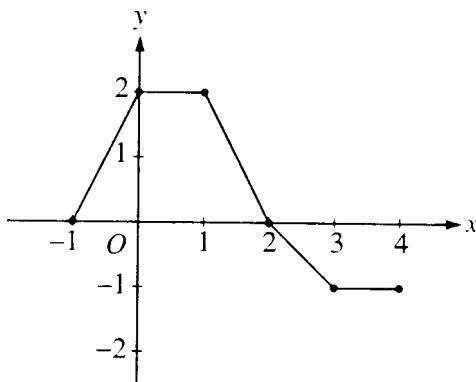


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55 Minutes—No Calculator

Note: Unless otherwise specified, the domain of a function f is assumed to be the set of all real numbers x for which $f(x)$ is a real number.

1. What is the x -coordinate of the point of inflection on the graph of $y = \frac{1}{3}x^3 + 5x^2 + 24$?
- (A) 5 (B) 0 (C) $-\frac{10}{3}$ (D) -5 (E) -10
-



2. The graph of a piecewise-linear function f , for $-1 \leq x \leq 4$, is shown above. What is the value of $\int_{-1}^4 f(x) dx$?
- (A) 1 (B) 2.5 (C) 4 (D) 5.5 (E) 8
-

3. $\int_1^2 \frac{1}{x^2} dx =$
- (A) $-\frac{1}{2}$ (B) $\frac{7}{24}$ (C) $\frac{1}{2}$ (D) 1 (E) $2 \ln 2$
-

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4. If f is continuous for $a \leq x \leq b$ and differentiable for $a < x < b$, which of the following could be false?

(A) $f'(c) = \frac{f(b) - f(a)}{b - a}$ for some c such that $a < c < b$.

(B) $f'(c) = 0$ for some c such that $a < c < b$.

(C) f has a minimum value on $a \leq x \leq b$.

(D) f has a maximum value on $a \leq x \leq b$.

(E) $\int_a^b f(x) dx$ exists.

