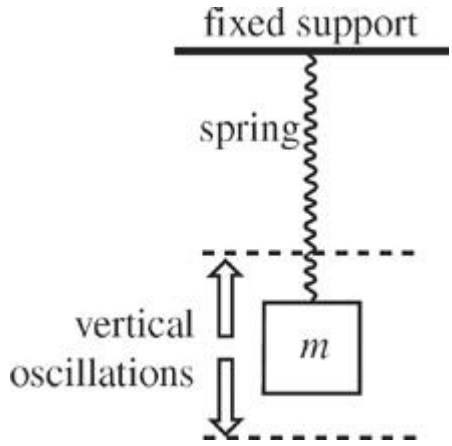
SAT Physics Practice Paper 15



1.

A block of mass *m* undergoing simple harmonic motion. Frictional forces are negligible and can be ignored.

Once the motion is underway, which quantity does NOT remain constant?

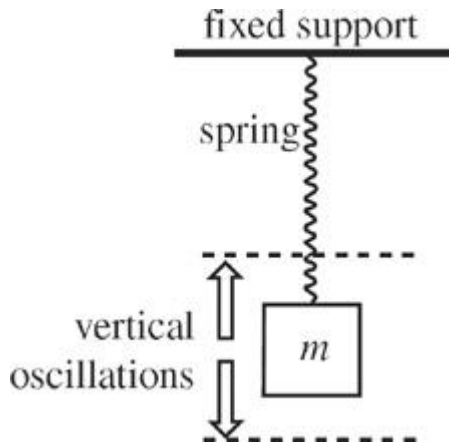
A. Amplitude

B. Frequency

C. Period

D. Position of block

E. Total mechanical energy of the block



2.

A block of mass *m* undergoing simple harmonic motion. Frictional forces are negligible and can be ignored.

Which quantity is inversely proportional to the square root of the block's mass?

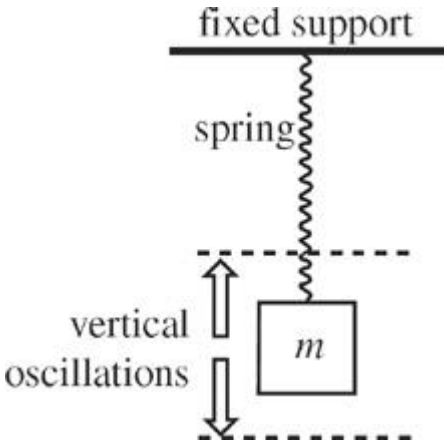
A. Amplitude

B. Frequency

C. Period

D. Position of block

E. Total mechanical energy of the block



3.

A block of mass *m* undergoing simple harmonic motion. Frictional forces are negligible and can be ignored.

Which quantity would always be greater if the block oscillated with a smaller force constant?

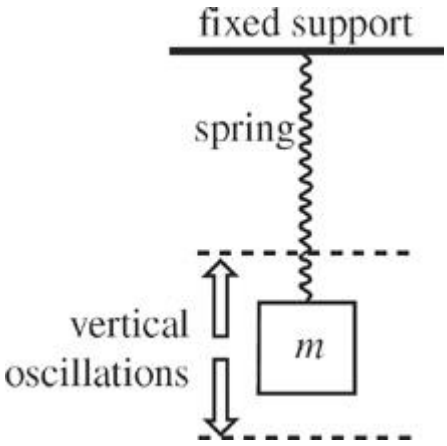
A. Amplitude

B. Frequency

C. Period

D. Position of block

E. Total mechanical energy of the block



4.

A block of mass *m* undergoing simple harmonic motion. Frictional forces are negligible and can be ignored.

The maximum speed of the block is proportional to what quantity?

A. Amplitude

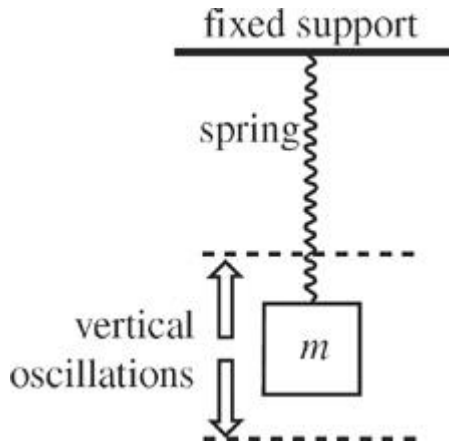
B. Frequency

C. Period

D. Position of block

E. Total mechanical energy of the block

5.



