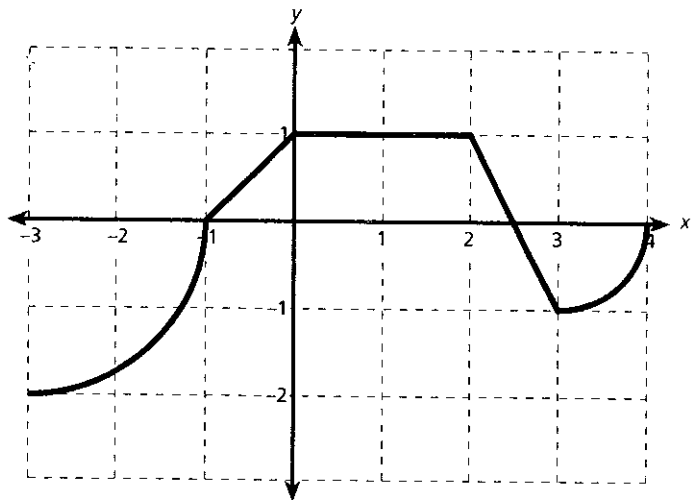


MULTIPLE-CHOICE QUESTIONS

A calculator may not be used for the following questions.

- $\int \sec^2 x - 2 dx =$
 (A) $\tan x + C$
 (B) $\tan x - 2x + C$
 (C) $\frac{\tan^3 x}{3} - x + C$
 (D) $\frac{\sec^3 x}{3} - 2x + C$
- Find $\int_0^2 3x^2 f(x^3) dx$ if $\int_0^8 f(t) dt = k$.
 (A) k^3
 (B) $9k$
 (C) $3k$
 (D) k
- If $F(x) = \int_0^{x^2} \sqrt{t+5}$, what is $F'(2)$?
 (A) $\sqrt{7}$
 (B) 3
 (C) 12
 (D) 18
- What is the average value of $f(x) = (\sin x)4^{\cos x}$ for the closed interval $0 \leq x \leq \frac{\pi}{2}$?
 (A) $\frac{3}{\ln 4}$
 (B) $\frac{6}{\pi \ln 4}$
 (C) $\frac{4}{\ln 4}$
 (D) $\frac{8}{\pi \ln 4}$
- The graph of $f(x)$ consists of line segments and quarter circles as shown in the graph to the right. What is the value of $\int_{-3}^4 f(x) dx$?
 (A) $\frac{10 - 5\pi}{4}$
 (B) $\frac{10 + 5\pi}{4}$
 (C) $\frac{12 + 5\pi}{4}$
 (D) $\frac{12 - 5\pi}{4}$



A calculator may be used for the following questions.

6. Let R be the region between the function $f(x) = x^3 + 6x^2 + 10x + 4$, the x -axis, and the lines $x = 0$ and $x = 4$. Using the Trapezoidal Sum, compute the area when there are four equal subdivisions.

- (A) 196
 (B) 288
 (C) 296
 (D) 396

7. What is $f(x)$ if $f'(x) = \frac{x}{x^2 - 1}$ and $f(2) = 0$?

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

8. What is the average value of $f(x) = 2 \ln x$? on the closed interval $1 \leq x \leq 3$

- (A) 2.592
 (B) 2.000
 (C) 1.296
 (D) 1.952

9. Evaluate: $\int_{-1}^0 \frac{x^2}{\sqrt[3]{2x^3 + 1}} dx$.

- (A) $\frac{4}{15}$
 (B) $\frac{5}{12}$
 (C) 0
 (D) The function is not integrable on the interval $-1 \leq x \leq 0$.

10. If $\int_1^3 f(x) dx = k$ and $\int_1^7 f(x) dx = -4$, what is the value of

$$\int_7^3 x + f(x) dx ?$$

- (A) $k - 4$
 (B) $16 - k$
 (C) $-16 - k$
 (D) $-16 + k$

x	-4	-3	-2	-1	0	1	2	3	4
$f(x)$	0.48	1.25	1.07	0.53	0.27	1.04	3.56	2.18	2

11. Selected values for the continuous function $f(x)$ are given in the table above. Using three left-hand rectangles of equal width, an approximation for $\int_{-3}^3 f(x) dx$ is

- (A) 9.90
 (B) 7.72
 (C) 5.64
 (D) 4.90

12. Initially a water tank contains 100 ft^3 . Water begins to drain from the tank at the rate of $\frac{30e^{\frac{t}{3}}}{1+e^{\frac{t}{3}}}$ cubic feet per hour. How many cubic feet of water will remain in the tank after 3 hours?
- (A) 39.768
 (B) 44.190
 (C) 55.810
 (D) 60.232

A calculator may not be used on the following questions.

