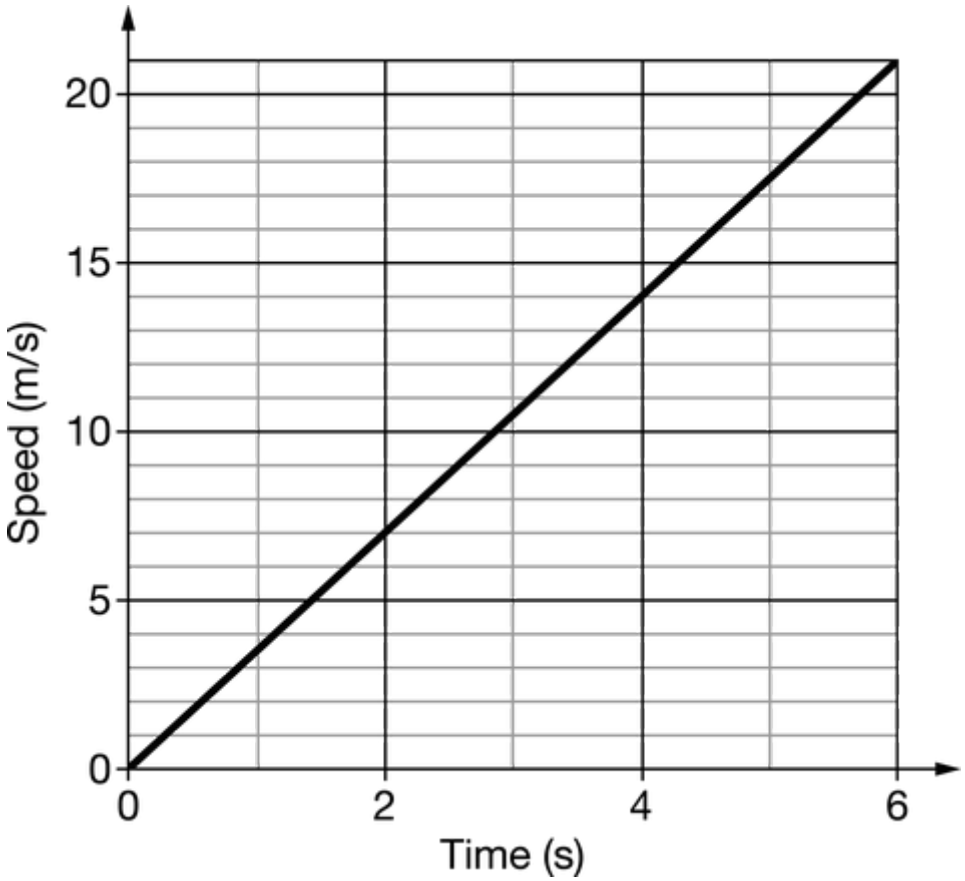
Midterm review

1.



An object of mass $10\ \text{kg}$ is released from rest above the surface of a planet such that the object's speed as a function of time is shown by the graph above. The force due to gravity exerted on the object is most nearly

(A) $3.5\ \text{N}$

(B) $7\ \text{N}$

(C) $35\ \text{N}$ ✓

(D) $70\ \text{N}$

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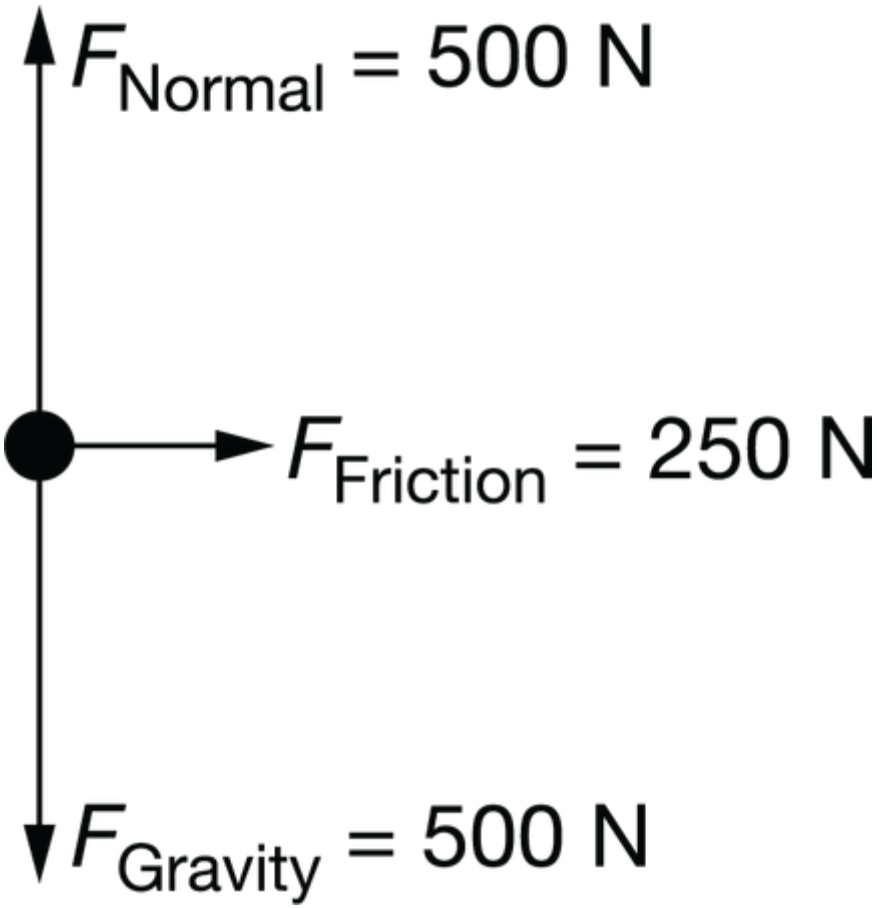
2.



A student rides a bicycle in a circle at a constant speed and constant radius. A force diagram for the student-bicycle system is shown in the figure above. The value for each force is shown in the figure. What is the acceleration of the student-bicycle system?