A block of mass *m* undergoing simple harmonic motion. Frictional forces are negligible and can be ignored.

The graph of which quantity (versus time) would look like a sine wave?

A. Amplitude

B. Frequency

C. Period

D. Position of block

E. Total mechanical energy of the block

6. Which type of decay would cause the number of neutrons in the nucleus to decrease by 1 ?

A. Alpha decay

B. β^- decay

C. β^+ decay

D. Electron capture

E. Gamma decay

7. In which type of decay is the identity of the nucleus unchanged?

A. Alpha decay

B. β^- decay

C. β^+ decay

D. Electron capture

E. Gamma decay

8. Which type of decay ejects the heaviest particle?

A. Alpha decay

B. β^- decay

C. β^+ decay

D. Electron capture

E. Gamma decay

9. Which type of decay would cause the atomic number of the nucleus to increase?

A. Alpha decay

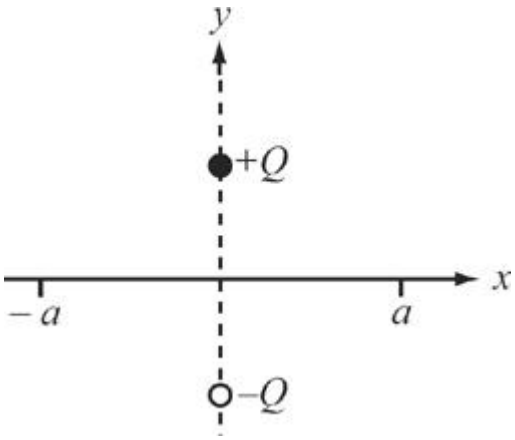
B. β^- decay

C. β^+ decay

D. Electron capture

E. Gamma decay

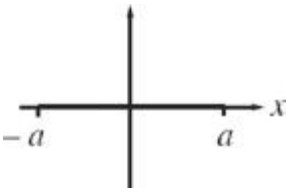
10.



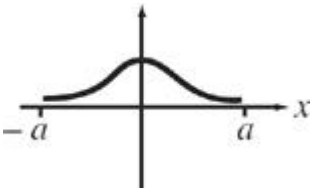
An electric dipole, a pair of equal but opposite charges. Two isolated point charges are fixed in the positions shown on the *y* axis; the positive charge is located at the point (0, *b*) and the negative charge is located at the point (0, –*b*).

Which graph best depicts the electric field magnitude along the *x* axis, from $x = -a$ to $x = a$?

A.



B.



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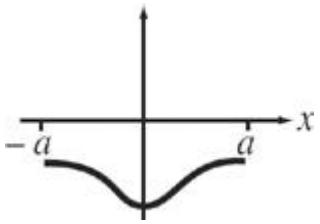

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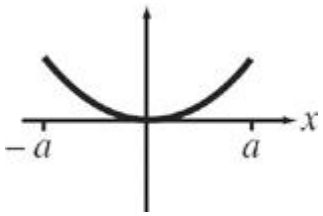

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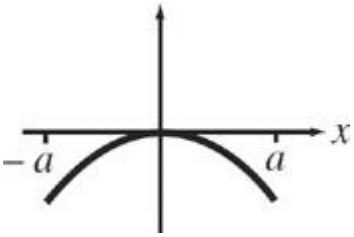
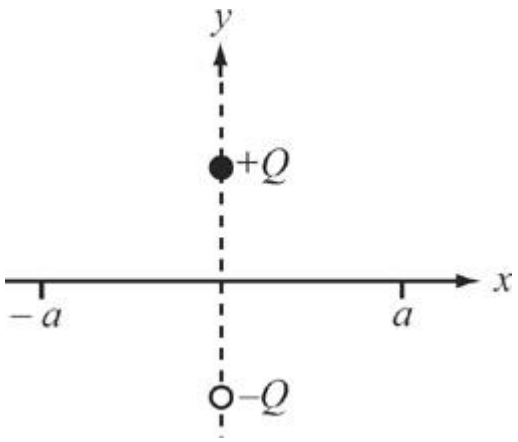


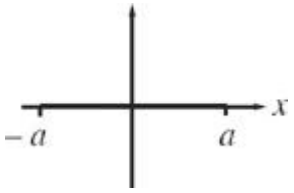
11.



An electric dipole, a pair of equal but opposite charges. Two isolated point charges are fixed in the positions shown on the *y* axis; the positive charge is located at the point (0, *b*) and the negative charge is located at the point (0, –*b*).

