

Calculus AB  
Section I, Part B  
Time — 50 minutes  
Number of questions — 17

A graphing calculator is required for some questions.

29. If  $f'(x) = \tan^{-1}(x^3 - x)$ , at how many points is the tangent line to the graph of  $y = f(x)$  parallel to the line  $y = 2x$ ?

(A) None    (B) One    (C) Two    (D) Three    (E) Infinitely many

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30. Which of the following functions are continuous but not differentiable at  $x = 0$ ?

- I.  $f(x) = x^{1/3}$   
II.  $g(x) = |x|$   
III.  $h(x) = x \cdot |x|$

(A) I only                      (B) II only                      (C) I and II  
(D) II and III                      (E) I, II, and III

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31. An object moves along the  $y$ -axis with coordinate position  $y(t)$  and velocity  $v(t) = \sqrt{t} - \cos(e^t)$  for  $t \geq 0$ . At time  $t = 1$ , the object is

- (A) moving downward with negative acceleration  
(B) moving upward with negative acceleration  
(C) moving downward with positive acceleration  
(D) moving upward with positive acceleration  
(E) at rest
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32. Let  $f$  and  $g$  be differentiable functions with  $g(x) \neq 0$  for all  $x$ . If  $h(x) = \frac{f(x)}{g(x)}$  and

$$h'(x) = \frac{f(x)[g(x) - g'(x)]}{[g(x)]^2},$$
 then  $f(x)$  could be

(A)  $e^x$     (B)  $\ln x$     (C)  $\sin x$     (D)  $\cos x$     (E)  $\frac{1}{x}$

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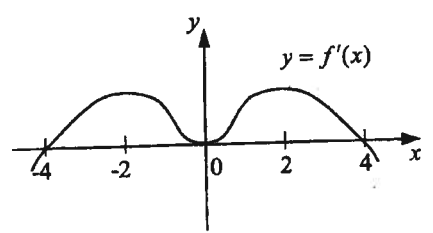
33. Let  $f$  be the function given by  $f(x) = x^2 e^{-x}$ . For what value of  $x$  is the slope of the line tangent to the graph of  $f$  at  $(x, f(x))$  equal to 0.2?

(A) -0.091    (B) 0.112    (C) 0.605    (D) 1.418    (E) 4.708

34. The average value of  $f(x) = x^3$  over the interval  $a \leq x \leq b$  is

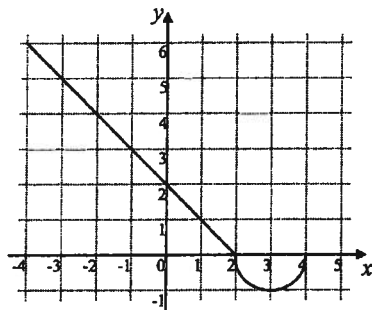
- (A)  $3b + 3a$
- (B)  $b^2 + ab + a^2$
- (C)  $\frac{b^3 + a^3}{2}$
- (D)  $\frac{b^3 - a^3}{2}$
- (E)  $\frac{(b^4 - a^4)}{4(b - a)}$

35.



The graph of the derivative of  $f$  is shown in the figure above. Which of the following could be the graph of  $f$ ?

- (A)
- (B)
- (C)
- (D)
- (E)



36. The graph of the piecewise-defined function  $f$ , for  $-4 \leq t \leq 4$ , consists of a line segment and a semicircle as shown in the figure above. The function  $g$  is defined by  $g(x) = \int_{-4}^x f(t) dt$ . What is the value of  $g(4)$ ?

(A)  $2 + \pi$     (B)  $18 - \pi$     (C)  $18 - \frac{\pi}{2}$     (D)  $18 + \frac{\pi}{2}$     (E)  $18 + \pi$

37. The first derivative of the function  $f$  is given by  $f'(x) = \frac{8 \cos x}{x^2} - \frac{1}{8}$ . On the open interval  $(1, 10)$  the graph of  $f$  has

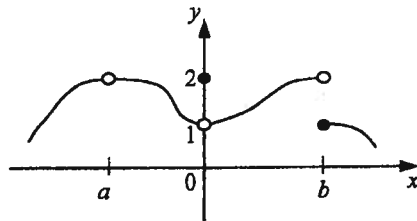
(A) one relative maximum and no relative minima  
 (B) one relative minimum and no relative maxima  
 (C) two relative maxima and one relative minimum  
 (D) two relative minima and one relative maximum  
 (E) no relative extrema

38.

