

Particle Motion on a Line

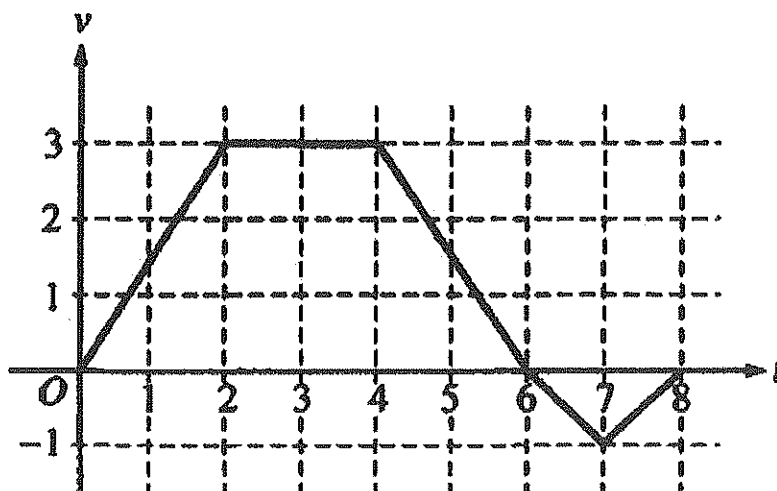
Multiple Choice

Identify the choice that best completes the statement or answers the question.

Questions 1 - 6: No calculator allowed

Questions 7 - 12: Graphing calculator allowed

Questions 1 - 2 refer to the following situation.



A bug begins to crawl up a vertical wire at time $t = 0$. The velocity v of the bug at time t , $0 \leq t \leq 8$, is given by the function whose graph is shown above.

- _____ 1. At what value of t does the bug change direction?
- 2
 - 4
 - 6
 - 7
 - 8
- _____ 2. What is the total distance the bug traveled from $t = 0$ to $t = 8$?
- 14
 - 13
 - 11
 - 8
 - 6

Name: _____

ID: A

- _____ 3. A particle moves along the x -axis so that its position at time t is given by $x(t) = t^2 - 6t + 5$. For what value of t is the velocity of the particle zero?
- a. 1
 - b. 2
 - c. 3
 - d. 4
 - e. 5
- _____ 4. The maximum acceleration attained on the interval $0 \leq t \leq 3$ by the particle whose velocity is given by $v(t) = t^3 - 3t^2 + 12t + 4$ is
- a. 9
 - b. 12
 - c. 14
 - d. 21
 - e. 40
- _____ 5. A particle moves along the x -axis so that its acceleration at any time t is $a(t) = 2t - 7$. If the initial velocity of the particle is 6, at what time t during the interval $0 \leq t \leq 4$ is the particle farthest to the right?
- a. 0
 - b. 1
 - c. 2
 - d. 3
 - e. 4
- _____ 6. A particle moves along the x -axis so that at time $t \geq 0$ its position is given by $x(t) = 2t^3 - 21t^2 + 72t - 53$. At what time t is the particle at rest?
- a. $t = 1$ only
 - b. $t = 3$ only
 - c. $t = \frac{7}{2}$ only
 - d. $t = 3$ and $t = \frac{7}{2}$
 - e. $t = 3$ and $t = 4$

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t (sec)	0	2	4	6
$a(t)$ (ft/sec ²)	5	2	8	3

7.

The data for the acceleration $a(t)$ of a car from 0 to 6 seconds are given in the table above. If the velocity at $t=0$ is 11 feet per second, the approximate value of the velocity at $t=6$, computed using a left-hand Riemann sum with three subintervals of equal length, is

- a. 26 ft/sec
- b. 30 ft/sec
- c. 37 ft/sec
- d. 39 ft/sec
- e. 41 ft/sec

8. At time $t \geq 0$, the acceleration of a particle moving on the x-axis is $a(t) = t + \sin t$. At $t=0$, the velocity of the particle is -2. For what value of t will the velocity of the particle be zero?

- a. 1.02
- b. 1.48
- c. 1.85
- d. 2.81
- e. 3.14

9. A particle moves along the x-axis so that at any time $t \geq 0$, its velocity is given by $v(t) = 3 + 4.1 \cos(0.9t)$. What is the acceleration of the particle at time $t=4$?

- a. -2.016
- b. -0.677
- c. 1.633
- d. 1.814
- e. 2.978

10. The position of an object attached to a spring is given by $y(t) = \frac{1}{6} \cos(5t) - \frac{1}{4} \sin(5t)$, where t is time in seconds. In the first 4 seconds, how many times is the velocity of the object equal to 0?

- a. Zero
- b. Three
- c. Five
- d. Six
- e. Seven

Name: _____

ID: A

- _____ 11. A particle moves along the x -axis so that at any time $t \geq 0$, its velocity is given by $v(t) = \cos(2 - t^2)$. The position of the particle is 3 at time $t = 0$. What is the position of the particle when its velocity is first equal to 0?
- a. 0.411
 - b. 1.310
 - c. 2.816
 - d. 3.091
 - e. 3.411
- _____ 12. The height h , in meters, of an object at time t is given by $h(t) = 24t + 24t^{\frac{3}{2}} - 16t^2$. What is the height of the object at the instant when it reaches its maximum upward velocity?
- a. 2.545 meters
 - b. 10.263 meters
 - c. 34.125 meters
 - d. 54.889 meters
 - e. 89.005 meters

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3. An object moves along the x -axis with initial position $x(0) = 2$. The velocity of the object at time $t \geq 0$ is given by $v(t) = \sin\left(\frac{\pi}{3}t\right)$.

(a) What is the acceleration of the object at time $t = 4$?

(b) Consider the following two statements.

Statement I: For $3 < t < 4.5$, the velocity of the object is decreasing.

Statement II: For $3 < t < 4.5$, the speed of the object is increasing.

Are either or both of these statements correct? For each statement provide a reason why it is correct or not correct.

(c) What is the total distance traveled by the object over the time interval $0 \leq t \leq 4$?

(d) What is the position of the object at time $t = 4$?

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Question 4

t (seconds)	0	10	20	30	40	50	60	70	80
$v(t)$ (feet per second)	5	14	22	29	35	40	44	47	49

Rocket A has positive velocity $v(t)$ after being launched upward from an initial height of 0 feet at time $t = 0$ seconds. The velocity of the rocket is recorded for selected values of t over the interval $0 \leq t \leq 80$ seconds, as shown in the table above.

(a) Find the average acceleration of rocket A over the time interval $0 \leq t \leq 80$ seconds. Indicate units of measure.

(b) Using correct units, explain the meaning of $\int_{10}^{70} v(t) dt$ in terms of the rocket's flight. Use a midpoint

Riemann sum with 3 subintervals of equal length to approximate $\int_{10}^{70} v(t) dt$.

(c) Rocket B is launched upward with an acceleration of $a(t) = \frac{3}{\sqrt{t+1}}$ feet per second per second. At time $t = 0$ seconds, the initial height of the rocket is 0 feet, and the initial velocity is 2 feet per second. Which of the two rockets is traveling faster at time $t = 80$ seconds? Explain your answer.