Which graph best illustrates the electric potential along the *x* axis, from *x* = –*a* to *x* = *a*?

A.



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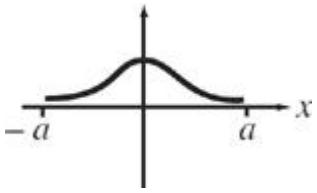

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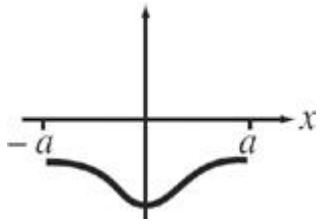

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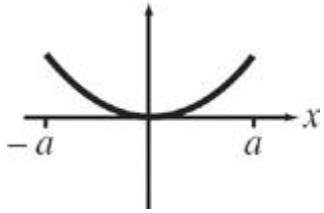

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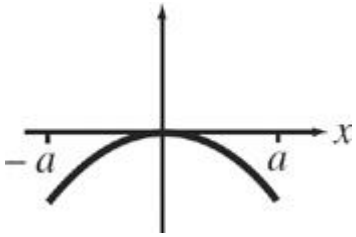
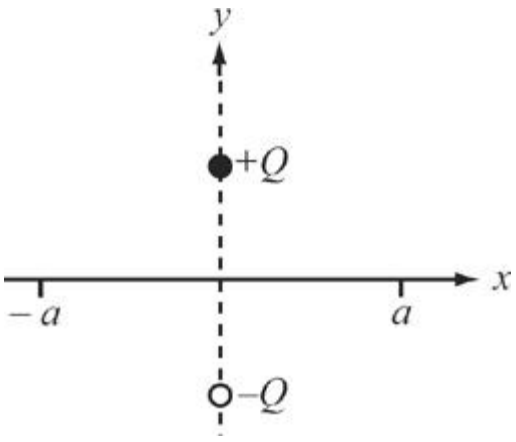


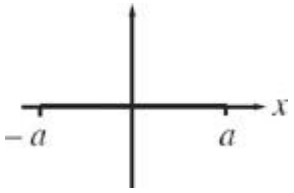


12.

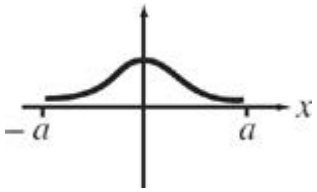
An electric dipole, a pair of equal but opposite charges. Two isolated point charges are fixed in the positions shown on the *y* axis; the positive charge is located at the point (0, *b*) and the negative charge is located at the point (0, –*b*).

If a negative charge, –*q*, were moved along the *x* axis from *x* = –*a* to *x* = *a*, which graph best depicts the magnitude of the electric force it would feel during this motion?

A.



B.



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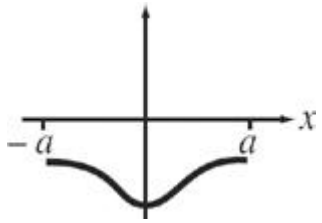
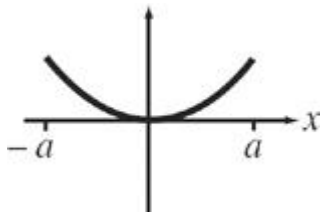
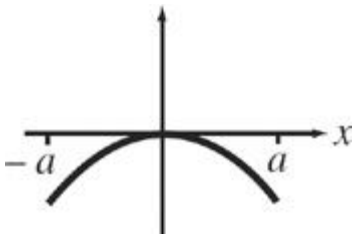


D.



E. 

13. Two people, one of mass 100 kg and the other of mass 50 kg, stand facing each other on an ice-covered (essentially frictionless) pond. If the heavier person pushes on the lighter one with a force **F**, then

A. the force felt by the heavier person is $-\frac{1}{2}$ **F**

B. the force felt by the heavier person is –2**F**

C. the magnitude of the acceleration of the lighter person will be $\frac{1}{2}$ of the magnitude of the acceleration of the heavier person

D. the magnitude of the acceleration of the lighter person will be twice the magnitude of the acceleration of the heavier person

E. None of the above

14. Each of the following particles is projected with the same speed into a uniform magnetic field **B** such that the particle's initial velocity is perpendicular to **B**. Which one would move in a circular path with the largest radius?