5. $\int_0^x \sin t dt =$

(A) $\sin x$

(B) $-\cos x$

(C) $\cos x$

(D) $\cos x - 1$

(E) $1 - \cos x$

6. If $x^2 + xy = 10$, then when $x = 2$, $\frac{dy}{dx} =$

(A) $-\frac{7}{2}$

(B) -2

(C) $\frac{2}{7}$

(D) $\frac{3}{2}$

(E) $\frac{7}{2}$

7. $\int_1^e \left(\frac{x^2 - 1}{x} \right) dx =$

(A) $e - \frac{1}{e}$

(B) $e^2 - e$

(C) $\frac{e^2}{2} - e + \frac{1}{2}$

(D) $e^2 - 2$

(E) $\frac{e^2}{2} - \frac{3}{2}$

8. Let f and g be differentiable functions with the following properties:

(i) $g(x) > 0$ for all x

(ii) $f(0) = 1$

If $h(x) = f(x)g(x)$ and $h'(x) = f(x)g'(x)$, then $f(x) =$

(A) $f'(x)$

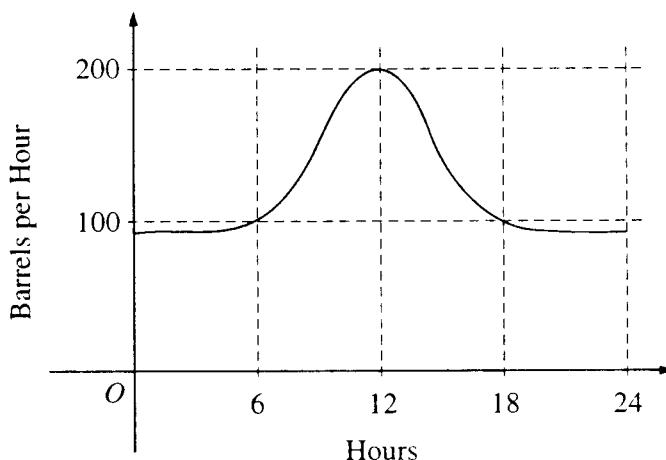
(B) $g(x)$

(C) e^x

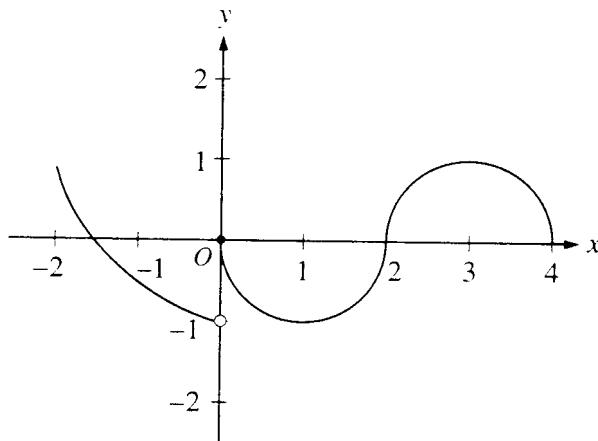
(D) 0

(E) 1

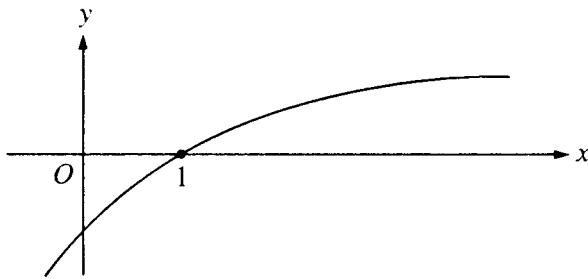
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9. The flow of oil, in barrels per hour, through a pipeline on July 9 is given by the graph shown above. Of the following, which best approximates the total number of barrels of oil that passed through the pipeline that day?
- (A) 500 (B) 600 (C) 2,400 (D) 3,000 (E) 4,800
-
10. What is the instantaneous rate of change at $x = 2$ of the function f given by $f(x) = \frac{x^2 - 2}{x - 1}$?
- (A) -2 (B) $\frac{1}{6}$ (C) $\frac{1}{2}$ (D) 2 (E) 6
-
11. If f is a linear function and $0 < a < b$, then $\int_a^b f''(x) dx =$
- (A) 0 (B) 1 (C) $\frac{ab}{2}$ (D) $b-a$ (E) $\frac{b^2 - a^2}{2}$
-
12. If $f(x) = \begin{cases} \ln x & \text{for } 0 < x \leq 2 \\ x^2 \ln 2 & \text{for } 2 < x \leq 4, \end{cases}$ then $\lim_{x \rightarrow 2} f(x)$ is
- (A) $\ln 2$ (B) $\ln 8$ (C) $\ln 16$ (D) 4 (E) nonexistent



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17. The graph of a twice-differentiable function f is shown in the figure above. 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) $f''(1) < f'(1) < f(1)$

18. An equation of the line tangent to the graph of $y = x + \cos x$ at the point $(0,1)$ is

- (A) $y = 2x + 1$ (B) $y = x + 1$ (C) $y = x$ (D) $y = x - 1$ (E) $y = 0$

19. If $f''(x) = x(x+1)(x-2)^2$, then the graph of f has inflection points when $x =$

- (A) -1 only (B) 2 only (C) -1 and 0 only (D) -1 and 2 only (E) -1, 0, and 2 only

20. What are all values of k for which $\int_{-3}^k x^2 dx = 0$?

- (A) -3 (B) 0 (C) 3 (D) -3 and 3 (E) -3, 0, and 3

21. If $\frac{dy}{dt} = ky$ and k is a nonzero constant, then y could be

- (A) $2e^{kt}$ (B) $2e^{kt}$ (C) $e^{kt} + 3$ (D) $kty + 5$ (E) $\frac{1}{2}ky^2 + \frac{1}{2}$