

**AP<sup>®</sup> 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 :  $\left\{ \begin{array}{l} 1 : \text{integral} \\ 1 : \text{answer} \end{array} \right.$

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

2 :  $\left\{ \begin{array}{l} 1 : \text{integral} \\ 1 : \text{answer} \end{array} \right.$

(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 :  $\left\{ \begin{array}{l} 1 : \text{considers } v(t) = 0 \\ 1 : \text{integral} \\ 1 : \text{answer} \end{array} \right.$