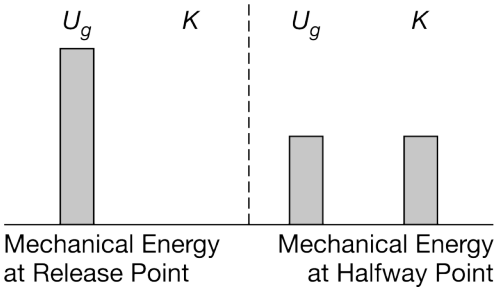
28. An object initially at rest falls from a height H until it reaches the ground. Two of the following energy bar charts represent the kinetic energy K and gravitational potential energy U_g of the object-Earth system at two positions. The first position is when the object is initially released, and the second position is when the object is halfway between its release point and the ground. Which two charts could represent the mechanical energy of the object-Earth system? Select two answers.

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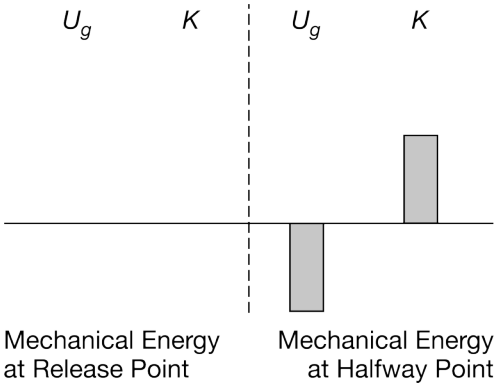
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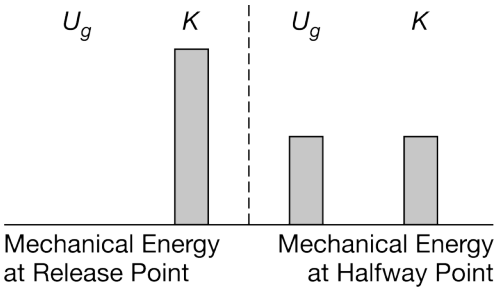
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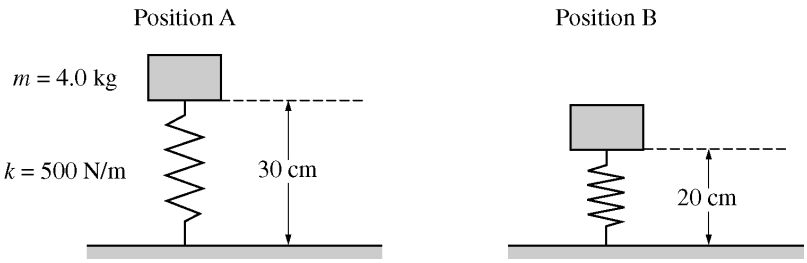


D



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29.



A person holds a 4.0 kg block at position A shown above on the left, in contact with an uncompressed vertical spring with a spring constant of 500 N/m. The person gently lowers the block from rest at position A to rest at position B. Which of the following describes the change in the energy of the block-spring-Earth system as a result of the block being lowered?

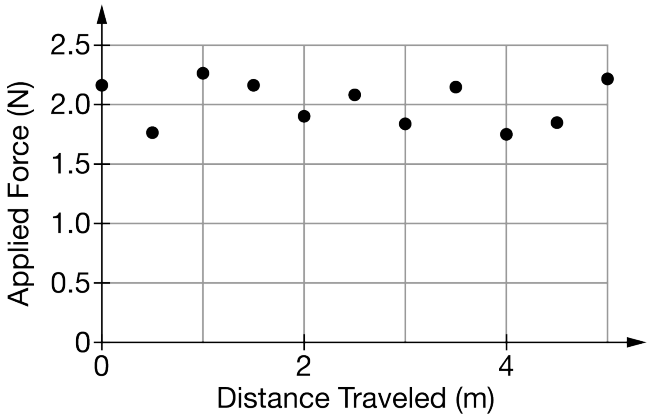
(A) The energy decreases by approximately 1.5 J.

(B) The energy decreases by approximately 2.5 J.

(C) The energy increases by approximately 4.0 J.

(D) The energy of the system does not change.

30.



An experiment is conducted such that an applied force is exerted on a $5\ \text{kg}$ object as it travels across a horizontal surface in which frictional forces are NOT considered to be negligible. A graph of the net force exerted on the object as a function of the object's distance traveled is shown. How could a student use the graph to determine the net work done on the object?

(A) Multiply the average value of the applied force by the total distance the object traveled.

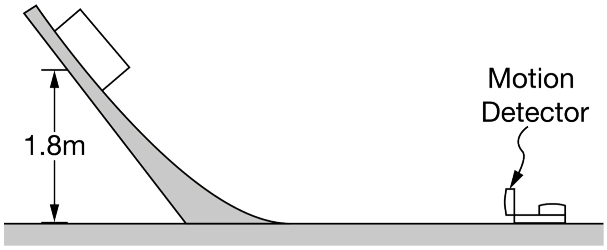
(B) Multiply the slope of the best fit line by the total distance the object traveled.

(C) Calculate the area bound by the line of best fit and the horizontal axis from $0\ \text{m}$ to $5\ \text{m}$.

(D) There is not enough information that is known or can be obtained from the graph to determine the net work done on the object.

CHAPTER4PARTB

31.



The surface of an incline is coated with an experimental substance that is intended to reduce the frictional force between a block and the surface of the incline. A $2\ \text{kg}$ block is placed at the top of the incline at a height of $1.8\ \text{m}$, as shown in the figure. After the block is released from rest, the block slides down the incline and a motion detector at the bottom of the incline measures the block's speed as $5.8\ \frac{\text{m}}{\text{s}}$ after the block is no longer on the incline. Which of the following claims is correct about the experimental substance?

(A) The experimental substance reduced all the frictional force because all the gravitational potential energy of the Earth-block system at the top of the incline was converted into the kinetic energy of the block at the bottom of the incline.

(B) The experimental substance did not reduce all the frictional force because some of the gravitational potential energy of the Earth-block system at the top of the incline was converted into nonmechanical energy.

(C) The effectiveness of the experimental substance cannot be determined because the speed of the block at the bottom of the inline, as measured by the motion detector, indicates that the block has more energy at this location than the Earth-block system had at the top of the incline.

(D) The effectiveness of the experimental substance cannot be determined without knowing the magnitude of the frictional force between the block and the incline before and after the experimental substance was applied to the incline.

32. 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.

33. A block is initially at rest at the bottom of a ramp. A student pulls the block along the ramp to the top of the ramp using a string. Frictional forces are negligible. The student measures the mass of the block and the speed of the block at the top of the ramp. Which of the following lists the fewest additional measurements required to estimate the total work done on the block as it moves from the bottom of the ramp to the top of the ramp?

CHAPTER4PARTB

(A) No additional measurements necessary

(B) The distance the block travels along the ramp

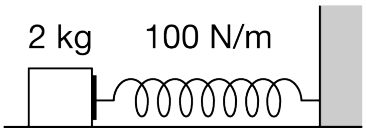
(C) The distance the block travels along the ramp

The force exerted on the block by the string as the block travels up the ramp

(D) The distance the block travels along the ramp

The force exerted on the block by the string as the block travels up the ramp

The angle of the ramp with the horizontal



A student is conducting an experiment to analyze the mechanical energy of a block-spring system. The student places a block of mass $2\ \text{kg}$ on a horizontal surface and attaches the block to a horizontal spring of negligible mass and spring constant $100\ \text{N/m}$, 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.

34. 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?

(A) Force probe and meterstick

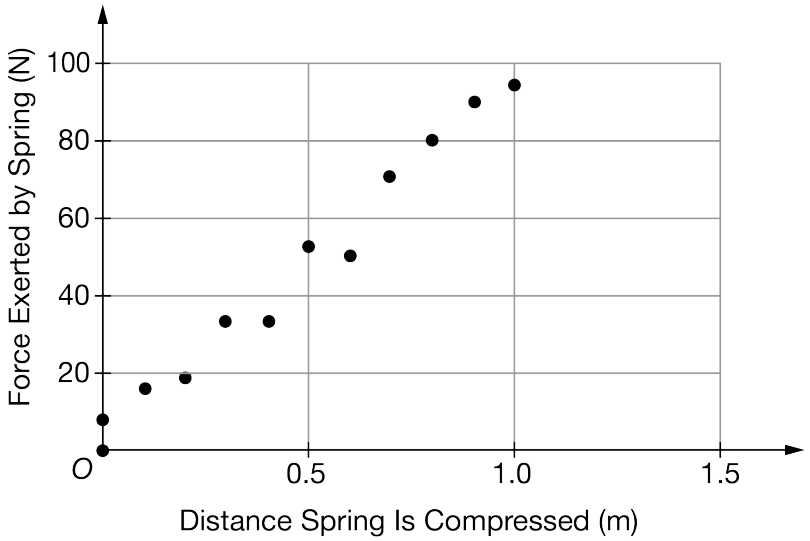
(B) Stopwatch and meterstick

(C) Stopwatch and force probe

(D) Force probe, stopwatch, and meterstick

CHAPTER4PARTB

35.



Based on data collected from the experiment, the student creates the graph that shows the force exerted on the spring as a function of the distance the spring is compressed. How can the student use the data to experimentally determine the work done on the spring by the block?

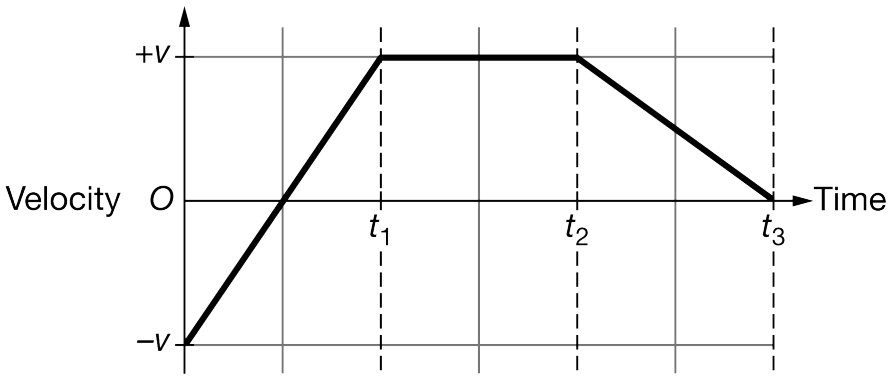
(A) Determine the slope of the line of best fit through the data from $0.0\ \text{m}$ to $1.0\ \text{m}$.