(A) $0 \frac{m}{s^2}$

(B) $0.2 \frac{m}{s^2}$

(C) $5 \frac{m}{s^2}$ ✔

(D) $25 \frac{m}{s^2}$

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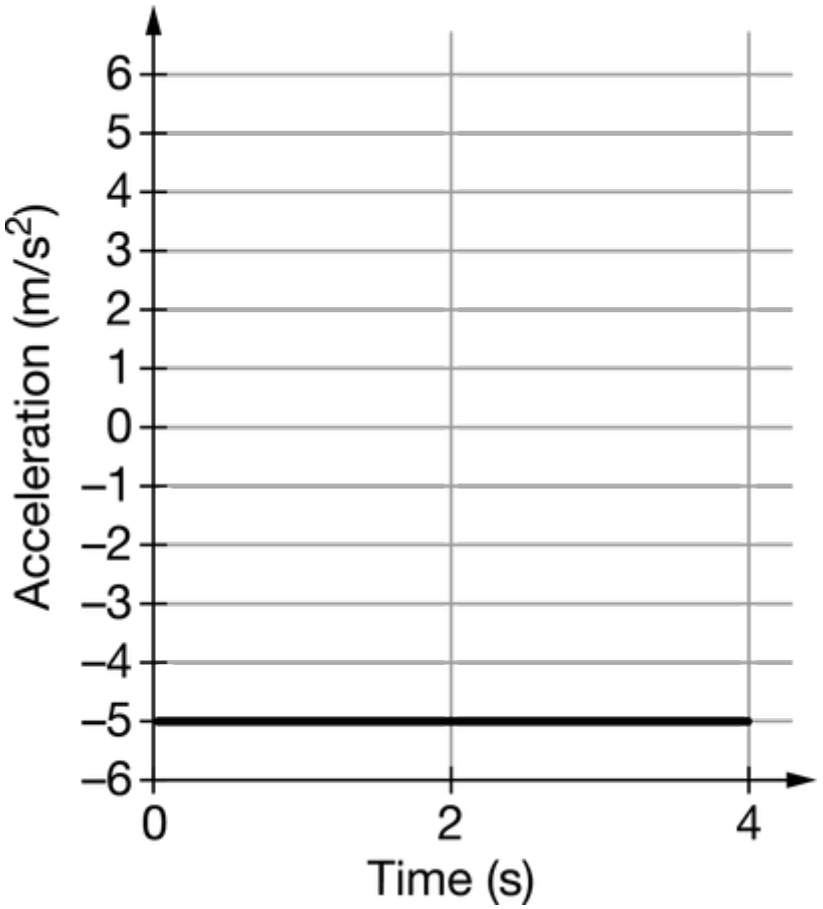
3.



An object is released from rest near a planet's surface. A graph of the acceleration as a function of time for the object is shown for the $4\,\mathrm{s}$ after the object is released. The positive direction is considered to be upward. What is the displacement of the object after $2\,\mathrm{s}$?

(A) $-20\,\mathrm{m}$

(B) $-10\,\mathrm{m}$ ✓

(C) $10\,\mathrm{m}$

(D) $20\ \mathrm{m}$

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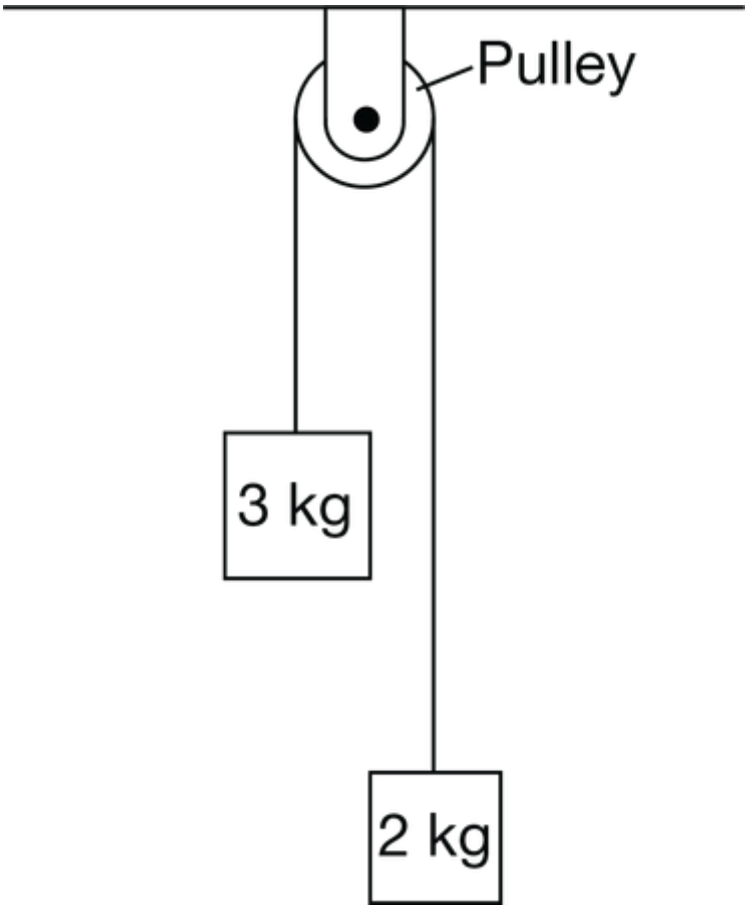
4.



An Atwood's machine is set up by suspending two blocks connected by a string of negligible mass over a pulley, as shown above. The blocks are initially held at rest and then released at time $t_0 = 0\,\mathrm{s}$. The speed of the $3\,\mathrm{kg}$ block at time $t_1 = 2.0\,\mathrm{s}$ is most nearly

(A) $2.0\ \mathrm{m/s}$

(B) $4.0\,\mathrm{m/s}$ ✓

(C) $7.0\,\mathrm{m/s}$

(D) $10.0\,\mathrm{m/s}$

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5. A ball is moved from Earth to a planet that has a gravitational acceleration that is double that of Earth. How does the gravitational force on the ball when it is on the new planet compare to the gravitational force on the ball when it is on Earth?

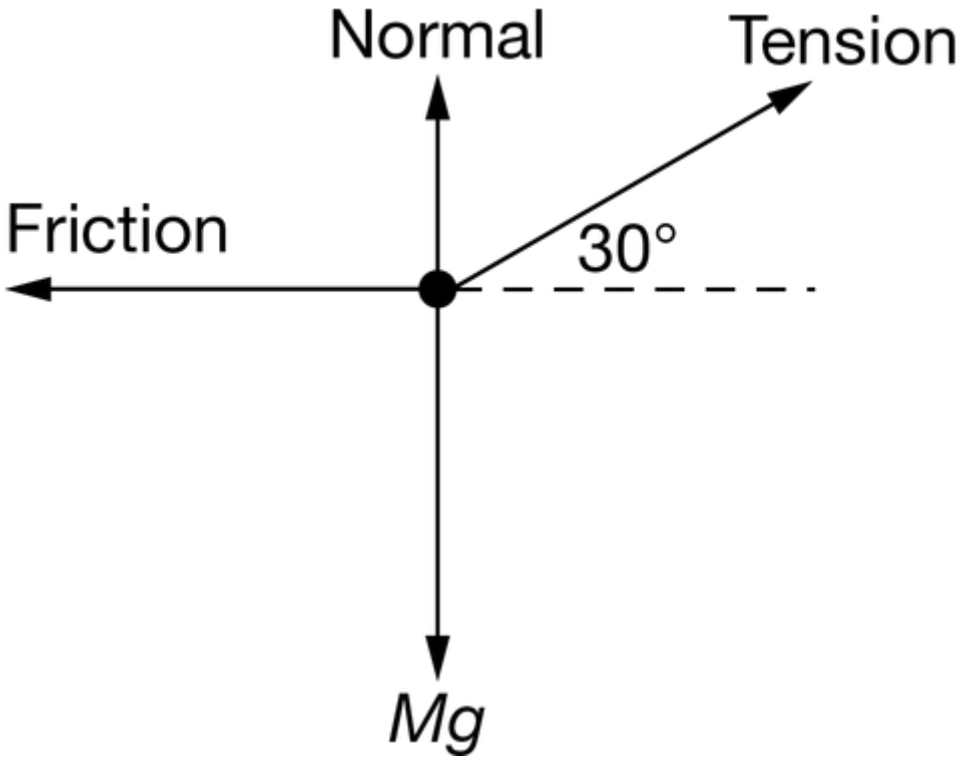
(A) The gravitational force on the ball when it is on the new planet is double the force on the ball when it is on Earth. ✓

(B) The gravitational force on the ball when it is on the new planet is half the force on the ball when it is on Earth.

