



## AP<sup>®</sup> Calculus BC

### 2003 Sample Student Responses

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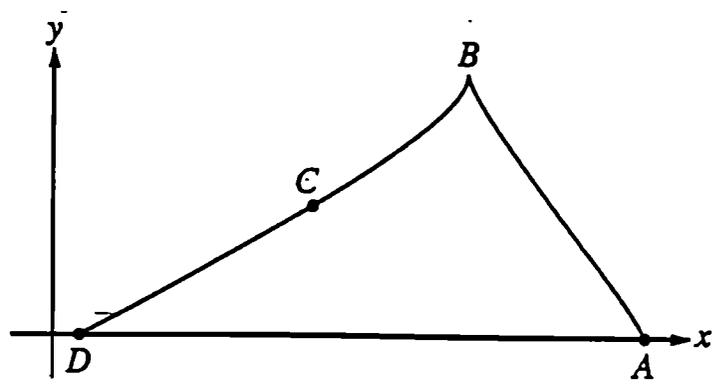
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Work for problem 2(a)

At C both  $\frac{dy}{dt}$  and  $\frac{dx}{dt}$  are negative since the particle is traveling in the - negative x and y directions. Each component of the velocity vector must be negative for the particle to travel down to the left.

Work for problem 2(b)

$t > 0$

$$-9 \cos \frac{\pi t}{6} \sin \left( \frac{\pi \sqrt{t+1}}{2} \right) = 0 \quad - \frac{\frac{dy}{dt}}{\frac{dx}{dt}} \rightarrow 0$$

$$\cos \frac{\pi t}{6} = 0$$

$$\sin \frac{\pi \sqrt{t+1}}{2} = 0$$

$$t = 3, 9, \dots$$

$$t = 3, \dots$$

at  $t = 3$

Continue problem 2 on page 7.

Work for problem-2(c)

$$\frac{dx}{dt}(8) = \frac{5}{9}$$

$$\frac{dy}{dt} = \frac{5}{-9}$$

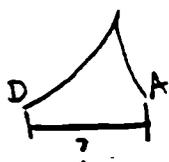
$$\frac{dy}{dt} = -2.5$$

$$\vec{v} = \langle x'(t), y'(t) \rangle$$

$$\vec{v}(8) = \langle -4.5, -2.5 \rangle$$

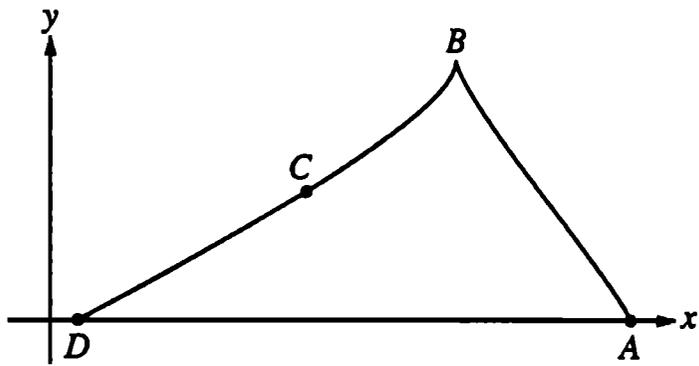
$$\text{speed} = |\vec{v}|_8 = \sqrt{(4.5)^2 + (-2.5)^2} = 5.148$$

Work for problem 2(d)



$$\text{dist} = \left| \int_0^9 \left[ 9 \cos \frac{\pi t}{6} \sin \frac{\pi \sqrt{t+1}}{2} \right] dt \right| = |-39.255| = 39.255$$

GO ON TO THE NEXT PAGE.



Work for problem 2(a)

$$\frac{dx}{dt} = -9 \cos\left(\frac{\pi t}{6}\right) \sin\left(\pi \frac{\sqrt{t+1}}{2}\right)$$

at point C  $\frac{dy}{dt}$  is negative. this is because the particle is moving downward at this moment.

at point C  $\frac{dx}{dt}$  is negative. this is because the particle is moving to the left at this moment.

Work for problem 2(b)

point B =  $\frac{dx}{dt} = 0$

$$-9 \cos\left(\frac{\pi t}{6}\right) \sin\left(\pi \frac{\sqrt{t+1}}{2}\right) = 0$$

when  $t = 3$ ,  $\frac{dx}{dt} = 0$

so point B is  $t = 3$

Continue problem 2 on page 7.

2

2

2

2

2

2

2

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2

2

YY<sub>2</sub>

Work for problem 2(c)

$$(x(s), y(s)) \quad y = \frac{5}{9}x - 2$$

$$\begin{aligned} x'(s) &= -9 \cos\left(\frac{\pi s}{6}\right) \sin\left(\frac{\pi\sqrt{s+1}}{2}\right) \\ &= -9 \cos\left(\frac{4\pi}{3}\right) \sin\left(\frac{3\pi}{2}\right) \\ &= -4.5 \end{aligned}$$

$$dx = 4.5$$

$$\frac{dy}{dx} =$$

$$dy = 9 \frac{dy}{dx} \cdot \frac{dx}{9}$$

$$\left(-\frac{9}{2}, -\frac{10}{9}\right)$$

Work for problem 2(d)

$$\begin{aligned} \text{distance} &= \int_0^9 -9 \cos\left(\frac{\pi t}{6}\right) \sin\left(\frac{\pi\sqrt{t+1}}{2}\right) \\ &= -39.255 \end{aligned}$$

points A and D are 39.255 units apart

GO ON TO THE NEXT PAGE.