(B) Determine the area bound by the line of best fit through the data and the horizontal axis from $0.0\ \text{m}$ to $1.0\ \text{m}$.

(C) Use the maximum value of the force exerted on the spring and multiply that value by the maximum distance that the spring is compressed.

(D) This graph cannot be used to determine the work done by the block on the spring because the force exerted on the spring by the block is not constant.

36.



A box experiences a varying net force that changes its velocity. The graph shows the velocity of the box as a function of time.

Which of the following correctly describes the net work, W_{net}, done on the box for the given intervals of time?

CHAPTER4PARTB

(A)

Between 0 and t_1	**Between t_1 and t_2**	**Between t_2 and t_3**
$W_{\text{net}} > 0$	$W_{\text{net}} = 0$	$W_{\text{net}} < 0$

(B)

Between 0 and t_1	**Between t_1 and t_2**	**Between t_2 and t_3**
$W_{\text{net}} = 0$	$W_{\text{net}} > 0$	$W_{\text{net}} > 0$

(C)

Between 0 and t_1	**Between t_1 and t_2**	**Between t_2 and t_3**
$W_{\text{net}} = 0$	$W_{\text{net}} = 0$	$W_{\text{net}} < 0$

(D)

Between 0 and t_1	**Between t_1 and t_2**	**Between t_2 and t_3**
$W_{\text{net}} > 0$	$W_{\text{net}} > 0$	$W_{\text{net}} > 0$

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37.

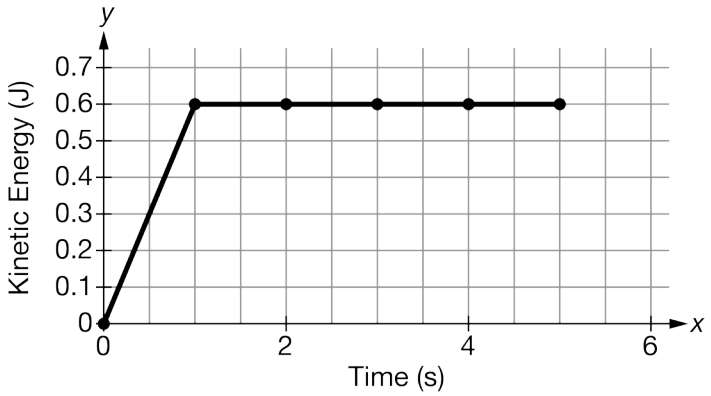


Figure 1

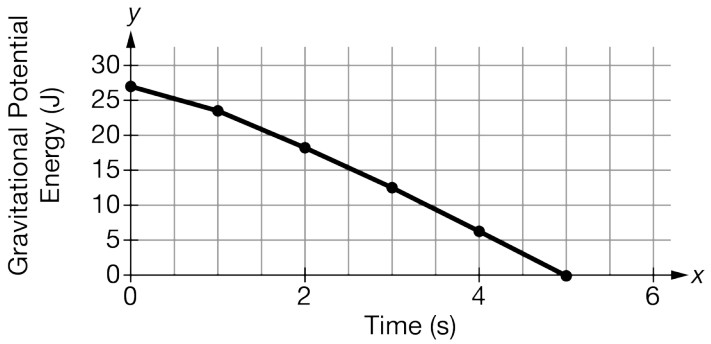


Figure 2

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 $5\ \text{s}$?

(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.

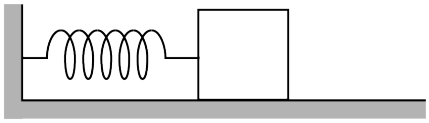
(B) Calculate the magnitude of the difference between the final gravitational potential energy of the system and the initial gravitational potential energy of the system by using the graph in Figure 2.

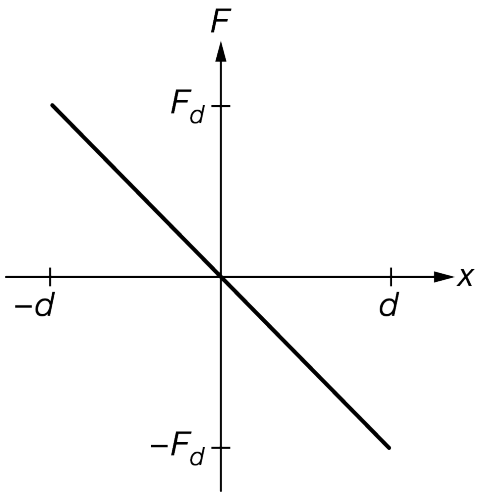
(C) Calculate the magnitude of the difference between the final kinetic energy of the object found from the graph in Figure 1 and the final gravitational potential energy of the object-Earth system found from the graph in Figure 2.

(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.

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38.





A block attached to a spring slides along a straight track with negligible friction, as shown in the figure above. The graph shows the force F exerted by the spring on the block as a function of the block's displacement x from equilibrium. The block is displaced a distance d to the right and released from rest. Which of the following are correct statements about the work done by the spring on the block between the moment of release and the moment it next comes to rest? Select two answers.

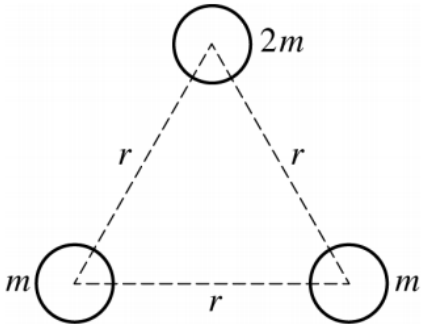
A The work done is zero.

B The work done is $F_d \times d$.

C The work done is the area under the graph between $x = -d$ and $x = d$.

D The work done is twice the area under the graph between $x = 0$ and $x = d$.

39.



Three spheres, with masses indicated above, are initially far away from each other, and the gravitational potential energy of the three-sphere system is zero. The spheres are then brought together until each sphere is a distance *r* from the other two, as shown above. What is the new gravitational potential energy of the three-sphere system?

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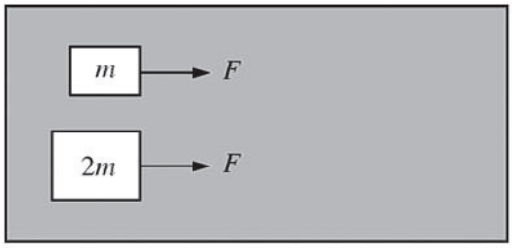
(A) $-\frac{Gm^2}{r}$

(B) $-\frac{2Gm^2}{r}$

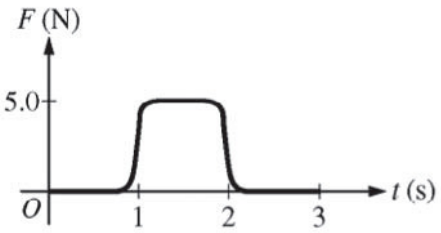
(C) $-\frac{4Gm^2}{r}$

(D) $-\frac{5Gm^2}{r}$

40.



Top View



Two blocks, of mass m and $2m$, are initially at rest on a horizontal frictionless surface. A force F is exerted individually on each block, as shown above. The graph shows how F varies with time t. Which block has the greatest average power provided to it between $t = 0$ s and $t = 3$ s?

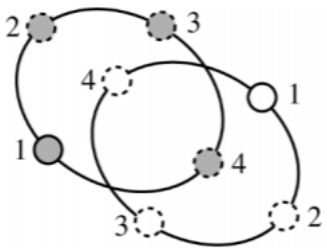
(A) The block of mass m

(B) The block of mass $2m$

(C) Both blocks have the same power provided to them.

(D) It cannot be determined without knowing the ratio of the maximum force to the mass m.

41.



The figure above shows the paths of two stars of equal mass as they orbit their common center of mass. The positions of the stars at four different times are labeled in the figure. At which of the positions do the stars have their greatest speed?

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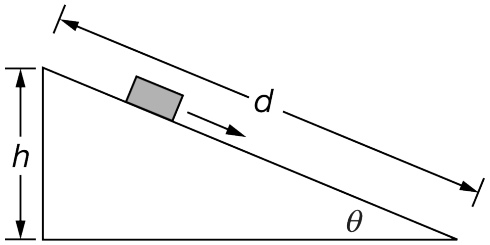
(A) Position 2 only

(B) Position 4 only

(C) Positions 1 and 3 only

(D) All of the positions, since the stars move with constant speed

42.



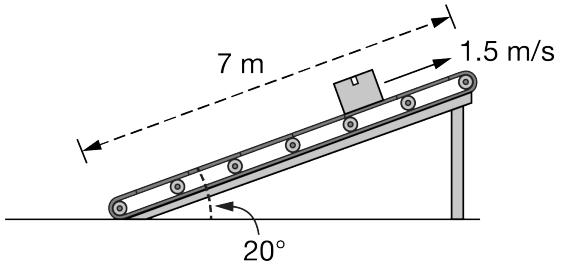
A box of mass m slides a distance d down a rough incline from an initial height h, as shown in the figure above. The surface of the incline has a coefficient of kinetic friction μ and makes an angle θ with the horizontal. How much mechanical energy is dissipated as the box slides to the bottom of the incline?

(A) $\mu dmg \cos \theta$

(B) $\mu dmg \sin \theta$

(C) μmgh

(D) μmgd



A conveyor belt ramp of length $7\ \text{m}$ is inclined at 20° with respect to the horizontal and is used to move objects from one location to another location. When an object is placed on the conveyor belt, the object travels up the incline with a constant speed of $1.5\ \frac{\text{m}}{\text{s}}$. A motor is used to keep the conveyor belt moving. The mass of the objects that are placed on the conveyor belt are varied.

43. Suppose the motor breaks and a person must push an object of mass $30\ \text{kg}$ from the bottom of the incline to the top of the incline. The person can exert a force of $150\ \text{N}$ on the object parallel to the incline. What is the approximate amount of work that the person does on the object to move it to the top of the incline? Assume that all frictional forces are negligible.

(A) $0\ \text{J}$

(B) $1050\ \text{J}$

(C) $658\ \text{J}$

(D) $239\ \text{J}$

CHAPTER4PARTB

44. For the system that only includes the object, which of the following claims best describes what happens to the mechanical energy of the system while the object is moving from the bottom of the ramp to the top of the ramp?

(A) The mechanical energy of the object increases because the gravitational potential energy increases as the object moves up the ramp.

