

Physics

9 Weeks Exam, Form: A

Name: _____

Date: _____

Period: _____

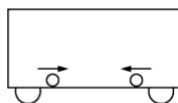
Primary Peer Reviewer: _____

+1	0	-1	Σ

Section 1. Multiple Choice

Choose the best answer to each question.

- Which of the following measurements is the closest to 1×10^{-2} m?
 - The diameter of an atom
 - The width of a student's finger
 - The height of a school teacher
 - The length of a football field
- A train is traveling to the right with a constant speed v_t . Two identical spheres are rolling on the floor of one train car. In the frame of reference of the train, the spheres are moving directly toward each other with a speed v_p , parallel to the train's motion, as shown in the figure above. A person is standing outside the train as it passes by. What are the velocities that the person would measure of each of the spheres as the train passes by?



- Left Sphere: $v_p + v_t$ Right sphere: $v_p + v_t$
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The following two questions refer to the following information:



During a drill in basketball practice, a player runs the length of a 30 meter court and back. The player does this three times in 60 seconds.

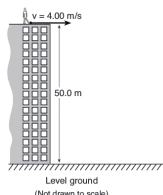
- What is the magnitude of the player's displacement at the end of the drill? (Hint: Magnitude means number only and not direction.)
 - 0 m
 - 30 m
 - 60 m
 - 180 m
- What is the player's average speed during this drill?
 - 0 m/s
 - 0.5 m/s
 - 3 m/s
 - 30 m/s

5. An airplane starts from rest and accelerates at a constant rate along a runway for a distance d in time t . If the same airplane were to accelerate at the same rate, what would be the time it takes the airplane to go a distance $2d$, in terms of t ?

(a) $\frac{t}{2}$
 (b) $\sqrt{2}t$
 (c) $2t$
 (d) $4t$

6. A student standing on the roof of a 50-meter tall building kicks a stone with an initial horizontal speed of 4 m/s, as shown in the diagram. How much time is required for the stone to reach the ground below?

(a) 3.19 s
 (b) 5.10 s
 (c) 10.2 s
 (d) 12.5 s



7. A blue car and a red car are racing. Both cars start from a stop and accelerate, each at a different constant rate. The blue car crosses the finish line in 10 seconds, and the red car crosses the finish line in 20 seconds. Compared to the blue car's final velocity, the red car's final velocity was -

(a) $\frac{1}{4}$ the blue car's final velocity
 (b) $\frac{1}{2}$ the blue car's final velocity
 (c) the same as the blue car's final velocity
 (d) 2 times the blue car's final velocity

8. Diana is in a bowling tournament when she rolls a bowling ball with an initial speed of 12 m/s toward the pins. Due to friction, the bowling ball decelerates at a rate of 0.3 m/s^2 . What is the final speed of the bowling ball when it hits the pins, 18.9 meters away?

(a) 0.812 m/s
 (b) 11.518 m/s
 (c) 12.464 m/s
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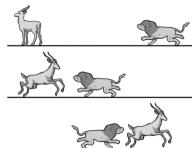
9. During a baseball game, a player hits a ball directly up. It is in the air for a total of 6.2 seconds. At the top of its path, the acceleration of the ball is -

(a) 0 m/s^2
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 (c) 30.411 m/s^2 upward
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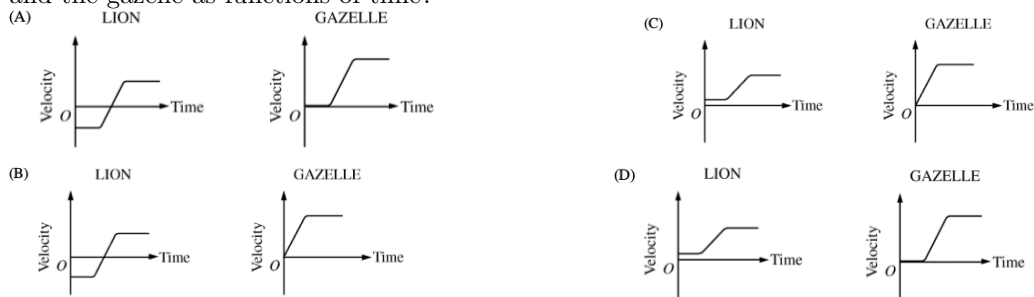
10. The area underneath a velocity-time graph is best interpreted as -

(a) change in velocity
 (b) distance traveled
 (c) acceleration
 (d) instantaneous velocity

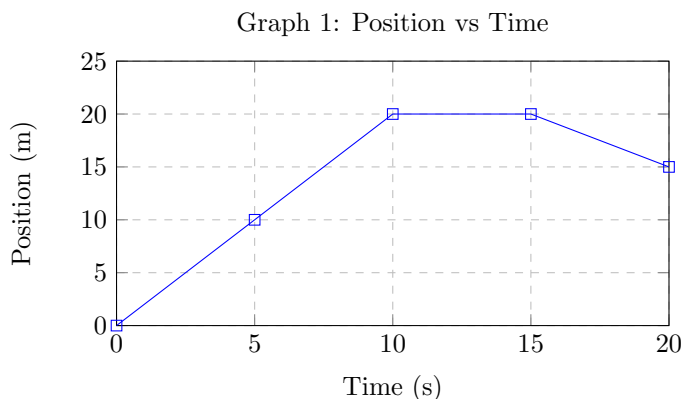
11. A lion is running at a constant speed toward a gazelle that is standing still, as shown in the top figure. After several seconds, the gazelle notices the lion and accelerates directly toward him, hoping to pass the lion and force him to reverse direction. As the gazelle accelerates toward and past the lion, the lion changes direction and accelerates in pursuit of the gazelle. The lion and Gazelle eventually reach constant but different speeds.



Which of the following sets of graphs shows a reasonable representation of the velocities of the lion and the gazelle as functions of time?



The following information applies to the next two questions:

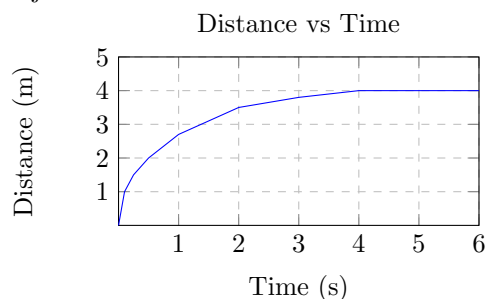


12. According to Graph 1, what is the average speed of this object from 0 to 10 seconds?
- (a) 100 m/s
 - (b) 20 m/s
 - (c) 2 m/s
 - (d) 0.5 m/s
13. According to graph 1, during what time interval is the object traveling backward?
- (a) 0-10 seconds
 - (b) 10-15 seconds
 - (c) 15-20 seconds
 - (d) The object does not travel backwards at any time.

14. What is the best description of acceleration?

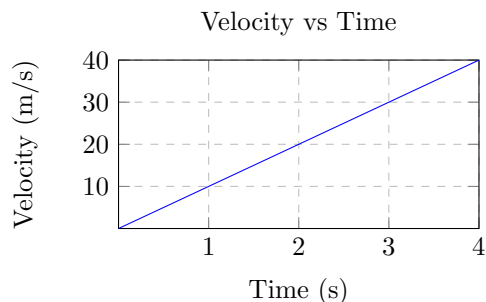
- (a) How fast an object is traveling.
- (b) How far an object travels in a certain amount of time.
- (c) How much an object slides or spins.
- (d) Speeding up, slowing down, or changing direction.