Time (sec)	0	3	8	10
Rate (gal/sec)	16	10	6	5

Water drains continuously from a tank. The rate (in gallons per second) at which the water drains out is measured at the times (in seconds) given in the table above. What is the trapezoidal approximation, based on all of the data in the table, for the total amount of water that has drained from the tank in the first ten minutes?

(A) 37 gallons                      (B) 70 gallons                      (C) 79.5 gallons  
 (D) 90 gallons                      (E) 110 gallons



39. The graph of the function  $f$  is shown in the figure above. Which of the following statements about  $f$  is true?

- (A)  $f(a)$  exists
- (B)  $\lim_{x \rightarrow a} f(x) = 2$
- (C)  $\lim_{x \rightarrow b} f(x) = 1$
- (D)  $\lim_{x \rightarrow b^-} f(x) = \lim_{x \rightarrow b^+} f(x)$
- (E)  $f$  is continuous at  $x = 0$

40. The volume of a sphere of radius  $r$  is  $\frac{4}{3}\pi r^3$ . The volume of a gas-filled spherical balloon increases 6 cubic inches for each degree (Celsius) increase in temperature. If the temperature increases at a constant rate of 2 degrees per minute, then at what rate is the radius of the balloon changing at the instant when the volume is  $36\pi$  cubic inches?

- (A)  $\frac{1}{\pi}$  inches per minute
- (B)  $\frac{1}{2\pi}$  inches per minute
- (C)  $\frac{1}{3\pi}$  inches per minute
- (D)  $\frac{1}{6\pi}$  inches per minute
- (E)  $\frac{2}{3\pi}$  inches per minute

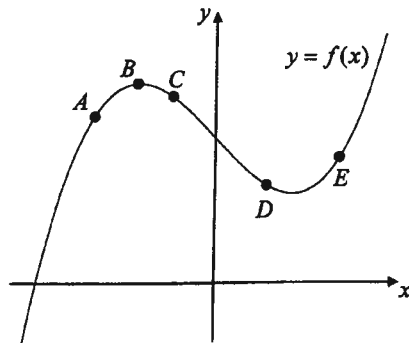
41. If  $x + \sin y = \ln y$ , then  $\frac{dy}{dx} =$

- (A)  $y + y \cos y$
- (B)  $\frac{y + \cos y - 1}{y}$
- (C)  $\frac{1 - y}{y \cos y}$
- (D)  $\frac{y}{y \cos y - 1}$
- (E)  $\frac{y}{1 - y \cos y}$

42. Let  $f$  be a twice differentiable function of  $x$  such that, when  $x = c$ ,  $f$  is decreasing, concave up, and has an  $x$ -intercept. Which of the following is true?
- (A)  $f(c) < f'(c) < f''(c)$   
 (B)  $f(c) < f''(c) < f'(c)$   
 (C)  $f'(c) < f(c) < f''(c)$   
 (D)  $f'(c) < f''(c) < f(c)$   
 (E)  $f''(c) < f(c) < f'(c)$
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43. If  $f'(x) = \sqrt{1+x^3}$  and  $f(1) = 0.5$ , then  $f(4) =$
- (A) 7.562    (B) 8.062    (C) 12.871    (D) 13.371    (E) 17.871
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44. A function  $f$  is continuous for  $0 \leq x \leq 5$  and differentiable for  $0 < x < 5$ . Given that  $f(0) = -2$  and  $f(5) = 3$ , which of the following statements must be true?
- I.  $f'(c) = 1$  for some  $c$  such that  $0 < c < 5$   
 II.  $f(c) = 0$  for some  $c$  such that  $0 < c < 5$   
 III.  $f(c) = -1$  for some  $c$  such that  $0 < c < 5$
- (A) I only                      (B) II only                      (C) I and II  
 (D) II and III                    (E) I, II, and III
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45. At which point on the graph shown above are both the first and second derivatives of  $f(x)$  negative?
- (A) A            (B) B            (C) C            (D) D            (E) E