(B) The mechanical energy of the object decreases because the force due to gravity from Earth does negative work on the object as it moves up the ramp.

(C) The mechanical energy of the object is constant because the kinetic energy of the object is constant.

(D) A determination of the change of the mechanical energy of the object cannot be made without knowing the power of the motor that is used to move the conveyor belt.

45. Object X and object Y are placed on the incline such that the motor moves the conveyor belt. The mass of object X is greater than the mass of object Y. After both objects have been placed on the conveyor belt and travel at a constant speed, how does the rate of change of the gravitational potential energy of the object X–Earth system per unit of time $\frac{\Delta U_{\mathrm{gX}}}{\Delta t}$ compare to that for the object Y–Earth system $\frac{\Delta U_{\mathrm{gY}}}{\Delta t}$?

(A) $\frac{\Delta U_{\mathrm{gX}}}{\Delta t} = \frac{\Delta U_{\mathrm{gY}}}{\Delta t} = 0 \ \frac{\mathrm{J}}{\mathrm{s}}$, because the speed of the conveyor belt remains constant and both objects move at the same constant speed.

(B) $\frac{\Delta U_{\mathrm{gX}}}{\Delta t} = \frac{\Delta U_{\mathrm{gY}}}{\Delta t} \neq 0 \ \frac{\mathrm{J}}{\mathrm{s}}$, because the speed of the conveyor belt remains constant and both objects move at a constant speed.

(C) $\frac{\Delta U_{\mathrm{gX}}}{\Delta t} > \frac{\Delta U_{\mathrm{gY}}}{\Delta t}$, because object X has a greater mass than object Y.

(D) $\frac{\Delta U_{\mathrm{gX}}}{\Delta t} < \frac{\Delta U_{\mathrm{gY}}}{\Delta t}$, because object X has a greater mass than object Y.

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46.

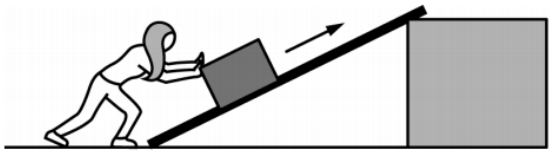


Figure 1

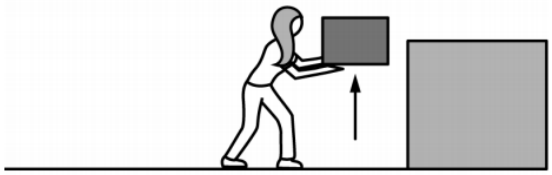


Figure 2

A student is asked to move a box from ground level to the top of a loading dock platform, as shown in the figures above. In Figure 1, the student pushes the box up an incline with negligible friction. In Figure 2, the student lifts the box straight up from ground level to the loading dock platform. In which case does the student do more work on the box, and why?

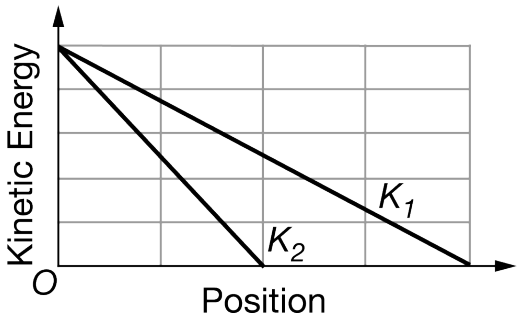
(A) Lifting the box straight up, because it requires a larger applied force to lift it straight up

(B) Pushing the box up the incline, because the force is applied for a longer distance

(C) Lifting the box straight up, because the incline acts as a simple machine and reduces the force required

(D) Neither method, because the work is the same in both cases, since using the ramp decreases the force by the same factor that it increases the distance

47.



Two blocks of the same mass but made of different material slide across a horizontal, rough surface and eventually come to rest. A graph of the kinetic energy of each block as a function of position along the surface is shown. Which of the following is a true statement about the frictional force F_f that is exerted on the two blocks?

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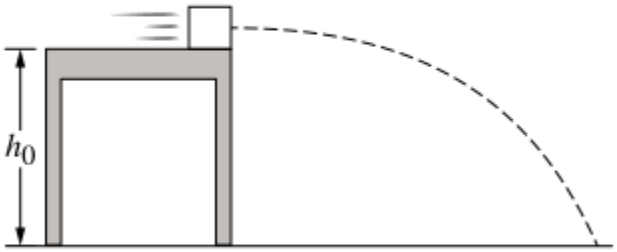
(A) $F_{f2} = 2F_{f1}$, since the force of friction is represented as the slope for each of the two curves.

(B) $F_{f2} = \frac{1}{2}F_{f1}$, since the force of friction is represented as the inverse slope for each of the two curves.

(C) $F_{f2} = 2F_{f1}$, since the force of friction is represented as the inverse of the area bound by each curve and the horizontal axis.

(D) $F_{f2} = \frac{1}{2}F_{f1}$, since the force of friction is represented as the area bound by each curve and the horizontal axis.

48.



A block is launched horizontally from a table with speed v_0 at time $t = 0$. The table is a distance h_0 above the ground. Which of the following represents the kinetic energy K of the block and the potential energy U of the block-Earth system as functions of time t as the block falls toward the ground?

	K	U
A	$\frac{m_0}{2}\left({v_0}^2 - g^2t^2\right)$	$m_0g\left(h_0 + \frac{gt^2}{2}\right)$
B	$\frac{m_0}{2}\left({v_0}^2 - g^2t^2\right)$	$m_0g\left(h_0 - \frac{gt^2}{2}\right)$
C	$\frac{m_0}{2}\left({v_0}^2 + g^2t^2\right)$	$m_0g\left(h_0 + \frac{gt^2}{2}\right)$
D	$\frac{m_0}{2}\left({v_0}^2 + g^2t^2\right)$	$m_0g\left(h_0 - \frac{gt^2}{2}\right)$

(A) A

(B) B

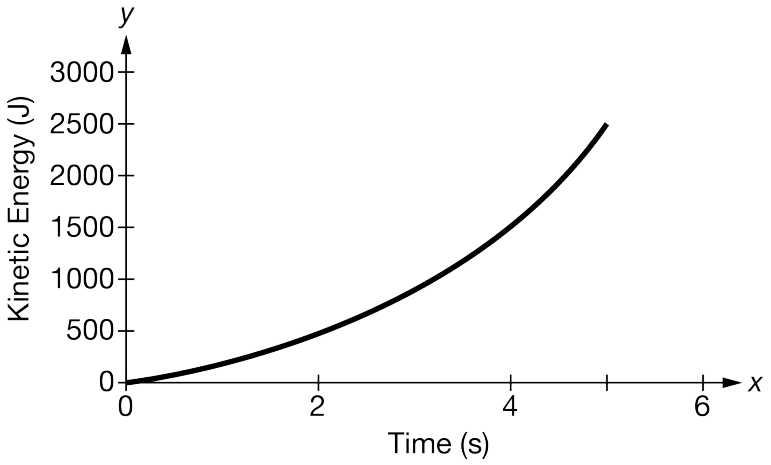
(C) C

(D) D

A student conducts an experiment in which an object is released from rest above a motion detector so that data can be collected about the object's motion as the object falls to the ground. The experiment is conducted near Earth's surface. All frictional forces are considered to be negligible unless otherwise stated.

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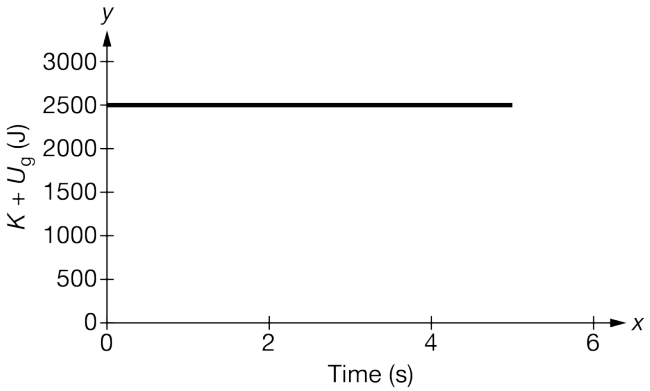
49.



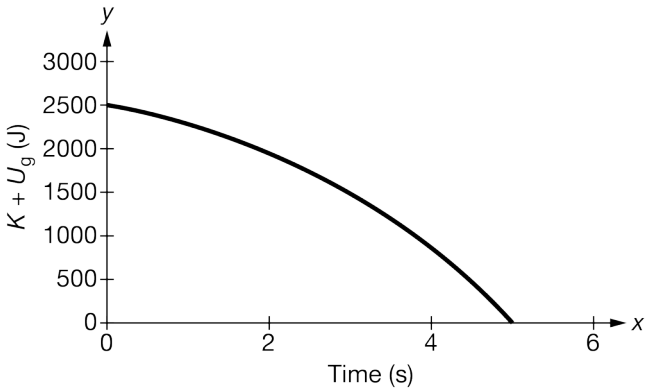
The student collects the data necessary to graph the object's kinetic energy as a function of time, as shown. Which of the following graphs represents the sum of the kinetic energy K and gravitational potential energy U_g of the object-Earth system as a function of time?

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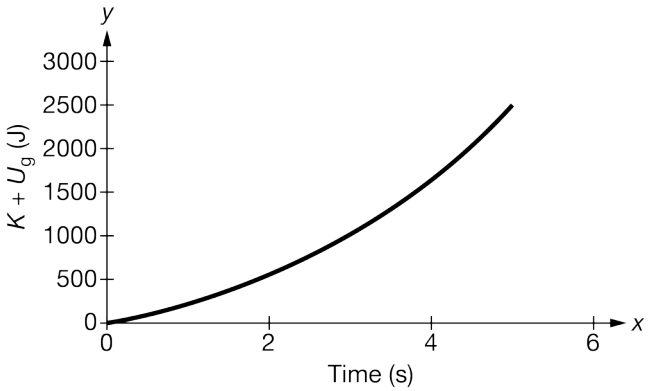
(A)



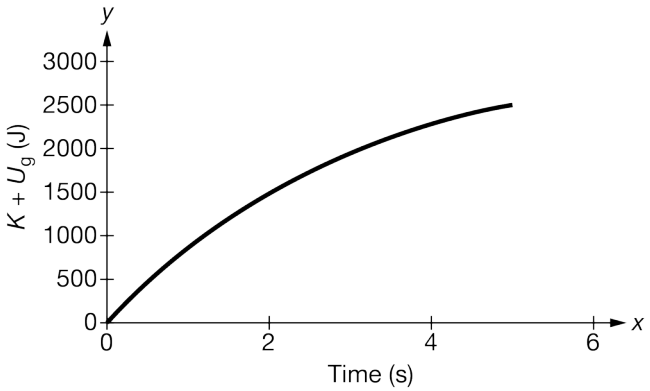
(B)



(C)



(D)



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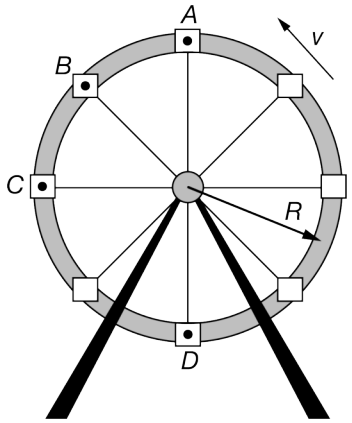
50. The student wants to collect data to determine the work done by the force due to gravity on the object as it falls. Which of the following lists contains the fewest number of measuring devices, in addition to the motion detector, that the student can use?