15. The graph below represents the relationship between the distance traveled and time elapsed for an object in motion.



What is the instantaneous speed of the object 5.0 seconds after the start?

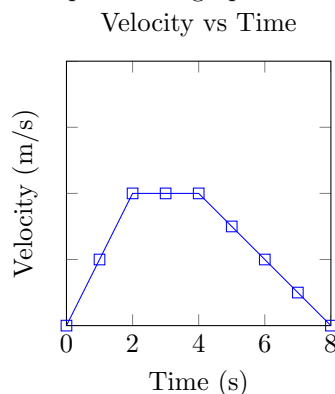
- (a) 0 m/s
 - (b) 2 m/s
 - (c) 4 m/s
 - (d) 5 m/s
16. A car is traveling eastward along a straight road. The graph below represents the velocity of the car as a function of time, t .



What is the magnitude of the displacement of the car from $t = 2.0$ seconds to $t = 4.0$ seconds?

- (a) 20. m
- (b) 40. m
- (c) 60. m
- (d) 80. m

17. The speed-time graph shown below represents the motion of an object:



- What is the best description for the motion of the object from 4 to 8 seconds?
- (a) The object is moving forward as it slows down and stops.
 - (b) The object is moving backward at a constant speed.
 - (c) The object is moving forward at a constant speed.
 - (d) The object is not moving.
18. An astronaut is standing on the surface of Venus. (Venus has an atmosphere that is nearly 100 times thicker than Earth's, and $g_{\text{venus}} = 8.87 \text{ m/s}^2$) He holds a hammer in one hand and a feather in the other hand, the same distance from the surface. He drops both at the same time. Which is the best description of what happens?
- (a) The feather lands first.
 - (b) The hammer lands first.
 - (c) Both objects land at the same time.
 - (d) Both objects float away.
19. An object with an initial speed of 4.0 m/s accelerates uniformly at 2.0 m/s^2 in the direction of its motion for a distance of 5.0 meters . What is the final speed of the object?
- (a) 6.0 m/s
 - (b) $10. \text{ m/s}$
 - (c) 14 m/s
 - (d) 36 m/s
20. A student drops an object from the top of a building 19.6 meters from the ground. How long does it take the object to fall to the ground?
- (a) 2 seconds
 - (b) 3 seconds
 - (c) 4 seconds
 - (d) 19.6 seconds

21. A bus is moving forward at 20 m/s. A student on the bus throws a tennis ball horizontally at 15 m/s toward the front of the bus. From the perspective of an observer standing on the sidewalk outside the bus, the tennis ball appears to move at -
- (a) 5 m/s
 - (b) 15 m/s
 - (c) 20 m/s
 - (d) 35 m/s
22. A car accelerates at 2 m/s^2 . What is its final velocity?
- (a) 0 m/s
 - (b) 2 m/s
 - (c) 4 m/s
 - (d) There is not enough information to solve this problem.

Section 2. Multiple Correct Multiple Choice

For the following question, **choose two** correct answers. No credit will be given for incorrect or partially correct answers. Mark **both** answers clearly.

23. Which of the following quantities are scalars? (CHOOSE TWO)

- (a) Distance
- (b) Displacement
- (c) Speed
- (d) Velocity
- (e) Acceleration

24. Which of the following objects are accelerating? (CHOOSE TWO)

- (a) A train that slows down as it pulls into the station.
- (b) A car that is stopped at a red light.
- (c) A boat traveling at a constant speed on calm water.
- (d) A racecar that is going around a turn at a constant speed.
- (e) An airplane traveling in a straight line at a constant speed.

25. A woman throws a rock horizontally off of a cliff. Which of the following statements are true concerning the time it takes for the rock to hit the ground. (CHOOSE TWO)

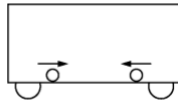
- (a) The harder the rock is thrown, the longer the rock will take to reach the ground.
- (b) The harder the rock is thrown, the less time the rock will take to reach the ground.
- (c) The speed that the rock is thrown horizontally has no effect on the time it takes the rock to reach the ground.
- (d) The time it takes the rock to reach the ground is the same as the time it would take a rock to reach the ground when dropped from the same height.
- (e) A rock that is thrown horizontally will always reach the ground faster than a rock that is dropped from the same height.

Answer Key for Exam A

Section 1. Multiple Choice

Choose the best answer to each question.

1. Which of the following measurements is the closest to 1×10^{-2} m?
 - (a) The diameter of an atom
 - (b) The width of a student's finger
 - (c) The height of a school teacher
 - (d) The length of a football field
2. A train is traveling to the right with a constant speed v_t . Two identical spheres are rolling on the floor of one train car. In the frame of reference of the train, the spheres are moving directly toward each other with a speed v_p , parallel to the train's motion, as shown in the figure above. A person is standing outside the train as it passes by. What are the velocities that the person would measure of each of the spheres as the train passes by?



- (a) Left Sphere: $v_p + v_t$ Right sphere: $v_p + v_t$
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During a drill in basketball practice, a player runs the length of a 30 meter court and back. The player does this three times in 60 seconds.

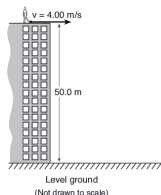
3. What is the magnitude of the player's displacement at the end of the drill? (Hint: Magnitude means number only and not direction.)
 - (a) 0 m
 - (b) 30 m
 - (c) 60 m
 - (d) 180 m
4. What is the player's average speed during this drill?
 - (a) 0 m/s
 - (b) 0.5 m/s
 - (c) 3 m/s
 - (d) 30 m/s

5. An airplane starts from rest and accelerates at a constant rate along a runway for a distance d in time t . If the same airplane were to accelerate at the same rate, what would be the time it takes the airplane to go a distance $2d$, in terms of t ?

- (a) $\frac{t}{2}$
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6. A student standing on the roof of a 50-meter tall building kicks a stone with an initial horizontal speed of 4 m/s, as shown in the diagram. How much time is required for the stone to reach the ground below?

- ☐ (a) 3.19 s
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7. A blue car and a red car are racing. Both cars start from a stop and accelerate, each at a different constant rate. The blue car crosses the finish line in 10 seconds, and the red car crosses the finish line in 20 seconds. Compared to the blue car's final velocity, the red car's final velocity was -

- (a) $\frac{1}{4}$ the blue car's final velocity
- ☐ (b) $\frac{1}{2}$ the blue car's final velocity
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8. Diana is in a bowling tournament when she rolls a bowling ball with an initial speed of 12 m/s toward the pins. Due to friction, the bowling ball decelerates at a rate of 0.3 m/s^2 . What is the final speed of the bowling ball when it hits the pins, 18.9 meters away?

