1. If $\int_2^5 f(x)\,dx = 14$, then find $\int_2^5 (4f(x) - 3)\,dx$

(A) 9 (B) 15 (C) 44 (D) 47 (E) 53

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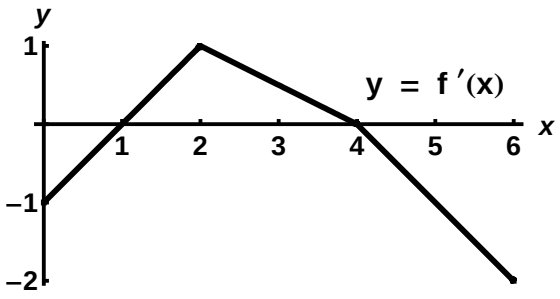
2. Find the x – coordinate of the point of inflection for the graph of $y = x^3 + 3x^2 - 1$

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

---

3. Consider the graph of f' below. If $f(5) = 2$, then $f(0) =$



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

---

4. The efficiency of a natural gas engine is modeled by the continuous function $n(k)$ where n is measured in liters/kilometer and k is measured in kilometers. What are the units of $\int_1^9 n(k)\,dk$?

(A) $\frac{\text{liters}}{\text{kilometer}}$ (B) $\frac{\text{kilometers}}{\text{liter}}$ (C) liters (D) kilometers (E) liters – kilometers

---

5. If the function given by $f(x) = ax + e^{bx}$ has a local minimum at $f(1) = 0$, find the value of ab.

(A) $-e$ (B) $\frac{1-\sqrt{5}}{2}$ (C) 0 (D) $\frac{1+\sqrt{5}}{2}$ (E) π

---

6. $\lim_{x \to 0} 3x \csc x =$

(A) $-\infty$ (B) $\frac{1}{3}$ (C) 1 (D) 3 (E) ∞

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7. $\frac{d}{dx}\left(\int_0^{\frac{\pi}{3}} \sec^3 x\,dx\right) =$

(A) 0 (B) $\sec^3 x$ (C) $\sec^3 x + C$ (D) 7 (E) $\frac{1}{2}\sec x \tan x + \frac{1}{2}\ln(\sec x + \tan x) + C$

---

8. If the function f is given by $f(x) = \begin{cases} \ln(3x), & 0 < x < 3 \\ 2\ln x, & x \geq 3 \end{cases}$ then find $\lim_{x \to 3} f(x)$

(A) 0 (B) $\frac{1}{3}$ (C) $\frac{2}{3}$ (D) $2\ln 3$ (E) Does Not Exist

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9. If $G(x) = \int_{-4}^{2x} \csc^{-1} t\,dt$ then find $G'(-1)$

(A) $\frac{-4\pi}{3}$ (B) $\frac{-\pi}{3}$ (C) $\frac{\pi}{3}$ (D) $\frac{4\pi}{3}$ (E) $\frac{7\pi}{3}$

10. Evaluate $\int_{\frac{1}{e}}^{1} \frac{x^2 - x}{x^2}\,dx$

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

---

11. $\lim_{x \to -2^+} \sqrt{x^2 - x - 6}$ =

(A) 0 (B) 1 (C) 2 (D) 3 (E) Does Not Exist

---

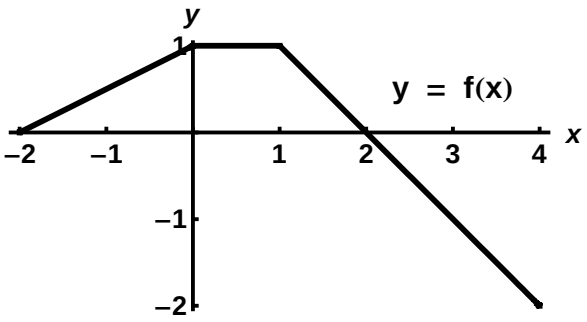
12. Consider the chart of values for the function $f(x)$. Use these values to find the average value of $f''(x)$ on the interval $[3, 18]$. Note that the chart extends beyond these values

x	0	3	6	9	12	15	18	21
f(x)	24	22	18	13	7	0	– 10	– 24

(A) $\frac{-1}{2}$ (B) $\frac{-2}{5}$ (C) $\frac{-1}{4}$ (D) $\frac{-1}{5}$ (E) 0

---

13. The graph of the piecewise linear function f on the closed interval $[-2, 4]$ is shown above. Find $\int_{-1}^{2} f(2x)\,dx$



(A) $\frac{1}{4}$ (B) $\frac{1}{2}$ (C) 1 (D) $\frac{9}{4}$ (E) $\frac{9}{2}$

---

14. A cube has a side length of 5 inches. If the length of the side is increased by 0.2 inch, find the approximate change in the volume of the cube, using differentials.