(A) Spring scale

(B) Spring scale and meterstick

(C) Stopwatch and meterstick

(D) Spring scale, meterstick, and stopwatch



An amusement park ride consists of a large vertical wheel of radius R that rotates counterclockwise on a horizontal axis through its center, as shown above. The cars on the wheel move at a constant speed v. Points A and D represent the position of a car at the highest and lowest point of the ride, respectively. A person of weight F_g sits upright on a seat in one of the cars. As the seat passes point A, the seat exerts a normal force with magnitude $0.8F_g$ on the person. While passing point A, the person releases a small rock of mass m, which falls to the ground without hitting anything.

51. The kinetic energy of the rock when it is at the same height as point D is most nearly

(A) $\frac{1}{2}mv^2$

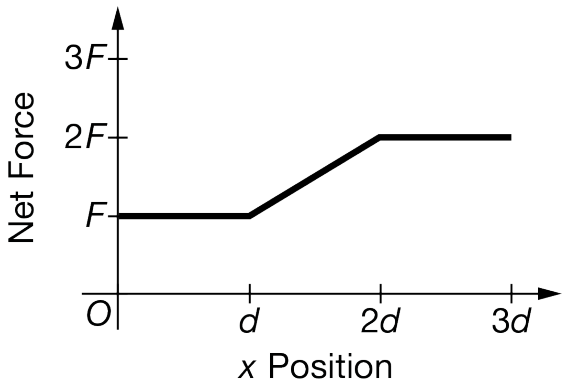
(B) $\frac{1}{2}2mgR$

(C) $\frac{1}{2}4mgR$

(D) $\frac{1}{2}m\left(v^2+4gR\right)$

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52.



A graph of the net force F exerted on an object as a function of x position is shown for the object of mass M as it travels a horizontal distance $3d$. Which expression represents the change in the kinetic energy of the object?

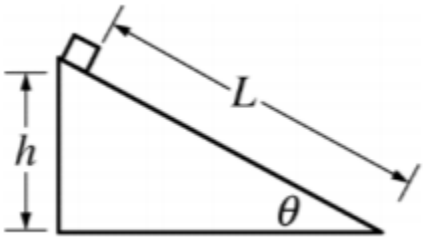
(A) $3Fd$

(B) $3.5Fd$

(C) $4.5Fd$

(D) $6Fd$

53.



A box of mass *m* is initially at rest at the top of a ramp that is at an angle θ with the horizontal. The block is at a height *h* and length *L* from the bottom of the ramp. The block is released and slides down the ramp. The coefficient of kinetic friction between the block and the ramp is μ .

What is the kinetic energy of the box at the bottom of the ramp?

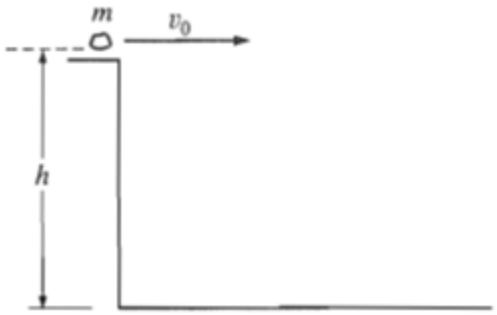
(A) mgh

(B) μmgL cos θ

(C) mgh - μmgL cos θ

(D) mgL - μmgh cos θ

CHAPTER4PARTB



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_0

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

(A) mgh

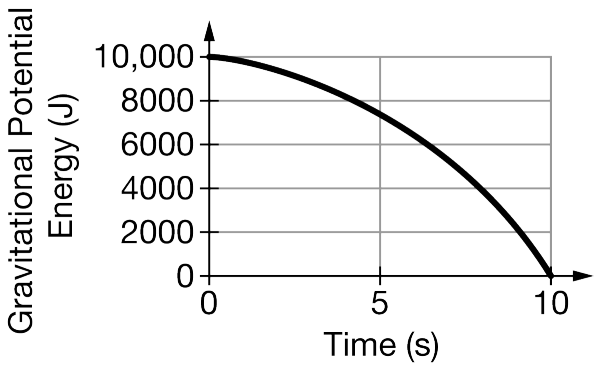
(B) $\frac{1}{2}\,mv_0^2$

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

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

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

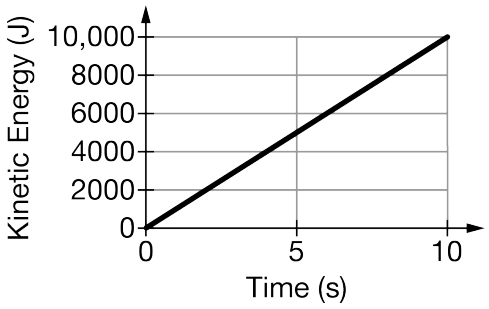
55.



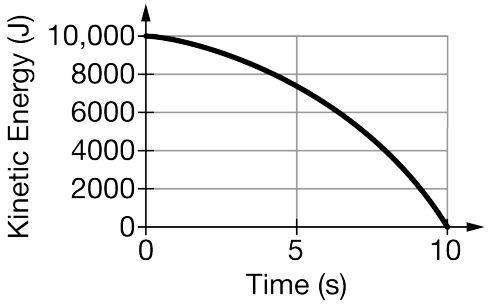
A $2\ \text{kg}$ object is released from rest near and above Earth's surface such that the object-Earth system's gravitational potential energy as a function of time is shown in the graph. Which of the following graphs represents the kinetic energy of the object as a function of time? Assume all frictional forces are considered to be negligible.

CHAPTER4PARTB

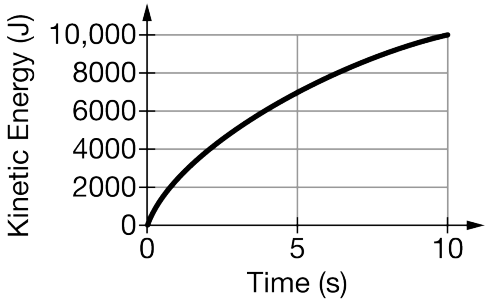
(A)



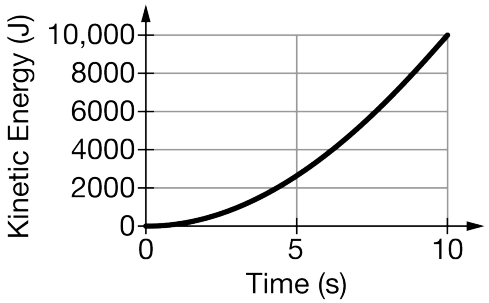
(B)



(C)

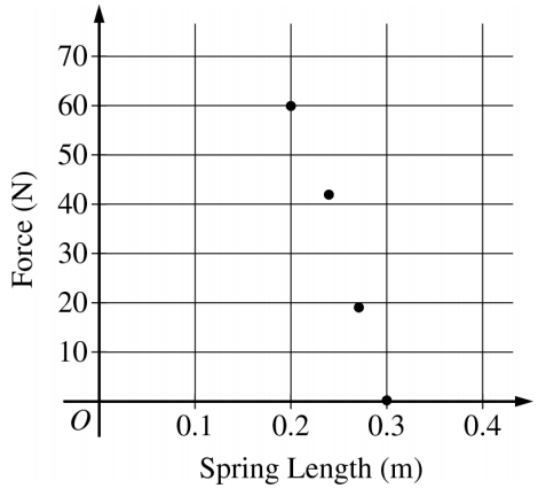


(D)



CHAPTER4PARTB

56.



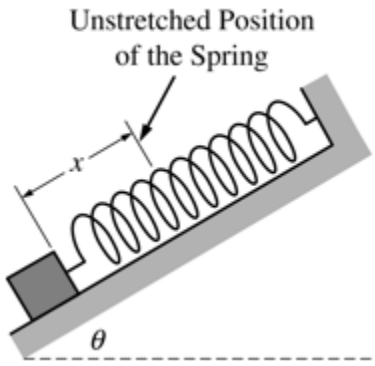
The graph above shows the force exerted by a spring as a function of the length of the spring. A block on a frictionless table is pushed against the spring that is fastened to a wall. The spring is compressed until its length is 20 cm. The block is then released. Which of the following values is closest to the kinetic energy with which the block leaves the spring?

(A) 3J

(B) 6J

(C) 12 J

(D) 15 J



An object of mass m is attached to a spring on a frictionless inclined plane that makes an angle θ with the horizontal, as shown above. The object is released from rest with the spring in its unstretched position. As the object moves on the plane, its displacement from the unstretched position is x.

57. What is the magnitude of the work done by gravity as the object slides down the incline?

CHAPTER4PARTB

(A) *mgx sinθ*

(B) *mgx cos θ*

(C) *mgx sinθ cosθ*

(D) $\frac{mgx}{\sin\theta}$

(E) $\frac{mgx}{\cos\theta}$

---

58. A marble is released from rest at the top of a ramp of height h. The marble rolls down the ramp without slipping. The translational speed of the marble at the bottom of the ramp is v. Which of the following correctly compares v to $\sqrt{2gh}$?

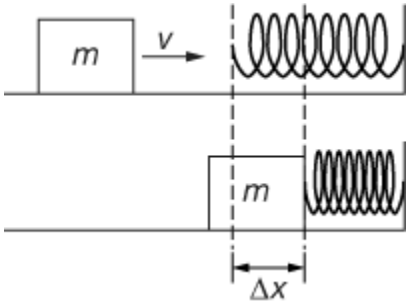
(A) $v < \sqrt{2gh}$

(B) $v = \sqrt{2gh}$

(C) $v > \sqrt{2gh}$

(D) The translational speed cannot be compared to $\sqrt{2gh}$ without knowing the slope of the ramp.

