Calculus AB
Section I, Part A
Time — 55 minutes
Number of questions — 28

No calculator is allowed for these questions.

1. If $f(x) = x^2 \ln x$, then $f'(x) =$

(A) 2 (B) $x + 2\ln x$ (C) $2x\ln x$
(D) $1 + 2x\ln x$ (E) $x + 2x\ln x$

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2. $\int_1^8 x^{-\frac{2}{3}}\,dx =$

(A) $-\frac{31}{48}$ (B) $-\frac{1}{4}$ (C) $\frac{1}{3}$ (D) 1 (E) 3

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3. If $f(x) = e^{-x} + \sin x - \cos x$, then $f''(0) =$

(A) -2 (B) -1 (C) 0 (D) 1 (E) 2

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4. The slope of the line tangent to the curve $3x^2 - 2xy + y^2 = 11$ at the point $(1,-2)$ is

(A) $-\frac{1}{6}$ (B) 0 (C) 1 (D) $\frac{5}{3}$ (E) 10

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5. $\frac{d}{dx}[\ln(\sec x)] =$

(A) $\cos x$ (B) $\tan x$ (C) $\cos x \cot x$
(D) $\frac{\sec x \tan x}{x}$ (E) $\frac{\sec x}{x} + \ln(\sec x \tan x)$

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6. $\frac{d}{dx}\left(2^{\cos x}\right) =$

(A) $-(\sin x)2^{\cos x}$ (B) $(\ln 2)2^{\cos x}$ (C) $-(\ln 2)(\sin x)2^{\cos x}$
(D) $(\sin x)2^{\cos x}$ (E) $(\ln 2)(\cos x)2^{\cos x - 1}$

7. If $f'(x) = x^3(x+2)^2$, then the graph of f has inflection points when $x =$

(A) -2 only (B) 0 only (C) -2 and 0

(D) -2 and $-\frac{6}{5}$ (E) -2, $-\frac{6}{5}$, and 0

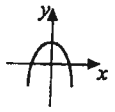
8. $\lim_{x\to-\infty} \frac{2x+3}{\sqrt{x^2+x+1}}$ is

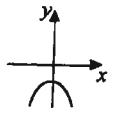
(A) -2 (B) -1 (C) 0 (D) 2 (E) nonexistent

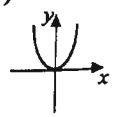
9. $\lim_{x\to 5} \frac{2x^2-50}{x^2-15x+50} =$

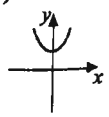
(A) -4 (B) -1 (C) 0 (D) 1 (E) 2

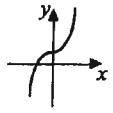
10. If $f''(0) < 0$, $f'(0) = 0$, and $f(0) > 0$, which of the following could be the graph of $y = f(x)$?

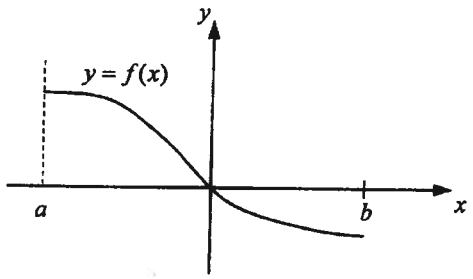
(A) 

(B) 

(C) 

(D) 

(E) 

11. 

Let f be a continuous function as shown in the figure above. The area of the region bounded by $f(x)$, the x-axis, and $x = a$ is 5. If $\int_a^b f(x)\,dx = 3$, then $\int_0^b f(x)\,dx$ is

(A) -3 (B) -2 (C) 2

(D) 8 (E) cannot be determined

12. The function g is given by $g(x)=\frac{3x^2}{e^{3x}}$. On which of the following intervals is g increasing?

(A) $(-\infty,0)$ (B) $\left(-\infty,\frac{2}{3}\right)$ (C) $\left(0,\frac{2}{3}\right)$ (D) $(0,\infty)$ (E) $\left(\frac{2}{3},\infty\right)$

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13. What is the x-coordinate of the point of inflection of the graph of $y=x^3+3x^2-45x+81$?

(A) -9 (B) -5 (C) -1 (D) 1 (E) 3

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14. If $x^2y+y^2+4=0$, then when $x=2$, the value of $\frac{dy}{dx}$ is

(A) -2 (B) -1 (C) 0 (D) 2 (E) nonexistent

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15. Given that $f(-3)=4$ and $f'(-3)=2$, which of the following is the tangent line approximation of $f(-3.1)$?