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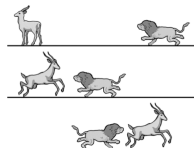
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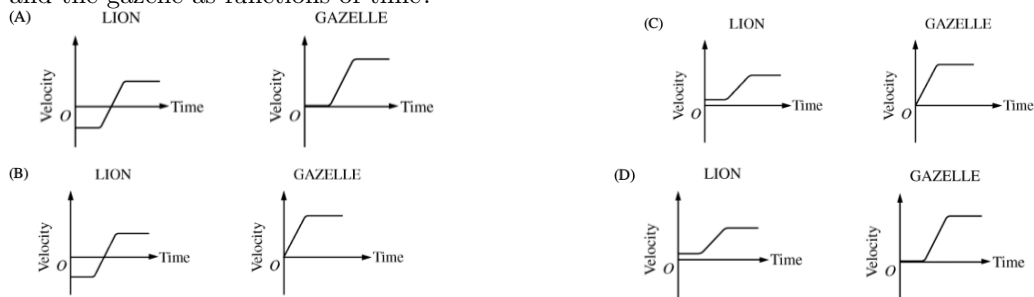
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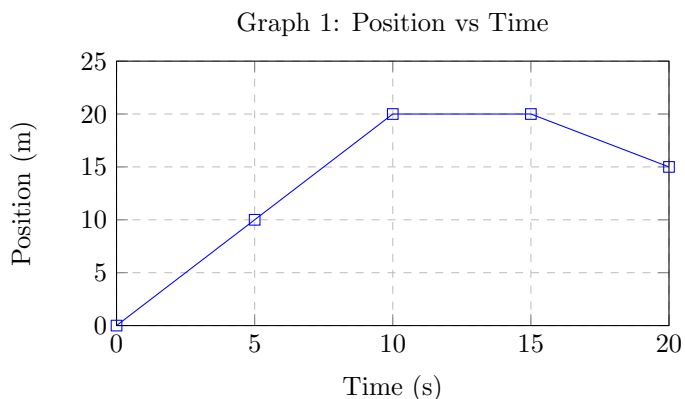
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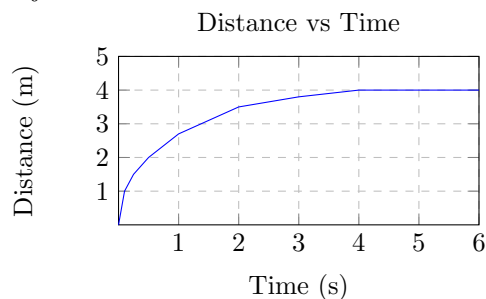


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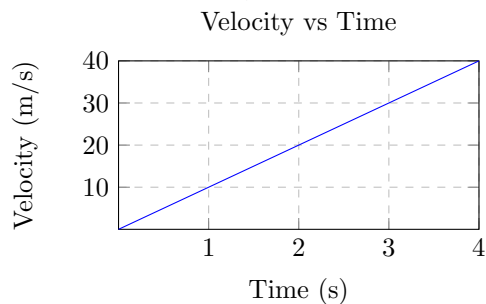
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What is the instantaneous speed of the object 5.0 seconds after the start?

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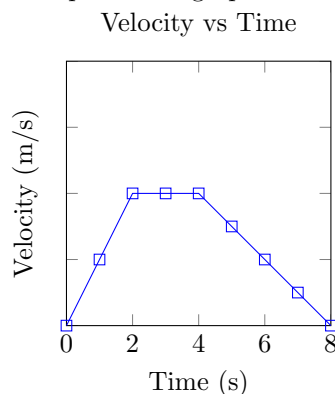
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22. A car accelerates at $2m/s^2$. What is its final velocity?

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Physics

9 Weeks Exam, Form: **B**

Name: _____

Date: _____

Period: _____

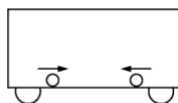
Primary Peer Reviewer: _____

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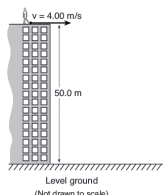
During a drill in basketball practice, a player runs the length of a 30 meter court and back. The player does this three times in 60 seconds.

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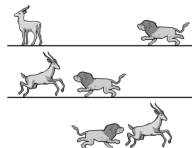
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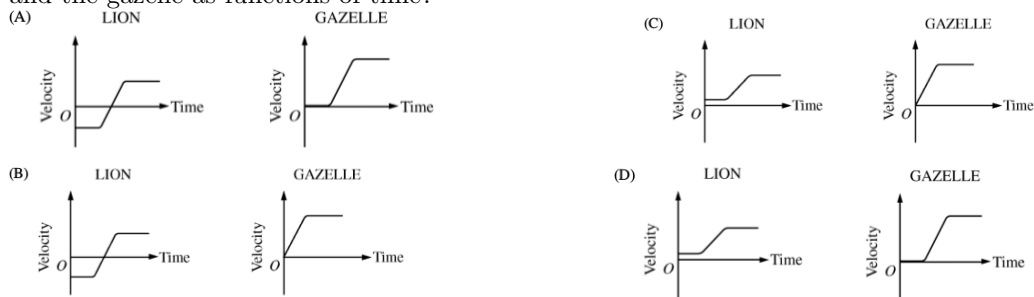
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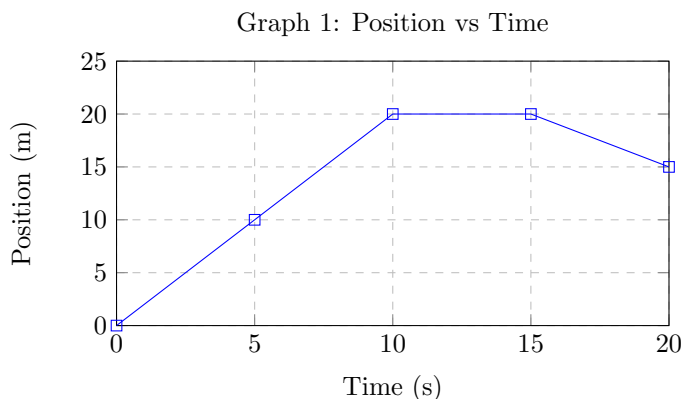
11. A lion is running at a constant speed toward a gazelle that is standing still, as shown in the top figure. After several seconds, the gazelle notices the lion and accelerates directly toward him, hoping to pass the lion and force him to reverse direction. As the gazelle accelerates toward and past the lion, the lion changes direction and accelerates in pursuit of the gazelle. The lion and Gazelle eventually reach constant but different speeds.



Which of the following sets of graphs shows a reasonable representation of the velocities of the lion and the gazelle as functions of time?

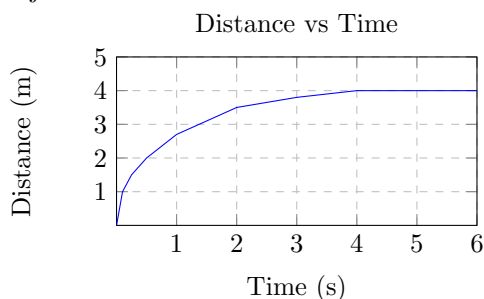


The following information applies to the next two questions:



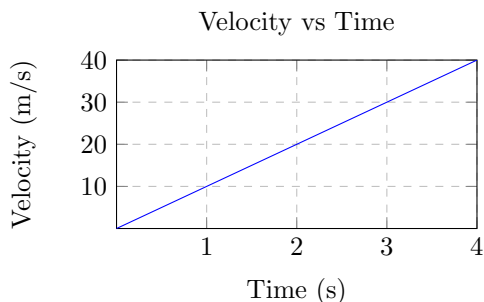
12. According to Graph 1, what is the average speed of this object from 0 to 10 seconds?
- 100 m/s
 - 20 m/s
 - 2 m/s
 - 0.5 m/s
13. According to graph 1, during what time interval is the object traveling backward?
- 0-10 seconds
 - 10-15 seconds
 - 15-20 seconds
 - The object does not travel backwards at any time.

