3.4 The Derivative as Rate of Change

The position of an ant with respect to a lump of substitute sugar in inches after t seconds is given by

$x(t) = t^2 - 9t + 8, 0 \le t \le 8$

a) Find the displacement of the ant and the ant's average velocity for the given time interval.

b) Find the ant's speed and acceleration at the endpoints of the time interval.

c) When, if ever, during the time interval does the ant change direction?

a) $\Delta(8) - \Delta(0) = (64 - 72 + 8) - (0 - 0 + 8)$

$= 0 - 8 =$ -8 inches

$v = \frac{\Delta\Delta}{\Delta t} = \frac{-8}{8} =$ -1 in/sec

b) $v(t) = 2t - 9$

$a(t) =$ 2 in/sec^2 every where

$v(0) = -9$ in/sec

$v(8) = 16 - 9 = 7$ in/sec

speed : 9 in/sec

speed : 7 in/sec

c) When is $v(t) = 0$?

$2t - 9 = 0 \Rightarrow$ $t = 4.5$ sec

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The position of a snail with respect to a leaf in inches after t minutes is given by $x(t) = t^3 - 9t^2 + 24t, 0 \le t \le 5$.

a) Find the snail's acceleration each time the velocity is zero.

b) Find the snail's speed each time its acceleration is zero.

c) Find the total distance traveled by the body from t=0 to t=3.

a) $v(t) = x'(t) = 3t^2 - 18t + 24$

Set $3t^2 - 18t + 24 = 0$

$t^2 - 6t + 8 = 0$

$(t-2)(t-4) = 0 \Rightarrow t = 2, t = 4$

$a(t) = x''(t) = 6t - 18$

$a(2) = -6$

$a(4) = 6$

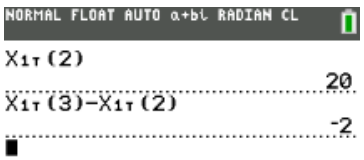
b) $6t - 18 = 0 \Rightarrow t = 3$

$v(3) = 3(3)^2 - 18(3) + 24 = 27 - 54 + 24 = -3$

c) $\Delta(2) = 20$

2

22 inches



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