



**AP[®] Calculus AB
2004 Sample Student Responses
Form B**

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Work for problem 2(a)

$$R(t) = 5\sqrt{t} \cos\left(\frac{t}{5}\right)$$

$$R(6) = 4.438$$

the derivative of the function is > 0 therefore the function is increasing

Work for problem 2(b)

$$R'(x) = \frac{2.5 \cos(2x)}{\sqrt{x}} - \sqrt{x} \sin(2x)$$

$$R'(6) = -1.913$$

increasing at a decreasing rate because

$$R'(6) < 0$$

Continue problem 2 on page 7.

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B₂

Work for problem 2(c)

$$1000 + \int_0^{31} 5\sqrt{x} \cos\left(\frac{x}{5}\right) dx = 964$$

Work for problem 2(d)

$$x = 7.854 \quad \text{max-absolute}$$

$$x = 23.562 \quad \text{min}$$

$$x = 31 \quad \text{max}$$

$$1000 + \int_0^{7.854} 5\sqrt{x} \cos\left(\frac{x}{5}\right) dx = \boxed{1039}$$

$$1000 + \int_0^{31} 5\sqrt{x} \cos\left(\frac{x}{5}\right) dx = 964$$

1039 mosquitoes is the maximum number for $0 \leq t \leq 31$

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Work for problem 2(a)

$$R(6) = 5\sqrt{6} \cos\left(\frac{6}{5}\right) = 4.438 > 0$$

the rate of change in the number of mosquitoes
is positive for $t=6$
the number of mosquitoes is increasing

Work for problem 2(b)

$$R'(t) = \frac{5 \cos\left(\frac{t}{5}\right)}{2\sqrt{t}} - \sqrt{t} \sin\left(\frac{t}{5}\right)$$

$$R'(6) = -1.913$$

the number of mosquitoes is increasing at a decreasing
rate at $t=6$ because $R'(6)$ is negative

Continue problem 2 on page 7.

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D₂

Work for problem 2(c)

$$R(t) = N'(t)$$

$N(t)$ is the number of mosquitoes at time t

$$N(31) - N(0) = \int_0^{31} R(t) dt$$

$$N(31) - 1000 = \int_0^{31} 5\sqrt{t} \cos\left(\frac{t}{5}\right) dt$$

$$N(31) = -35.665 + 1000 \approx 946 \text{ mosquitoes}$$

there will be 946 mosquitoes at $t=31$

Work for problem 2(d)

maximum number when $R(t) = 0$

$$5\sqrt{t} \cos\left(\frac{t}{5}\right) = 0$$

$$t = 7.853 \quad t = 23.561$$

at $t = 7.853$ maximum

$$N(7.853) - N(0) = \int_0^{7.853} R(t) dt$$

$$N(7.853) = 1039.357$$

the maximum number of mosquitoes is 1039

$$\begin{array}{ccccccc} \text{+++} & 0 & \text{-----} & 0 & \text{+++} \\ & | & & | & \\ & 7.853 & & 23.561 & \end{array}$$

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