

# 1D Kinematic Items - Ver8

June 2024

# 1 Kinematics Assessment

The questions which follow ask about the motion of an object in one dimension. All objects move along the  $x$  axis. The positive  $x$  axis is to the right of the page. For any vector quantity (acceleration, velocity, etc.), the problem asks about the  $x$  component of the vector.

**Problem 1:** (KD1-1-V3)

An object is initially at the point  $+2\text{m}$  along the  $x$ -axis. The object then moves to the point  $+1\text{m}$ . What is the displacement of the object?

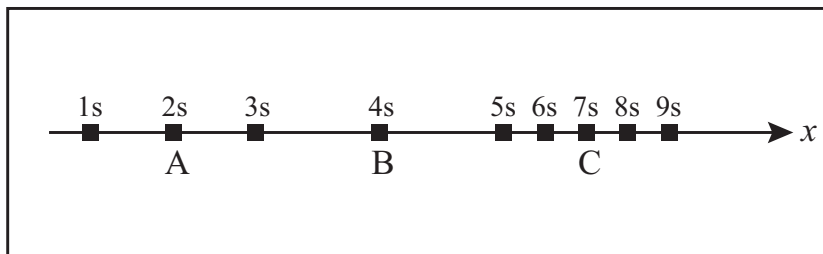
- A. The displacement is  $1\text{m}$ .
- B. The displacement is  $1\text{m}$  in the positive  $x$  direction.
- C. The displacement is  $1\text{m}$  in the negative  $x$  direction.
- D. The displacement is  $2\text{m}$ .
- E. The displacement is  $2\text{m}$  in the positive  $x$  direction.
- F. The displacement is  $2\text{m}$  in the negative  $x$  direction.

**Problem 2:** (KD1-10-V7EC)

Object A moves at a rate of  $2\text{m/s}$  to the north. Object B moves at a rate of  $2\text{m/s}$  to the south. Which of the following best describes the speeds and velocities of the objects?

- A. Object A and Object B have the same speed, and Object A and Object B have the same velocity.
- B. Object A and Object B have the same speed, but Object A and Object B have different velocities.
- C. Object A and Object B have different speeds, but Object A and Object B have the same velocity.
- D. Object A and Object B have different speeds, and Object A and Object B have different velocities.

**Problem 3:** (KD1-5-V4EC)

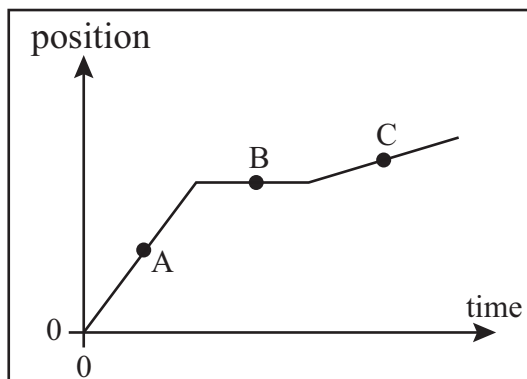


The figure above shows the location of an object moving to the right along the  $x$  axis. Each square represents the location at a point in time. The amount of time between each pair of sequential squares is one second.

Select the inequality below which best represents the relation of the average velocity in the  $x$  direction,  $v$ , at the points A, B, and C.

- A.  $v_A = v_B = v_C$
- B.  $v_A > v_B > v_C$
- C.  $v_C > v_B > v_A$
- D.  $v_C > v_A > v_B$
- E.  $v_B > v_A > v_C$

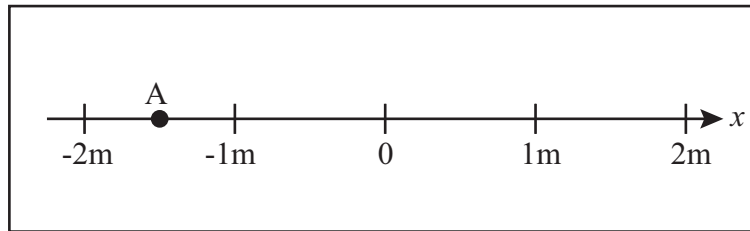
**Problem 4:** (KD1-6-V3)



An object moves along the  $x$  axis. The figure above shows the graph of the position on the  $x$  axis as a function of time. Three locations on the plot have been marked. Select the inequality below which best represents the relation of the velocity in the  $x$  direction,  $v$ , at the points A, B, and C.