14. What is the best description of acceleration?
- (a) How fast an object is traveling.
 - (b) How far an object travels in a certain amount of time.
 - (c) How much an object slides or spins.
 - (d) Speeding up, slowing down, or changing direction.
15. The graph below represents the relationship between the distance traveled and time elapsed for an object in motion.



What is the instantaneous speed of the object 5.0 seconds after the start?

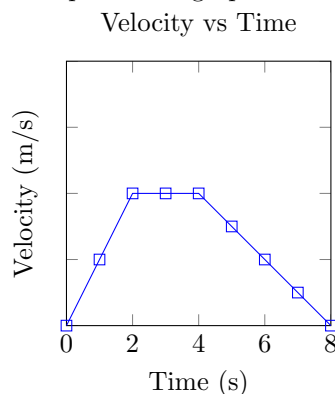
- (a) 0 m/s
 - (b) 2 m/s
 - (c) 4 m/s
 - (d) 5 m/s
16. A car is traveling eastward along a straight road. The graph below represents the velocity of the car as a function of time, t .



What is the magnitude of the displacement of the car from $t = 2.0$ seconds to $t = 4.0$ seconds?

- (a) 20. m
- (b) 40. m
- (c) 60. m
- (d) 80. m

17. The speed-time graph shown below represents the motion of an object:



- What is the best description for the motion of the object from 4 to 8 seconds?
- (a) The object is moving forward as it slows down and stops.
 - (b) The object is moving backward at a constant speed.
 - (c) The object is moving forward at a constant speed.
 - (d) The object is not moving.
18. An astronaut is standing on the surface of Venus. (Venus has an atmosphere that is nearly 100 times thicker than Earth's, and $g_{\text{venus}} = 8.87 \text{ m/s}^2$) He holds a hammer in one hand and a feather in the other hand, the same distance from the surface. He drops both at the same time. Which is the best description of what happens?
- (a) The feather lands first.
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 - (c) Both objects land at the same time.
 - (d) Both objects float away.
19. An object with an initial speed of 4.0 m/s accelerates uniformly at 2.0 m/s^2 in the direction of its motion for a distance of 5.0 meters . What is the final speed of the object?
- (a) 6.0 m/s
 - (b) $10. \text{ m/s}$
 - (c) 14 m/s
 - (d) 36 m/s
20. A student drops an object from the top of a building 19.6 meters from the ground. How long does it take the object to fall to the ground?
- (a) 2 seconds
 - (b) 3 seconds
 - (c) 4 seconds
 - (d) 19.6 seconds

21. A bus is moving forward at 20 m/s. A student on the bus throws a tennis ball horizontally at 15 m/s toward the front of the bus. From the perspective of an observer standing on the sidewalk outside the bus, the tennis ball appears to move at -
- (a) 5 m/s
 - (b) 15 m/s
 - (c) 20 m/s
 - (d) 35 m/s
22. A car accelerates at 2 m/s^2 . What is its final velocity?
- (a) 0 m/s
 - (b) 2 m/s
 - (c) 4 m/s
 - (d) There is not enough information to solve this problem.

Section 2. Multiple Correct Multiple Choice

For the following question, **choose two** correct answers. No credit will be given for incorrect or partially correct answers. Mark **both** answers clearly.

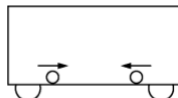
23. A woman throws a rock horizontally off of a cliff. Which of the following statements are true concerning the time it takes for the rock to hit the ground. (CHOOSE TWO)
- (a) The harder the rock is thrown, the longer the rock will take to reach the ground.
 - (b) The harder the rock is thrown, the less time the rock will take to reach the ground.
 - (c) The speed that the rock is thrown horizontally has no effect on the time it takes the rock to reach the ground.
 - (d) The time it takes the rock to reach the ground is the same as the time it would take a rock to reach the ground when dropped from the same height.
 - (e) A rock that is thrown horizontally will always reach the ground faster than a rock that is dropped from the same height.
24. Which of the following objects are accelerating? (CHOOSE TWO)
- (a) A train that slows down as it pulls into the station.
 - (b) A car that is stopped at a red light.
 - (c) A boat traveling at a constant speed on calm water.
 - (d) A racecar that is going around a turn at a constant speed.
 - (e) An airplane traveling in a straight line at a constant speed.
25. Which of the following quantities are scalars? (CHOOSE TWO)
- (a) Distance
 - (b) Displacement
 - (c) Speed
 - (d) Velocity
 - (e) Acceleration

Answer Key for Exam B

Section 1. Multiple Choice

Choose the best answer to each question.

1. Which of the following measurements is the closest to 1×10^{-2} m?
 - (a) The diameter of an atom
 - (b) The width of a student's finger
 - (c) The height of a school teacher
 - (d) The length of a football field
2. A train is traveling to the right with a constant speed v_t . Two identical spheres are rolling on the floor of one train car. In the frame of reference of the train, the spheres are moving directly toward each other with a speed v_p , parallel to the train's motion, as shown in the figure above. A person is standing outside the train as it passes by. What are the velocities that the person would measure of each of the spheres as the train passes by?



- (a) Left Sphere: $v_p + v_t$ Right sphere: $v_p + v_t$
- (b) Left Sphere: $v_p - v_t$ Right sphere: $v_p + v_t$
- (c) Left Sphere: $v_p + v_t$ Right sphere: $v_p - v_t$
- (d) Left Sphere: $v_p - v_t$ Right sphere: $v_p - v_t$

The following two questions refer to the following information:



During a drill in basketball practice, a player runs the length of a 30 meter court and back. The player does this three times in 60 seconds.

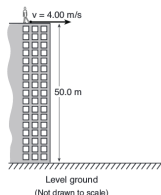
3. What is the magnitude of the player's displacement at the end of the drill? (Hint: Magnitude means number only and not direction.)
 - (a) 0 m
 - (b) 30 m
 - (c) 60 m
 - (d) 180 m
4. What is the player's average speed during this drill?
 - (a) 0 m/s
 - (b) 0.5 m/s
 - (c) 3 m/s
 - (d) 30 m/s

5. An airplane starts from rest and accelerates at a constant rate along a runway for a distance d in time t . If the same airplane were to accelerate at the same rate, what would be the time it takes the airplane to go a distance $2d$, in terms of t ?

- (a) $\frac{t}{2}$
- ☐ (b) $\sqrt{2}t$
- (c) $2t$
- (d) $4t$

6. A student standing on the roof of a 50-meter tall building kicks a stone with an initial horizontal speed of 4 m/s, as shown in the diagram. How much time is required for the stone to reach the ground below?

- ☐ (a) 3.19 s
- (b) 5.10 s
- (c) 10.2 s
- (d) 12.5 s



7. A blue car and a red car are racing. Both cars start from a stop and accelerate, each at a different constant rate. The blue car crosses the finish line in 10 seconds, and the red car crosses the finish line in 20 seconds. Compared to the blue car's final velocity, the red car's final velocity was -

- (a) $\frac{1}{4}$ the blue car's final velocity
- ☐ (b) $\frac{1}{2}$ the blue car's final velocity
- (c) the same as the blue car's final velocity
- (d) 2 times the blue car's final velocity

8. Diana is in a bowling tournament when she rolls a bowling ball with an initial speed of 12 m/s toward the pins. Due to friction, the bowling ball decelerates at a rate of 0.3 m/s^2 . What is the final speed of the bowling ball when it hits the pins, 18.9 meters away?

