



**AP[®] Calculus AB
2004 Sample Student Responses
Form B**

The materials included in these files are intended for noncommercial use by AP teachers for course and exam preparation; permission for any other use must be sought from the Advanced Placement Program[®]. Teachers may reproduce them, in whole or in part, in limited quantities, for face-to-face teaching purposes but may not mass distribute the materials, electronically or otherwise. This permission does not apply to any third-party copyrights contained herein. These materials and any copies made of them may not be resold, and the copyright notices must be retained as they appear here.

The College Board is a not-for-profit membership association whose mission is to connect students to college success and opportunity. Founded in 1900, the association is composed of more than 4,500 schools, colleges, universities, and other educational organizations. Each year, the College Board serves over three million students and their parents, 23,000 high schools, and 3,500 colleges through major programs and services in college admissions, guidance, assessment, financial aid, enrollment, and teaching and learning. Among its best-known programs are the SAT[®], the PSAT/NMSQT[®], and the Advanced Placement Program[®] (AP[®]). The College Board is committed to the principles of excellence and equity, and that commitment is embodied in all of its programs, services, activities, and concerns.

For further information, visit www.collegeboard.com

Copyright © 2004 College Entrance Examination Board. All rights reserved. College Board, Advanced Placement Program, AP, AP Central, AP Vertical Teams, APCD, Pacesetter, Pre-AP, SAT, Student Search Service, and the acorn logo are registered trademarks of the College Entrance Examination Board. PSAT/NMSQT is a registered trademark of the College Entrance Examination Board and National Merit Scholarship Corporation. Educational Testing Service and ETS are registered trademarks of Educational Testing Service. Other products and services may be trademarks of their respective owners.

For the College Board's online home for AP professionals, visit AP Central at apcentral.collegeboard.com.

4

4

4

4

4

4

4

4

4

A,

4

NO CALCULATOR ALLOWED

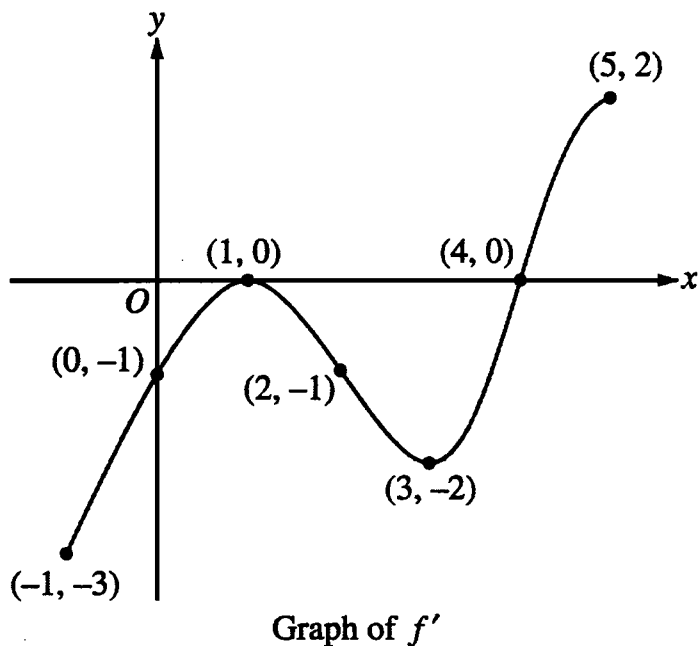
CALCULUS AB

SECTION II, Part B

Time—45 minutes

Number of problems—3

No calculator is allowed for these problems.



Work for problem 4(a)

The two points of inflections of f are at $x=1$
and $x=3$.

reason: $f''(x) > 0$ for $x \in (-1, 1)$
 $f''(x) < 0$ for $x \in (1, 3)$
 $f''(x) > 0$ for $x \in (3, 5)$

Continue problem 4 on page 11.