- A.  $v_A = v_B = v_C$
- B.  $v_A > v_C > v_B$
- C.  $v_C > v_B > v_A$
- D.  $v_C > v_A > v_B$
- E.  $v_B > v_A > v_C$

**Problem 5:** (KD1-8-V4EC)

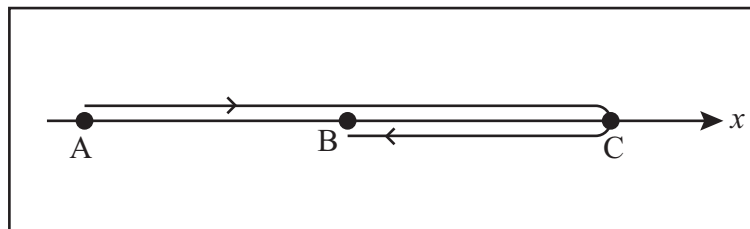


An object moves along the  $x$  axis. At time  $t_A$ , the object is at point A. The object's position is negative at point A as shown in the figure above. The object has a constant negative velocity.

Select the response that best describes the motion of the object after time  $t_A$ .

- A. The object moves to the left.
- B. The object moves to the left until it reaches the origin and then stops.
- C. The object moves to the left until it reaches the origin, stops, then moves to the right.
- D. The object moves to the right.
- E. The object moves to the right until it reaches the origin and then stops.
- F. The object moves to the right until it reaches the origin, stops, then moves to the left.

**Problem 6:** (KD1-11-V6EC)

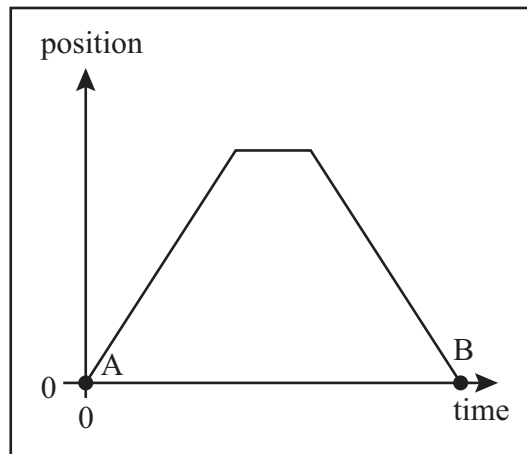


The figure above shows the trajectory of an object that starts at point A, travels to the right with a constant velocity in the  $x$  direction of  $+1\text{m/s}$  until it reaches point C, then reverses direction and travels to the left with a constant velocity in the  $x$  direction of  $-1\text{m/s}$  to point B.

Select the response which best represents the relation of the average speed of the object and the average velocity in the  $x$  direction over the entire trajectory.

- A. The average speed and the average velocity are equal.
- B. The average speed is greater than the average velocity.
- C. The average speed is less than the average velocity.

