

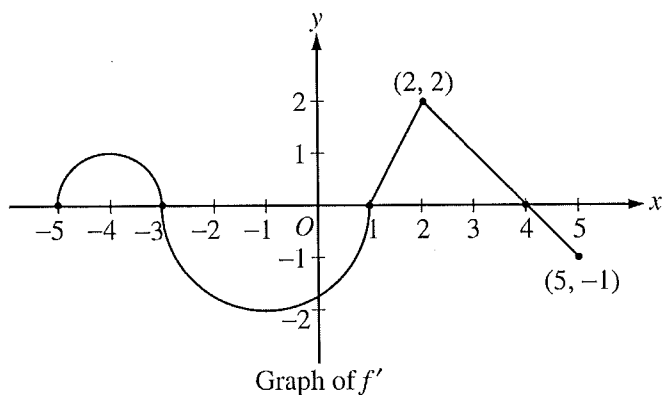
2007 AP<sup>®</sup> CALCULUS AB FREE-RESPONSE QUESTIONS (Form B)

CALCULUS AB  
SECTION II, Part B

Time—45 minutes

Number of problems—3

No calculator is allowed for these problems.



4. Let  $f$  be a function defined on the closed interval  $-5 \leq x \leq 5$  with  $f(1) = 3$ . The graph of  $f'$ , the derivative of  $f$ , consists of two semicircles and two line segments, as shown above.
- For  $-5 < x < 5$ , find all values  $x$  at which  $f$  has a relative maximum. Justify your answer.
  - For  $-5 < x < 5$ , find all values  $x$  at which the graph of  $f$  has a point of inflection. Justify your answer.
  - Find all intervals on which the graph of  $f$  is concave up and also has positive slope. Explain your reasoning.
  - Find the absolute minimum value of  $f(x)$  over the closed interval  $-5 \leq x \leq 5$ . Explain your reasoning.

WRITE ALL WORK IN THE EXAM BOOKLET.

# 2005 AP<sup>®</sup> CALCULUS AB FREE-RESPONSE QUESTIONS

## CALCULUS AB SECTION II, Part B

Time—45 minutes

Number of problems—3

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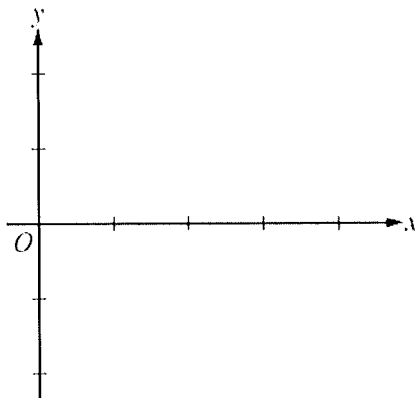
$x$	0	$0 < x < 1$	1	$1 < x < 2$	2	$2 < x < 3$	3	$3 < x < 4$
$f(x)$	-1	Negative	0	Positive	2	Positive	0	Negative
$f'(x)$	4	Positive	0	Positive	DNE	Negative	-3	Negative
$f''(x)$	-2	Negative	0	Positive	DNE	Negative	0	Positive

4. Let  $f$  be a function that is continuous on the interval  $[0, 4)$ . The function  $f$  is twice differentiable except at  $x = 2$ . The function  $f$  and its derivatives have the properties indicated in the table above, where DNE indicates that the derivatives of  $f$  do not exist at  $x = 2$ .

(a) For  $0 < x < 4$ , find all values of  $x$  at which  $f$  has a relative extremum. Determine whether  $f$  has a relative maximum or a relative minimum at each of these values. Justify your answer.

(b) On the axes provided, sketch the graph of a function that has all the characteristics of  $f$ .

(Note: Use the axes provided in the pink test booklet.)



(c) Let  $g$  be the function defined by  $g(x) = \int_1^x f(t) dt$  on the open interval  $(0, 4)$ . For  $0 < x < 4$ , find all values of  $x$  at which  $g$  has a relative extremum. Determine whether  $g$  has a relative maximum or a relative minimum at each of these values. Justify your answer.