4

4

4

4

4

4

4

4

4

4

A₂

NO CALCULATOR ALLOWED

Work for problem 4(b)

f has an absolute minimum at $x = 4$

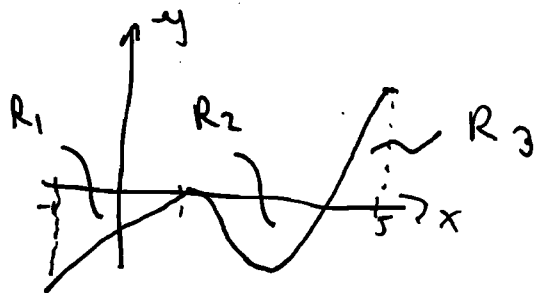
reason: $f'(4) = 0$ and:

x	-1	1	4	5
f'	-	-	0	+
f	↘	↘	↗	↗

↘ abs. min.

f has an absolute maximum at $x = -1$

reason:



$$R_1 + R_2 > R_3 \Rightarrow$$

$$f(-1) > f(5)$$

Work for problem 4(c)

$$g(x) = x f(x)$$

$$g'(x) = (x)' f(x) + x f'(x)$$

$$g'(2) = f(2) + 2f'(2)$$

$$= 6 + 2 \cdot (-1)$$

$$= 4$$

$$g(2) = 2 \cdot f(2)$$

$$= 12$$

$$(2, 12)$$

$$y = \frac{5-12}{x-2}$$

$$4x - 8 + 12 = y$$

$$y = 4x + 4$$

GO ON TO THE NEXT PAGE.

4

4

4

4

4

4

4

4

4

4

C₁

NO CALCULATOR ALLOWED

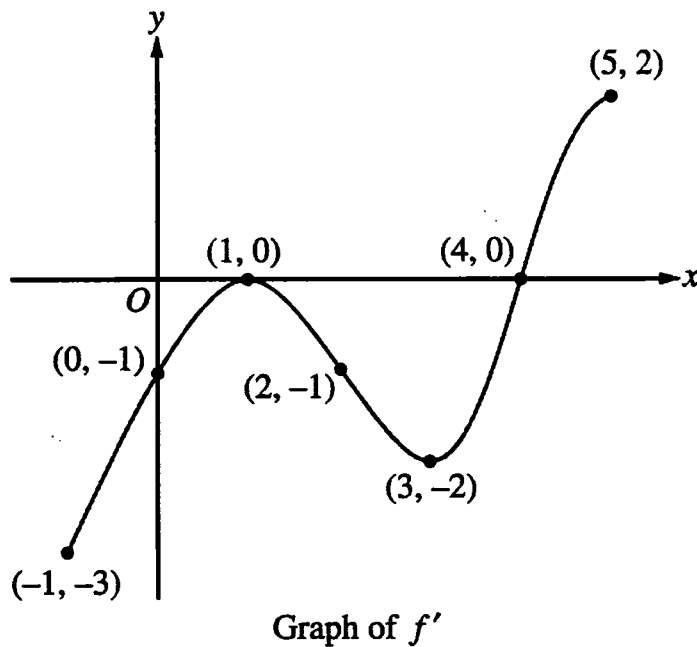
CALCULUS AB

SECTION II, Part B

Time—45 minutes

Number of problems—3

No calculator is allowed for these problems.



Work for problem 4(a)

Inflection $\Rightarrow f''(x)$ changes sign, $f''(x)=0$
 \Rightarrow slope of $f'(x)$ changes sign f' slope = 0

at $x=1$ slope of $f'(x)$ from +ve to -ve \Rightarrow inflection
 at $x=3$ slope of $f'(x)$ from -ve to +ve \Rightarrow inflection

Continue problem 4 on page 11.

4

4

4

4

4

4

4

4

4

4

C₂

NO CALCULATOR ALLOWED

Work for problem 4(b)

minimum $\Rightarrow f'(x) = 0$ and $f'(x)$ changes from -ve to +ve

$$f'(x) = 0 \Rightarrow x = 4$$

x	-1	4	5
f'(x)	-	+	

\Rightarrow local minimum at $x = 4$
and absolute minimum

maximum $\Rightarrow f'(x)$ and $f'(x)$ changes from +ve to -ve
but there is no such pt \Rightarrow check endpoints

The decrease from $x = -1$ to $x = 4$ is more than increase from $x = 4$ to $x = 5$

$$\Rightarrow f(5) < f(-1) \Rightarrow \text{abs. max at } \underline{\underline{x = 5}}$$

Work for problem 4(c)

$$g(x) = x f(x)$$

$$g'(x) = f(x) + x f'(x)$$

$$g'(2) = f(2) + 2f'(2) = 6 + 2(-1) = 4$$

$$\Rightarrow g(2) = 2f(2) = 2(6) = 12$$

$$\Rightarrow y - 12 = 4(x - 2)$$

eqn of tm $\underline{\underline{y = 4x + 4}}$

GO ON TO THE NEXT PAGE.