**Problem 7:** (KD1-12)

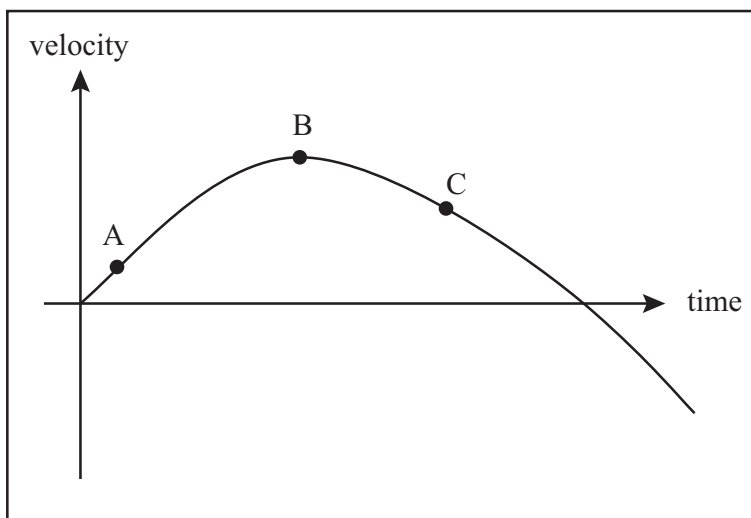


The position versus time graph of an object moving along the  $x$  axis is shown above. The object starts at point A at time zero.

Select the response below that best describes its motion after time zero.

- A. The object first moves in the positive  $x$  direction at constant velocity, then stops moving, then moves in the negative  $x$  direction with constant velocity.
- B. The object first moves in the positive  $x$  direction at constant velocity, then stops moving, then moves in the positive  $x$  direction with constant velocity.
- C. The object first moves in the positive  $x$  direction with increasing velocity, then moves with in the positive  $x$  direction with constant velocity, then moves in the positive  $x$  direction with negative velocity increasing in magnitude with time.

**Problem 8:** (KD1-13-V5EC)



An object moves along the  $x$  axis. The figure above shows the graph of the velocity of the object as a function of time. Select the response that best describes the relation of the acceleration in the  $x$  direction,  $a$ , at points A, B, and C.

- A. magnitude of the acceleration at B  $>$  magnitude of the acceleration at C  $>$  magnitude of acceleration at A  
and  
The accelerations at B, C, and A all point in the positive  $x$  direction.
- B. magnitude of acceleration at B  $>$  magnitude of acceleration at C  $>$  magnitude of acceleration at A.  
and  
The accelerations at B and A point in the positive  $x$  direction, and the acceleration at C points in the negative  $x$  direction.
- C. magnitude of acceleration at A  $>$  magnitude of acceleration at C  $>$  magnitude of acceleration at B.  
and  
The acceleration at A points in the positive direction. The acceleration at C points in the negative direction. The acceleration at B is approximately zero.

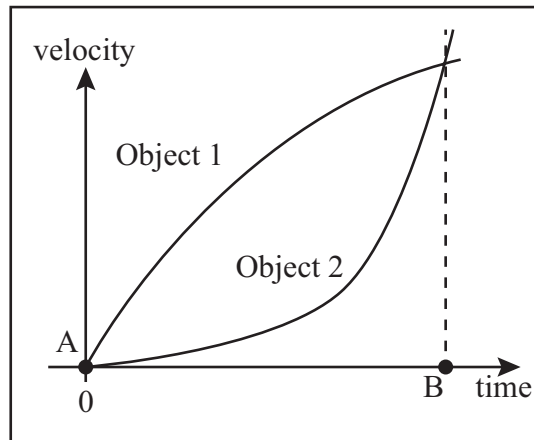
KD1-13Changed distractors to defocus signed acceleration.

**Problem 9:** (KD1-14-V3)

An object moves along the  $x$  axis. When the object passes through  $x = +1\text{m}$  the object has a velocity of  $v = +2\text{m/s}$  in the positive  $x$  direction. When the object passes through  $x = +2\text{m}$  the object has a velocity of  $v = +1\text{m/s}$  in the positive  $x$  direction. Select the response which best describes the average acceleration of the object between the two points.

- A. The object's average acceleration is zero.
- B. The object's average acceleration is in the positive  $x$  direction.
- C. The object's average acceleration is in the negative  $x$  direction.