(C) The gravitational force on the ball when it is on the new planet is the same as the force on the ball when it is on Earth.

(D) The gravitational force on the ball when it is on the new planet is one-fourth the force on the ball when it is on Earth.

6.



The free body diagram shown above is for a $5\ \text{kg}$ box on a rough surface being pulled to the right at a constant speed by a string that is at an angle of 30° above the horizontal. The coefficient of kinetic friction between the box and the surface is 0.30. The tension in this string is most nearly

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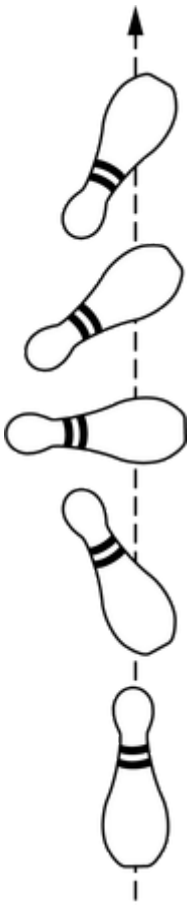
(A) $14.47\,\mathrm{N}$ ✓

(B) $16.97\,\mathrm{N}$

(C) $20.53\,\mathrm{N}$

(D) $29.40\,\mathrm{N}$

7.



A bowling pin is thrown vertically upward such that it rotates as it moves through the air, as shown in the figure. Initially, the center of mass of the bowling pin is moving upward with a speed v_i of $10\,\frac{\mathrm{m}}{\mathrm{s}}$. The maximum height of the center of mass of the bowling pin is most nearly

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(A) $\frac{v_i^2}{2g}$ ✓

(B) $\frac{2g}{v_i^2}$

(C) The answer cannot be determined without knowing how long it takes the bowling pin to reach its maximum height.

(D) The answer cannot be determined because an irregularly shaped object is too complex to treat as a single point mass.

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8. An object is released from rest near the surface of a planet. The velocity of the object as a function of time is expressed in the following equation. $v_y = (-3\ \frac{\mathrm{m}}{\mathrm{s}^2})t$

All frictional forces are considered to be negligible. What distance does the object fall $10\,\mathrm{s}$ after it is released from rest?

(A) $3\,\mathrm{m}$

(B) $30\,\mathrm{m}$

(C) $150\,\mathrm{m}$ ✓

(D) $500\,\mathrm{m}$

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9. A $10\ \mathrm{kg}$ object is near a planet's surface such that the gravitational field strength is $4\ \frac{\mathrm{N}}{\mathrm{kg}}$. With what force is the planet attracted to the $10\ \mathrm{kg}$ object?

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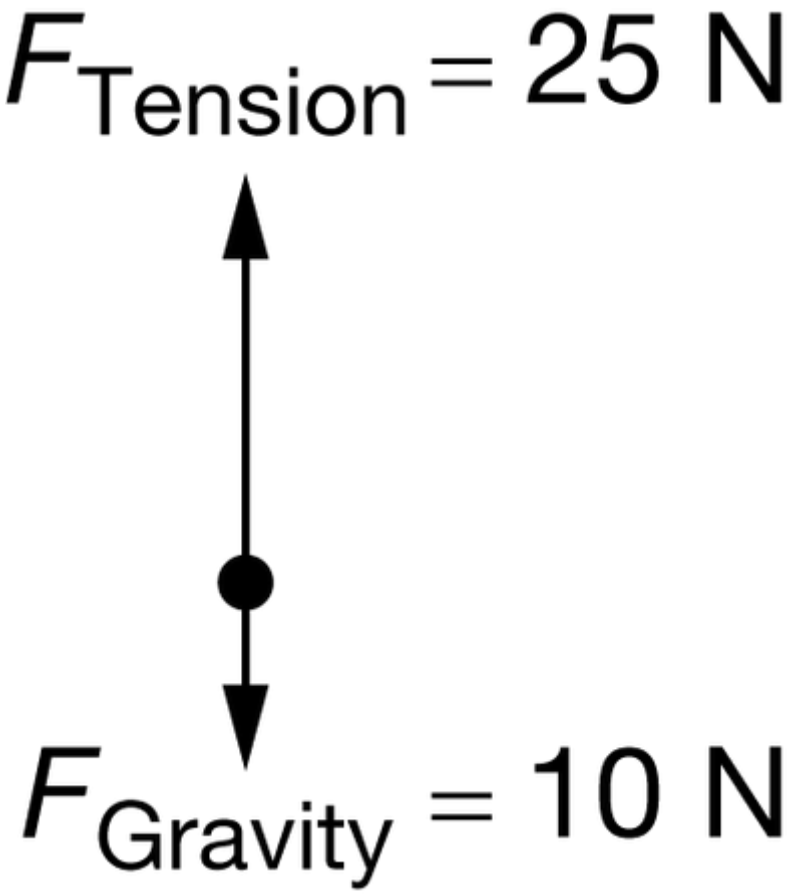
(A) $4\ \frac{\text{N}}{\text{kg}}$

(B) $10\ \text{N}$

(C) $40\ \text{N}$ ✓

(D) $100\ \text{N}$

10.



A ball is attached to one end of a string such that the ball travels in a vertical circular path near Earth's surface. The force diagram of the ball at its lowest point in the circular path is shown above. What is the net centripetal force exerted on the ball?

