

PLACE SEAL HERE

AP[®] Calculus BC Exam

SECTION I: Multiple Choice

2012

DO NOT OPEN THIS BOOKLET UNTIL YOU ARE TOLD TO DO SO.

At a Glance

Total Time
1 hour, 45 minutes

Number of Questions
45

Percent of Total Score
50%

Writing Instrument
Pencil required

Part A

Number of Questions
28

Time
55 minutes

Electronic Device
None allowed

Part B

Number of Questions
17

Time
50 minutes

Electronic Device
Graphing calculator required

Instructions

Section I of this exam contains 45 multiple-choice questions and 4 survey questions. For Part A, fill in only the circles for numbers 1 through 28 on page 2 of the answer sheet. For Part B, fill in only the circles for numbers 76 through 92 on page 3 of the answer sheet. The survey questions are numbers 93 through 96.

Indicate all of your answers to the multiple-choice questions on the answer sheet. No credit will be given for anything written in this exam booklet, but you may use the booklet for notes or scratch work. After you have decided which of the suggested answers is best, completely fill in the corresponding circle on the answer sheet. Give only one answer to each question. If you change an answer, be sure that the previous mark is erased completely. Here is a sample question and answer.

Sample Question Sample Answer

Chicago is a (A) ● (C) (D) (E)

(A) state

(B) city

(C) country

(D) continent

(E) village

Use your time effectively, working as quickly as you can without losing accuracy. Do not spend too much time on any one question. Go on to other questions and come back to the ones you have not answered if you have time. It is not expected that everyone will know the answers to all of the multiple-choice questions.

Your total score on the multiple-choice section is based only on the number of questions answered correctly. Points are not deducted for incorrect answers or unanswered questions.

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Minimum 20% post-consumer waste

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DO NOT seal answer sheet inside

Form I
Form Code 4IBP4-Q-S

68

A A

25. $\int_1^{\infty} x e^{-x^2} dx$ is

- (A) $-\frac{1}{e}$ (B) $\frac{1}{2e}$ (C) $\frac{1}{e}$ (D) $\frac{2}{e}$ (E) divergent

A A

26. What is the slope of the line tangent to the polar curve $r = 1 + 2\sin \theta$ at $\theta = 0$?

- (A) 2 (B) $\frac{1}{2}$ (C) 0 (D) $-\frac{1}{2}$ (E) -2

27. For what values of p will both series $\sum_{n=1}^{\infty} \frac{1}{n^{2p}}$ and $\sum_{n=1}^{\infty} \left(\frac{p}{2}\right)^n$ converge?

(A) $-2 < p < 2$ only

(B) $-\frac{1}{2} < p < \frac{1}{2}$ only

(C) $\frac{1}{2} < p < 2$ only

(D) $p < \frac{1}{2}$ and $p > 2$

(E) There are no such values of p .

28. Let g be a continuously differentiable function with $g(1) = 6$ and $g'(1) = 3$. What is $\lim_{x \rightarrow 1} \frac{\int_1^x g(t) dt}{g(x) - 6}$?

- (A) 0 (B) $\frac{1}{2}$ (C) 1 (D) 2 (E) The limit does not exist.

END OF PART A OF SECTION I

**IF YOU FINISH BEFORE TIME IS CALLED, YOU MAY
CHECK YOUR WORK ON PART A ONLY.**

DO NOT GO ON TO PART B UNTIL YOU ARE TOLD TO DO SO.

B**B****B****B****B****B****B****B****B****CALCULUS BC****SECTION I, Part B****Time—50 minutes****Number of questions—17**

A GRAPHING CALCULATOR IS REQUIRED FOR SOME QUESTIONS ON THIS PART OF THE EXAM.

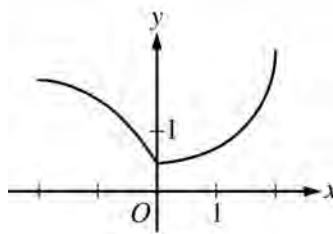
Directions: Solve each of the following problems, using the available space for scratch work. After examining the form of the choices, decide which is the best of the choices given and fill in the corresponding circle on the answer sheet. No credit will be given for anything written in the exam book. Do not spend too much time on any one problem.

