



2000 Advanced Placement Program® Free-Response Questions

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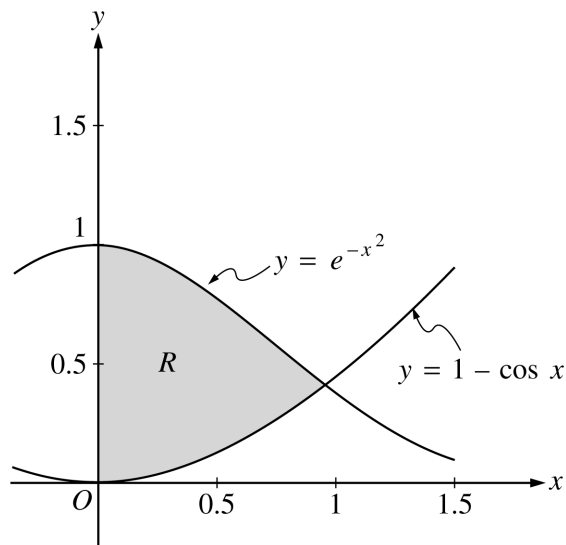
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2000 AP® CALCULUS AB FREE-RESPONSE QUESTIONS

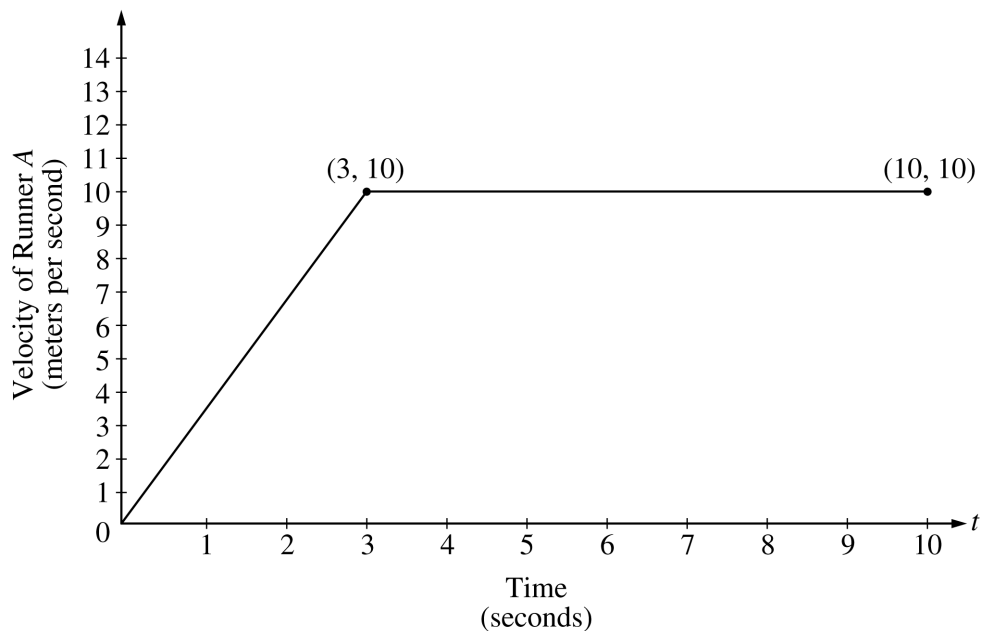
CALCULUS AB
SECTION II, Part A
Time—45 minutes
Number of problems—3