(A) 3 inches^3 (B) 5 inches^3 (C) 15 inches^3 (D) 15.6 inches^3 (E) 16 inches^3

---

15. If $g(x) = f(x^2)$, then find $g''(x)$

(A) $2x f''(x^2)$ (B) $4x^2 f''(x^2)$ (C) $(4x^2 + 2x) f''(x^2)$ (D) $4x^2 f''(x^2) + 2f'(x^2)$ (E) $4x^2 f''(x^2) + 2x f'(x^2)$

---

16. Assuming that the function $f(x)$ is an inverse of the function $h(x)$, use the chart below to find $f'(-1)$

x	– 3	– 1	4
h(x)	– 5	– 2	– 1
h'(x)	2	$\frac{4}{5}$	$\frac{1}{7}$

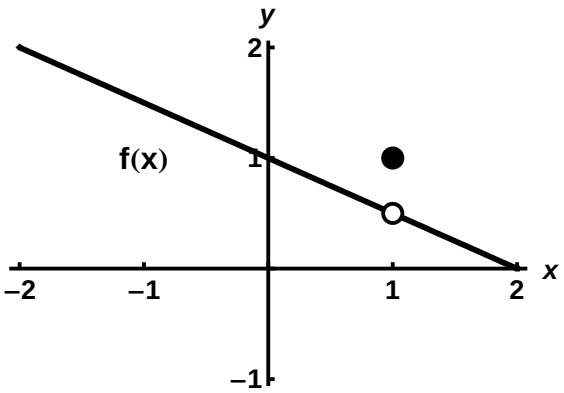
(A) $\frac{1}{2}$ (B) $\frac{4}{5}$ (C) $\frac{5}{4}$ (D) 2 (E) 7

---

17. If $\lim_{x \to a} f(x) = L$, where L is a real number, which of the following must be true?

(A) $f'(a)$ exists (B) $f(x)$ is continuous at $x = a$ (C) $f(x)$ is defined at $x = a$
(D) $f(a) = L$ (E) None of the above

18. Consider the piecewise function, $f(x)$, below. Find the best answer for the derivative at $x = 1$, or $\lim_{x \to 1} \frac{f(x) - f(1)}{x - 1}$



(A) $-\infty$ (B) $\frac{-1}{2}$ (C) 1 (D) ∞ (E) Does Not Exist

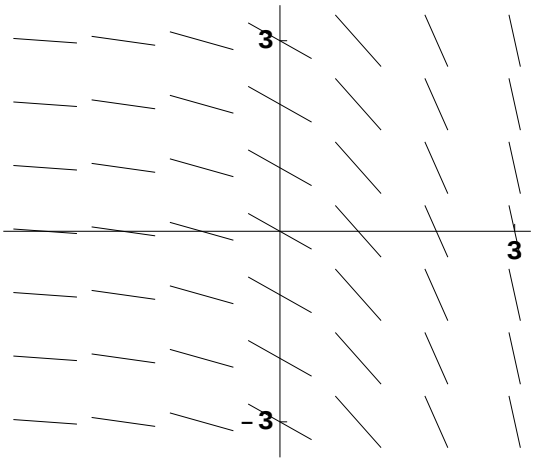
19. Find the area of the region enclosed by the graphs of $y = x$ and $y = x^2 - 3x + 3$

(A) $\frac{2}{3}$ (B) 1 (C) $\frac{4}{3}$ (D) 2 (E) $\frac{14}{3}$

20. The area of the region in the first quadrant bounded by the graph of $y = x\sqrt{9 + x^2}$, the $x-$axis, and the line $x = 4$ is

(A) $\frac{8}{3}$ (B) $\frac{32}{3}$ (C) $\frac{37}{3}$ (D) $\frac{64}{3}$ (E) $\frac{98}{3}$