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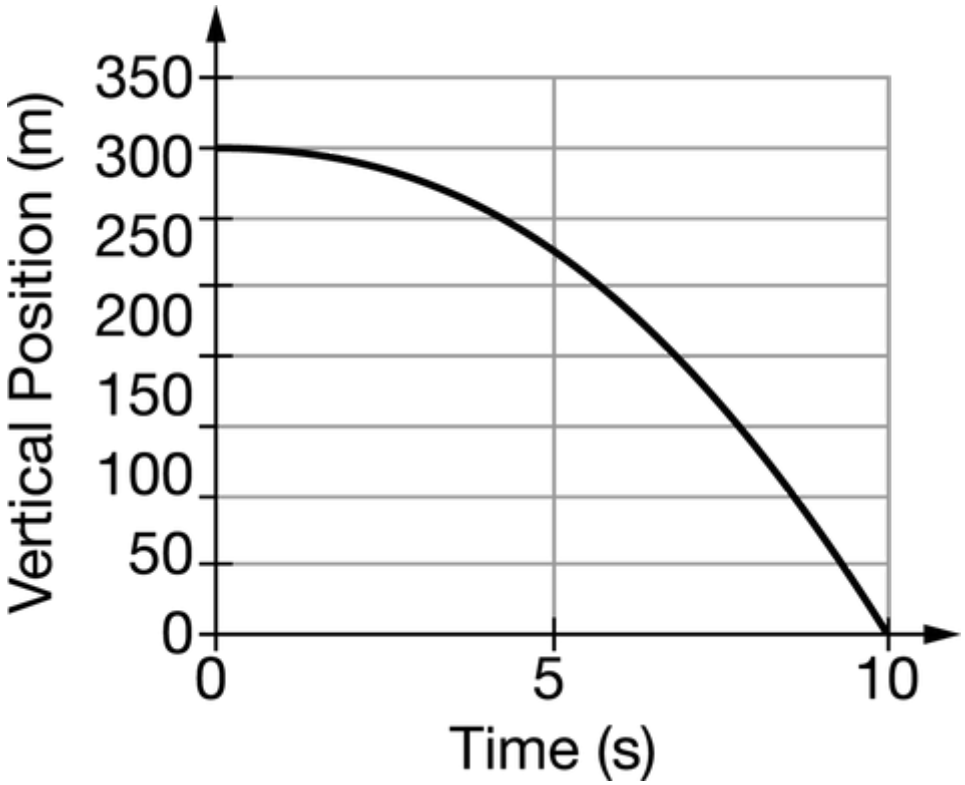
(A) 10 N

(B) 15 N ✓

(C) 25 N

(D) 35 N

11.



An object is released from rest near the surface of a planet. The vertical position of the object as a function of time is shown in the graph. All frictional forces are considered to be negligible. The strength of the gravitational field is most nearly

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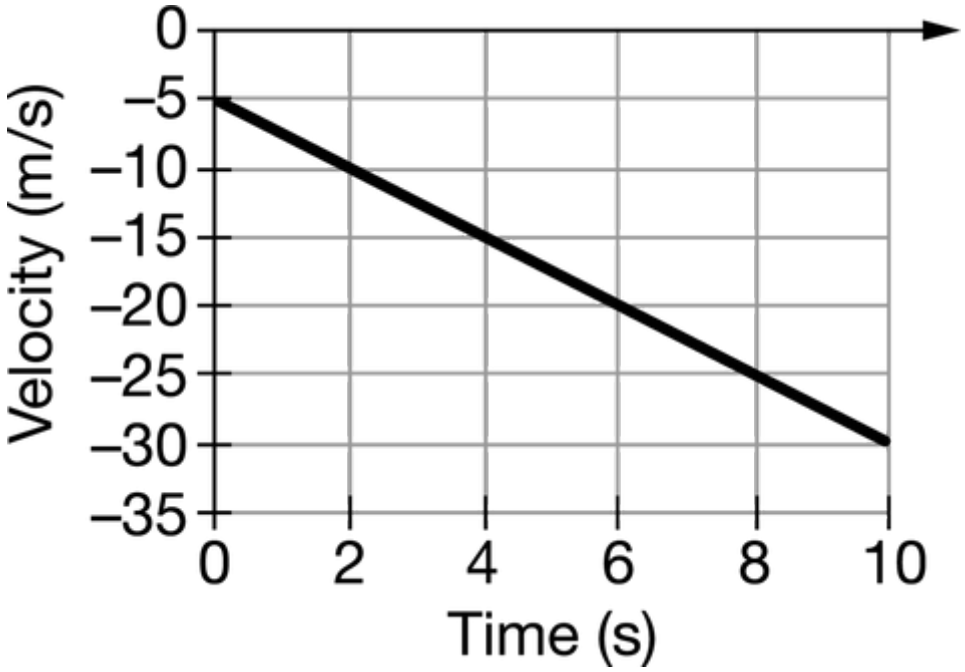
(A) $3\ \frac{\text{N}}{\text{kg}}$

(B) $6\ \frac{\text{N}}{\text{kg}}$ ✓

(C) $10\ \frac{\text{N}}{\text{kg}}$

(D) The strength of the gravitational field cannot be determined without applying Newton's law of universal gravitation.

12.



A $0.5\ \text{kg}$ object is in free fall as it falls downward near the surface of a planet. A graph of the object's velocity as a function of time is shown. What is the force due to gravity exerted on the object by the planet?

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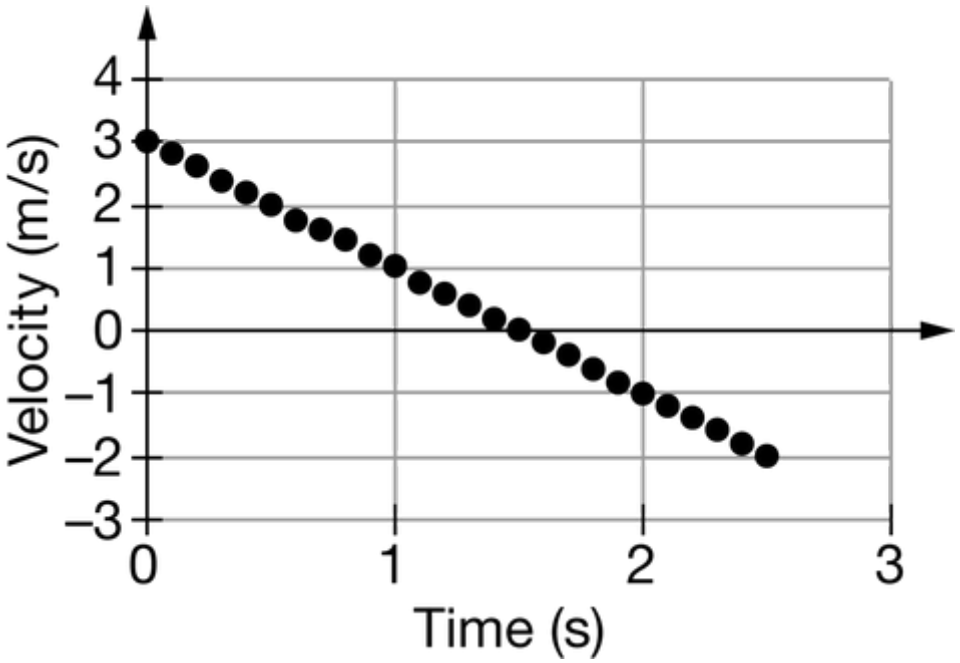
(A) $0.5\ \text{N}$

(B) $1.25\ \text{N}$ ✓

(C) $2.5\ \text{N}$

(D) $5\ \text{N}$

13.