BE SURE YOU ARE USING PAGE 3 OF THE ANSWER SHEET TO RECORD YOUR ANSWERS TO QUESTIONS NUMBERED 76–92.

YOU MAY NOT RETURN TO PAGE 2 OF THE ANSWER SHEET.

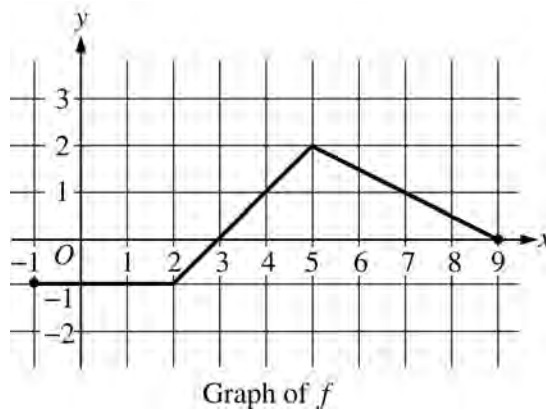
In this exam:

- (1) The exact numerical value of the correct answer does not always appear among the choices given. When this happens, select from among the choices the number that best approximates the exact numerical value.
- (2) Unless otherwise specified, the domain of a function f is assumed to be the set of all real numbers x for which $f(x)$ is a real number.
- (3) The inverse of a trigonometric function f may be indicated using the inverse function notation f^{-1} or with the prefix “arc” (e.g., $\sin^{-1}x = \arcsin x$).

B**B****B****B****B****B****B****B****B**Graph of f

76. The function f , whose graph is shown above, is defined on the interval $-2 \leq x \leq 2$. Which of the following statements about f is false?
- (A) f is continuous at $x = 0$.
 - (B) f is differentiable at $x = 0$.
 - (C) f has a critical point at $x = 0$.
 - (D) f has an absolute minimum at $x = 0$.
 - (E) The concavity of the graph of f changes at $x = 0$.

77. Let f and g be the functions given by $f(x) = e^x$ and $g(x) = x^4$. On what intervals is the rate of change of $f(x)$ greater than the rate of change of $g(x)$?
- (A) $(0.831, 7.384)$ only
 - (B) $(-\infty, 0.831)$ and $(7.384, \infty)$
 - (C) $(-\infty, -0.816)$ and $(1.430, 8.613)$
 - (D) $(-0.816, 1.430)$ and $(8.613, \infty)$
 - (E) $(-\infty, \infty)$

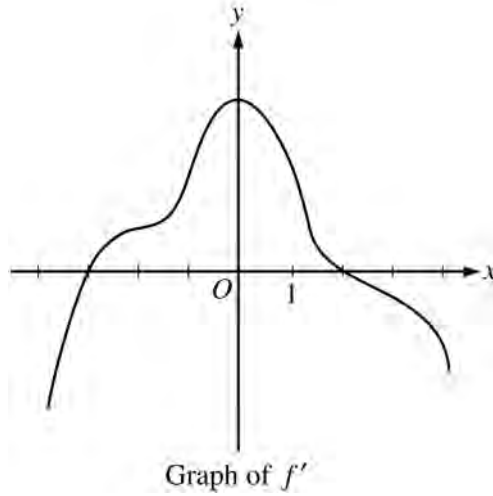
B**B****B****B****B****B****B****B****B**

78. The graph of the piecewise linear function f is shown above. What is the value of $\int_{-1}^9 (3f(x) + 2) dx$?

- (A) 7.5 (B) 9.5 (C) 27.5 (D) 47 (E) 48.5

79. Let f be a function having derivatives of all orders for $x > 0$ such that $f(3) = 2$, $f'(3) = -1$, $f''(3) = 6$, and $f'''(3) = 12$. Which of the following is the third-degree Taylor polynomial for f about $x = 3$?

