

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

Distance $x$ (cm)	0	1	5	6	8
Temperature $T(x)$ (°C)	100	93	70	62	55

3. A metal wire of length 8 centimeters (cm) is heated at one end. The table above gives selected values of the temperature  $T(x)$ , in degrees Celsius (°C), of the wire  $x$  cm from the heated end. The function  $T$  is decreasing and twice differentiable.
- (a) Estimate  $T'(7)$ . Show the work that leads to your answer. Indicate units of measure.
- (b) Write an integral expression in terms of  $T(x)$  for the average temperature of the wire. Estimate the average temperature of the wire using a trapezoidal sum with the four subintervals indicated by the data in the table. Indicate units of measure.
- (c) Find  $\int_0^8 T'(x) dx$ , and indicate units of measure. Explain the meaning of  $\int_0^8 T'(x) dx$  in terms of the temperature of the wire.
- (d) Are the data in the table consistent with the assertion that  $T''(x) > 0$  for every  $x$  in the interval  $0 < x < 8$ ? Explain your answer.
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**WRITE ALL WORK IN THE TEST BOOKLET.**

**END OF PART A OF SECTION II**

# **2005 AP® CALCULUS AB FREE-RESPONSE QUESTIONS**

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

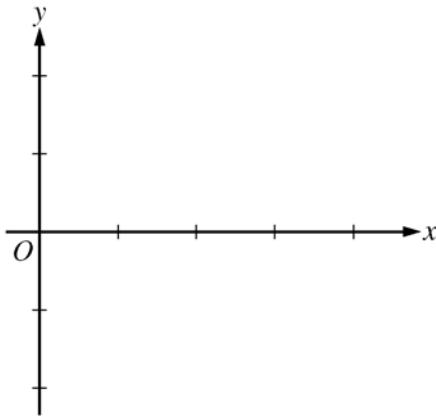
**No calculator is allowed for these problems.**

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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.**