- (a) 0.812 m/s
- ☐ (b) 11.518 m/s
- (c) 12.464 m/s
- (d) 132.66 m/s

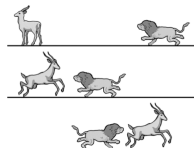
9. During a baseball game, a player hits a ball directly up. It is in the air for a total of 6.2 seconds. At the top of its path, the acceleration of the ball is -

- (a) 0 m/s^2
- ☐ (b) 9.81 m/s^2 downward
- (c) 30.411 m/s^2 upward
- (d) 50.227 m/s^2 upward

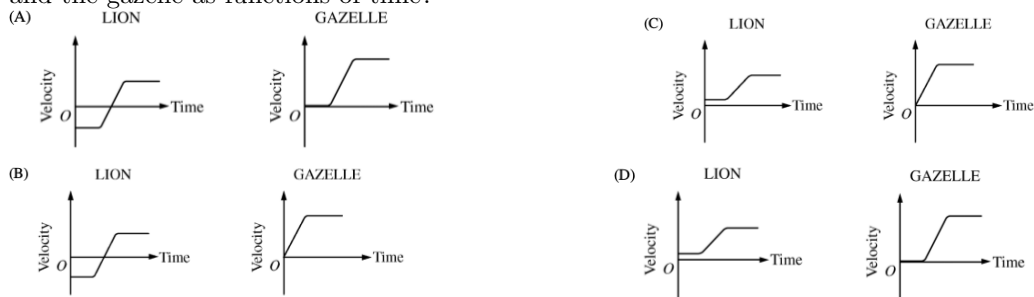
10. The area underneath a velocity-time graph is best interpreted as -

- (a) change in velocity
- ☐ (b) distance traveled
- (c) acceleration
- (d) instantaneous velocity

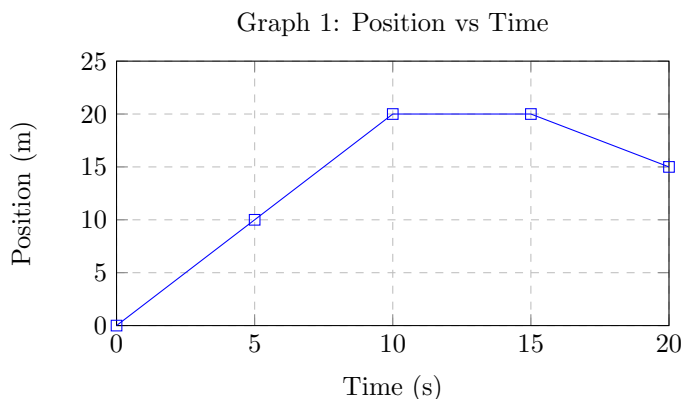
11. A lion is running at a constant speed toward a gazelle that is standing still, as shown in the top figure. After several seconds, the gazelle notices the lion and accelerates directly toward him, hoping to pass the lion and force him to reverse direction. As the gazelle accelerates toward and past the lion, the lion changes direction and accelerates in pursuit of the gazelle. The lion and Gazelle eventually reach constant but different speeds.



Which of the following sets of graphs shows a reasonable representation of the velocities of the lion and the gazelle as functions of time?



The following information applies to the next two questions:

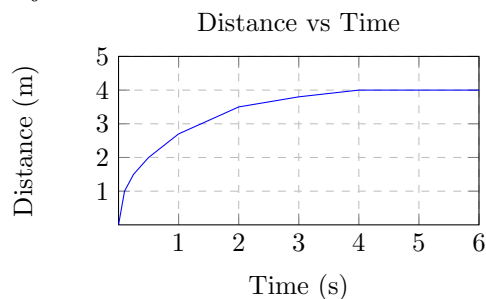


12. According to Graph 1, what is the average speed of this object from 0 to 10 seconds?
- (a) 100 m/s
(b) 20 m/s
☒ (c) 2 m/s
(d) 0.5 m/s
13. According to graph 1, during what time interval is the object traveling backward?
- (a) 0-10 seconds
(b) 10-15 seconds
☒ (c) 15-20 seconds
(d) The object does not travel backwards at any time.

14. What is the best description of acceleration?

- (a) How fast an object is traveling.
- (b) How far an object travels in a certain amount of time.
- (c) How much an object slides or spins.
- ☒ (d) Speeding up, slowing down, or changing direction.

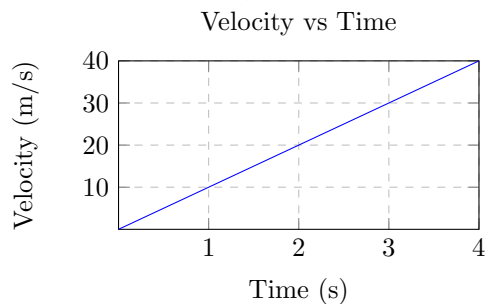
15. The graph below represents the relationship between the distance traveled and time elapsed for an object in motion.



What is the instantaneous speed of the object 5.0 seconds after the start?

- ☒ (a) 0 m/s
- (b) 2 m/s
- (c) 4 m/s
- (d) 5 m/s

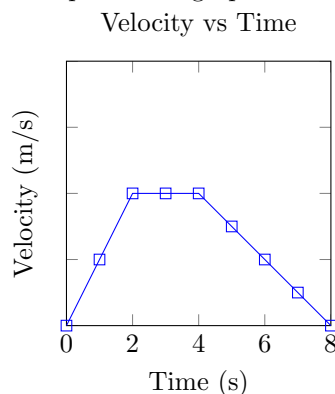
16. A car is traveling eastward along a straight road. The graph below represents the velocity of the car as a function of time, t .



What is the magnitude of the displacement of the car from $t = 2.0$ seconds to $t = 4.0$ seconds?

- (a) 20. m
- (b) 40. m
- ☒ (c) 60. m
- (d) 80. m

17. The speed-time graph shown below represents the motion of an object:



What is the best description for the motion of the object from 4 to 8 seconds?

- ☐ (a) The object is moving forward as it slows down and stops.
- ☐ (b) The object is moving backward at a constant speed.
- ☐ (c) The object is moving forward at a constant speed.
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18. An astronaut is standing on the surface of Venus. (Venus has an atmosphere that is nearly 100 times thicker than Earth's, and $g_{venus} = 8.87 m/s^2$) He holds a hammer in one hand and a feather in the other hand, the same distance from the surface. He drops both at the same time. Which is the best description of what happens?
- ☐ (a) The feather lands first.
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- ☐ (c) Both objects land at the same time.
- ☐ (d) Both objects float away.
19. An object with an initial speed of 4.0 m/s accelerates uniformly at $2.0 m/s^2$ in the direction of its motion for a distance of 5.0 meters. What is the final speed of the object?
- ☐ (a) 6.0 m/s
- ☐ (b) 10. m/s
- ☐ (c) 14 m/s
- ☐ (d) 36 m/s
20. A student drops an object from the top of a building 19.6 meters from the ground. How long does it take the object to fall to the ground?
- ☐ (a) 2 seconds
- ☐ (b) 3 seconds
- ☐ (c) 4 seconds
- ☐ (d) 19.6 seconds
21. A bus is moving forward at 20 m/s. A student on the bus throws a tennis ball horizontally at 15 m/s toward the front of the bus. From the perspective of an observer standing on the sidewalk outside the bus, the tennis ball appears to move at -
- ☐ (a) 5 m/s
- ☐ (b) 15 m/s
- ☐ (c) 20 m/s
- ☐ (d) 35 m/s

22. A car accelerates at $2m/s^2$. What is its final velocity?

(a) 0 m/s

(b) 2 m/s

(c) 4 m/s

☒ (d) There is not enough information to solve this problem.