21. A <u>solution</u> to the differential equation with its slopefield shown below could be



(A) $y = -2^{-x}$ (B) $y = -2^{x}$ (C) $y = 2^{x}$ (D) $y = 2^{-x}$ (E) $y = \log_2 |x|$

22. Evaluate $\lim_{x \to \frac{\pi}{3}} \frac{\cos x - \frac{1}{2}}{x - \frac{\pi}{3}}$

(A) $\frac{-\sqrt{3}}{2}$ (B) $\frac{-1}{2}$ (C) $\frac{1}{2}$ (D) $\frac{\sqrt{3}}{2}$ (E) Does Note Exist

23. Determine the number of critical values (related to the first derivative) for the function $f(x) = (x + 2)^5 (x - 3)^4$

(A) One (B) Two (C) Three (D) Five (E) Nine

24. Consider the function $f(x)$, where $f(x) > 0$ on $[a, b]$, $f'(x) > 0$ on $[a, b]$, and $f''(x) < 0$ on $[a, b]$ If the interval is split into 6 equal subdivisions, and L is the left – hand Riemann sum for the partitioning, R is the right – hand Riemann sum for the partitioning, and T is the trapezoidal approximation for the partitioning, then

(A) $L < T < R$ (B) $T < R < L$ (C) $R < T < L$ (D) $L < R < T$ (E) $R < L < T$

---

25. If $y^2 + xy = 6$, find $\dfrac{dy}{dx}$ at the point $(-1, 3)$

(A) $\dfrac{-3}{5}$ (B) $\dfrac{-3}{7}$ (C) $\dfrac{3}{7}$ (D) $\dfrac{3}{5}$ (E) $\dfrac{6}{5}$

---

26. Let $y = f(x)$ be the solution to the differential equation $\dfrac{dy}{dx} = x - 2y - 1$ with the initial condition $f(-2) = -1$.

What is the approximation for $f(0)$ if Euler's Method is used, starting at $x = -2$ with 2 steps of equal size?

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

---

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

(A) $L(-1.1)$ overestimates $f(-1.1)$ and $L(-0.9)$ overestimates $f(-0.9)$
(B) $L(-1.1)$ underestimates $f(-1.1)$ and $L(-0.9)$ underestimates $f(-0.9)$
(C) $L(-1.1)$ underestimates $f(-1.1)$ and $L(-0.9)$ overestimates $f(-0.9)$
(D) $L(-1.1)$ overestimates $f(-1.1)$ and $L(-0.9)$ underestimates $f(-0.9)$
(E) None of the above are true

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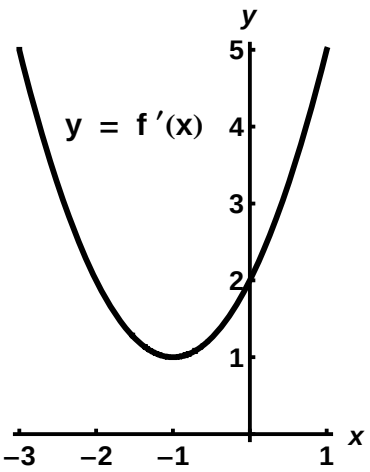
28. The graph of the derivative of the function f is shown below. If $f(0) = 0$, then which of the following is true?



(A) $f(-1) < f'(-1) < f''(-1)$ (B) $f(-1) < f''(-1) < f'(-1)$ (C) $f'(-1) < f''(-1) < f(-1)$
(D) $f''(-1) < f(-1) < f'(-1)$ (E) $f''(-1) < f'(-1) < f(-1)$

---

29. Evaluate $\displaystyle\int x \sec^2 x \, dx$

(A) $x \tan x - \sec^2 x + C$ (B) $x \tan x - \dfrac{1}{2}\tan^2 x + C$ (C) $x \tan x - \ln\left|\sec x\right| + C$

(D) $\dfrac{1}{2}x^2 \tan x + C$ (E) $\dfrac{1}{2}\tan^2 x + C$

---

30. Evaluate $\displaystyle\int_0^x \sin t \cos^2 t \, dt$

(A) $-\cos^3 x$ (B) $\dfrac{-\cos^3 x}{3}$ (C) $\dfrac{\cos^3 x}{3}$ (D) $\cos^3 x$ (E) $\dfrac{1 - \cos^3 x}{3}$