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



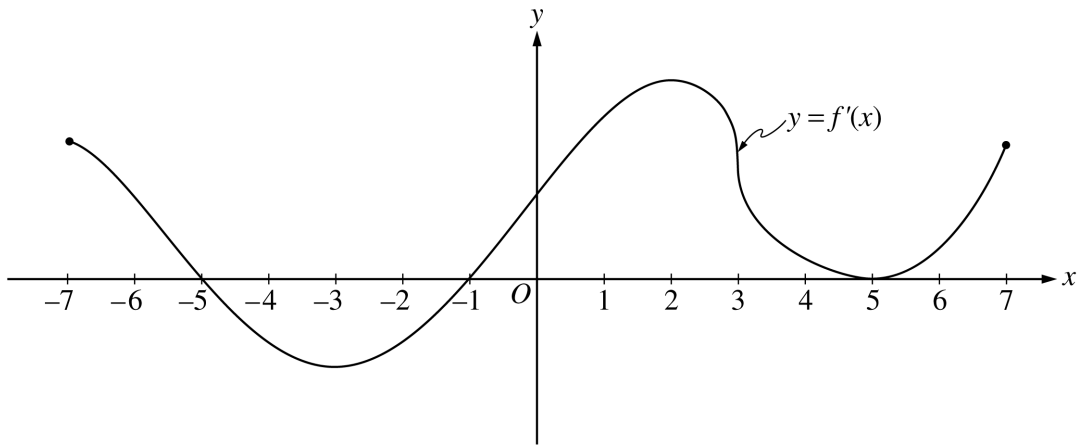
- Let R be the shaded region in the first quadrant enclosed by the graphs of $y = e^{-x^2}$, $y = 1 - \cos x$, and the y -axis, as shown in the figure above.
 - Find the area of the region R .
 - Find the volume of the solid generated when the region R is revolved about the x -axis.
 - The region R is the base of a solid. For this solid, each cross section perpendicular to the x -axis is a square. Find the volume of this solid.

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2. Two runners, A and B , run on a straight racetrack for $0 \leq t \leq 10$ seconds. The graph above, which consists of two line segments, shows the velocity, in meters per second, of Runner A . The velocity, in meters per second, of Runner B is given by the function v defined by $v(t) = \frac{24t}{2t + 3}$.
- Find the velocity of Runner A and the velocity of Runner B at time $t = 2$ seconds. Indicate units of measure.
 - Find the acceleration of Runner A and the acceleration of Runner B at time $t = 2$ seconds. Indicate units of measure.
 - Find the total distance run by Runner A and the total distance run by Runner B over the time interval $0 \leq t \leq 10$ seconds. Indicate units of measure.
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3. The figure above shows the graph of f' , the derivative of the function f , for $-7 \leq x \leq 7$. The graph of f' has horizontal tangent lines at $x = -3$, $x = 2$, and $x = 5$, and a vertical tangent line at $x = 3$.
- (a) Find all values of x , for $-7 < x < 7$, at which f attains a relative minimum. Justify your answer.
- (b) Find all values of x , for $-7 < x < 7$, at which f attains a relative maximum. Justify your answer.
- (c) Find all values of x , for $-7 < x < 7$, at which $f''(x) < 0$.
- (d) At what value of x , for $-7 \leq x \leq 7$, does f attain its absolute maximum? Justify your answer.
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END OF PART A OF SECTION II

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**CALCULUS AB
SECTION II, Part B**

Time—45 minutes

Number of problems—3

No calculator is allowed for these problems.

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4. Water is pumped into an underground tank at a constant rate of 8 gallons per minute. Water leaks out of the tank at the rate of $\sqrt{t+1}$ gallons per minute, for $0 \leq t \leq 120$ minutes. At time $t = 0$, the tank contains 30 gallons of water.
- (a) How many gallons of water leak out of the tank from time $t = 0$ to $t = 3$ minutes?
 - (b) How many gallons of water are in the tank at time $t = 3$ minutes?
 - (c) Write an expression for $A(t)$, the total number of gallons of water in the tank at time t .
 - (d) At what time t , for $0 \leq t \leq 120$, is the amount of water in the tank a maximum? Justify your answer.
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5. Consider the curve given by $xy^2 - x^3y = 6$.

(a) Show that $\frac{dy}{dx} = \frac{3x^2y - y^2}{2xy - x^3}$.

- (b) Find all points on the curve whose x -coordinate is 1, and write an equation for the tangent line at each of these points.
 - (c) Find the x -coordinate of each point on the curve where the tangent line is vertical.
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6. Consider the differential equation $\frac{dy}{dx} = \frac{3x^2}{e^{2y}}$.

(a) Find a solution $y = f(x)$ to the differential equation satisfying $f(0) = \frac{1}{2}$.

- (b) Find the domain and range of the function f found in part (a).
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END OF EXAMINATION