**Problem 10:** (KD1-15-V2EC)

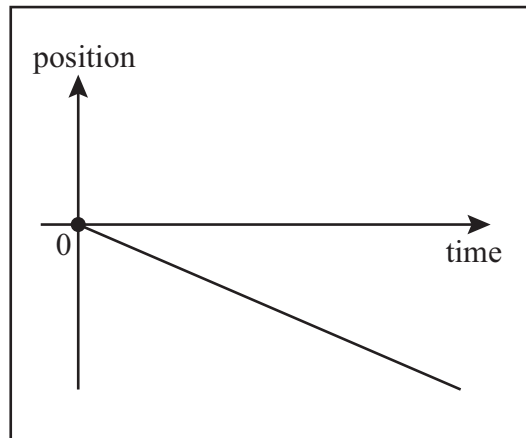


Two objects, Object 1 and 2, move along the  $x$  axis. The figure above shows their velocity as a function of time.

Compare the distance traveled by each object between time  $A$  and time  $B$ .

- A. The distance traveled is the same for both objects.
- B. Object 1 travels farther than Object 2.
- C. Object 2 travels farther than Object 1.

**Problem 11:** (KD1-17-V2EC)



The figure above shows the position of an object as a function of time. Compare the velocity of the object with the acceleration of the object.

- A. The velocity and acceleration are constant. Both are greater than zero.
- B. The velocity and acceleration both decrease in magnitude with time.
- C. The velocity and acceleration are constant. Both are less than zero.
- D. The velocity is constant and negative while the acceleration is constant and positive.
- E. The velocity is constant and negative while the acceleration is zero.

**Problem 12:** (KD1-18)

An object moves in one dimension, along the  $x$ -axis. The object is at  $x = -1\text{m}$  on the  $x$  axis at time  $t = 0$ . The object's velocity at time  $t = 0$  is positive. The object travels along the  $x$  axis with a constant positive acceleration in the  $x$  direction.

Select the response which best describes the motion of the object at times after  $t = 0$ .

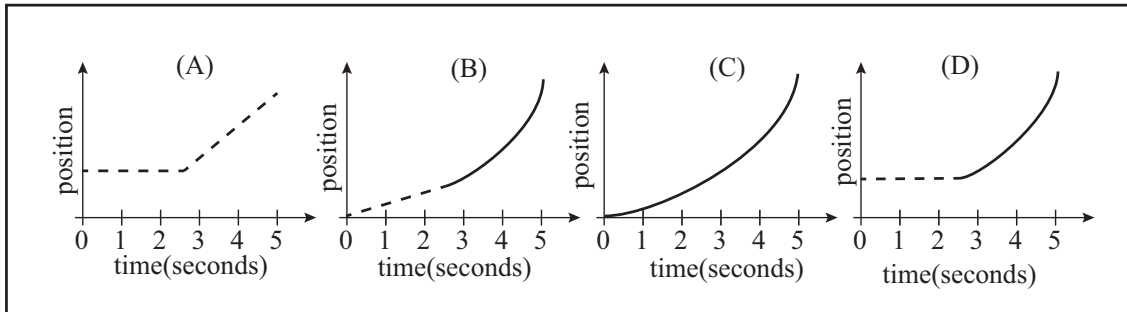
- A. The object moves in the positive  $x$  direction with increasing speed.
- B. The object moves in the negative  $x$  direction with increasing speed.
- C. The object moves in the positive  $x$  direction with constant speed.
- D. The object moves in the positive  $x$  direction with decreasing speed until it stops. Then it remains stationary.
- E. The object moves in the positive  $x$  direction with decreasing speed until it stops. Then it travels in the negative  $x$  direction with increasing speed.



**Problem 13:** (KD1-48)

An object starts from rest at time  $t = 0$  and travels with a constant positive velocity for 2.5 seconds. It then travels with a positive acceleration until 5 seconds.

Select the figure below which best represents its position as a function of time. To help read the graph, straight segments are dashed lines and curved segments are solid lines.