A. Proton

B. Beta particle

C. Alpha particle

D. Electron

E. Positron

15. Which of the following best describes the magnetic field lines created by a long, straight, current-carrying wire?

A. Rays that emanate from the wire

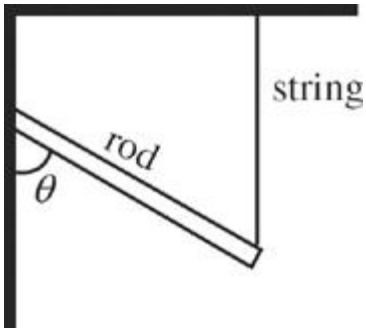
B. Circles centered on the wire

C. Lines parallel to the wire

D. Lines perpendicular to the wire

E. Noncircular ellipses centered on the wire

16.



If the rod is uniform and has mass *m*, what is the tension in the supporting string?

A. $\frac{(mg \sin \theta)}{2}$

B. $\frac{mg \sin}{2}$

C. $\frac{(mg \cos \theta)}{2}$

D. $\frac{mg}{2}$

E. *mg*

17. A lightweight toy car crashes head-on into a heavier toy truck. Which of the following statements is true as a result of the collision?

I. The car will experience a greater impulse than the truck.

II. The car will experience a greater change in momentum than the truck.

III. The magnitude of the acceleration experienced by the car will be greater than that experienced by the truck.

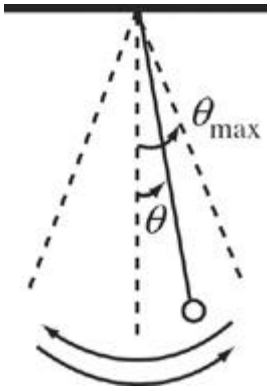
A. I and II only

B. II only

C. III only

D. II and III only

E. I, II, and III



18.

A simple pendulum, composed of a bob of mass m connected to the end of a massless rod, executes simple harmonic motion as it swings through small angles of oscillation. The largest angle the pendulum makes with the vertical is denoted by θ_{max}. Frictional effects are negligible and can be ignored, and the pendulum is near the surface of the earth, where $g = 9.8\ m/s^2$.

Which one of the following statements is true?

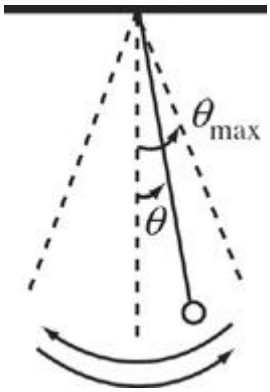
A. At $\theta = 0$, the tangential acceleration is 0.

B. At $\theta = \theta_{max}$, the tangential acceleration is 0.

C. At $\theta = 0$, the speed is 0.

D. At $\theta = 0$, the restoring force is maximized.

E. At $\theta = \theta_{max}$, the speed is maximized.



19.

A simple pendulum, composed of a bob of mass m connected to the end of a massless rod, executes simple harmonic motion as it swings through small angles of oscillation. The largest angle the pendulum makes with the vertical is denoted by θ_{max}. Frictional effects are negligible and can be ignored, and the pendulum is near the surface of the earth, where $g = 9.8\ m/s^2$.

Knowing which one of the following would enable you to calculate the length of the pendulum?

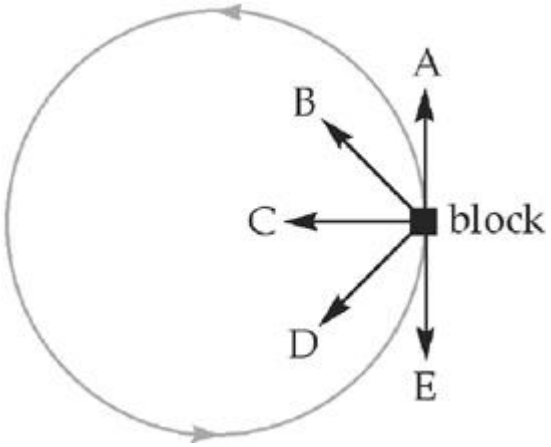
A. The mass of the bob

B. The period of the oscillations

C. The tangential acceleration at $\theta = 0$

D. The maximum speed of the bob

E. The acceleration at $\theta = \theta_{max}$



20.

A block is moving counter-clockwise in a circular path on a flat table. If the speed of the block is increasing at the moment it is at the position shown, which one of the five arrows best illustrates the direction of the acceleration on the block?

