1. If $y = g(x^5)$ and $g'(x) = \log_5 x$ then $\frac{dy}{dx} =$

(A) $25x^4 \log_5 x$ (B) $5x^5 \log_5 x$ (C) $x^4 \log_5 x^5$ (D) $25x^4 \log_5 x^5$ (E) $x \log_5 x^5$

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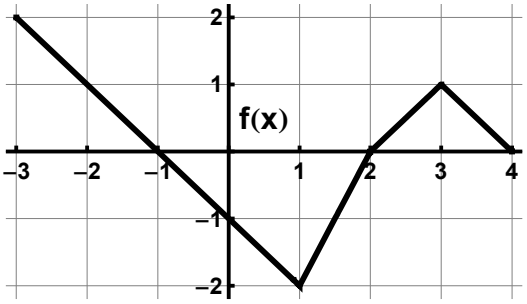
2. The graph of the function $f(x)$, shown below, consists of four line segments. If the function $g(x)$ is an antiderivative of f such that $g(-1) = 1$, for how many values of c, where $-3 \le c \le 4$, does $g(c) = -1$?



(A) Zero (B) One (C) Two (D) Three (E) Four

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3. Find the average value of the function $f(x) = 1 - \sqrt{4 - x^2}$ on the interval $[-2, 0]$

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

---

4. Let $y = f(x)$ be a twice – differentiable function such that $f(-2) = 3$ and $\frac{dy}{dx} = y^2 + y$. What is the value of $\frac{d^2y}{dx^2}$ at $x = -2$?

(A) 12 (B) 24 (C) 48 (D) 72 (E) 84

---

5. $\lim_{h \to 0} \left(\frac{1}{h} \int_{\sqrt{\pi}}^{\sqrt{\pi}+h} \cos(x^2)\, dx \right)$

(A) -1 (B) 0 (C) 1 (D) 2 (E) The limit does not exist

---

6. The table below gives selected values for a differentiable and decreasing function f and its derivative. If f^{-1} is the inverse function of f, what is the value of $(f^{-1})'(3)$?

x	$f(x)$	$f'(x)$
1	37	0
2	3	-7
3	-4	-62

(A) -62 (B) $\frac{-1}{7}$ (C) $\frac{-1}{62}$ (D) $\frac{1}{62}$ (E) $\frac{1}{7}$

---

7. The function f is continuous on the closed interval $[-3, 5]$. If $\int_{-3}^{5} f(x)\, dx = 18$ and $\int_{5}^{1} f(x)\, dx = -14$,

then $\int_{1}^{-3} 2f(x)\, dx =$

(A) -12 (B) -8 (C) -4 (D) 4 (E) 8

8. The function $y = h(x)$ is differentiable and increasing for all real numbers. On what intervals is the function $y = h\left(x^3 + 6x^2\right)$ increasing ?

(A) $(-\infty, -4]$ and $[0, \infty)$ (B) $[-4, 0]$ (C) $[-6, \infty)$ (D) $[-4, \infty)$ (E) $(-\infty, \infty)$

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9. Suppose $L(x)$ is the linearization formula for $f(x) = x^3 - 6x^2 + 6x + 1$ at $x = 2$. Which of the following is true?

(A) $L(1.9)$ underestimates $f(1.9)$, and $L(2.1)$ underestimates $f(2.1)$
(B) $L(1.9)$ underestimates $f(1.9)$, and $L(2.1)$ overestimates $f(2.1)$
(C) $L(1.9)$ overestimates $f(1.9)$, and $L(2.1)$ underestimates $f(2.1)$
(D) $L(1.9)$ overestimates $f(1.9)$, and $L(2.1)$ overestimates $f(2.1)$
(E) None of the above are true

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10. The table below gives values of f, f', g, and g' for selected values of x. If $h(x) = f(g(2x))$, what is the value of $h'(2)$?