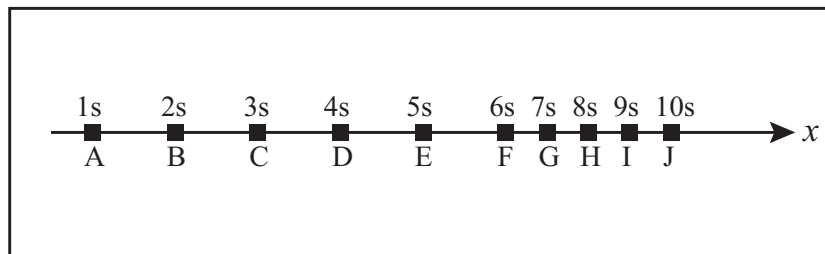
**Problem 14:** (KD1-19-V3)

An object moves in one dimension, along the  $x$ -axis. At time  $t = 0$ , the object is at  $x = +1\text{m}$  on the  $x$ -axis. The object's velocity is positive at time  $t = 0$ , and the object has constant negative acceleration.

Select the response which best describes the motion of the object, starting at  $t = 0$ .

- A. The object moves in the negative  $x$  direction with increasing speed until it eventually stops, then travels in the positive  $x$  direction with decreasing speed.
- B. The object moves in the positive  $x$  direction with decreasing speed until it eventually stops, then travels in the negative  $x$  direction with increasing speed.
- C. The object moves in the positive  $x$  direction with decreasing speed until it eventually stops, then continues to travel in the positive  $x$  direction with decreasing speed.
- D. The object moves in the negative  $x$  direction with decreasing speed until it eventually stops, then travels in the positive  $x$  direction with decreasing speed.

**Problem 15:** (KD1-20-V2EC)

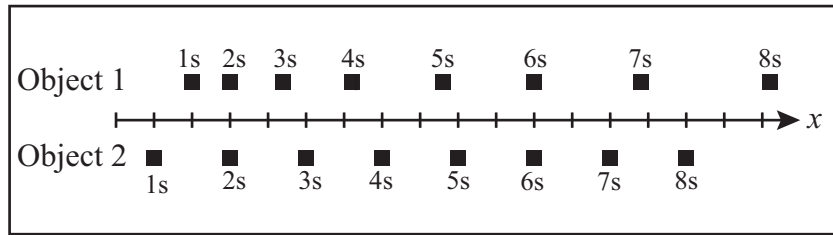


The figure above shows the motion of an object in the positive  $x$  direction. The position of the object is indicated by a set of squares. Each sequential square is one second apart in time.

Select the response which best describes the average acceleration of the object between point C and point H.

- A. The average acceleration is zero.
- B. The average acceleration is positive.
- C. The average acceleration is negative.

**Problem 16:** (KD1-22-V2EC)

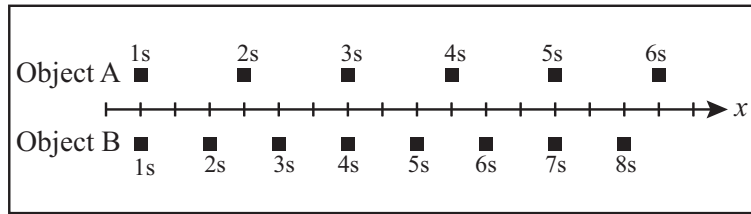


The figure above shows the position of two objects moving in the positive  $x$  direction. The time interval between each numbered square is one second.

Do the objects ever have the same speed?

- A. No. The objects **never** have the same speed.
- B. The objects have the same speed **at** points 2s and 6s.
- C. The objects have the same speed somewhere **between** points 2s and 5s.