- (A) $2 - x + 6x^2 + 12x^3$
 (B) $2 - x + 3x^2 + 2x^3$
 (C) $2 - (x - 3) + 6(x - 3)^2 + 12(x - 3)^3$
 (D) $2 - (x - 3) + 3(x - 3)^2 + 4(x - 3)^3$
 (E) $2 - (x - 3) + 3(x - 3)^2 + 2(x - 3)^3$

B**B****B****B****B****B****B****B****B**

80. The graph of f' , the derivative of the function f , is shown above. Which of the following statements must be true?
- I. f has a relative minimum at $x = -3$.
 - II. The graph of f has a point of inflection at $x = -2$.
 - III. The graph of f is concave down for $0 < x < 4$.
- (A) I only (B) II only (C) III only (D) I and II only (E) I and III only

B**B****B****B****B****B****B****B****B**

	$0 < x < 1$	$1 < x < 2$
$f(x)$	Positive	Negative
$f'(x)$	Negative	Negative
$f''(x)$	Negative	Positive

81. Let f be a function that is twice differentiable on $-2 < x < 2$ and satisfies the conditions in the table above. If $f(x) = f(-x)$, what are the x -coordinates of the points of inflection of the graph of f on $-2 < x < 2$?

- (A) $x = 0$ only
 (B) $x = 1$ only
 (C) $x = 0$ and $x = 1$
 (D) $x = -1$ and $x = 1$
 (E) There are no points of inflection on $-2 < x < 2$.

82. What is the average value of $y = \sqrt{\cos x}$ on the interval $0 \leq x \leq \frac{\pi}{2}$?

- (A) -0.637 (B) 0.500 (C) 0.763 (D) 1.198 (E) 1.882

B**B****B****B****B****B****B****B****B**

83. If the function f is continuous at $x = 3$, which of the following must be true?

(A) $f(3) < \lim_{x \rightarrow 3} f(x)$

(B) $\lim_{x \rightarrow 3^-} f(x) \neq \lim_{x \rightarrow 3^+} f(x)$

(C) $f(3) = \lim_{x \rightarrow 3^-} f(x) = \lim_{x \rightarrow 3^+} f(x)$

(D) The derivative of f at $x = 3$ exists.

(E) The derivative of f is positive for $x < 3$ and negative for $x > 3$.

84. For $-1.5 < x < 1.5$, let f be a function with first derivative given by $f'(x) = e^{(x^4 - 2x^2 + 1)} - 2$. Which of the following are all intervals on which the graph of f is concave down?

(A) $(-0.418, 0.418)$ only

(B) $(-1, 1)$

(C) $(-1.354, -0.409)$ and $(0.409, 1.354)$

(D) $(-1.5, -1)$ and $(0, 1)$

(E) $(-1.5, -1.354)$, $(-0.409, 0)$, and $(1.354, 1.5)$

B**B****B****B****B****B****B****B****B**

85. The fuel consumption of a car, in miles per gallon (mpg), is modeled by $F(s) = 6e^{\left(\frac{s}{20} - \frac{s^2}{2400}\right)}$, where s is the speed of the car, in miles per hour. If the car is traveling at 50 miles per hour and its speed is changing at the rate of 20 miles/hour², what is the rate at which its fuel consumption is changing?

- (A) 0.215 mpg per hour
- (B) 4.299 mpg per hour
- (C) 19.793 mpg per hour
- (D) 25.793 mpg per hour
- (E) 515.855 mpg per hour

B**B****B****B****B****B****B****B****B**

86. If $f'(x) > 0$ for all real numbers x and $\int_4^7 f(t) dt = 0$, which of the following could be a table of values for the function f ?

(A)

x	$f(x)$
4	-4
5	-3
7	0

(B)

x	$f(x)$
4	-4
5	-2
7	5

(C)

x	$f(x)$
4	-4
5	6
7	3

(D)

x	$f(x)$
4	0
5	0
7	0

(E)

x	$f(x)$
4	0
5	4
7	6

B**B****B****B****B****B****B****B****B**

87. Let R be the region in the first quadrant bounded above by the graph of $y = \ln(3 - x)$, for $0 \leq x \leq 2$. R is the base of a solid for which each cross section perpendicular to the x -axis is a square. What is the volume of the solid?