x	$f(x)$	$f'(x)$	$g(x)$	$g'(x)$
-1	-6	3	8	9
2	6	-4	-2	7
4	5	-2	-1	-3

(A) -24 (B) -18 (C) -9 (D) 9 (E) 18

---

11. Given that $F'(x) = f(x)$, the value of $\int_a^b \frac{f\left(\sqrt{x}\right)}{\sqrt{x}}\,dx$ is

(A) $\frac{1}{2}\left(F\left(\sqrt{b}\right) - F\left(\sqrt{a}\right)\right)$ (B) $(F(b) - F(a))$ (C) $\left(F\left(\sqrt{b}\right) - F\left(\sqrt{a}\right)\right)$
(D) $2\left(F\left(\sqrt{b}\right) - F\left(\sqrt{a}\right)\right)$ (E) $4\left(F\left(\sqrt{b}\right) - F\left(\sqrt{a}\right)\right)$

---

12. Find the solution to the differential equation $\frac{dy}{dx} = 3y^2$ with the initial condition $y(0) = 5$

(A) $y = \frac{5}{1 - 15x}$ (B) $y = \frac{5}{1 + 15x}$ (C) $y = \sqrt{e^{3x} + 25}$ (D) $y = \sqrt{\frac{e^{3x}}{25}}$ (E) $y = \sqrt{25e^{3x}}$

---

13. Evaluate $\lim_{x \to \frac{-\pi}{12}} \frac{\csc(2x) + 2}{x + \frac{\pi}{12}}$

(A) $-4\sqrt{3}$ (B) $-2\sqrt{3}$ (C) $-\sqrt{3}$ (D) $\sqrt{3}$ (E) $4\sqrt{3}$

---

14. Evaluate $\lim_{n \to \infty} \sum_{k=1}^{n} \left(3\left(-1 + \frac{3k}{n}\right)^2 - 2\left(-1 + \frac{3k}{n}\right)\right)\left(\frac{6}{n}\right)$

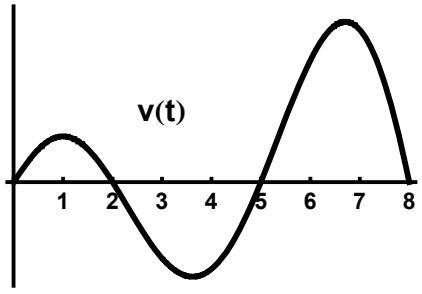
(A) 2 (B) 3 (C) 6 (D) 12 (E) 24

---

15. If $G(x) = \int_1^{\frac{x}{2}} \cot^{-1} t\,dt$ then $G'\left(-2\sqrt{3}\right) =$

(A) $\frac{-\pi}{3}$ (B) $\frac{-\pi}{6}$ (C) $\frac{\pi}{12}$ (D) $\frac{\pi}{6}$ (E) $\frac{5\pi}{12}$

16. Over the time interval $0 \le t \le 8$, a particle moves along the x – axis. The graph of the particle's velocity, v, is shown below. Over the time interval $0 \le t \le 8$, the particle's displacement is 4 and the particle travels a total distance of 11. What is the value of $\int_2^5 v(t)\,dt$?



(A) -4 (B) -3.5 (C) -3 (D) -2.5 (E) -2

---

17. Find the Linearization formula, $L(x)$, for the function $f(x) = 5 + \int_x^{-1} e^{-t^3}\,dt$ at the point where $t = -1$

(A) $L(x) = 5 + \frac{1}{e}(x - 1)$ (B) $L(x) = 5 + \frac{1}{e}(x + 1)$ (C) $L(x) = 5 - \frac{1}{e}(x + 1)$

(D) $L(x) = 5 + e(x + 1)$ (E) $L(x) = 5 - e(x + 1)$

---

18. If $f(x) = \ln x$, which of the following is equal to $f'(e)$?

(A) $\lim_{a \to 0} \frac{\ln(x + a)}{a}$ (B) $\lim_{a \to 0} \frac{\ln(x + a) - \ln x}{a}$ (C) $\lim_{a \to 0} \frac{\ln(e + a) - e}{a}$ (D) $\lim_{a \to 0} \frac{\ln(e + a) - 1}{a}$ (E) $\lim_{a \to 0} \frac{\ln(e + h) - 1}{a}$

---

19. Evaluate $\int_0^{\frac{1}{2}} \cos^{-1} x\,dx$

(A) $\frac{\pi}{6}$ (B) $\frac{\pi}{3}$ (C) $\frac{\pi}{6} - \frac{\sqrt{3}}{2}$ (D) $\frac{\pi}{3} - \frac{\sqrt{3}}{2}$ (E) $\frac{\pi}{6} - \frac{\sqrt{3}}{2} + 1$

---

20. Let f be the function given by $f(x) = \frac{cx}{x^2 + 4}$, where c is a constant. For what values of c, if any, is f strictly increasing for all x values on the interval $(-2, 2)$?