**Problem 17:** (KD1-23-V2)

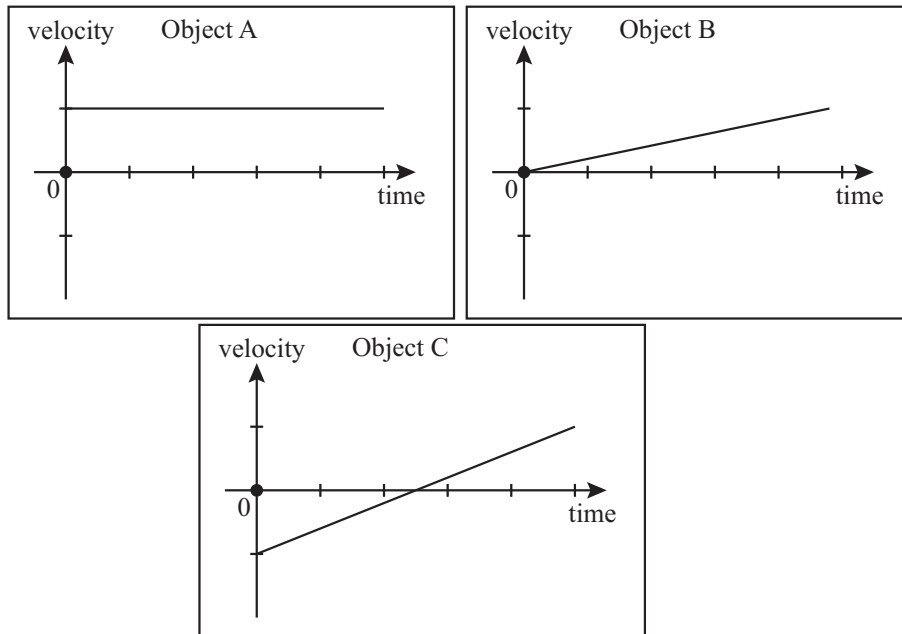


The figure above shows the position of two objects moving in the positive  $x$  direction. The time interval between each numbered square is one second.

Select the response that best describes the relation of the acceleration of the two objects.

- A. The acceleration of object A is greater than the acceleration of object B.
- B. The acceleration of objects A and B are equal. Both accelerations are greater than zero.
- C. The acceleration of object B is greater than the acceleration of object A.
- D. The acceleration of objects A and B are equal. Both accelerations are zero.
- E. The acceleration of objects A and B are equal. Both accelerations are less than zero.

**Problem 18:** (KD1-32-V4EC)



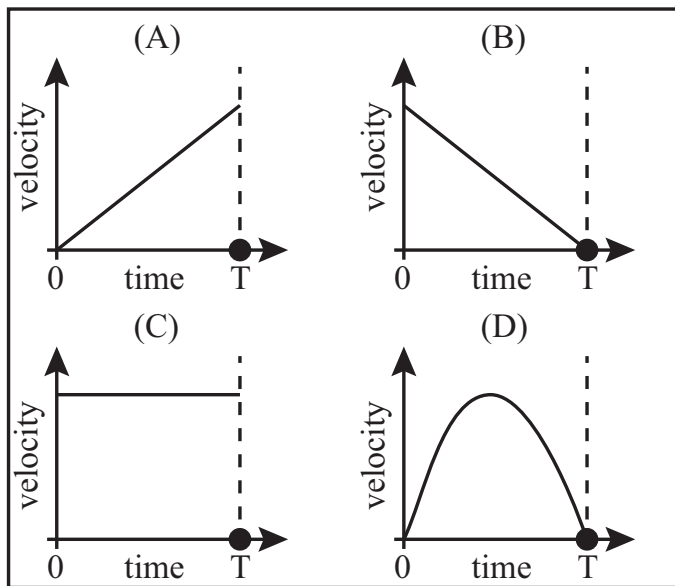
Three objects travel along the  $x$  axis. The figures above show the velocity along the  $x$  axis of each object as a function of time. All graphs are plotted on the same scale.

Select the response that best describes the relationship of the displacements of the objects over the entire time shown.

