

**AP<sup>®</sup> CALCULUS AB**  
**2004 SCORING GUIDELINES (Form B)**

**Question 2**

For  $0 \leq t \leq 31$ , the rate of change of the number of mosquitoes on Tropical Island at time  $t$  days is modeled by  $R(t) = 5\sqrt{t} \cos\left(\frac{t}{5}\right)$  mosquitoes per day. There are 1000 mosquitoes on Tropical Island at time  $t = 0$ .

- (a) Show that the number of mosquitoes is increasing at time  $t = 6$ .  
 (b) At time  $t = 6$ , is the number of mosquitoes increasing at an increasing rate, or is the number of mosquitoes increasing at a decreasing rate? Give a reason for your answer.  
 (c) According to the model, how many mosquitoes will be on the island at time  $t = 31$ ? Round your answer to the nearest whole number.  
 (d) To the nearest whole number, what is the maximum number of mosquitoes for  $0 \leq t \leq 31$ ? Show the analysis that leads to your conclusion.

(a) Since  $R(6) = 4.438 > 0$ , the number of mosquitoes is increasing at  $t = 6$ .

1 : shows that  $R(6) > 0$

(b)  $R'(6) = -1.913$   
 Since  $R'(6) < 0$ , the number of mosquitoes is increasing at a decreasing rate at  $t = 6$ .

2 :  $\left\{ \begin{array}{l} 1 : \text{considers } R'(6) \\ 1 : \text{answer with reason} \end{array} \right.$

(c)  $1000 + \int_0^{31} R(t) dt = 964.335$   
 To the nearest whole number, there are 964 mosquitoes.

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

(d)  $R(t) = 0$  when  $t = 0$ ,  $t = 2.5\pi$ , or  $t = 7.5\pi$   
 $R(t) > 0$  on  $0 < t < 2.5\pi$   
 $R(t) < 0$  on  $2.5\pi < t < 7.5\pi$   
 $R(t) > 0$  on  $7.5\pi < t < 31$   
 The absolute maximum number of mosquitoes occurs at  $t = 2.5\pi$  or at  $t = 31$ .

4 :  $\left\{ \begin{array}{l} 2 : \text{absolute maximum value} \\ 1 : \text{integral} \\ 1 : \text{answer} \\ 2 : \text{analysis} \\ 1 : \text{computes interior critical points} \\ 1 : \text{completes analysis} \end{array} \right.$

$$1000 + \int_0^{2.5\pi} R(t) dt = 1039.357,$$

There are 964 mosquitoes at  $t = 31$ , so the maximum number of mosquitoes is 1039, to the nearest whole number.