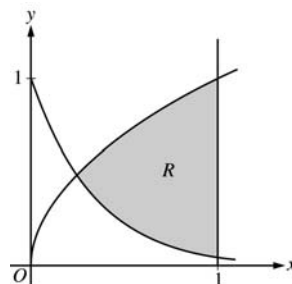


**AP[®] CALCULUS AB
2003 SCORING GUIDELINES**

Question 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.



Point of intersection

$$e^{-3x} = \sqrt{x} \text{ at } (T, S) = (0.238734, 0.488604)$$

$$\begin{aligned} \text{(a) Area} &= \int_T^1 (\sqrt{x} - e^{-3x}) dx \\ &= 0.442 \text{ or } 0.443 \end{aligned}$$

$$\begin{aligned} \text{(b) Volume} &= \pi \int_T^1 \left((1 - e^{-3x})^2 - (1 - \sqrt{x})^2 \right) dx \\ &= 0.453\pi \text{ or } 1.423 \text{ or } 1.424 \end{aligned}$$

$$\begin{aligned} \text{(c) Length} &= \sqrt{x} - e^{-3x} \\ \text{Height} &= 5(\sqrt{x} - e^{-3x}) \end{aligned}$$

$$\text{Volume} = \int_T^1 5(\sqrt{x} - e^{-3x})^2 dx = 1.554$$

1: Correct limits in an integral in
(a), (b), or (c)

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

3: $\left\{ \begin{array}{l} 2 : \text{integrand} \\ \quad < -1 > \text{ reversal} \\ \quad < -1 > \text{ error with constant} \\ \quad < -1 > \text{ omits 1 in one radius} \\ \quad < -2 > \text{ other errors} \\ 1 : \text{answer} \end{array} \right.$

3: $\left\{ \begin{array}{l} 2 : \text{integrand} \\ \quad < -1 > \text{ incorrect but has} \\ \quad \quad \sqrt{x} - e^{-3x} \\ \quad \quad \text{as a factor} \\ 1 : \text{answer} \end{array} \right.$