- A.  $\text{displacement}_A > \text{displacement}_B > \text{displacement}_C$
- B.  $\text{displacement}_A = \text{displacement}_B = \text{displacement}_C$
- C.  $\text{displacement}_A = \text{displacement}_C > \text{displacement}_B$
- D.  $\text{displacement}_B > \text{displacement}_A = \text{displacement}_C$
- E.  $\text{displacement}_B = \text{displacement}_C > \text{displacement}_A$

JCS: 5/25/2024 Each figure changed to The figures in second sentence.

**Problem 19:** (KD1-44-V6EC)



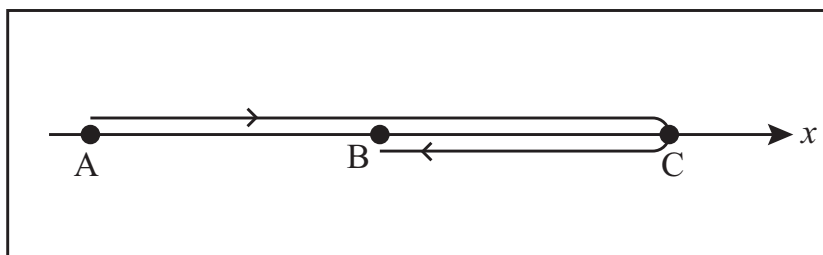
The figure above shows four velocity versus time graphs for an object moving in a straight line. All graphs are plotted on the same scale.

Select the graph where the displacement from time 0 to time T is the greatest.

- A. Graph A
- B. Graph B
- C. Graph C
- D. Graph D
- E. Graphs A and B

**Problem 20:** (KD1-40-V4EC)

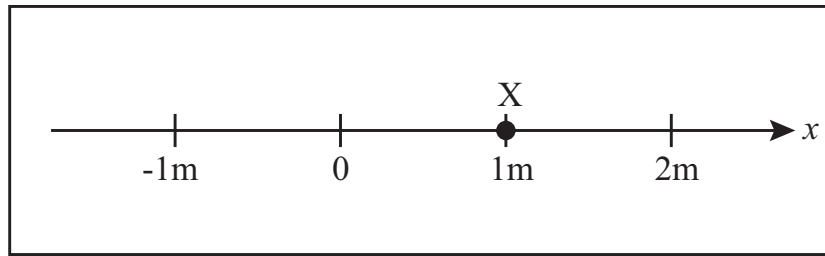
The figure below shows the path of an object that starts at point A, travels to the right along the  $x$  axis until it reaches point C, then reverses direction and travels to the left along the  $x$  axis to point B.



Select the response that best describes the object's velocity and acceleration at **point C**.

- A. The object's velocity in the  $x$  direction is zero, and its acceleration in the  $x$  direction is zero.
- B. The object's velocity in the  $x$  direction is positive, and its acceleration is negative.
- C. The object's velocity in the  $x$  direction is zero, and its acceleration in the  $x$  direction is negative.
- D. The object's velocity in the  $x$  direction is negative, and its acceleration in the  $x$  direction is negative.

**Problem 21:** (KD1-41)

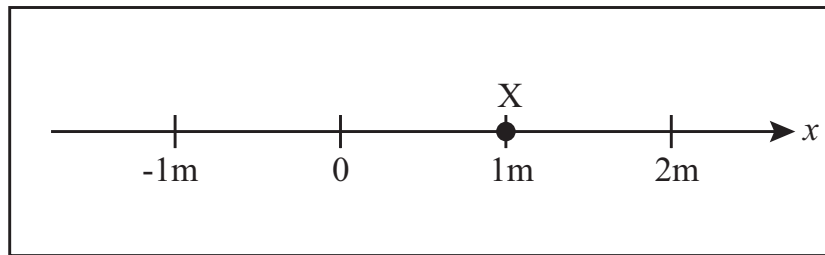


An object moves along the  $x$  axis as shown above. When it passes the point X, it has velocity  $+2\text{m/s}$ .

Which of the following could be true about the acceleration at point X?