Section 2. Multiple Correct Multiple Choice

For the following question, **choose two** correct answers. No credit will be given for incorrect or partially correct answers. Mark **both** answers clearly.

23. A woman throws a rock horizontally off of a cliff. Which of the following statements are true concerning the time it takes for the rock to hit the ground. (CHOOSE TWO)
- (a) The harder the rock is thrown, the longer the rock will take to reach the ground.
 - (b) The harder the rock is thrown, the less time the rock will take to reach the ground.
 - ☐ (c) The speed that the rock is thrown horizontally has no effect on the time it takes the rock to reach the ground.
 - ☐ (d) The time it takes the rock to reach the ground is the same as the time it would take a rock to reach the ground when dropped from the same height.
 - (e) A rock that is thrown horizontally will always reach the ground faster than a rock that is dropped from the same height.
24. Which of the following objects are accelerating? (CHOOSE TWO)
- ☐ (a) A train that slows down as it pulls into the station.
 - (b) A car that is stopped at a red light.
 - (c) A boat traveling at a constant speed on calm water.
 - ☐ (d) A racecar that is going around a turn at a constant speed.
 - (e) An airplane traveling in a straight line at a constant speed.
25. Which of the following quantities are scalars? (CHOOSE TWO)
- ☐ (a) Distance
 - (b) Displacement
 - ☐ (c) Speed
 - (d) Velocity
 - (e) Acceleration

Physics

9 Weeks Exam, Form: C

Name: _____

Date: _____

Period: _____

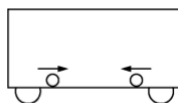
Primary Peer Reviewer: _____

+1	0	-1	Σ

Section 1. Multiple Choice

Choose the best answer to each question.

- Which of the following measurements is the closest to 1×10^{-2} m?
 - The diameter of an atom
 - The width of a student's finger
 - The height of a school teacher
 - The length of a football field
- A train is traveling to the right with a constant speed v_t . Two identical spheres are rolling on the floor of one train car. In the frame of reference of the train, the spheres are moving directly toward each other with a speed v_p , parallel to the train's motion, as shown in the figure above. A person is standing outside the train as it passes by. What are the velocities that the person would measure of each of the spheres as the train passes by?



- Left Sphere: $v_p + v_t$ Right sphere: $v_p + v_t$
- Left Sphere: $v_p - v_t$ Right sphere: $v_p + v_t$
- Left Sphere: $v_p + v_t$ Right sphere: $v_p - v_t$
- Left Sphere: $v_p - v_t$ Right sphere: $v_p - v_t$

The following two questions refer to the following information:



During a drill in basketball practice, a player runs the length of a 30 meter court and back. The player does this three times in 60 seconds.

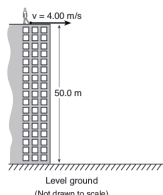
- What is the magnitude of the player's displacement at the end of the drill? (Hint: Magnitude means number only and not direction.)
 - 0 m
 - 30 m
 - 60 m
 - 180 m
- What is the player's average speed during this drill?
 - 0 m/s
 - 0.5 m/s
 - 3 m/s
 - 30 m/s

5. An airplane starts from rest and accelerates at a constant rate along a runway for a distance d in time t . If the same airplane were to accelerate at the same rate, what would be the time it takes the airplane to go a distance $2d$, in terms of t ?

(a) $\frac{t}{2}$
 (b) $\sqrt{2}t$
 (c) $2t$
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6. A student standing on the roof of a 50-meter tall building kicks a stone with an initial horizontal speed of 4 m/s, as shown in the diagram. How much time is required for the stone to reach the ground below?

(a) 3.19 s
 (b) 5.10 s
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7. A blue car and a red car are racing. Both cars start from a stop and accelerate, each at a different constant rate. The blue car crosses the finish line in 10 seconds, and the red car crosses the finish line in 20 seconds. Compared to the blue car's final velocity, the red car's final velocity was -

(a) $\frac{1}{4}$ the blue car's final velocity
 (b) $\frac{1}{2}$ the blue car's final velocity
 (c) the same as the blue car's final velocity
 (d) 2 times the blue car's final velocity

8. Diana is in a bowling tournament when she rolls a bowling ball with an initial speed of 12 m/s toward the pins. Due to friction, the bowling ball decelerates at a rate of 0.3 m/s^2 . What is the final speed of the bowling ball when it hits the pins, 18.9 meters away?

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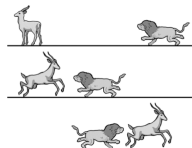
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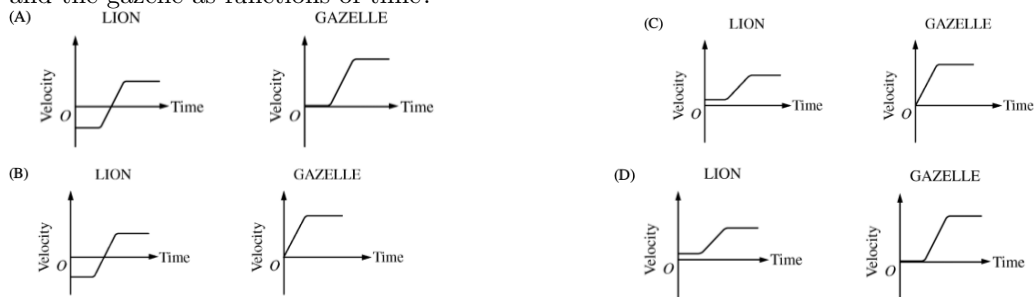
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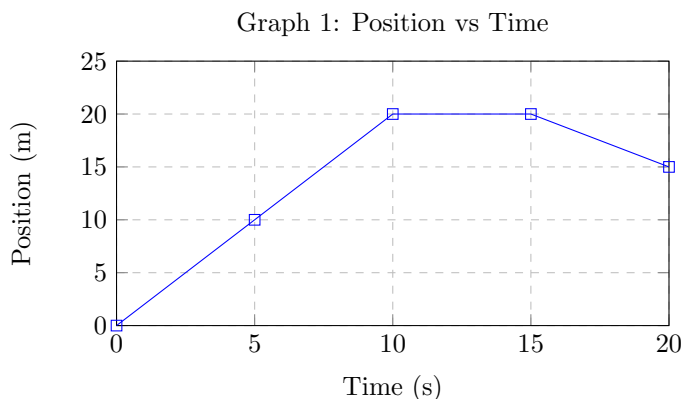
11. A lion is running at a constant speed toward a gazelle that is standing still, as shown in the top figure. After several seconds, the gazelle notices the lion and accelerates directly toward him, hoping to pass the lion and force him to reverse direction. As the gazelle accelerates toward and past the lion, the lion changes direction and accelerates in pursuit of the gazelle. The lion and Gazelle eventually reach constant but different speeds.



