

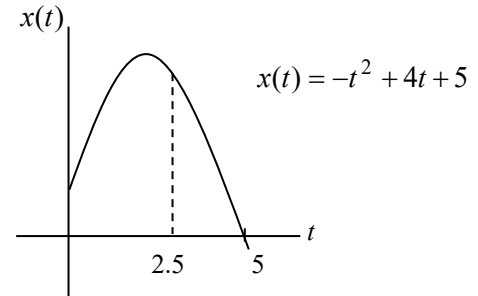
AP Calculus AB – Particles in Motion

Name: _____

No Graphing Calculator is allowed for problems #1 to #7.

A particle moves along a coordinate line, where its position at time t seconds, for $t \geq 0$, is given by $x(t) = -t^2 + 4t + 5$ feet. Note that the vertex of the parabola is at $t = 2$. Find the position, velocity, speed, and acceleration at time $t = 2.5$, and the total distance traveled from time $t = 0$ to $t = 2.5$.

1. position:
2. velocity:
3. speed:
4. acceleration:
5. distance traveled from $t = 0$ to $t = 2.5$:



6. Find the total distance traveled time $t = 0$ to $t = 5$ seconds.

7. A particle moves along the x -axis so that at time $t \geq 0$, its position is given by $x(t) = \frac{4}{3}t^3 - 14t^2 + 49t - 53$. 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 $t = 4$

8. A particle moves along the x -axis so that at time $t \geq 0$, its velocity is given by $v(t) = 5 - 4.9\sec^2(5t)$. What is the acceleration of the particle at time $t = 3$?

- (A) -32.016
- (B) -0.677
- (C) 19.053
- (D) 44.185
- (E) 72.682

9. A particle moves along a horizontal path so that at time $t \geq 0$, its velocity is given by $v(t) = \sin(0.15t^3 + 1)$. How many times does the particle change directions on the interval $0 \leq t \leq 5$?

- (A) Two
 - (B) Four
 - (C) Five
 - (D) Six
 - (E) None
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10. A particle moves along a sky with the velocity $v(t) = e^t \sin t$. How many relative extrema does the particle experience during the first ten seconds?

- (A) One (B) Two (C) Three (D) Four (E) Five

11. The position function, $x(t) = -4.905t^2 + v_0t + x_0$, is the height of the object, measured in meters, at time t seconds. If an explosion on the top of a 50-meter tower causes debris to rise vertically with an initial 72 m/s, then

- (a) Find the velocity of the object at time $t = 3$.
(b) Find its maximum height.
(c) Find the velocity when the object is at a height of 32 meters.
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12. A particle moves along the y -axis so that its velocity v at time $t \geq 0$ is given by $v(t) = 1 - \tan^{-1}(e^t)$. At time $t = 0$, the particle is at $y = -1$. (Note: $\tan^{-1} x = \arctan x$)
- (a) Find the acceleration of the particle at time $t = 2$.
 - (b) Is the speed of the particle increasing or decreasing at time $t = 2$? Give a reason for your answer.
 - (c) Find the time $t \geq 0$ at which the particle reached its highest point. Justify your answer.
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ANSWERS:

1) 8.75	5) 4.25	9) D	11a) 42.57 m/s	12a) -0.133
2) -1	6) 13	10) C	b) 314.220 m	b) increasing
3) 1	7) C		c) -74.412 m/s	c) 0.443
4) -2	8) E			