13. If $R(x)$ is an even function and $S(x)$ is an odd function where

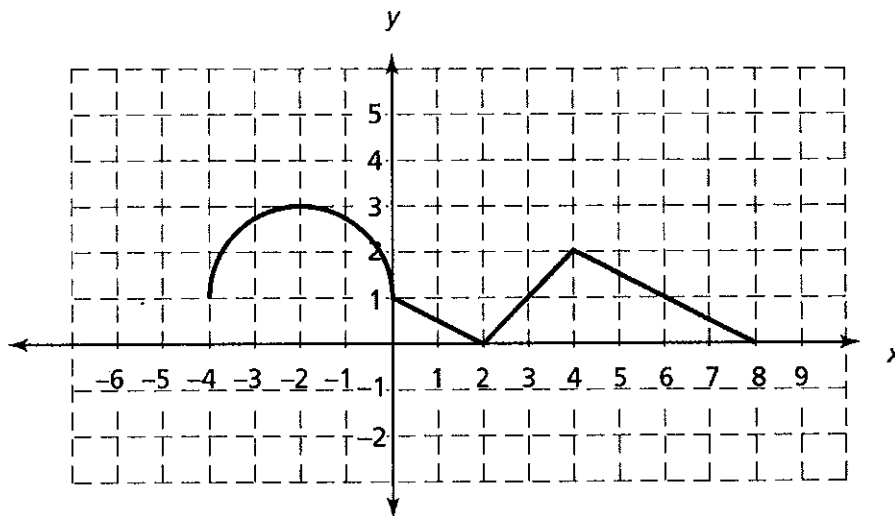
$$\int_{-a}^0 R(x) dx = 5 \text{ and } \int_0^a S(x) dx = -3, \text{ find the value of}$$

$$\int_{-a}^a [2(S(x)) - R(x) + 3] dx.$$

- (A) $-10 + 3a$
 (B) $-10 + 6a$
 (C) $10 + 6a$
 (D) $-6 + 6a$

14. $\int \frac{9x}{\sqrt{1-81x^4}} dx =$

- (A) $(1-9x^2)^{\frac{1}{2}} + C$
 (B) $\frac{1}{2}(1-9x^2)^{\frac{3}{2}} + C$
 (C) $\sin^{-1}(9x^2) + C$
 (D) $\frac{1}{2}\sin^{-1}(9x^2) + C$



15. The graph of $f(x)$ shown above consists of three line segments and one semicircle. Let $g(x) = \int_{-2}^x f(t) dt$. Which of the following statements must be false?

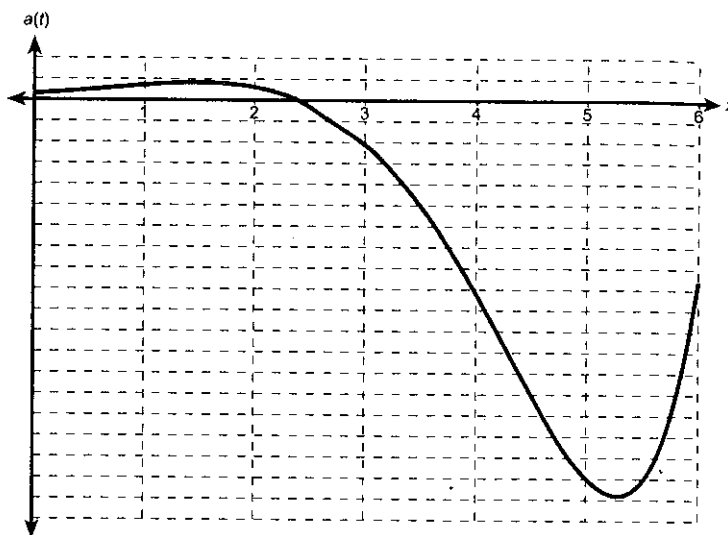
- (A) $g(4) = \int_{-2}^4 f(t) dt = \pi + 5$
 (B) $g(-4) = \int_{-2}^{-4} f(t) dt = -\pi - 2$
 (C) $g'(6) = 1$
 (D) $g(x)$ has a relative maximum at $x = 4$.

FREE-RESPONSE QUESTION

This question requires the use of a calculator.

1. The acceleration of a particle is given as $a(t) = 3e^x - x^4$ cm/sec² on the closed interval $[0, 3]$ as illustrated on the graph shown.

- Find the velocity of the particle at any time t if $v(0) = 6$ cm/sec.
- Find the position of the particle at any time t if $x(0) = -5$ cm.
- At $t = 6.5$, is the speed of the particle increasing or decreasing? Explain your reasoning.
- On the closed interval $[0, 3]$, what is the velocity of the particle when its acceleration is at a maximum? Explain your reasoning.