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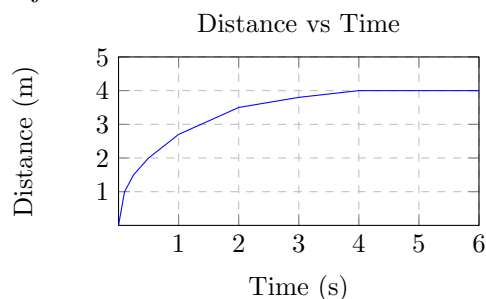


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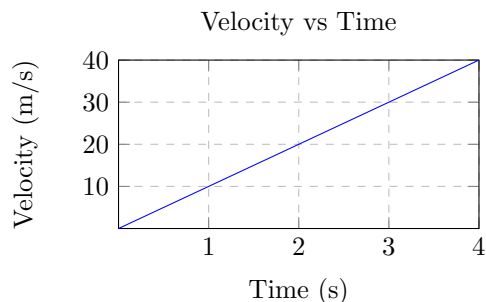
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- (a) 0-10 seconds
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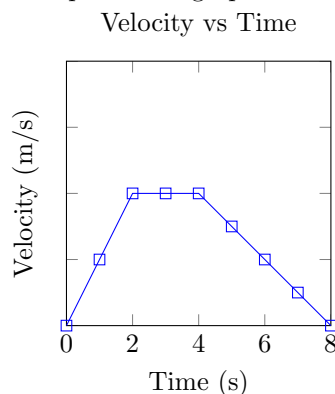
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What is the magnitude of the displacement of the car from $t = 2.0$ seconds to $t = 4.0$ seconds?

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 - (c) 4 seconds
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21. A bus is moving forward at 20 m/s. A student on the bus throws a tennis ball horizontally at 15 m/s toward the front of the bus. From the perspective of an observer standing on the sidewalk outside the bus, the tennis ball appears to move at -
- (a) 5 m/s
 - (b) 15 m/s
 - (c) 20 m/s
 - (d) 35 m/s
22. A car accelerates at 2 m/s^2 . What is its final velocity?
- (a) 0 m/s
 - (b) 2 m/s
 - (c) 4 m/s
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Section 2. Multiple Correct Multiple Choice

For the following question, **choose two** correct answers. No credit will be given for incorrect or partially correct answers. Mark **both** answers clearly.

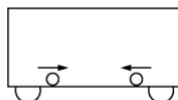
23. A woman throws a rock horizontally off of a cliff. Which of the following statements are true concerning the time it takes for the rock to hit the ground. (CHOOSE TWO)
- (a) The harder the rock is thrown, the longer the rock will take to reach the ground.
 - (b) The harder the rock is thrown, the less time the rock will take to reach the ground.
 - (c) The speed that the rock is thrown horizontally has no effect on the time it takes the rock to reach the ground.
 - (d) The time it takes the rock to reach the ground is the same as the time it would take a rock to reach the ground when dropped from the same height.
 - (e) A rock that is thrown horizontally will always reach the ground faster than a rock that is dropped from the same height.
24. Which of the following quantities are scalars? (CHOOSE TWO)
- (a) Distance
 - (b) Displacement
 - (c) Speed
 - (d) Velocity
 - (e) Acceleration
25. Which of the following objects are accelerating? (CHOOSE TWO)
- (a) A train that slows down as it pulls into the station.
 - (b) A car that is stopped at a red light.
 - (c) A boat traveling at a constant speed on calm water.
 - (d) A racecar that is going around a turn at a constant speed.
 - (e) An airplane traveling in a straight line at a constant speed.

Answer Key for Exam C

Section 1. Multiple Choice

Choose the best answer to each question.

1. Which of the following measurements is the closest to 1×10^{-2} m?
 - (a) The diameter of an atom
 - (b) The width of a student's finger
 - (c) The height of a school teacher
 - (d) The length of a football field
2. A train is traveling to the right with a constant speed v_t . Two identical spheres are rolling on the floor of one train car. In the frame of reference of the train, the spheres are moving directly toward each other with a speed v_p , parallel to the train's motion, as shown in the figure above. A person is standing outside the train as it passes by. What are the velocities that the person would measure of each of the spheres as the train passes by?



- (a) Left Sphere: $v_p + v_t$ Right sphere: $v_p + v_t$
- (b) Left Sphere: $v_p - v_t$ Right sphere: $v_p + v_t$
- (c) Left Sphere: $v_p + v_t$ Right sphere: $v_p - v_t$
- (d) Left Sphere: $v_p - v_t$ Right sphere: $v_p - v_t$

The following two questions refer to the following information:



During a drill in basketball practice, a player runs the length of a 30 meter court and back. The player does this three times in 60 seconds.

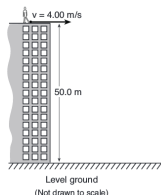
3. What is the magnitude of the player's displacement at the end of the drill? (Hint: Magnitude means number only and not direction.)
 - (a) 0 m
 - (b) 30 m
 - (c) 60 m
 - (d) 180 m
4. What is the player's average speed during this drill?
 - (a) 0 m/s
 - (b) 0.5 m/s
 - (c) 3 m/s
 - (d) 30 m/s

5. An airplane starts from rest and accelerates at a constant rate along a runway for a distance d in time t . If the same airplane were to accelerate at the same rate, what would be the time it takes the airplane to go a distance $2d$, in terms of t ?

- (a) $\frac{t}{2}$
- ☐ (b) $\sqrt{2}t$
- (c) $2t$
- (d) $4t$

6. A student standing on the roof of a 50-meter tall building kicks a stone with an initial horizontal speed of 4 m/s, as shown in the diagram. How much time is required for the stone to reach the ground below?

- ☐ (a) 3.19 s
- (b) 5.10 s
- (c) 10.2 s
- (d) 12.5 s



7. A blue car and a red car are racing. Both cars start from a stop and accelerate, each at a different constant rate. The blue car crosses the finish line in 10 seconds, and the red car crosses the finish line in 20 seconds. Compared to the blue car's final velocity, the red car's final velocity was -

- (a) $\frac{1}{4}$ the blue car's final velocity
- ☐ (b) $\frac{1}{2}$ the blue car's final velocity
- (c) the same as the blue car's final velocity
- (d) 2 times the blue car's final velocity

8. Diana is in a bowling tournament when she rolls a bowling ball with an initial speed of 12 m/s toward the pins. Due to friction, the bowling ball decelerates at a rate of 0.3 m/s^2 . What is the final speed of the bowling ball when it hits the pins, 18.9 meters away?