At time $t = 0$, a moving cart on a horizontal track is at position $0.5\ \text{m}$. Using a motion detector, students generate a graph of the cart's velocity as a function of time, as shown above. At $t = 2.5\ \text{s}$, the cart's position is most nearly

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(A) $0.5\ \mathrm{m}$

(B) $1.25\ \mathrm{m}$

(C) $1.75\ \mathrm{m}$ ✓

(D) $2\ \mathrm{m}$

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14. An object is dropped near the surface of a planet such that the gravitational field at the object's location is $8\ \frac{\mathrm{N}}{\mathrm{kg}}$. If the object is thrown upward at a speed of $20\ \frac{\mathrm{m}}{\mathrm{s}}$, what is the position of the object in relation to the position in which the object was released and thrown upward after $3\mathrm{s}$?

(A) $96\ \mathrm{m}$ below the release position

(B) $36\ \mathrm{m}$ below the release position

(C) $15\ \mathrm{m}$ above the release position

(D) $24\ \mathrm{m}$ above the release position ✓

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15. A car initially at rest accelerates at $10\frac{\mathrm{m}}{\mathrm{s}^2}$. The car's speed after it has traveled 25 meters is most nearly

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(A) $0.0\ \frac{\text{m}}{\text{s}}$

(B) $10.0\ \frac{\text{m}}{\text{s}}$

(C) $22.0\ \frac{\text{m}}{\text{s}}$ ✓

(D) $25.0\ \frac{\text{m}}{\text{s}}$

16.

Force Label	Magnitude of Force (N)
F_{Applied}	28
F_{Friction}	4
F_{Gravity}	20
F_{Normal}	20

A $2\ \text{kg}$ object is initially at rest at time $t = 0\ \text{s}$. It then slides across a rough, horizontal surface under the influence of only the four forces shown in the table above. What is the speed of the object at time $t = 3\ \text{s}$?

(A) $12\ \text{m/s}$

(B) $14\ \text{m/s}$

(C) $24\ \text{m/s}$

(D) $36\ \text{m/s}$ ✓

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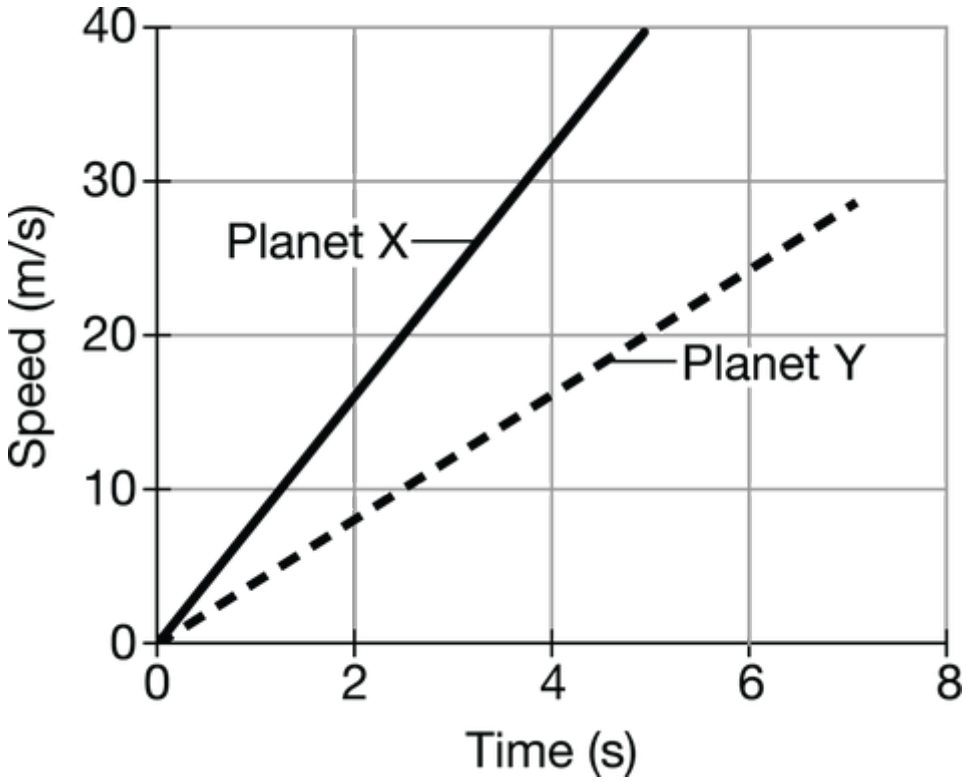
17.



Identical spheres are dropped from a height of $100\,\mathrm{m}$ above the surfaces of Planet X and Planet Y. The speed of the spheres as a function of time is recorded for each planet in the graph above. Which planet exerts the greater force of gravity on the sphere, and what evidence supports this conclusion?

(A) Planet X, because its line has the greater area under it.

(B) Planet X, because its line has the greater slope. ✔

(C) Planet Y, because it falls for the smaller amount of time.

(D) Planet Y, because the object's final speed is greater.

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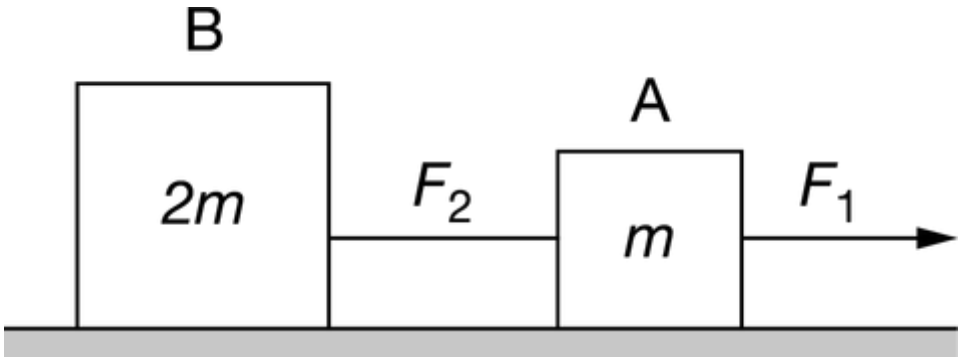
18.



Blocks A and B, of masses m and $2m$, respectively, are connected by a light string and pulled across a surface of negligible friction with a constant force F_1, as shown above. The acceleration of the blocks is a. The force of the string pulling block B forward has magnitude F_2. Which of the following claims correctly describes the relationship between the magnitude of the forces acting on the blocks?

(A) F_1 is equal to F_2.

(B) F_1 is greater than F_2. ✔

(C) F_2 is equal to $3ma$.

(D) F_2 is greater than $3ma$.

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19. A $2\,\text{kg}$ object is released from rest near the surface of a planet such that its gravitational field is considered to be constant. The mass of the planet is unknown. The object's speed after falling for $3\,\text{s}$ is $75\,\text{m/s}$. Air resistance is considered to be negligible. Calculate the weight of the $2\,\text{kg}$ object on the planet of unknown mass.

