

1. $\int \sin 3\theta \, d\theta =$

- A) $3 \cos 3\theta + C$
 - B) $-3 \cos 3\theta + C$
 - C) $-\cos 3\theta + C$
 - D) $\frac{1}{3} \cos 3\theta + C$
 - E) $-\frac{1}{3} \cos 3\theta + C$
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2. $\int 3^{x^2} x \, dx =$

- A) $\frac{3^{x^2+1}}{x^2+1} + C$
 - B) $\frac{3^{x^2}}{\ln 9} + C$
 - C) $3^{x^2} \ln 3 + C$
 - D) $3^{x^3/3} + C$
 - E) None of these
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3. Let $f(x)$ be defined as below. Evaluate $\int_0^6 f(x) \, dx$.

$$f(x) = \begin{cases} x & 0 < x \leq 2 \\ 1 & 2 < x \leq 4 \\ \frac{1}{2}x & 4 < x \leq 6 \end{cases}$$

- A) 5
- B) 6
- C) 7
- D) 8
- E) 9

4. $\int_0^1 \frac{x}{x^2+1} dx =$

- A) $\frac{\pi}{4}$
 - B) $\ln \sqrt{2}$
 - C) $\frac{1}{2}(\ln 2 - 1)$
 - D) $\frac{3}{2}$
 - E) $\ln 2$
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5. The average value of $g(x) = (x - 3)^2$ in the interval $[1, 3]$ is

- A) 2
 - B) $\frac{2}{3}$
 - C) $\frac{4}{3}$
 - D) $\frac{8}{3}$
 - E) None of these
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6. $\int_0^5 \frac{dx}{\sqrt{3x+1}} =$

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

7. There is a point between $P(1, 0)$ and $Q(e, 1)$ on the graph of $y = \ln x$ such that the tangent to the graph at that point is parallel to the line through points P and Q . The x -coordinate of this point is

- A) $e - 1$
- B) e
- C) -1
- D) $\frac{1}{e - 1}$
- E) $\frac{1}{e + 1}$

8. Which of the following statements are true?

- I. If the graph of a function is always concave up, then the left-hand Riemann sums with the same subdivisions over the same interval are always less than the right-hand Riemann sum.
 - II. If the function f is continuous on the interval $[a, b]$ and $\int_a^b f(x) dx = 0$, then f must have at least one zero between a and b .
 - III. If $f'(x) > 0$ for all x in an interval, then the function f is concave up in that interval.
- A) I only
 - B) II only
 - C) III only
 - D) II and III only
 - E) None are true.

9. If $f(x) = \int_2^{2x} \frac{1}{\sqrt{t^3 + 1}} dt$, then $f'(1) =$

- A) 0
- B) $\frac{1}{3}$
- C) $\frac{2}{3}$
- D) $\sqrt{2}$
- E) undefined

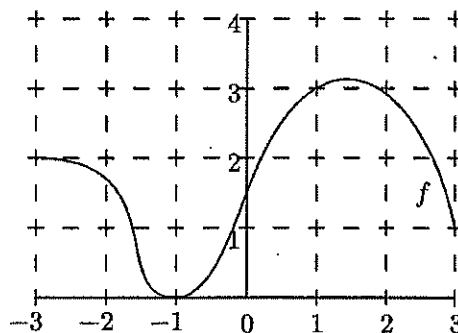
10. If $\int_a^b f(x) dx = 3$ and $\int_a^b g(x) dx = -2$, then which of the following must be true?

- I. $f(x) > g(x)$ for all $a \leq x \leq b$
- II. $\int_a^b [f(x) + g(x)] dx = 1$
- III. $\int_a^b [f(x)g(x)] dx = -6$

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

11. The graph of f is shown below. Approximate $\int_{-3}^3 f(x) dx$ using the trapezoid rule with 3 equal subdivisions.

- A) $\frac{9}{4}$
- B) $\frac{9}{2}$
- C) 9
- D) 18
- E) 36

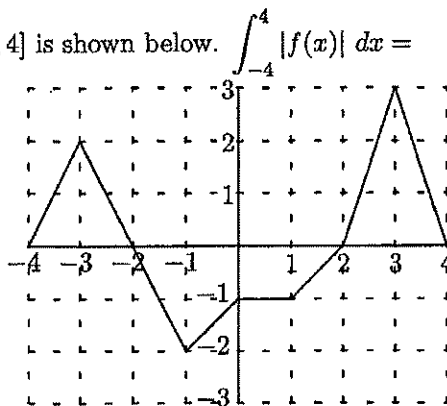


12. If $\int_0^k \frac{\sec^2 x}{1 + \tan x} dx = \ln 2$, then the value of k is

- A) $\pi/6$.
- B) $\pi/4$.
- C) $\pi/3$.
- D) $\pi/2$.
- E) π .

13. The graph of the function f on the interval $[-4, 4]$ is shown below. $\int_{-4}^4 |f(x)| dx =$

- A) 1
 B) 2
 C) 5
 D) 8
 E) 9



14. The acceleration of a particle moving along the x -axis at time $t > 0$ is given by $a(t) = \frac{1}{t^2}$. When $t = 1$ second, the particle is at $x = 2$ and has velocity -1 unit per second. If $x(t)$ is the particle's position, then the position when $t = e$ seconds is

- A) $x = -2$.
 B) $x = -1$.
 C) $x = 0$.
 D) $x = 1$.
 E) $x = 2$.

15. The area enclosed by the two curves $y = x^2 - 4$ and $y = x - 4$ is given by

- A) $\int_0^1 (x - x^2) dx$
 B) $\int_0^1 (x^2 - x) dx$
 C) $\int_0^2 (x - x^2) dx$
 D) $\int_0^2 (x^2 - x) dx$
 E) $\int_0^4 (x^2 - x) dx$

1. The temperature on New Year's Day in Buffalo, New York, is given by

$$T(h) = -A - B \cos\left(\frac{\pi h}{12}\right),$$

where T is the temperature in degrees Fahrenheit and h is the number of hours from midnight ($0 \leq h \leq 24$).

- The initial temperature at midnight was -15° F, and at Noon of New Year's Day it was 5° F. Find A and B .
- Find the average temperature for the first 10 hours.
- Use the trapezoid rule with 4 equal subdivisions to estimate $\int_6^{10} T(h) \, dh$. Using correct units, explain the meaning of your answer.
- Find an expression for the rate that the temperature is changing with respect to h .

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2. Let f be a differentiable function, defined for all real numbers x , with the following properties.

- $f'(x) = ax^2 + bx$, where a and b are real numbers
- $f'(1) = 6$ and $f''(1) = 18$
- $\int_1^2 f(x) \, dx = 18$

Find $f(x)$. Show your work.

3. A particle moves along the x -axis so that its velocity at any time $t \geq 0$ is given by $v(t) = 1 - \sin(2\pi t)$.
- Find the acceleration $a(t)$ of the particle at any time t .
 - Find all values of t , $0 \leq t \leq 2$, for which the particle is at rest.
 - Find the position $x(t)$ of the particle at any time t if $x(0) = 0$.