- (a) 0.812 m/s
- ☐ (b) 11.518 m/s
- (c) 12.464 m/s
- (d) 132.66 m/s

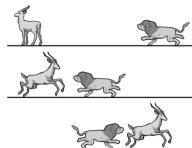
9. During a baseball game, a player hits a ball directly up. It is in the air for a total of 6.2 seconds. At the top of its path, the acceleration of the ball is -

- (a) 0 m/s^2
- ☐ (b) 9.81 m/s^2 downward
- (c) 30.411 m/s^2 upward
- (d) 50.227 m/s^2 upward

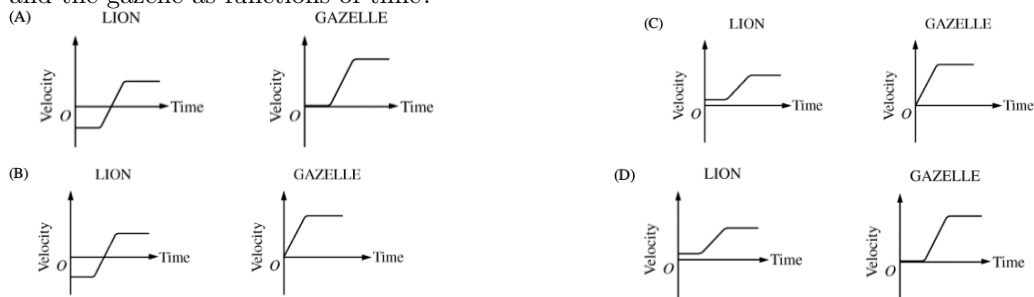
10. The area underneath a velocity-time graph is best interpreted as -

- (a) change in velocity
- ☐ (b) distance traveled
- (c) acceleration
- (d) instantaneous velocity

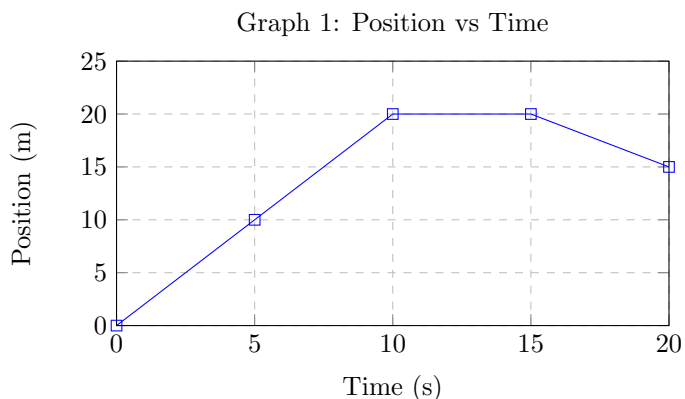
11. A lion is running at a constant speed toward a gazelle that is standing still, as shown in the top figure. After several seconds, the gazelle notices the lion and accelerates directly toward him, hoping to pass the lion and force him to reverse direction. As the gazelle accelerates toward and past the lion, the lion changes direction and accelerates in pursuit of the gazelle. The lion and Gazelle eventually reach constant but different speeds.



Which of the following sets of graphs shows a reasonable representation of the velocities of the lion and the gazelle as functions of time?



The following information applies to the next two questions:

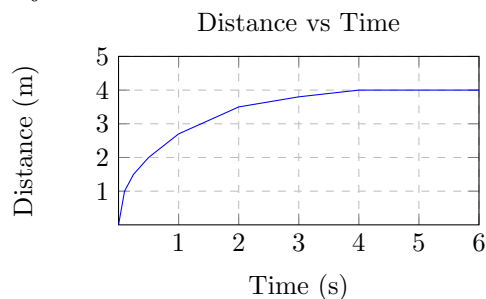


12. According to Graph 1, what is the average speed of this object from 0 to 10 seconds?
- (a) 100 m/s
(b) 20 m/s
☒ (c) 2 m/s
(d) 0.5 m/s
13. According to graph 1, during what time interval is the object traveling backward?
- (a) 0-10 seconds
(b) 10-15 seconds
☒ (c) 15-20 seconds
(d) The object does not travel backwards at any time.

14. What is the best description of acceleration?

- (a) How fast an object is traveling.
- (b) How far an object travels in a certain amount of time.
- (c) How much an object slides or spins.
- ☒ (d) Speeding up, slowing down, or changing direction.

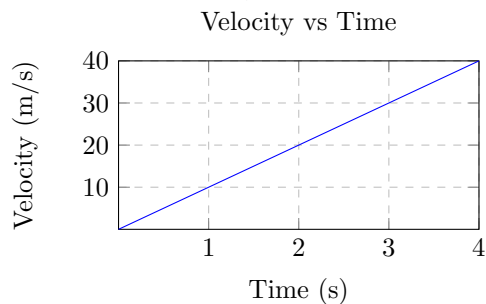
15. The graph below represents the relationship between the distance traveled and time elapsed for an object in motion.



What is the instantaneous speed of the object 5.0 seconds after the start?

- ☒ (a) 0 m/s
- (b) 2 m/s
- (c) 4 m/s
- (d) 5 m/s

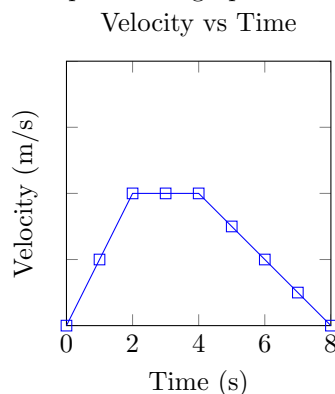
16. A car is traveling eastward along a straight road. The graph below represents the velocity of the car as a function of time, t .



What is the magnitude of the displacement of the car from $t = 2.0$ seconds to $t = 4.0$ seconds?

- (a) 20. m
- (b) 40. m
- ☒ (c) 60. m
- (d) 80. m

17. The speed-time graph shown below represents the motion of an object:



What is the best description for the motion of the object from 4 to 8 seconds?

- ☐ (a) The object is moving forward as it slows down and stops.
- ☐ (b) The object is moving backward at a constant speed.
- ☐ (c) The object is moving forward at a constant speed.
- ☐ (d) The object is not moving.
18. An astronaut is standing on the surface of Venus. (Venus has an atmosphere that is nearly 100 times thicker than Earth's, and $g_{venus} = 8.87 m/s^2$) He holds a hammer in one hand and a feather in the other hand, the same distance from the surface. He drops both at the same time. Which is the best description of what happens?
- ☐ (a) The feather lands first.
- ☐ (b) The hammer lands first.
- ☐ (c) Both objects land at the same time.
- ☐ (d) Both objects float away.
19. An object with an initial speed of 4.0 m/s accelerates uniformly at $2.0 m/s^2$ in the direction of its motion for a distance of 5.0 meters. What is the final speed of the object?
- ☐ (a) 6.0 m/s
- ☐ (b) 10. m/s
- ☐ (c) 14 m/s
- ☐ (d) 36 m/s
20. A student drops an object from the top of a building 19.6 meters from the ground. How long does it take the object to fall to the ground?
- ☐ (a) 2 seconds
- ☐ (b) 3 seconds
- ☐ (c) 4 seconds
- ☐ (d) 19.6 seconds
21. A bus is moving forward at 20 m/s. A student on the bus throws a tennis ball horizontally at 15 m/s toward the front of the bus. From the perspective of an observer standing on the sidewalk outside the bus, the tennis ball appears to move at -
- ☐ (a) 5 m/s
- ☐ (b) 15 m/s
- ☐ (c) 20 m/s
- ☐ (d) 35 m/s

22. A car accelerates at $2m/s^2$. What is its final velocity?

(a) 0 m/s

(b) 2 m/s

(c) 4 m/s

☒ (d) There is not enough information to solve this problem.

Section 2. Multiple Correct Multiple Choice

For the following question, **choose two** correct answers. No credit will be given for incorrect or partially correct answers. Mark **both** answers clearly.

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- (a) The harder the rock is thrown, the longer the rock will take to reach the ground.
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