

1. Which of the following represents the area of the shaded region in the figure above?

- (A) $\int_c^d f(y) dy$ (B) $\int_a^b (d - f(x)) dx$ (C) $f'(b) - f'(a)$
 (D) $(b - a)[f(b) - f(a)]$ (E) $(d - c)[f(b) - f(a)]$

2. If $x^3 + 3xy + 2y^3 = 17$, then in terms of x and y , $\frac{dy}{dx} =$

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

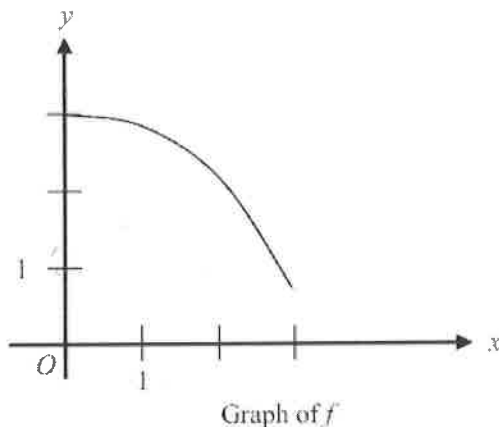
3. $\int \frac{3x^2}{\sqrt{x^3 + 1}} dx =$

- (A) $2\sqrt{x^3 + 1} + C$ (B) $\frac{3}{2}\sqrt{x^3 + 1} + C$ (C) $\sqrt{x^3 + 1} + C$ (D) $\ln\sqrt{x^3 + 1} + C$ (E) $\ln(x^3 + 1) + C$

4. For what value of x does the function $f(x) = (x-2)(x-3)^2$ have a relative maximum?
- (A) -3 (B) $-\frac{7}{3}$ (C) $-\frac{5}{2}$ (D) $\frac{7}{3}$ (E) $\frac{5}{2}$
5. If $f(x) = \sin\left(\frac{x}{2}\right)$, then there exists a number c in the interval $\frac{\pi}{2} < x < \frac{3\pi}{2}$ that satisfies the conclusion of the Mean Value Theorem. Which of the following could be c ?
- (A) $\frac{2\pi}{3}$ (B) $\frac{3\pi}{4}$ (C) $\frac{5\pi}{6}$ (D) π (E) $\frac{3\pi}{2}$
6. If $f(x) = (x-1)^2 \sin x$, then $f'(0) =$
- (A) -2 (B) -1 (C) 0 (D) 1 (E) 2
7. The acceleration of a particle moving along the x -axis at time t is given by $a(t) = 6t - 2$. If the velocity is 25 when $t = 3$ and the position is 10 when $t = 1$, then the position $x(t) =$
- (A) $9t^2 + 1$ (B) $3t^2 - 2t + 4$ (C) $t^3 - t^2 + 4t + 6$ (D) $t^3 - t^2 + 9t - 20$ (E) $36t^3 - 4t^2 - 77t + 55$

8. $\frac{d}{dx} \int_0^x \cos(2\pi u) du$ is

- (A) 0 (B) $\frac{1}{2\pi} \sin x$ (C) $\frac{1}{2\pi} \cos(2\pi x)$ (D) $\cos(2\pi x)$ (E) $2\pi \cos(2\pi x)$



9. The graph of the function f is shown above for $0 \leq x \leq 3$. Of the following, which has the least value?

(A) $\int_1^3 f(x) dx$

(B) Left Riemann sum approximation of $\int_1^3 f(x) dx$ with 4 subintervals of equal length.

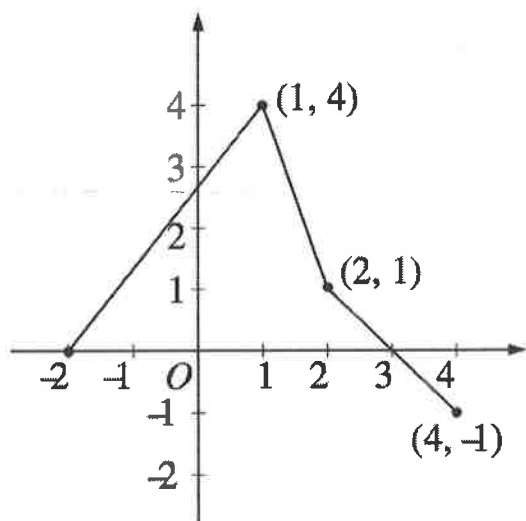
(C) Right Riemann sum approximation of $\int_1^3 f(x) dx$ with 4 subintervals of equal length.

(D) Midpoint Riemann sum approximation of $\int_1^3 f(x) dx$ with 4 subintervals of equal length.

(E) Trapezoidal sum approximation of $\int_1^3 f(x) dx$ with 4 subintervals of equal length.

10. What is the minimum value of $f(x) = x \ln x$?

- (A) $-e$ (B) -1 (C) $-\frac{1}{e}$ (D) 0 (E) $f(x)$ has no minimum value.



11. (1999, AB-5) The graph of the function f , consisting of three line segments, is shown above. Let

$$g(x) = \int_1^x f(t) dt.$$

(a) Compute $g(4)$ and $g(-2)$.

(b) Find the instantaneous rate of change of g , with respect to x , at $x = 1$.

(c) Find the absolute minimum value of g on the closed interval $[-2, 4]$. Justify your answer.

(d) The second derivative of g is not defined at $x = 1$ and $x = 2$. How many of these values are x -coordinates of points of inflection of the graph of g ? Justify your answer.

12. (1998, AB-4) Let f be a function with $f(1) = 4$ such that for all points (x, y) on the graph of f the slope is given by $\frac{3x^2 + 1}{2y}$.

(a) Find the slope of the graph of f at the point where $x = 1$.

(b) Write an equation for the line tangent to the graph of f at $x = 1$, and use it to approximate $f(1.2)$.

(c) Find $f(x)$ by solving the separable differential equation $\frac{dy}{dx} = \frac{3x^2 + 1}{2y}$ with the initial condition $f(1) = 4$.

(d) Use your solution from part (c) to find $f(1.2)$.