

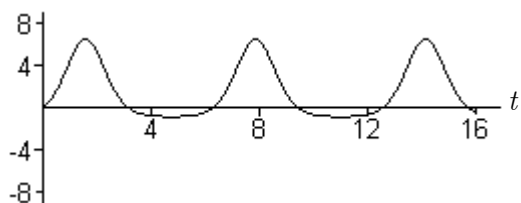
AP[®] CALCULUS AB
2002 SCORING GUIDELINES (Form B)

Question 3

A particle moves along the x -axis so that its velocity v at any time t , for $0 \leq t \leq 16$, is given by $v(t) = e^{2\sin t} - 1$. At time $t = 0$, the particle is at the origin.

- (a) On the axes provided, sketch the graph of $v(t)$ for $0 \leq t \leq 16$.
- (b) During what intervals of time is the particle moving to the left? Give a reason for your answer.
- (c) Find the total distance traveled by the particle from $t = 0$ to $t = 4$.
- (d) Is there any time t , $0 < t \leq 16$, at which the particle returns to the origin? Justify your answer.

(a) $v(t)$



- (b) Particle is moving to the left when $v(t) < 0$, i.e. $e^{2\sin t} < 1$.
 $(\pi, 2\pi)$, $(3\pi, 4\pi)$ and $(5\pi, 16]$

(c) $\int_0^4 |v(t)| dt = 10.542$

or

$$v(t) = e^{2\sin t} - 1 = 0$$

$$t = 0 \text{ or } t = \pi$$

$$x(\pi) = \int_0^\pi v(t) dt = 10.10656$$

$$x(4) = \int_0^4 v(t) dt = 9.67066$$

$$|x(\pi) - x(0)| + |x(4) - x(\pi)| = 10.542$$

- (d) There is no such time because $\int_0^T v(t) dt > 0$ for all $T > 0$.

1 : graph

three "humps"

periodic behavior

starts at origin

reasonable relative max and min values

3 { 2 : intervals

< -1 > each missing or incorrect interval

1 : reason

3 { 1 : limits of 0 and 4 on an integral of

$v(t)$ or $|v(t)|$

or

uses $x(0)$ and $x(4)$ to compute distance

1 : handles change of direction at student's turning point

1 : answer

note: 0/1 if incorrect turning point

2 { 1 : no such time

1 : reason