- A. The acceleration is not zero and points to the right.
- B. The acceleration is not zero and points to the left.
- C. The acceleration is zero.
- D. Both A and B are possible.
- E. Both A and C are possible.
- F. Both A and D are possible.
- G. A, B, and C are possible.

**Problem 22:** (KD1-42-V6EC)

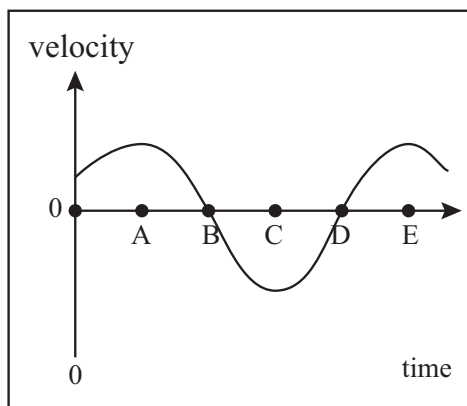


An object moves along the  $x$  axis as shown above. It is traveling either to the left or the right. When it passes the point X, it has acceleration  $+2\text{m/s}^2$ .

Which of the following could be true about the motion of the object when it passes through point X?

- A. The object is moving to the right and its speed is increasing.
- B. The object is moving to the right and its speed is decreasing.
- C. The object is moving to the left and its speed is increasing.
- D. The object is moving to the left and its speed is decreasing.
- E. Both A and B are possible.
- F. Both A and C are possible.
- G. Both A and D are possible.
- H. A, B, C, and D are possible.

**Problem 23:** (KD1-38-V3AH)



An object is moving along the  $x$  axis. The velocity of the object as a function of time is shown in the figure above.

When does the object change its direction of motion?

- A. At times A and E
- B. At times B and D
- C. At time C
- D. At times A, C, and E
- E. At times A, B, C, D, and E

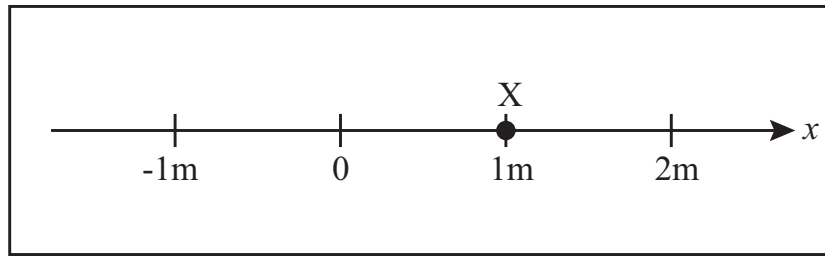
**Problem 24:** (KD1-18-V5EC)

An object moves in one dimension, along the  $x$ -axis. At time  $t = 0$ , the object is at  $x = -1\text{m}$  on the  $x$ -axis. The object's velocity is negative at time  $t = 0$ , and the object has constant positive acceleration. Select the response which best describes the motion of the object at  $t = 0$ .

- A. The object moves in the negative  $x$  direction with increasing speed.
- B. The object moves in the negative  $x$  direction with decreasing speed.
- C. The object moves in the negative  $x$  direction with constant speed.
- D. The object moves in the positive  $x$  direction with increasing speed.
- E. The object moves in the positive  $x$  direction with decreasing speed.
- F. The object moves in the positive  $x$  direction with constant speed.



**Problem 25:** (KD1-52)



An object is located on the  $x$  axis as shown above. When it passes the point X, it has acceleration  $-2\text{m/s}^2$ .

Which of the following could be true about the speed of the object when it passes through point X?

- A. The speed is decreasing.
- B. The speed is increasing.
- C. The speed is instantaneously zero.
- D. Both A and B are possible.
- E. Both A and C are possible.
- F. A, B, and C are possible.

Physics Evidence-Centered Assessment Project (PE-CAP) ©2024 by John Stewart, Andrew Heckler, Rachel Henderson, and Dena Izadi is licensed under CC BY-NC-SA 4.0