

AP[®] CALCULUS AB
2011 SCORING GUIDELINES

Question 1

For $0 \leq t \leq 6$, a particle is moving along the x -axis. The particle's position, $x(t)$, is not explicitly given. The velocity of the particle is given by $v(t) = 2\sin(e^{t/4}) + 1$. The acceleration of the particle is given by $a(t) = \frac{1}{2}e^{t/4} \cos(e^{t/4})$ and $x(0) = 2$.

- (a) Is the speed of the particle increasing or decreasing at time $t = 5.5$? Give a reason for your answer.
 (b) Find the average velocity of the particle for the time period $0 \leq t \leq 6$.
 (c) Find the total distance traveled by the particle from time $t = 0$ to $t = 6$.
 (d) For $0 \leq t \leq 6$, the particle changes direction exactly once. Find the position of the particle at that time.

(a) $v(5.5) = -0.45337$, $a(5.5) = -1.35851$

The speed is increasing at time $t = 5.5$, because velocity and acceleration have the same sign.

2 : conclusion with reason

(b) Average velocity = $\frac{1}{6} \int_0^6 v(t) dt = 1.949$

2 : $\begin{cases} 1 : \text{integral} \\ 1 : \text{answer} \end{cases}$

(c) Distance = $\int_0^6 |v(t)| dt = 12.573$

2 : $\begin{cases} 1 : \text{integral} \\ 1 : \text{answer} \end{cases}$

(d) $v(t) = 0$ when $t = 5.19552$. Let $b = 5.19552$.
 $v(t)$ changes sign from positive to negative at time $t = b$.
 $x(b) = 2 + \int_0^b v(t) dt = 14.134$ or 14.135

3 : $\begin{cases} 1 : \text{considers } v(t) = 0 \\ 1 : \text{integral} \\ 1 : \text{answer} \end{cases}$