MULTIPLE-CHOICE QUESTIONS

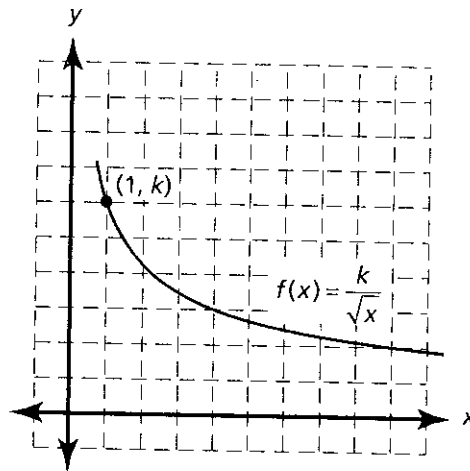
A calculator may not be used for the following questions.

1. $\int 9x \cos(3x+1) dx =$
 (A) $9x \cos(3x+1) + \sin(3x+1) + C$
 (B) $3x \sin(3x+1) - \cos(3x+1) + C$
 (C) $3 \sin(3x+1) - \frac{1}{3} \cos(3x+1) + C$
 (D) $3x \sin(3x+1) + \cos(3x+1) + C$

x	$g(x)$	$g'(x)$	$g''(x)$
0	2	-3	5
1	3	8	-2

3. Let g be a twice-differentiable function with the selected values of g and its derivatives shown in the table above. What is the value of $\int_0^1 2xg''(x) dx$?
 (A) 10
 (B) 12
 (C) 8
 (D) -4

4. Let $f(x) = \frac{k}{\sqrt{x}}$, where $x > 0$ and k is some finite positive constant, as pictured at the right. Let $L = \int_0^1 f(x) dx$ and $M = \int_1^{\infty} f(x) dx$. Which one of the following statements is true?
 (A) $L < M$
 (B) $L = M$
 (C) $L > M$
 (D) No conclusion can be made about the relative values of L and M .



6. $\int \frac{4 dx}{(x-3)(x+1)} =$
 (A) $\ln|x-3| + \ln|x+1| + C$
 (B) $\ln\left|\frac{x-3}{x+1}\right| + C$
 (C) $4 \ln|(x-3)(x+1)| + C$
 (D) $4 \ln\left|\frac{x-3}{x+1}\right| + C$
8. Let $f(x)$ be a differentiable function with the properties that $f(1) = 5$ and $\lim_{x \rightarrow \infty} f(x) = -8$. $\int_1^{\infty} f'(x) dx =$
 (A) -13
 (B) -8
 (C) 5
 (D) ∞

10. $\int \frac{2}{x^2 + 4x + 3} dx =$

- (A) $\ln|x+1| + \ln|x+3| + C$
- (B) $(\ln|x+1|)(\ln|x+3|) + C$
- (C) $\ln\left|\frac{x+1}{x+3}\right| + C$
- (D) $\frac{\ln|x+1|}{\ln|x+3|} + C$

12. $\int 2x^2 e^{3x} dx =$

- (A) $\frac{2}{3}x^2 e^{3x} - \frac{4}{9}x e^{3x} + \frac{4}{27}e^{3x} + C$
- (B) $2x^2 e^{3x} + 4x e^{3x} + C$
- (C) $6x^2 e^{3x} - 36x e^{3x} + 108e^{3x} + C$
- (D) $\frac{2}{3}x^2 e^{3x} - \frac{4}{3}x e^{3x} + \frac{4}{3}e^{3x} + C$

13. $f(x)$ is a twice differentiable function on $x \in [2, 6]$ with selected values given in the table below.

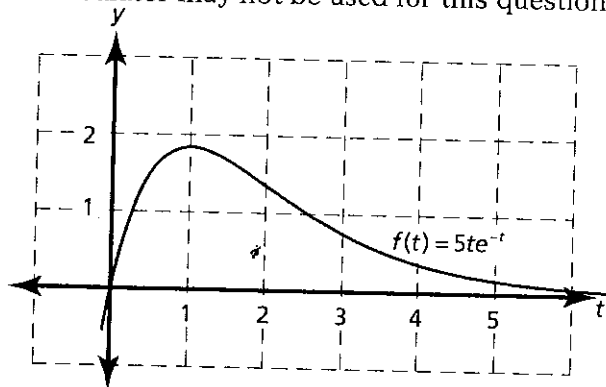
x	$f(x)$	$f'(x)$	$f''(x)$
2	8	1	-1
6	3	2	3

$\int_2^6 x \cdot f''(x) dx =$

- (A) 15
- (B) 20
- (C) 26
- (D) 34

FREE-RESPONSE QUESTION

A calculator may not be used for this question.



Let $F(x) = \int_0^x 5te^{-t} dt$ for $t \geq 0$ and $x \geq 0$.

- (a) Find an expression for $F'(x)$ in terms of x only.
- (b) Is the graph of $F(x)$ concave up or concave down at $x = 2$? Explain your answer.
- (c) Find an expression for $F(x)$, in terms of x only, that does not involve an integral.
- (d) Using your answer to c, find $\lim_{x \rightarrow \infty} F(x)$. Justify your answer.
- (e) Using your answer to d, explain what is meant by the expression $\lim_{x \rightarrow \infty} F(x)$.