A. A

B. B

C. C

D. D

E. E

21. If a particle of charge –0.2 mC were placed at a certain location within an electric field, the magnitude of the electric force it would feel is 1 N. What is the magnitude of the electric field at this location? (1 mC = 10^{-3} C)

A. 2,000 N/C

B. 5,000 N/C

C. 20,000 N/C

D. 50,000 N/C

E. 500,000 N/C

22. Traveling at an initial speed of 1.5×10^6 m/s, a proton enters a region of constant magnetic field, B, of magnitude 1.0 tesla. If the proton's initial velocity vector makes an angle of 30° with the direction of B, compute the proton's speed 4 seconds after entering the magnetic field.

A. 5.0×10^5 m/s

B. 7.5×10^5 m/s

C. 1.5×10^6 m/s

D. 3.0×10^6 m/s

E. 6.0×10^6 m/s

23. An object of mass 2 kg increases in speed from 2 m/s to 4 m/s in 3 s. What was the total work performed on the object during this time interval?

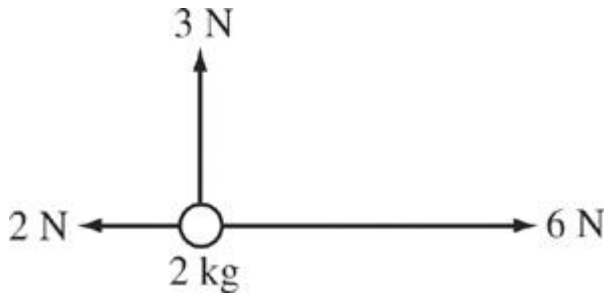
A. 4 J

B. 6 J

C. 12 J

D. 24 J

E. 36 J



24.

The figure above shows the forces acting on an object of mass 2 kg. What is the object's acceleration?

A. 2 m/s^2

B. 2.5 m/s^2

C. 3 m/s^2

D. 3.5 m/s^2

E. 4 m/s^2

25. Two traveling waves of equal frequency, one of amplitude 4 cm and the other of amplitude 6 cm, superimpose in a single medium. Which of the following best describes the amplitude, *A*, of the resultant wave?

A. 2 cm ≤ *A* ≤ 10 cm

B. *A* = 5 cm

C. $A = 10$ cm

D. $10 \text{ cm} \leq A \leq 12$ cm

E. $12 \text{ cm} \leq A \leq 24$ cm

26. A uniform bar is lying on a flat table. Besides the gravitational and normal forces (which cancel), the bar is acted upon by exactly two other forces, $\mathbf{F}_1$ and $\mathbf{F}_2$, which are parallel to the surface of the table. If the net force on the rod is zero, then which one of the following is true?

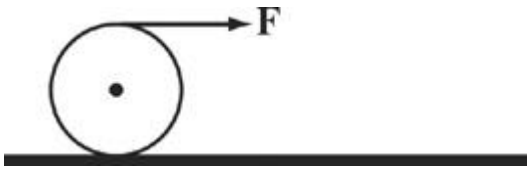
A. The net torque on the bar must also be zero.

B. The bar can accelerate translationally if $\mathbf{F}_1$ and $\mathbf{F}_2$ are not applied at the same point.

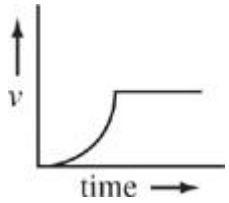
C. The net torque will be zero if $\mathbf{F}_1$ and $\mathbf{F}_2$ are applied at the same point.

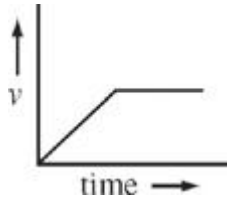
D. The bar cannot accelerate translationally or rotationally.

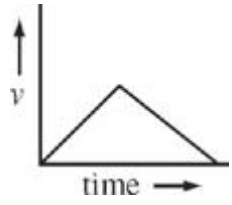
E. None of the above

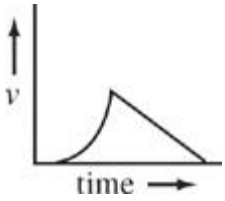
27. 

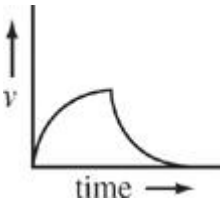
A uniform cylinder, initially at rest on a frictionless, horizontal surface, is pulled by a constant force **F** from time $t = 0$ to time $t = T$. From time $t = T$ on, this force is removed. Which of the following graphs best illustrates the speed, v, of the cylinder's center of mass from $t = 0$ to $t = 2T$?