(A) $c < 0$ (B) $c = 0$ (C) $c > 0$ (D) $c > 1$ only (E) There are no such values of c

---

21. If the differential equation $\frac{dy}{dx} = \frac{1}{5}y - \frac{1}{300}y^2$ has the solution curve $y = f(x)$ containing the point $(0, 20)$, then find $\lim_{x \to \infty} f(x)$

(A) 60 (B) 80 (C) 120 (D) 180 (E) The limit does not exist

---

22. Approximate $\int_0^3 (9x^2 - 24x + 18)\,dx$ using three inscribed rectangles of equal width.

(A) 10 (B) 11 (C) $\frac{23}{2}$ (D) 12 (E) $\frac{25}{2}$

23. Evaluate $\lim_{x \to 0} \left(\frac{5}{x} + \frac{3}{x^2} - \frac{1}{x^3} \right)$

(A) $-\infty$ (B) -1 (C) 0 (D) ∞ (E) Does Not Exist

---

24. Let f be the function defined below. Which of the following statements about f are true?

$$f(x) = \begin{cases} 2x - 7 & \text{for } x < 4 \\ \ln(2x - 7) & \text{for } x \geq 4 \end{cases}$$

I. $\lim_{x \to 4^-} f(x) = \lim_{x \to 4^+} f(x)$ II. $\lim_{x \to 4^-} f'(x) = \lim_{x \to 4^+} f'(x)$

III. f is differentiable at $x = 4$

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

---

25. Which of the following functions satisfies $f'(x) < f''(x) < f(x)$ for all x?

(A) 2^x (B) 5^x (C) e^x (D) 2^{-x} (E) 5^{-x}

---

26. If $f''(x) = (x - 2)(x + 3)^2$ then the graph of f is concave up for

(A) $x < -3$ (B) $-3 < x < 2$ (C) $x > 2$ (D) $x < -3$ and $x > 2$ (E) $x < 3$

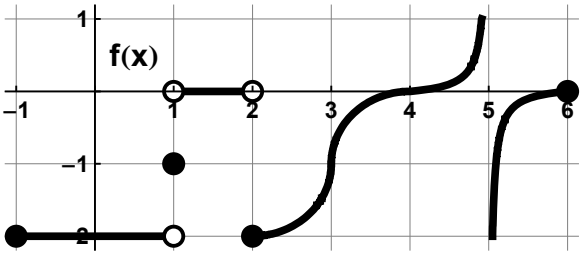
---

27. Which of the following is a critical value for the function $f(x) = (2 + 3x)^2(3 - 2x)^3$?

(A) $\frac{-2}{7}$ (B) $\frac{1}{12}$ (C) $\frac{1}{5}$ (D) $\frac{3}{7}$ (E) 8

---

28. The graph of the function f is shown below. For what values of x does $\lim_{h \to 0} \frac{f(x + h) - f(x)}{h} = \infty$?



(A) 3 only (B) 1 and 3 (C) 1 and 5 (D) 3 and 5 (E) 1, 3, and 5

---

29. Let f be the function defined below, where a and b are constants. If f is differentiable at $x = \frac{-\pi}{6}$, then the product ab =

$$f(x) = \begin{cases} 2a \sin x + b & \text{for } x \leq \frac{-\pi}{6} \\ \cos 2x & \text{for } x > \frac{-\pi}{6} \end{cases}$$

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

---

30. The slope of the line tangent to the curve $3y - 2\sqrt{x^2 y} - x^2 = 7$ at the point $(-1, 4)$ is

(A) $\frac{-12}{5}$ (B) -2 (C) $\frac{-4}{5}$ (D) $\frac{6}{5}$ (E) $\frac{8}{5}$