59.



A block of mass m slides with speed v along a frictionless, horizontal surface toward an unstretched spring attached to a wall, as shown above. The block compresses the spring a maximum distance Δx. Which of the following values of block mass and initial speed would result in the same maximum compression distance Δx for the spring?

CHAPTER4PARTB

(A)

Block Mass	Initial Speed
$2m$	$v/4$

(B)

Block Mass	Initial Speed
$2m$	$2v$

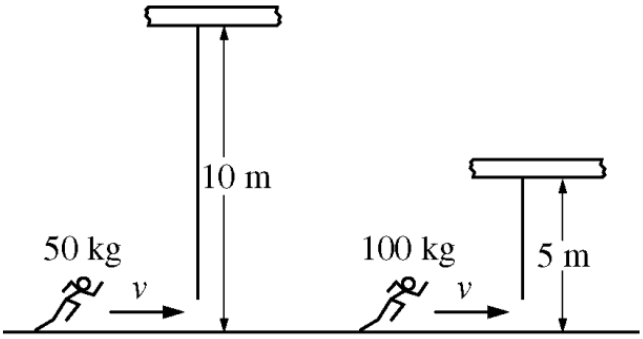
(C)

Block Mass	Initial Speed
$4m$	$v/4$

(D)

Block Mass	Initial Speed
$4m$	$v/2$

60.



A 50 kg athlete running at speed v grabs a light rope that hangs from a 10-meter-high platform and swings to a maximum of 1.8 m above the ground. Later, a 100 kg athlete, running at the same speed, grabs a similar rope hanging from a 5-meter-high platform. What is the maximum height to which the 100 kg athlete swings?

(A) 0.9 m

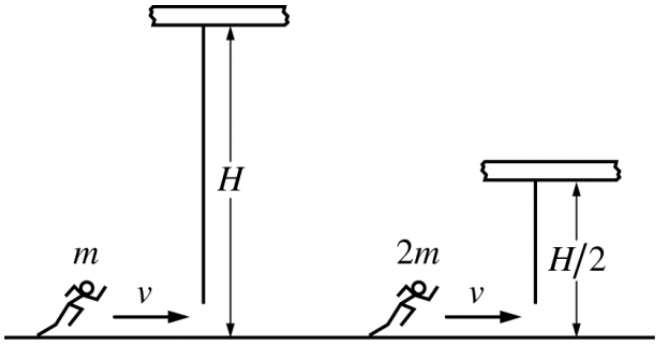
(B) 1.8 m

(C) 2.5 m

(D) 3.6 m

CHAPTER4PARTB

61.



An athlete with mass m running at speed v grabs a light rope that hangs from a ceiling of height H and swings to a maximum height of h_1. In another room with a lower ceiling of height $H/2$, a second athlete with mass $2m$ running at the same speed v grabs a light rope hanging from the ceiling and swings to a maximum height of h_2 . How does the maximum height reached by the two athletes compare, and why?

(A) The first athlete reaches a greater height, because this athlete swings on a longer rope.

(B) The second athlete reaches a greater height, because this athlete has a greater mass.

(C) The two athletes reach the same height, because the effect of the rope length offsets the effect of the athletes' masses.

(D) The two athletes reach the same height, because the athletes run with the same speed.

62. Some students want to calculate the work done by friction as an object with unknown mass moves along a straight line on a rough horizontal surface. The students have a force probe, a meterstick, and a stopwatch. Which of the following will allow the students to take the measurements needed to calculate the work done by friction?

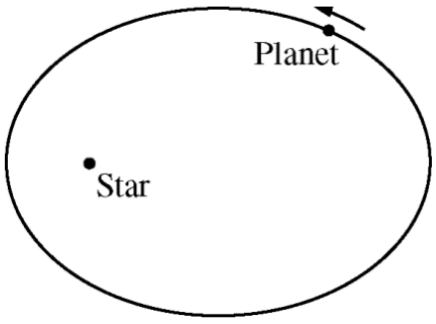
(A) Pulling the block at an unknown constant acceleration with the force probe for a measured time

(B) Pulling the block at an unknown constant speed with the force probe for a measured time

(C) Pulling the block at an unknown constant acceleration with the force probe for a measured distance

(D) Pulling the block at an unknown constant speed with the force probe for a measured distance

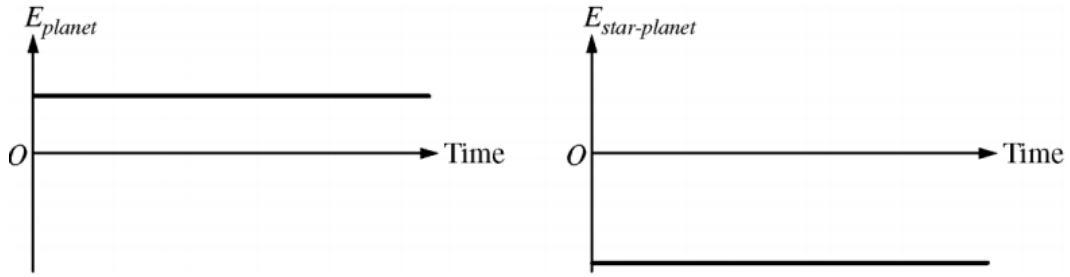
63.



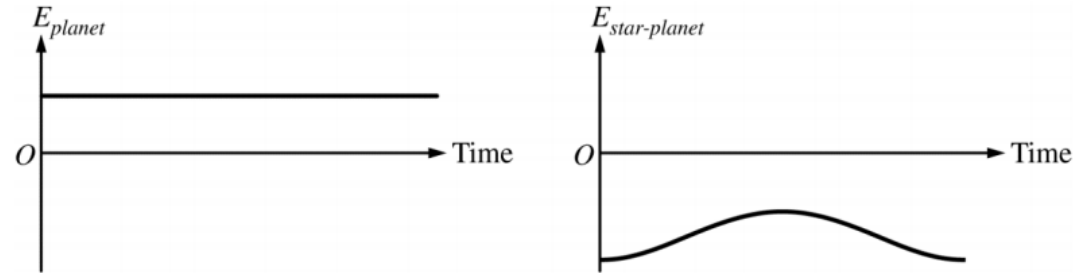
A planet is in an elliptical orbit around a star, as shown above. Which of the following best represents the mechanical energy E_{planet} of just the planet and the mechanical energy $E_{star\text{-}planet}$ of the star-planet system as functions of time for one complete orbit?

CHAPTER4PARTB

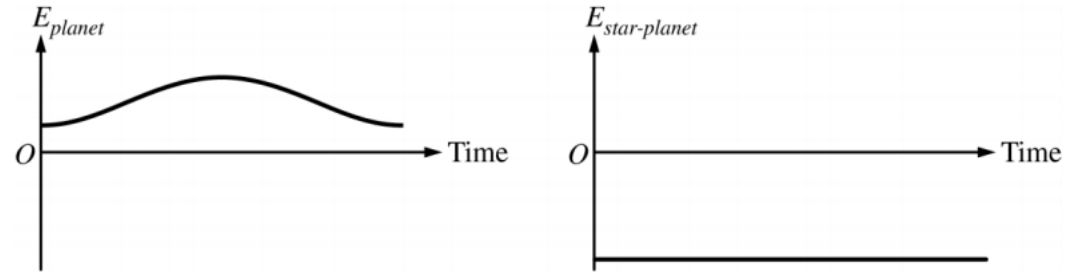
(A)



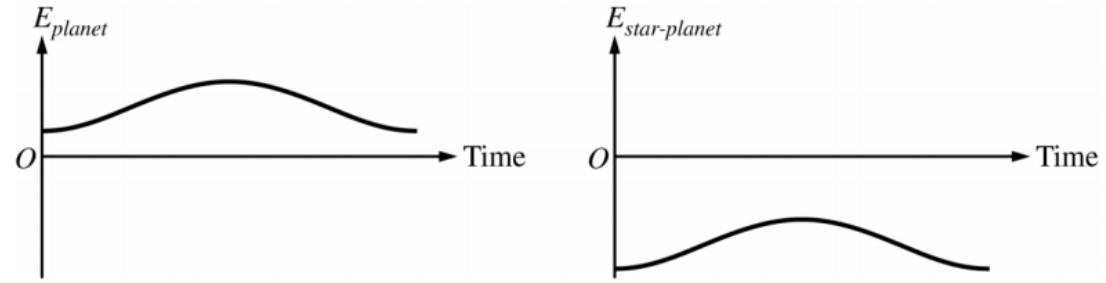
(B)



(C)

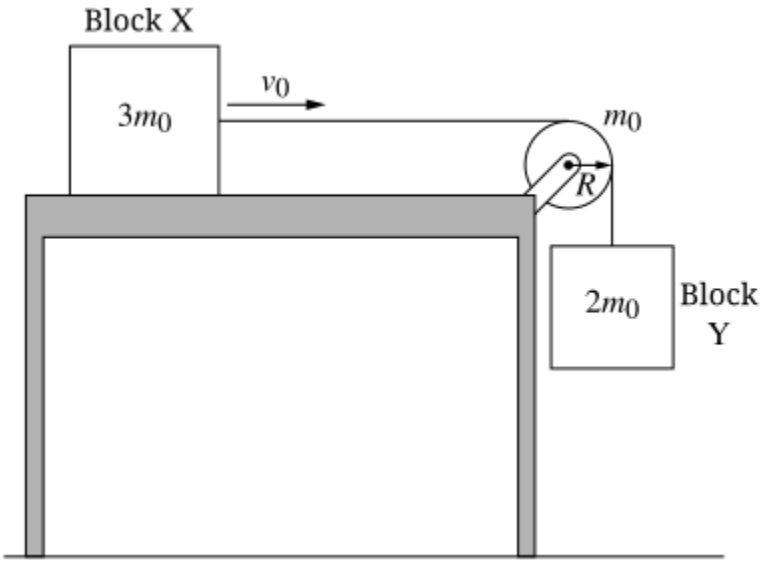


(D)



CHAPTER4PARTB

64.