(A) 0.442

(B) 1.029

(C) 1.296

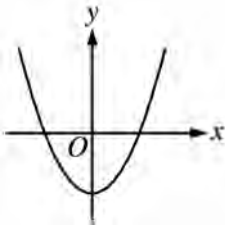
(D) 3.233

(E) 4.071

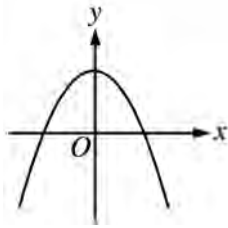
B**B****B****B****B****B****B****B****B**

88. The derivative of a function f is increasing for $x < 0$ and decreasing for $x > 0$. Which of the following could be the graph of f ?

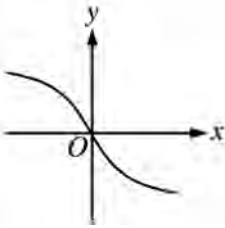
(A)



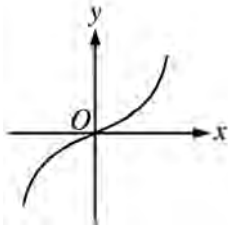
(B)



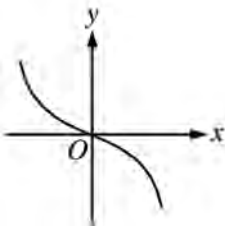
(C)



(D)



(E)



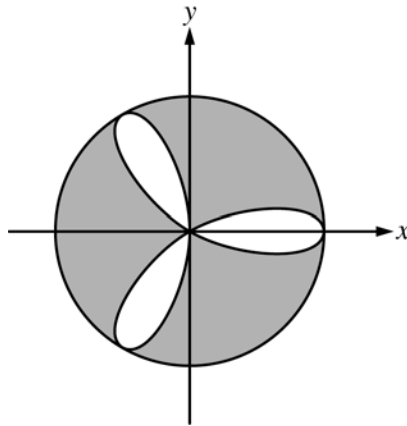
B**B****B****B****B****B****B****B****B**

89. A particle moves along a line so that its acceleration for $t \geq 0$ is given by $a(t) = \frac{t+3}{\sqrt{t^3+1}}$. If the particle's velocity at $t = 0$ is 5, what is the velocity of the particle at $t = 3$?

- (A) 0.713 (B) 1.134 (C) 6.134 (D) 6.710 (E) 11.710

90. If the series $\sum_{n=1}^{\infty} a_n$ converges and $a_n > 0$ for all n , which of the following must be true?

- (A) $\lim_{n \rightarrow \infty} \left| \frac{a_{n+1}}{a_n} \right| = 0$
- (B) $|a_n| < 1$ for all n
- (C) $\sum_{n=1}^{\infty} a_n = 0$
- (D) $\sum_{n=1}^{\infty} na_n$ diverges.
- (E) $\sum_{n=1}^{\infty} \frac{a_n}{n}$ converges.

B**B****B****B****B****B****B****B****B**

91. The figure above shows the graphs of the polar curves $r = 2 \cos(3\theta)$ and $r = 2$. What is the sum of the areas of the shaded regions?
- (A) 0.858 (B) 3.142 (C) 8.566 (D) 9.425 (E) 15.708

B**B****B****B****B****B****B****B****B**

92. The function h is differentiable, and for all values of x , $h(x) = h(2 - x)$. Which of the following statements must be true?

I. $\int_0^2 h(x) dx > 0$

II. $h'(1) = 0$

III. $h'(0) = h'(2) = 1$

(A) I only

(B) II only

(C) III only

(D) II and III only

(E) I, II, and III

END OF SECTION I

**IF YOU FINISH BEFORE TIME IS CALLED, YOU MAY
CHECK YOUR WORK ON PART B ONLY.**

DO NOT GO ON TO SECTION II UNTIL YOU ARE TOLD TO DO SO.

MAKE SURE YOU HAVE DONE THE FOLLOWING.

- **PLACED YOUR AP NUMBER LABEL ON YOUR ANSWER SHEET**
- **WRITTEN AND GRIDDED YOUR AP NUMBER CORRECTLY ON YOUR ANSWER SHEET**
- **TAKEN THE AP EXAM LABEL FROM THE FRONT OF THIS BOOKLET AND PLACED IT ON YOUR ANSWER SHEET**

**AFTER TIME HAS BEEN CALLED, TURN TO PAGE 38 AND
ANSWER QUESTIONS 93–96.**