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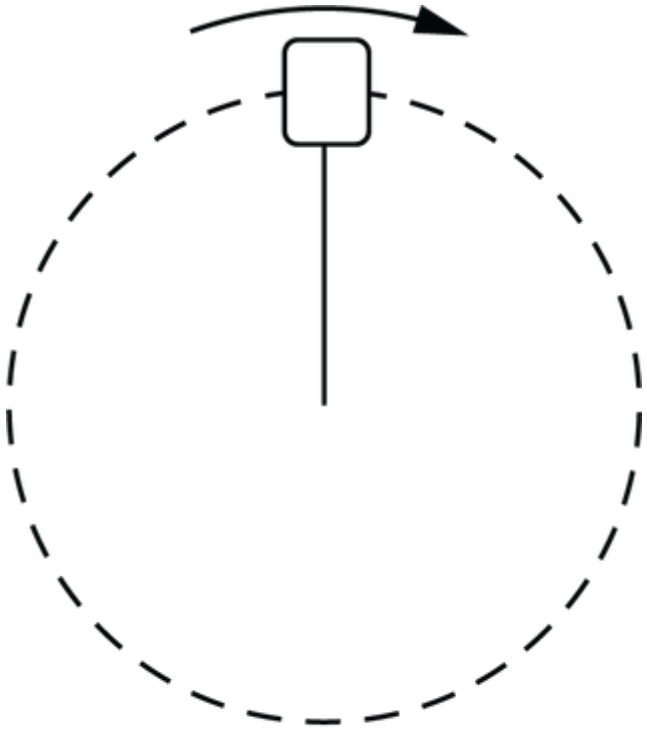
(A) 2 N

(B) 25 N

(C) 50 N ✔

(D) 75 N

20.



Side View

An object of unknown mass is swung in a vertical circle at the end of a light string, as seen in the figure above. A measurement is made of the object's tangential speed at the bottom circular path. A student must determine the tension in the string at the bottom of the circular path. Which of the following measurements, in conjunction with the object's tangential speed, are required to determine the tension in the string? Select two answers.

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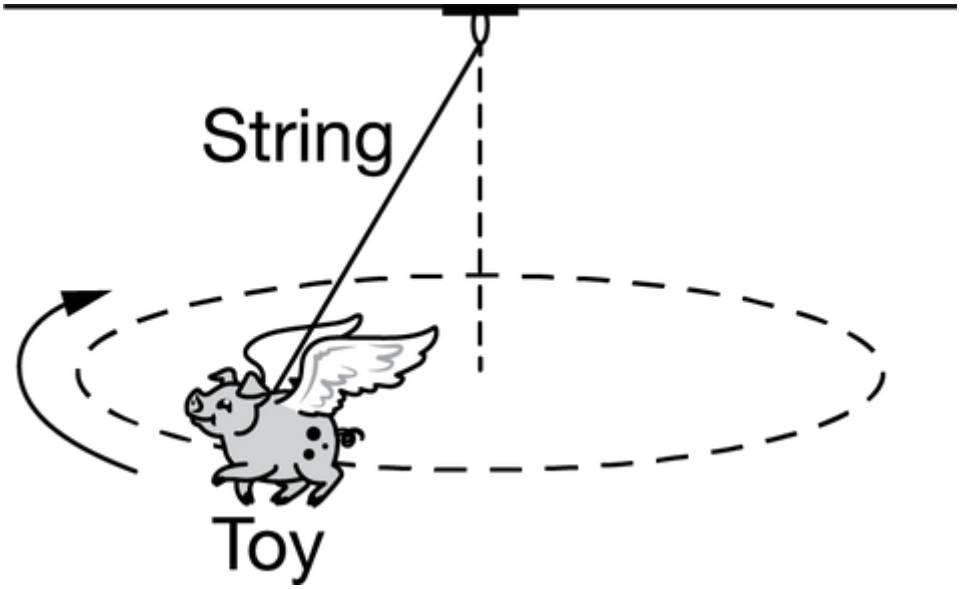
(A) The object's tangential speed at the top of the circle

(B) The object's mass ✓

(C) The diameter of the circular path ✓

(D) The time required for the object to complete one revolution

21.



One end of a string is attached to the ceiling with the other end attached to a toy. The toy can be set into motion such that it travels in a horizontal circular path at a constant tangential speed, as shown above. Which of the following measuring tools, when used together, could be used to determine the time it takes for the toy to complete one revolution around the circle? Select two answers.

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(A) Protractor ✓

(B) Meterstick ✓

(C) Force probe

(D) Motion sensor

22. An object travels down a ramp at a constant acceleration. The object experiences a force of friction and a gravitational force. Which of the following could be true about the motion of the object? Select two answers.

(A) The force of friction between the surface and the object is less than the component of the gravitational force that is parallel to the ramp. ✓

(B) If the object increased in mass, the object's acceleration would change. ✓

(C) If the object increased in mass, the normal force exerted on the object would remain the same.

(D) The force of friction acts in the same direction as the object travels.

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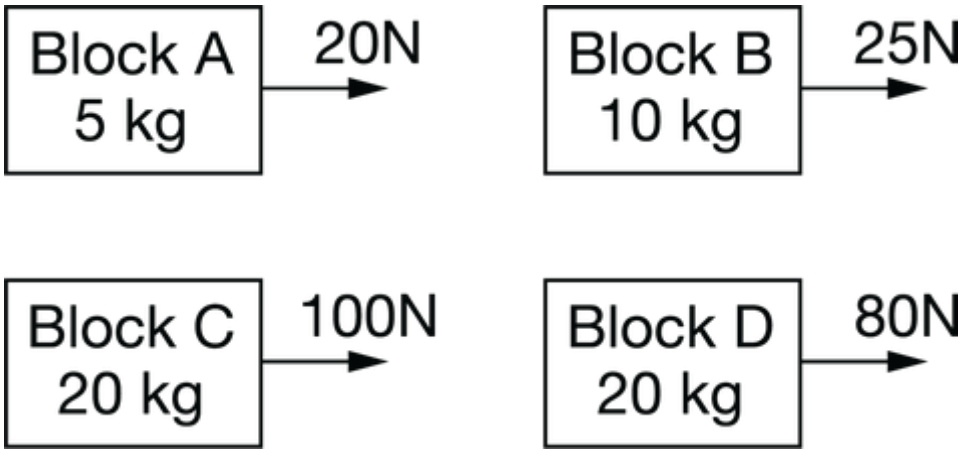
23.



Given the net forces on and the masses of the blocks shown above, which two blocks have the same acceleration? Select two answers.

- (A) Block A ✓
- (B) Block B
- (C) Block C
- (D) Block D ✓

24. An object undergoes an acceleration as it travels along a straight, horizontal section of a track. Which of the following graphs could represent the motion of the object? Select two answers.