(A) 3.8 (B) 3.9 (C) 4.0 (D) 4.1 (E) 4.2

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16. The slope to the tangent line to the graph of $y=\tan 2x$ at $x=\frac{\pi}{8}$ is

(A) $\frac{1}{\sqrt{2}}$ (B) $\sqrt{2}$ (C) 2 (D) $2\sqrt{2}$ (E) 4

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17. If $x^2-y^2=5$, what is the value of $\frac{d^2y}{dx^2}$ at the point (3, 2)?

(A) $-\frac{13}{8}$ (B) $-\frac{11}{8}$ (C) $-\frac{7}{8}$ (D) $-\frac{5}{8}$ (E) $-\frac{1}{4}$

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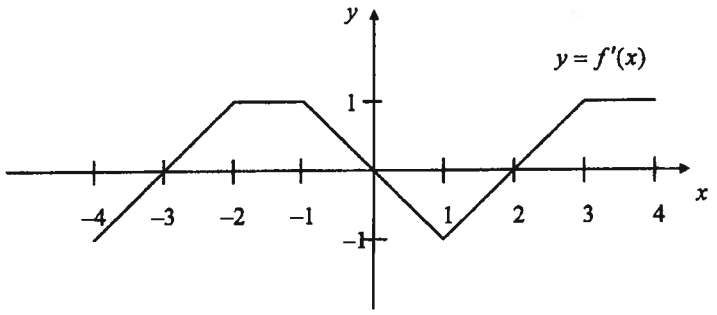
18. The velocity of a particle at time t is given by the function $v(t)=t^3-\sin t+2$. What is the acceleration of the particle at time $t=2\pi$?

(A) $6\pi-1$ (B) $6\pi+1$ (C) $12\pi^2-1$ (D) $12\pi^2$ (E) $12\pi^2+1$



Questions 19-21 refer to the graph of $y = f'(x)$, the derivative of f, shown above. The graph consists of five line segments, two of which are horizontal.

19. At $x = 1$, f has a

(A) point of discontinuity
(B) point of inflection
(C) point of nondifferentiability
(D) local maximum
(E) local minimum

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20. Over the interval $-4 < x < 4$, how many local maxima does f have?

(A) One (B) Two (C) Three (D) Four (E) Infinitely many

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21. If $f(2) = 1$, what is the value of $f(-2)$?

(A) $-\frac{3}{2}$ (B) $-\frac{1}{2}$ (C) $\frac{1}{2}$ (D) $\frac{3}{2}$ (E) $\frac{5}{2}$

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22. $\int_0^{\sqrt{e-1}} \frac{x}{x^2+1}\,dx =$

(A) 0 (B) $\frac{\ln(e-1)}{2}$ (C) $\frac{1}{2}$

(D) 1 (E) $\sqrt{e-1}$

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23. If $f(x) = e^{2\ln x}$, then $f'(3) =$

(A) 6 (B) 9 (C) e^6 (D) e^9 (E) $\frac{e^9}{9}$

24. For what value of x is the line tangent to $y = x^2$ parallel to the line tangent to $y = \sqrt{x}$?

(A) 0 (B) $\frac{\sqrt[3]{4}}{4}$ (C) $\frac{1}{2}$ (D) $\frac{\sqrt[3]{2}}{2}$ (E) 1

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25. If $F(x) = \int_0^{x^2} \cos(t^3)\,dt$, then $F'(x) =$

(A) $\cos(x^3)$ (B) $\cos(x^6)$ (C) $2x\cos(x^3)$
(D) $2x\cos(x^6)$ (E) $x^2\cos(x^3)$

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26. $\lim_{x\to 2} \frac{e^{2x} - e^4}{x-2} =$

(A) e (B) $2e$ (C) $2e^2$ (D) e^4 (E) $2e^4$

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27. The side of a cube is expanding at a constant rate of 2 centimeters per second. What is the instantaneous rate of change of the surface area of the cube, in cm^2 per second, when its volume is 27 cubic centimeters?

(A) 6 (B) 24 (C) 36 (D) 54 (E) 72

28.

x	-1	1	5	8
$f(x)$	5	2	5	-1

Let f be a continuous, differentiable function defined for all real values of x. The table above shows values of f at certain values of x. The function f must have at least

(A) one point of inflection and at least one relative minimum
(B) one point of inflection and at least two relative maxima
(C) one zero and at least two points of inflection
(D) two zeros and at least one relative minimum
(E) two points of inflection and at least one relative maximum