Block X of mass $3m_0$ is attached to Block Y of mass $2m_0$ by a string of negligible mass that passes over a pulley of rotational inertia $\frac{1}{2}m_0R^2$ about its central axis. At the moment shown in the figure, both blocks move with speed v_0. A student uses $K = \frac{1}{2}(3m_0)v_0^2 + \frac{1}{2}(2m_0)v_0^2$ to model the kinetic energy K of the system that contains the two blocks and the pulley as the blocks move and the pulley rotates. Which of the following statements justifies whether the student's equation can be used to model K ?

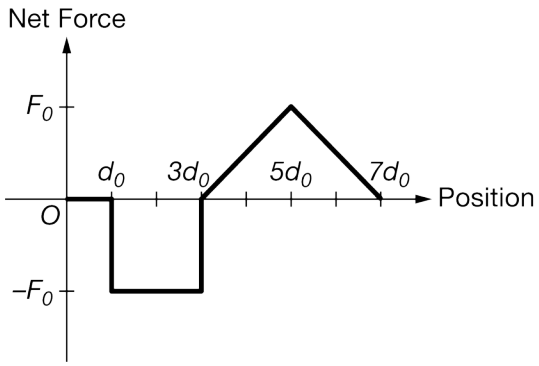
(A) The equation can be used, because the kinetic energy of the pulley is negligible compared to the kinetic energies of the blocks.

(B) The equation can be used, because the kinetic energies of the blocks and pulley are represented in the equation.

(C) The equation cannot be used, because the kinetic energy of the system is greater than what is represented in the equation.

(D) The equation cannot be used, because the kinetic energy of Block X is horizontal and the kinetic energy of Block Y is vertical.

65.

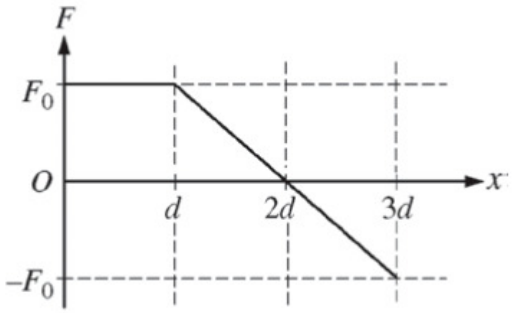


An object is moving along a straight, flat section of track. The net force acting on the object as a function of position is shown in the graph, where the positive direction is in the direction of motion of the object. Assuming the object moves from position $x = 0$ to $x = 7d_0$ without stopping or moving backward, which of the following statements about its motion are correct? Select two answers.

CHAPTER4PARTB

A	The object has its greatest kinetic energy at position $5d_0$.
B	The kinetic energy of the object at position d_0 is greater than $2F_0d_0$.
C	The object has the same kinetic energy at position d_0 that it has at position $7d_0$.
D	The kinetic energy of the object is not changing when it is between positions d_0 and $3d_0$.

66.



An object is moving in the positive *x*-direction while a net force directed along the *x*-axis is exerted on the object. The figure above shows the force as a function of position. What is the net work done on the object over the distance shown?

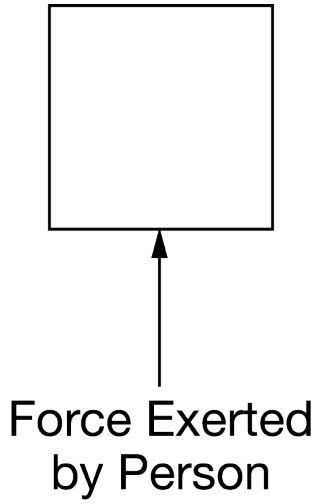
(A) F_0d

(B) $3F_0d/2$

(C) $2F_0d$

(D) $4F_0d$

67.



A person exerts an upward force on a box, as shown above. The box may be moving upward, downward, or not at all while the person exerts the upward force. For which of the following motions of the box is the work done by the person on the box correctly indicated?

CHAPTER4PARTB

(A)

Motion of Box	Work Done by Person on Box
No motion	Positive

(B)

Motion of Box	Work Done by Person on Box
Upward with decreasing speed	Negative

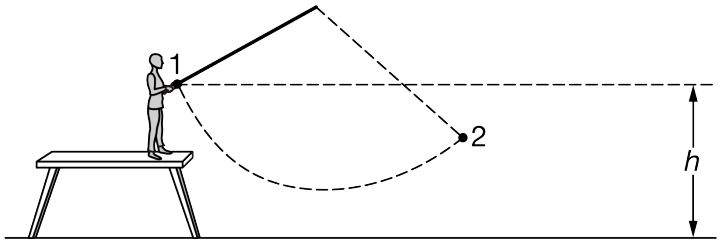
(C)

Motion of Box	Work Done by Person on Box
Downward with constant speed	Zero

(D)

Motion of Box	Work Done by Person on Box
Downward with increasing speed	Negative

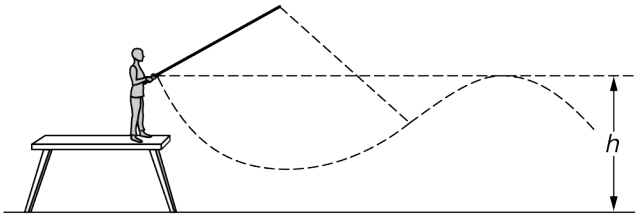
68.



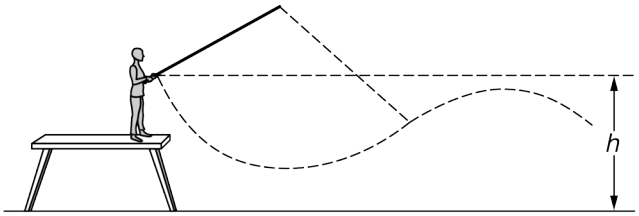
A person starting from rest at point 1 swings along a circular arc from a rope, as shown above. Point 2 is at a lower height than point 1. What is the trajectory of the person when the person lets go of the rope at Point 2 ?

CHAPTER4PARTB

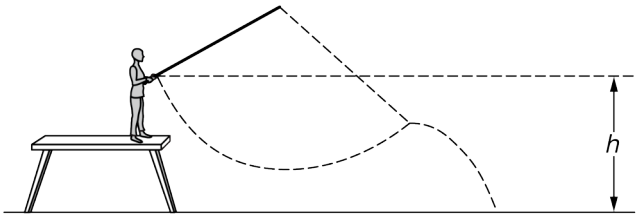
(A)



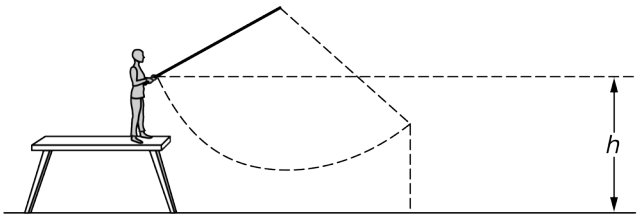
(B)



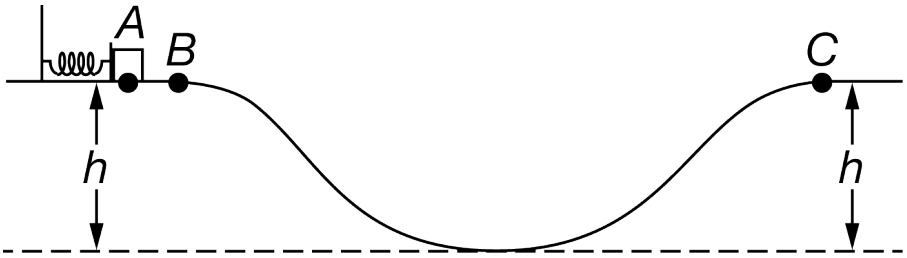
(C)



(D)



69.



A block is held at rest against a compressed spring at point A at the top of a frictionless track of height h, as shown above. The block is released, loses contact with the spring at point B, and slides along the track until it passes point C, also at height h. How do the potential energy U of the block-Earth system and the kinetic energy K of the block at point C compare with those at point A ?

CHAPTER4PARTB

(A)

Potential Energy of Block-Earth System	Kinetic Energy of Block
$U_C = U_A$	$K_C = K_A$

(B)

Potential Energy of Block-Earth System	Kinetic Energy of Block
$U_C = U_A$	$K_C > K_A$

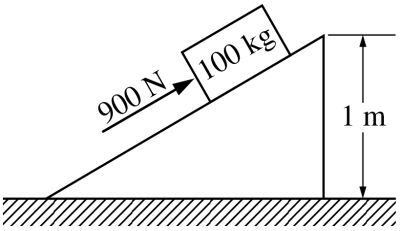
(C)

Potential Energy of Block-Earth System	Kinetic Energy of Block
$U_C > U_A$	$K_C = K_A$

(D)

Potential Energy of Block-Earth System	Kinetic Energy of Block
$U_C > U_A$	$K_C > K_A$

70.

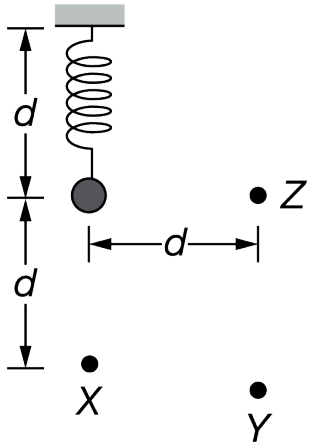


A constant force of 900 N pushes a 100 kg mass up the inclined plane shown above at a uniform speed of 4 m/s. The power developed by the 900 N force is most nearly

CHAPTER4PARTB

(A) 400 W
(B) 800 W
(C) 900 W
(D) 1000 W
(E) 3600 W

71.



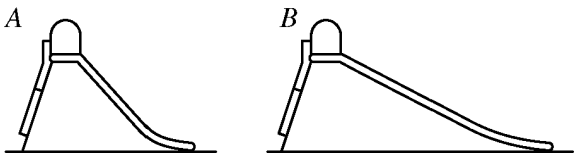
An object hangs in equilibrium from a spring, as shown above. The object is then displaced to one of the labeled points X, Y, or Z . Which of the following correctly ranks the elastic potential energy U stored in the spring when the object is at each of the three positions?

(A) $U_Z > (U_X = U_Y)$
(B) $U_Y > (U_X = U_Z)$
(C) $U_Y > U_X > U_Z$
(D) $U_Y > U_Z > U_X$

72. What is the ratio of the kinetic energy of an object of mass 3*m* moving at speed 2*v* to an object of mass *m*/2 moving at a speed *v*?

