

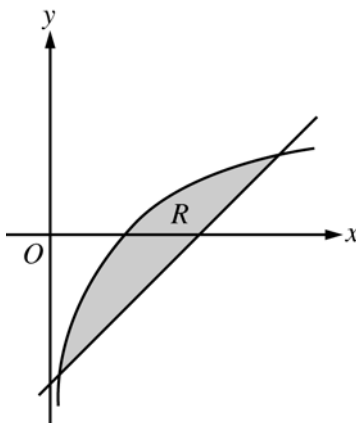
2006 AP[®] CALCULUS BC FREE-RESPONSE QUESTIONS

**CALCULUS BC
SECTION II, Part A**

Time—45 minutes

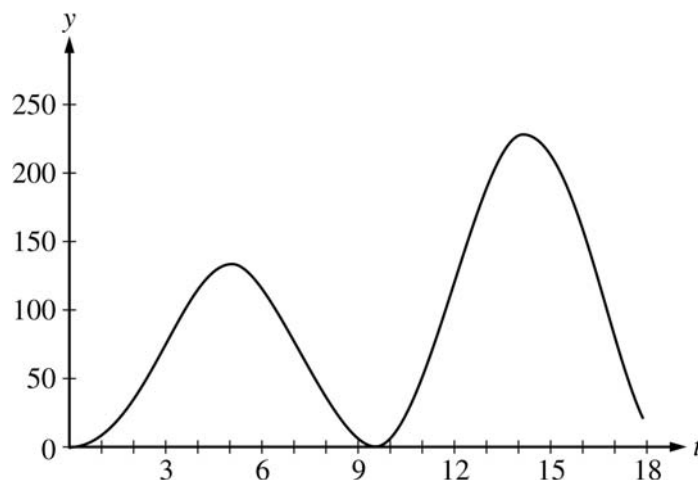
Number of problems—3

A graphing calculator is required for some problems or parts of problems.



1. Let R be the shaded region bounded by the graph of $y = \ln x$ and the line $y = x - 2$, as shown above.
 - (a) Find the area of R .
 - (b) Find the volume of the solid generated when R is rotated about the horizontal line $y = -3$.
 - (c) Write, but do not evaluate, an integral expression that can be used to find the volume of the solid generated when R is rotated about the y -axis.

WRITE ALL WORK IN THE PINK EXAM BOOKLET.

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2. At an intersection in Thomasville, Oregon, cars turn left at the rate $L(t) = 60\sqrt{t} \sin^2\left(\frac{t}{3}\right)$ cars per hour over the time interval $0 \leq t \leq 18$ hours. The graph of $y = L(t)$ is shown above.
- (a) To the nearest whole number, find the total number of cars turning left at the intersection over the time interval $0 \leq t \leq 18$ hours.
- (b) Traffic engineers will consider turn restrictions when $L(t) \geq 150$ cars per hour. Find all values of t for which $L(t) \geq 150$ and compute the average value of L over this time interval. Indicate units of measure.
- (c) Traffic engineers will install a signal if there is any two-hour time interval during which the product of the total number of cars turning left and the total number of oncoming cars traveling straight through the intersection is greater than 200,000. In every two-hour time interval, 500 oncoming cars travel straight through the intersection. Does this intersection require a traffic signal? Explain the reasoning that leads to your conclusion.
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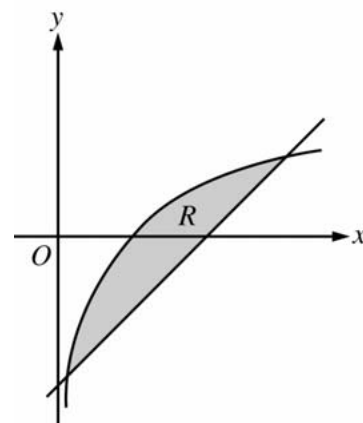
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**AP[®] CALCULUS BC
2006 SCORING GUIDELINES**

Question 1

Let R be the shaded region bounded by the graph of $y = \ln x$ and the line $y = x - 2$, as shown above.

- (a) Find the area of R .
- (b) Find the volume of the solid generated when R is rotated about the horizontal line $y = -3$.
- (c) Write, but do not evaluate, an integral expression that can be used to find the volume of the solid generated when R is rotated about the y -axis.



$$\ln(x) = x - 2 \text{ when } x = 0.15859 \text{ and } 3.14619.$$

$$\text{Let } S = 0.15859 \text{ and } T = 3.14619$$

$$(a) \text{ Area of } R = \int_S^T (\ln(x) - (x - 2)) \, dx = 1.949$$

$$3 : \begin{cases} 1 : \text{integrand} \\ 1 : \text{limits} \\ 1 : \text{answer} \end{cases}$$

$$(b) \text{ Volume} = \pi \int_S^T ((\ln(x) + 3)^2 - (x - 2 + 3)^2) \, dx \\ = 34.198 \text{ or } 34.199$$

$$3 : \begin{cases} 2 : \text{integrand} \\ 1 : \text{limits, constant, and answer} \end{cases}$$

$$(c) \text{ Volume} = \pi \int_{S-2}^{T-2} ((y + 2)^2 - (e^y)^2) \, dy$$

$$3 : \begin{cases} 2 : \text{integrand} \\ 1 : \text{limits and constant} \end{cases}$$