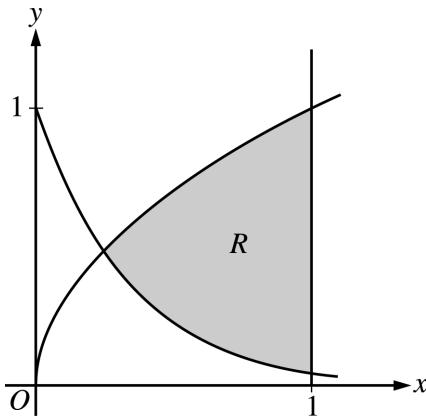


2003 AP[®] CALCULUS AB FREE-RESPONSE QUESTIONS

CALCULUS AB
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 graphs of $y = \sqrt{x}$ and $y = e^{-3x}$ and the vertical line $x = 1$, as shown in the figure above.
 - (a) Find the area of R .
 - (b) Find the volume of the solid generated when R is revolved about the horizontal line $y = 1$.
 - (c) The region R is the base of a solid. For this solid, each cross section perpendicular to the x -axis is a rectangle whose height is 5 times the length of its base in region R . Find the volume of this solid.
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2. A particle moves along the x -axis so that its velocity at time t is given by

$$v(t) = -(t + 1) \sin\left(\frac{t^2}{2}\right).$$

At time $t = 0$, the particle is at position $x = 1$.

- Find the acceleration of the particle at time $t = 2$. Is the speed of the particle increasing at $t = 2$? Why or why not?
 - Find all times t in the open interval $0 < t < 3$ when the particle changes direction. Justify your answer.
 - Find the total distance traveled by the particle from time $t = 0$ until time $t = 3$.
 - During the time interval $0 \leq t \leq 3$, what is the greatest distance between the particle and the origin? Show the work that leads to your answer.
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