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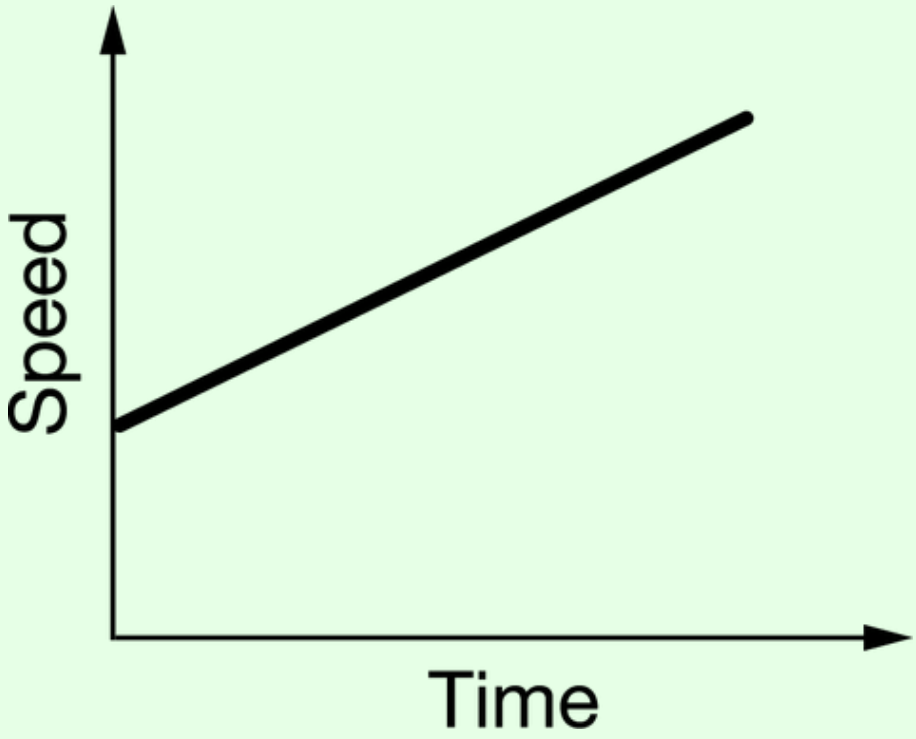
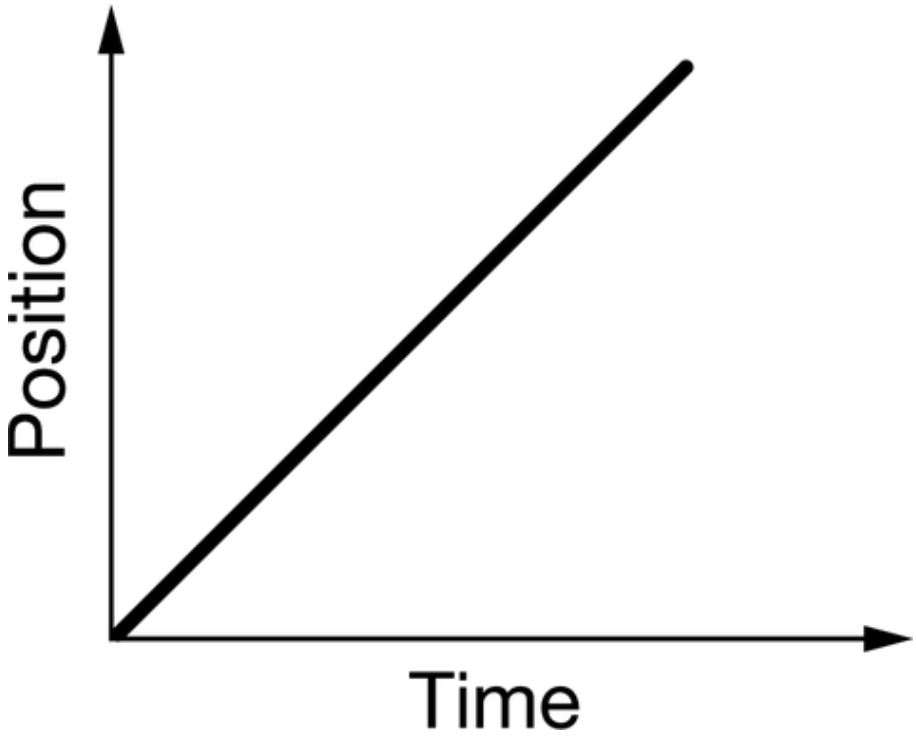
A



B



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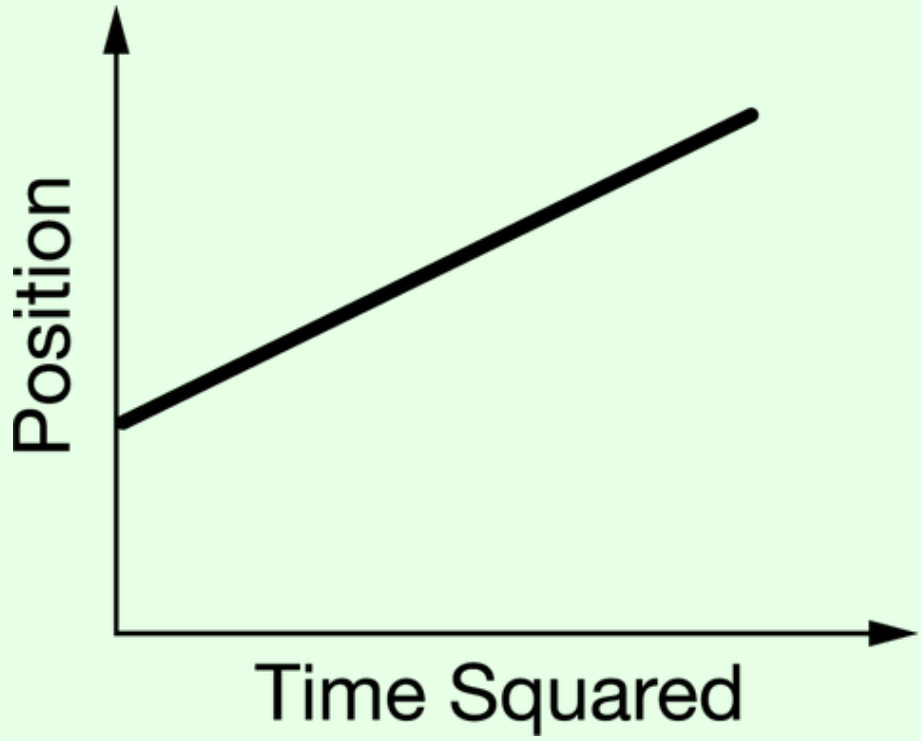
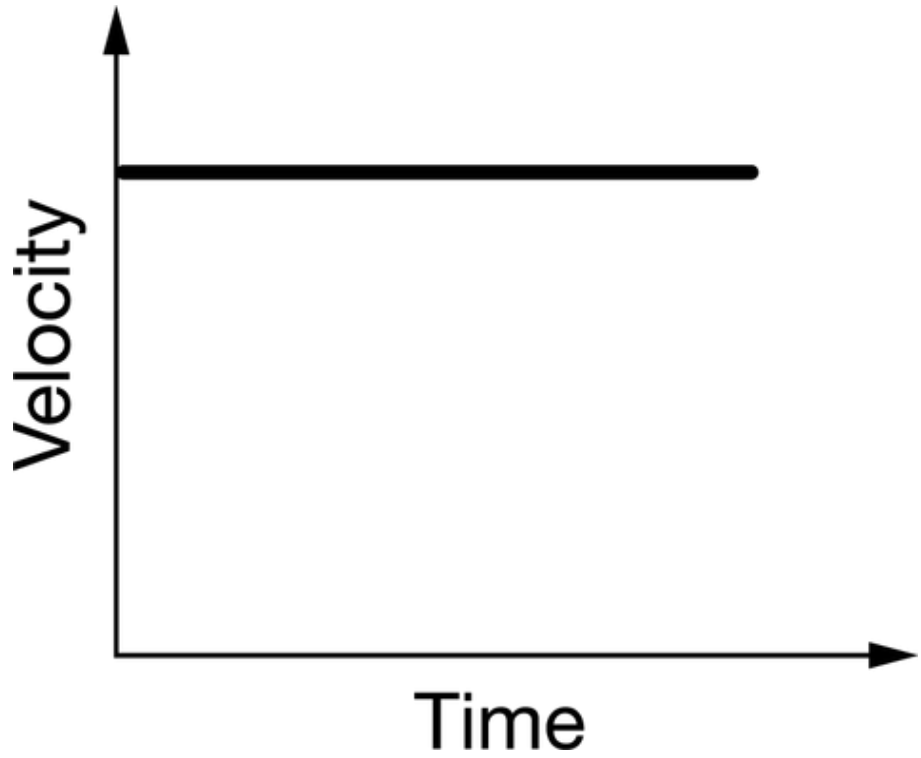
C