(d) For the function  $g$  defined in part (c), find all values of  $x$ , for  $0 < x < 4$ , at which the graph of  $g$  has a point of inflection. Justify your answer.

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WRITE ALL WORK IN THE TEST BOOKLET.

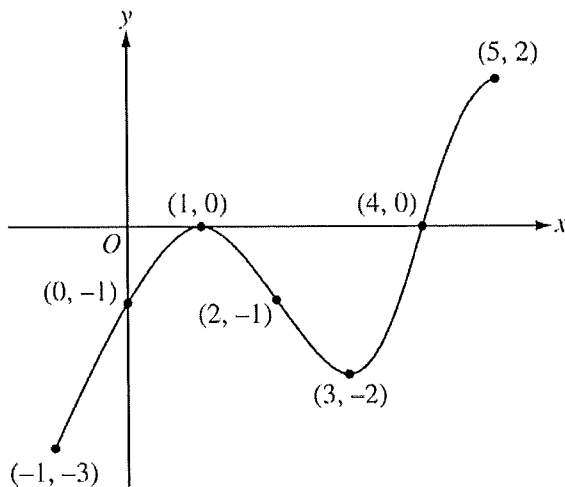
2004 AP<sup>®</sup> CALCULUS AB FREE-RESPONSE QUESTIONS (Form B)

CALCULUS AB  
SECTION II, Part B

Time—45 minutes

Number of problems—3

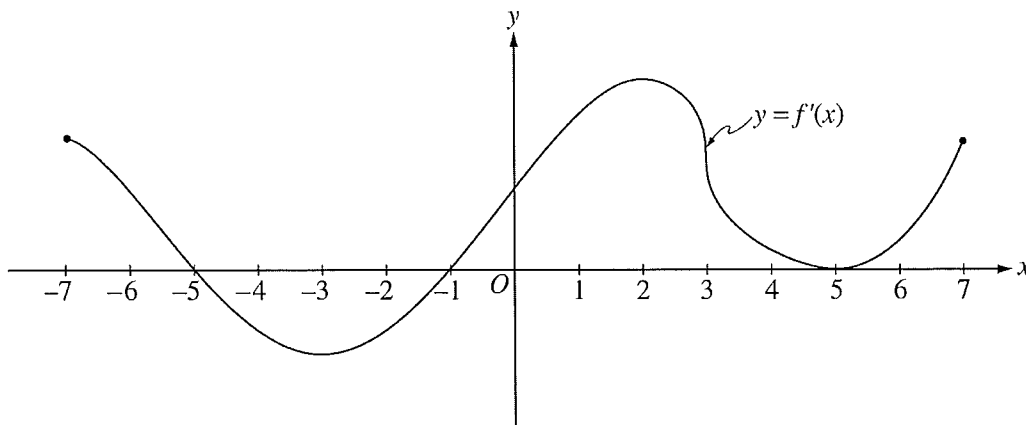
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Graph of  $f'$

4. The figure above shows the graph of  $f'$ , the derivative of the function  $f$ , on the closed interval  $-1 \leq x \leq 5$ . The graph of  $f'$  has horizontal tangent lines at  $x = 1$  and  $x = 3$ . The function  $f$  is twice differentiable with  $f(2) = 6$ .
- (a) Find the  $x$ -coordinate of each of the points of inflection of the graph of  $f$ . Give a reason for your answer.
- (b) At what value of  $x$  does  $f$  attain its absolute minimum value on the closed interval  $-1 \leq x \leq 5$ ? At what value of  $x$  does  $f$  attain its absolute maximum value on the closed interval  $-1 \leq x \leq 5$ ? Show the analysis that leads to your answers.
- (c) Let  $g$  be the function defined by  $g(x) = xf(x)$ . Find an equation for the line tangent to the graph of  $g$  at  $x = 2$ .

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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