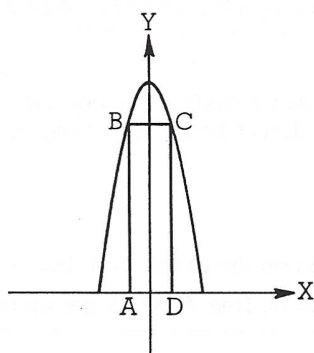


The College Board
 Advanced Placement Examination
 CALCULUS AB
 SECTION II
 Time—1 hour and 30 minutes

SHOW ALL YOUR WORK. INDICATE CLEARLY THE METHODS YOU USE BECAUSE YOU WILL BE GRADED ON THE CORRECTNESS OF YOUR METHODS AS WELL AS ON THE ACCURACY OF YOUR FINAL ANSWERS.

1. Let R be the region enclosed by the graphs of $y = x^3$ and $y = \sqrt{x}$.
- (a) Find the area of R .
- (b) Find the volume of the solid generated by revolving R about the X -axis.



2. A rectangle $ABCD$ with sides parallel to the coordinate axes is inscribed in the region enclosed by the graph of $y = -4x^2 + 4$ and the X -axis as shown in the figure above.

- (a) Find the x - and y -coordinates of C so that the area of rectangle $ABCD$ is a maximum.
- (b) The point C moves along the curve with its x -coordinate increasing at the constant rate of 2 units per second. Find the rate of change of the area of rectangle $ABCD$ when $x = \frac{1}{2}$.

3. Let $f(x) = \ln(x^2)$ for $x > 0$ and $g(x) = e^{2x}$ for $x \geq 0$. Let H be the composition of f with g , that is $H(x) = f(g(x))$, and let K be the composition of g with f , that is $K(x) = g(f(x))$.
- (a) Find the domain of H and write an expression for $H(x)$ that does not contain the exponential function.
- (b) Find the domain of K and write an expression for $K(x)$ that does not contain the exponential function.
- (c) Find an expression for $f^{-1}(x)$, where f^{-1} denotes the inverse function of f , and find the domain of f^{-1} .

TURN THE PAGE 

This insert may be used for reference and/or scratchwork as you answer the free-response questions, but be sure to show all your work on problems and write your answers in the pink booklet. No credit will be given for work shown on this green insert.

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4. The acceleration of a particle moving along a straight line is given by $a = 10e^{2t}$.
- Write an expression for the velocity v , in terms of time t , if $v = 5$ when $t = 0$.
 - During the time when the velocity increases from 5 to 15, how far does the particle travel?
 - Write an expression for the position s , in terms of time t , of the particle if $s = 0$ when $t = 0$.
-
5. Given the function f defined by $f(x) = \cos x - \cos^2 x$ for $-\pi \leq x \leq \pi$.
- Find the x -intercepts of the graph of f .
 - Find the x - and y -coordinates of all relative maximum points of f . Justify your answer.
 - Find the intervals on which the graph of f is increasing.
 - Using the information found in parts (a), (b), and (c), sketch the graph of f on the axes provided.
-
6. Let $y = f(x)$ be the continuous function that satisfies the equation $x^4 - 5x^2y^2 + 4y^4 = 0$ and whose graph contains the points $(2, 1)$ and $(-2, -2)$. Let ℓ be the line tangent to the graph of f at $x = 2$.
- Find an expression for y' .
 - Write an equation for line ℓ .
 - Give the coordinates of a point that is on the graph of f but is not on line ℓ .
 - Give the coordinates of a point that is on line ℓ but is not on the graph of f .
-
7. Let p and q be real numbers and let f be the function defined by $f(x) = \begin{cases} 1 + 2p(x - 1) + (x - 1)^2, & \text{for } x \leq 1 \\ qx + p, & \text{for } x > 1. \end{cases}$
- Find the value of q , in terms of p , for which f is continuous at $x = 1$.
 - Find the values of p and q for which f is differentiable at $x = 1$.
 - If p and q have the values determined in part (b), is f'' a continuous function? Justify your answer.

END OF EXAMINATION