D



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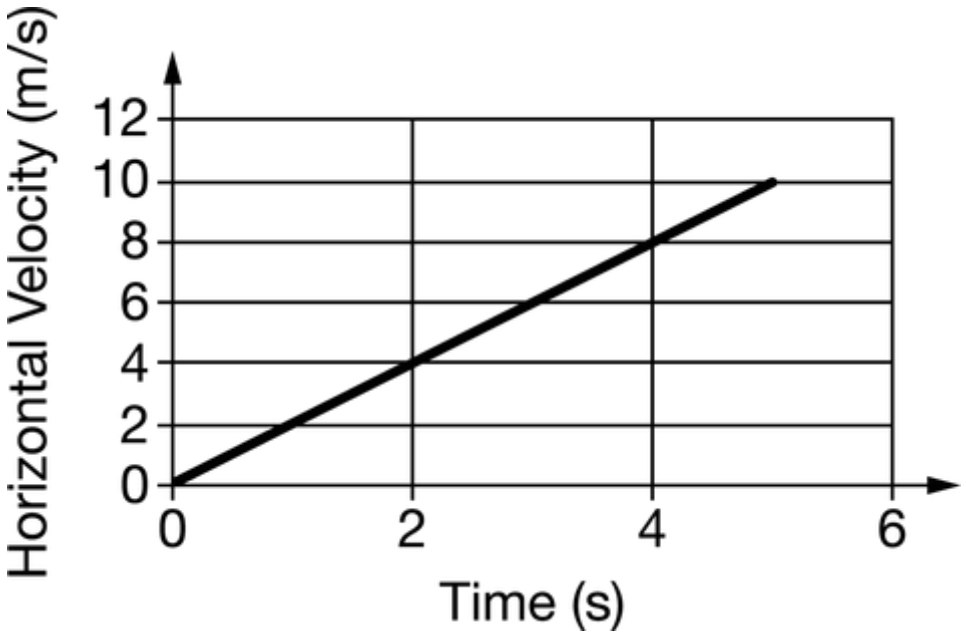
25.



An object travels along a straight line across a horizontal surface, and its motion is described by the velocity versus time graph shown in the figure. Which of the following methods will determine the total displacement of the object between $0\,\mathrm{s}$ and $5\,\mathrm{s}$? Select two answers.

(A) Finding the slope of the line between $0\,\mathrm{s}$ to $5\,\mathrm{s}$

(B) Dividing the change in velocity between $0\,\mathrm{s}$ to $5\,\mathrm{s}$ by the change in time

(C) Finding the area bound by the horizontal axis and the curve from $0\,\mathrm{s}$ to $5\,\mathrm{s}$ ✓

(D) Using $\mathrm{Average\,Speed} = \frac{\text{total dis tan ce}}{\text{total}}$ and multiplying the average speed of $5\,\frac{\mathrm{m}}{\mathrm{s}}$ by a total time of $5\,\mathrm{s}$ ✓

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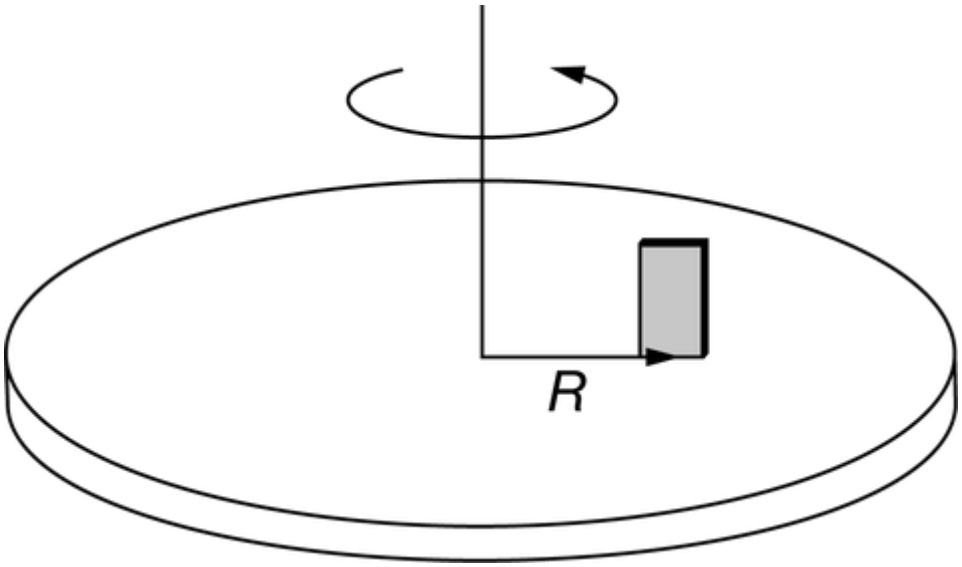
26.



Distance (m)	0.05
Speed $(\mathrm{m/s})$	0.16
Force (N)	0.050

A block of known mass M is on a disk that rotates about its center, as shown above. The block does not slip on the disk, and travels at a constant tangential speed v when at a distance R from the center with a centripetal force of magnitude F exerted on it. Which of the following statements about other quantities that might be determined is correct?

(A) The centripetal force exerted on the block at a larger radius can be determined, since $F = mv^2/R$ can be applied using the given known quantities.

(B) The centripetal acceleration of the block can be determined, since $a_c = \frac{v^2}{r}$ since the block's tangential speed is known and the radius is known. ✓

(C) The coefficient of friction between the block and the disk can be determined, since friction provides the centripetal force and the equation $F = \mu mg$ can be applied. ✓

(D) The total distance traveled by block can be determined by using $\Delta x = x - x_0$ using the known quantities.