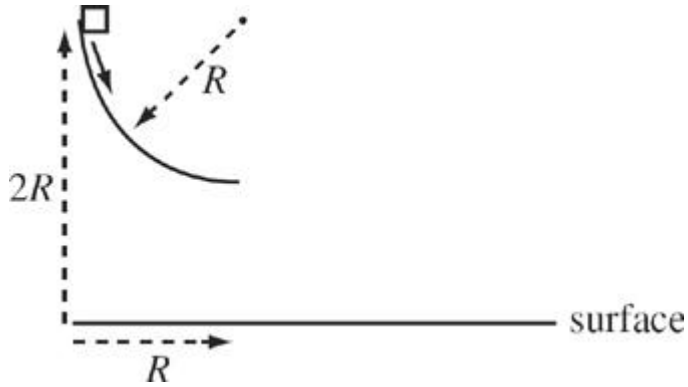
A. 

B. 

C. 

D. 

E. 

28. 

A small box slides down a frictionless track in the shape of a quarter-circle of radius *R*. The box starts from rest at the top of the track, a height equal to 2*R* above a horizontal surface. At the moment the box leaves the bottom of the track, a ball of the same mass as the box is dropped from the same height at the bottom of the track.

How fast is the box moving when it reaches the end of the track?

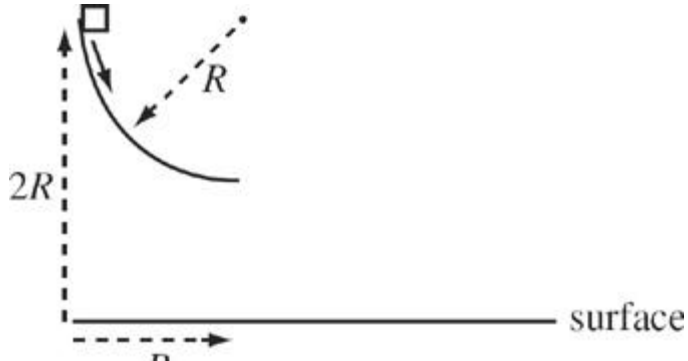
A. $v = \sqrt{gR}$

B. $v = \sqrt{2gR}$

C. $v = \sqrt{\pi gR}$

D. $v = \sqrt{2\pi gR}$

E. $v = \pi\sqrt{2gR}$



29.

A small box slides down a frictionless track in the shape of a quarter-circle of radius *R*. The box starts from rest at the top of the track, a height equal to 2*R* above a horizontal surface. At the moment the box leaves the bottom of the track, a ball of the same mass as the box is dropped from the same height at the bottom of the track.

Which of the following quantities must decrease as the box slides down the track?

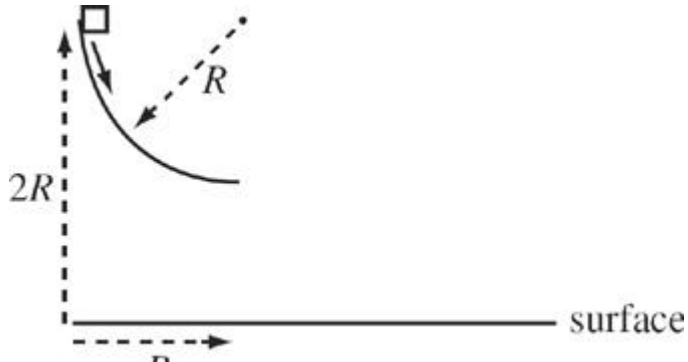
A. The normal force on the box

B. The net force on the box

C. The kinetic energy of the box

D. The potential energy of the box

E. The total mechanical energy (kinetic + potential) of the box



30.

A small box slides down a frictionless track in the shape of a quarter-circle of radius *R*. The box starts from rest at the top of the track, a height equal to 2*R* above a horizontal surface. At the moment the box leaves the bottom of the track, a ball of the same mass as the box is dropped from the same height at the bottom of the track.

Once the box leaves the bottom of the slide, which of the following statements best describes the motions of the box and the ball?

A. The ball hits the floor at the same time as the box.

B. The ball hits the floor before the box does.

C. The ball hits the floor after the box does.

D. The acceleration of the box is greater than the acceleration of the ball.

E. The acceleration of the ball is greater than the acceleration of the box.