(A) 2
(B) 3
(C) 6
(D) 12
(E) 24

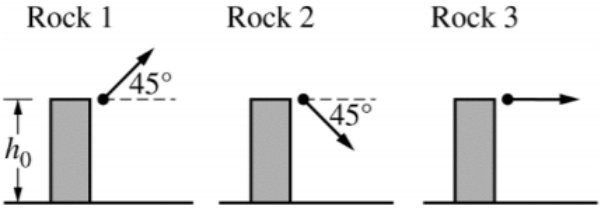
73.



A child slides from rest down slides *A* and *B* shown above. The slides are the same height, and the coefficient of friction between the slides and the child is the same. Which of the following compares the change ΔK in the kinetic energy of the child and the change ΔU in the potential energy of the child-Earth system for the two slides?

CHAPTER4PARTB

(A) $\Delta K_A = \Delta K_B$; $\Delta U_A = \Delta U_B$
(B) $\Delta K_A < \Delta K_B$; $\Delta U_A > \Delta U_B$
(C) $\Delta K_A > \Delta K_B$; $\Delta U_A = \Delta U_B$
(D) $\Delta K_A > \Delta K_B$; $\Delta U_A > \Delta U_B$

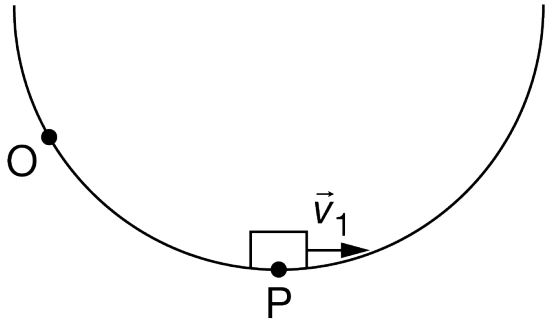


Three identical rocks are launched with identical speeds from the top of a platform of height 0 h . The rocks are launched in the directions indicated above.

74. Rock 1, of mass m, reaches a maximum height h_{max} after being launched. During the time between the instant rock 1 is launched from height h_0 and the instant it returns to height h_0, the work done on the rock by the gravitational force is

(A) 0
(B) $-mgh_0$
(C) $-mg(h_{max} - h_0)$
(D) $2mg(h_{max} - h_0)$

75.

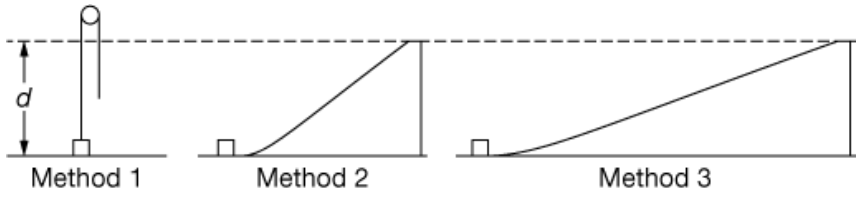


The small block shown in the figure above was released from rest at point O and slid down the track such that friction was considered to be negligible. The block reached point P with speed v_1. Between points O and P, what kind of work did the track do on the block, and why?

(A) Positive work, because the block's kinetic energy increased.
(B) Positive work, because a component of the gravitational force is directed along the track, making the block gain kinetic energy.
(C) Zero work, because the average force exerted by the track on the block is zero.
(D) Zero work, because the track does not exert a force on the block directed along the block's direction of motion.

CHAPTER4PARTB

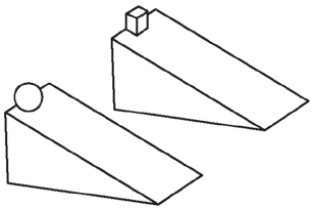
76.



Using the three methods shown above, a small block is raised from rest on the ground until it is again at rest a distance d above the ground. In method 1 a rope pulls the block straight up, and in methods 2 and 3 the block is pushed up frictionless ramps of different lengths. Which of the following ranks the total work W done on the block by external forces as the block is raised using each method?

(A) $W_1 = W_2 = W_3$
(B) $W_1 > W_2 > W_3$
(C) $W_1 > (W_2 = W_3)$
(D) $W_3 > W_2 > W_1$

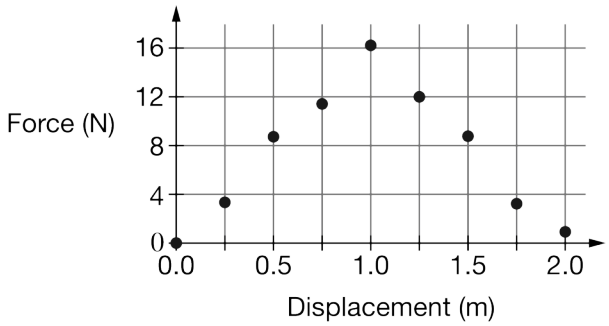
77.



Two objects are released from rest at the top of ramps with the same dimensions, as shown in the figure above. The sphere rolls down one ramp without slipping. The small block slides down the other ramp without friction. Which object reaches the bottom of its ramp first, and why?

(A) The sphere, because it gains rotational kinetic energy, but the block does not
(B) The sphere, because it gains mechanical energy due to the torque exerted on it, but the block does not
(C) The block, because it does not lose mechanical energy due to friction, but the sphere does
(D) The block, because it does not gain rotational kinetic energy, but the sphere does

78.

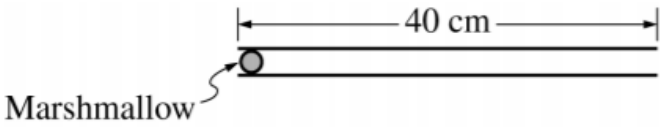


A $2.0\ \text{kg}$ disk is able to move on a straight, level track with negligible friction. With the disk initially at rest, a horizontal force is applied to the disk. The force is measured as a function of the disk's displacement, and the data are shown in the graph. When the disk's displacement is $2.0\ \text{m}$, the speed of the disk is most nearly

CHAPTER4PARTB

(A) $2.8\ \mathrm{m/s}$
(B) $4.0\ \mathrm{m/s}$
(C) $5.6\ \mathrm{m/s}$
(D) $8.0\ \mathrm{m/s}$

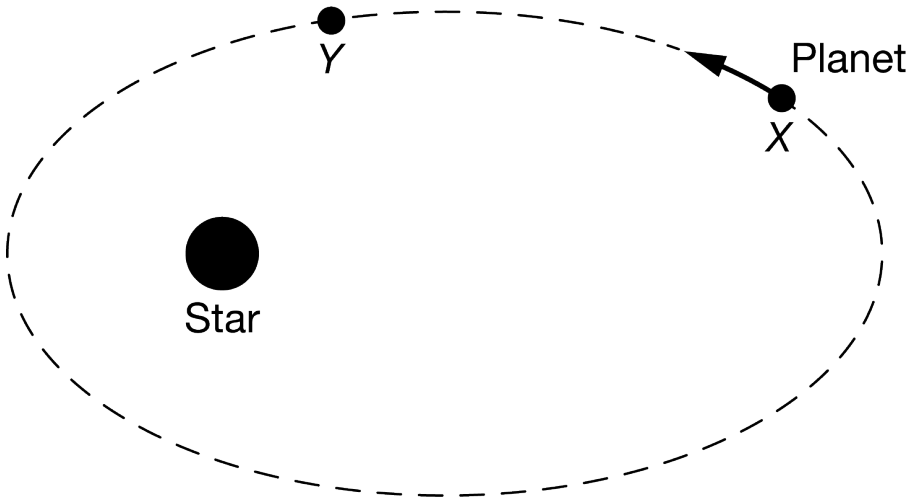
79.



A 2.5 g marshmallow is placed in one end of a 40 cm pipe, as shown in the figure above. A person blows into the left end of the pipe to eject the marshmallow from the right end. The average net force exerted on the marshmallow while it is in the pipe is 0.7 N. The speed of the marshmallow as it leaves the pipe is most nearly

(A) 4.7 m/s
(B) 11 m/s
(C) 15 m/s
(D) 280 m/s

80.



A planet orbits a star along an elliptical path, as shown in the figure above. How do the planet's kinetic energy and the total mechanical energy of the star-planet system change as the planet moves from point X to point Y?

CHAPTER4PARTB

(A)

Planet's Kinetic Energy	System's Total Mechanical Energy
Increases	Remains the same

(B)

Planet's Kinetic Energy	System's Total Mechanical Energy
Increases	Increases

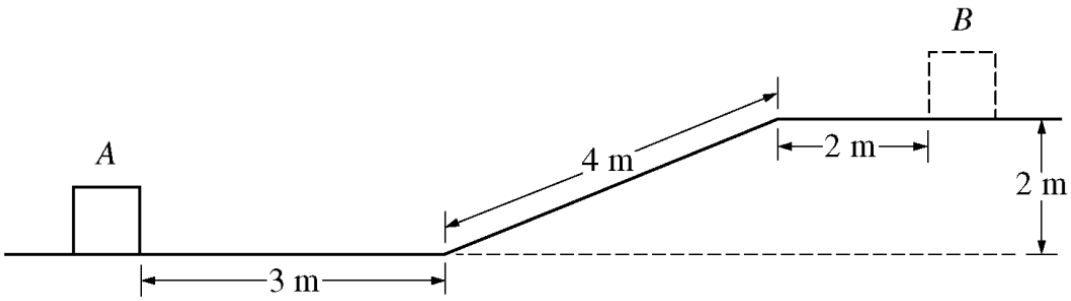
(C)

Planet's Kinetic Energy	System's Total Mechanical Energy
Decreases	Remains the same

(D)

Planet's Kinetic Energy	System's Total Mechanical Energy
Decreases	Decreases

81.



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

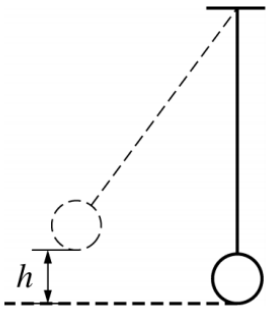
(B) -220 J

(C) -200 J

(D) 0 J

CHAPTER4PARTB

82.



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?

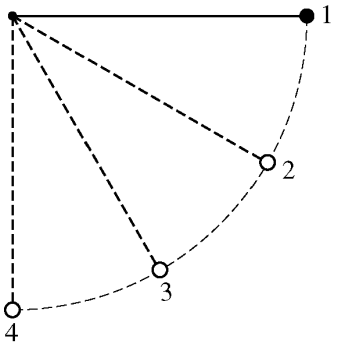
(A) It is at a maximum when the pendulum is at its lowest position.

(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.

83.



A ball is suspended by a lightweight string, as shown in the figure above. The ball is displaced to position 1 and released. The four labeled positions are evenly spaced along the arc of the ball's motion. Between which adjacent pairs of positions is the change in kinetic energy of the ball greatest?

(A) 1 and 2

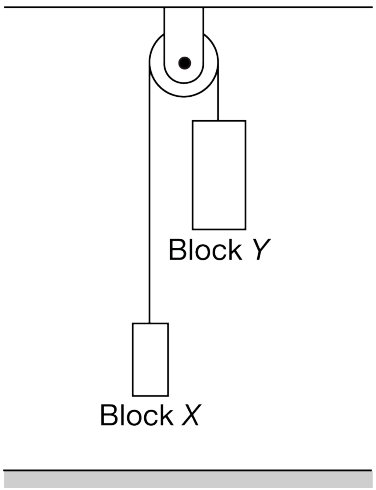
(B) 2 and 3

(C) 3 and 4

(D) The change is the same for all adjacent pairs.

CHAPTER4PARTB

84.



Blocks X and Y are connected by a string that passes over a pulley, as shown in the figure. Block Y has more mass than Block X. The string and pulley have negligible mass, and the pulley rotates with negligible friction. After the blocks are released from rest, what happens to the mechanical energy E_{mech} of the system consisting of the two blocks and Earth?

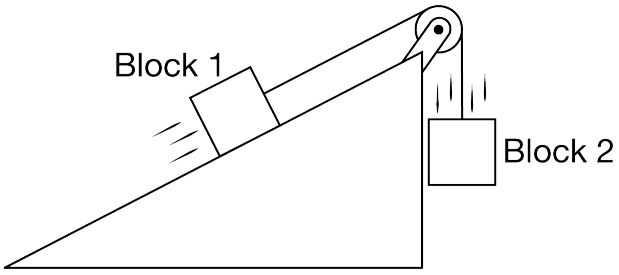
(A) E_{mech} decreases.

(B) E_{mech} remains constant.

(C) E_{mech} increases.

(D) The change of E_{mech} cannot be determined without knowing the ratio of the blocks' masses and their initial distances from Earth's surface.

85.



Two identical blocks are connected by a lightweight string that passes over a lightweight pulley that can rotate about its axle with negligible friction. The two-block system is released from rest and the blocks accelerate. Which of the following correctly relates the potential energy gained by the block 1-Earth system $|\Delta U_1|$ to the potential energy lost by the block 2-Earth system $|\Delta U_2|$ and provides correct evidence?

(A) $|\Delta U_1| = |\Delta U_2|$, because both blocks travel the same distance.

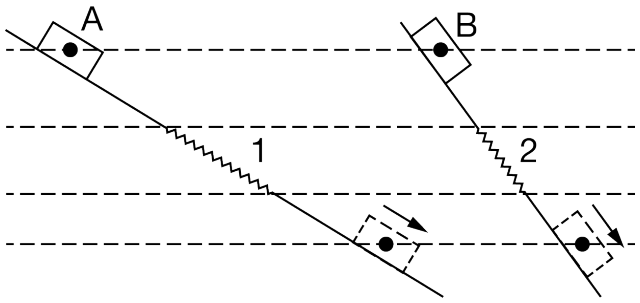
(B) $|\Delta U_1| = |\Delta U_2|$, because both blocks gain the same amount of kinetic energy.

(C) $|\Delta U_1| < |\Delta U_2|$, because the two-block system gains kinetic energy.

(D) $|\Delta U_1| < |\Delta U_2|$, because the tension exerted on block 1 by the string is less than the tension exerted on block 2 by the string.

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86.



Identical blocks A and B are initially at rest on ramps inclined at different angles and with their centers of mass at the same height, as shown above. The ramps are frictionless except for rough sections 1 and 2 represented by the jagged lines, which have the same coefficient of kinetic friction. The blocks are released. How do the speeds of the blocks compare when they are at the locations represented by the dashed rectangles at the bottom of each ramp?

(A) Block A has a greater speed.

(B) Block B has a greater speed.

(C) The blocks have the same speed.

(D) The speeds cannot be compared without knowing the angles of the ramps or the coefficient of kinetic friction in sections 1 and 2.

87.

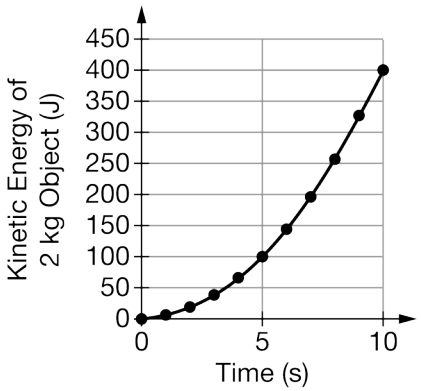


Figure 1

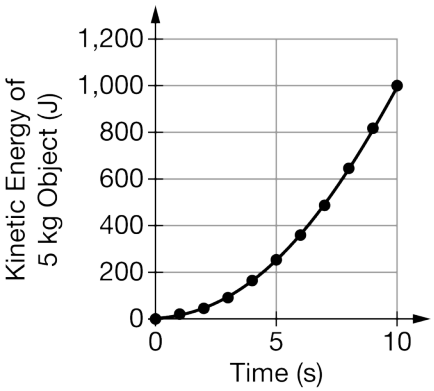


Figure 2

Figure 1 shows the kinetic energy as a function of time for a 2 kg object that is released from rest and falls toward Earth's surface. Figure 2 shows the kinetic energy as a function of time for a 5 kg object that is released from rest and falls toward Earth's surface. Both objects are released simultaneously from the same height. How much does the gravitational potential energy of the object-object-Earth system change from 0 s to 10 s ?

(A) 400 J

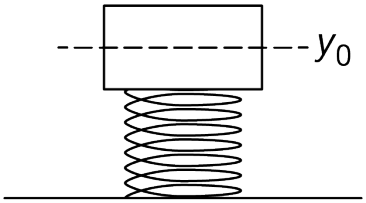
(B) 600 J

(C) 1000 J

(D) 1400 J

CHAPTER4PARTB

88.



A block of mass m is at rest on top of a spring of spring constant k as shown above. The block is then pushed down a distance y below its initial position y_0 and released from rest. What is the block's kinetic energy when it first returns to position y_0 ?

(A) $2mgy$

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

(C) $\frac{1}{2}ky^2 + mgy$

(D) $\frac{1}{2}ky^2 - mgy$

89. A student wants to approximate the amount of work that the force due to gravity does on the student as the student walks up a set of stairs. Which of the following measurements must the student collect in order to approximate the amount of work done by Earth on the student? Select two answers.

A The mass of the student.

B The angle between the inclined portion of the stairs and the horizontal.

C The total inclined length of the stairs.

D The final vertical height above the initial vertical position.

90. What is the kinetic energy of a satellite of mass *m* in that orbits the Earth, of mass *M,* in a circular orbit of radius *R* ?

(A) Zero

(B) $\frac{1}{2}\frac{GMm}{R}$

(C) $\frac{1}{4}\frac{GMm}{R}$

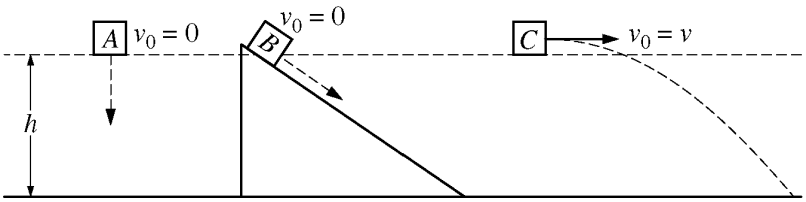
(D) $\frac{1}{2}\frac{GMm}{R^2}$

(E) $\frac{GMm}{R^2}$

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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*.



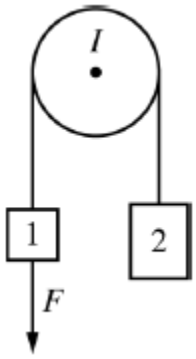
91. Which block has the greatest speed just before hitting the ground?

(A) A

(B) B

(C) C

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



Two blocks are connected by a string with negligible mass that passes over a pulley with nonzero rotational inertia I, as shown above. The axle of the pulley has negligible friction. The string does not slip on the pulley. Block 1 has mass 4 kg and block 2 has mass 6 kg. An additional force with magnitude F is initially exerted on block 1 so that the blocks do not move and is then removed.

92. After the additional force is removed, what happens to the gravitational potential energy of the pulley-blocks-Earth system?

(A) It remains constant and zero.

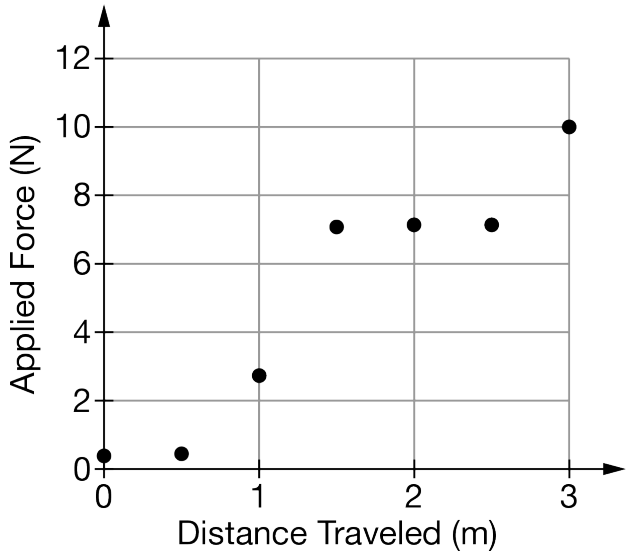
(B) It remains constant but is greater than zero.

(C) It increases.

(D) It decreases.

CHAPTER4PARTB

93.



An experiment is conducted such that an applied force is exerted on a $2\ \text{kg}$ object as it travels across a horizontal surface. A graph of the net force exerted on the object as a function of the object's distance traveled is shown. How could a student use the graph to determine the work done by the applied force?

(A) Multiply the maximum value of the applied force by the total distance the object traveled.

(B) Multiply the weight of the object by the total distance traveled by the object.

(C) Calculate the slope of the line of best fit.

(D) Calculate the area bound by the line of best fit and the horizontal axis from $0\ \text{m}$ to $3\ \text{m}$.