1. Find the $x$-value that maximizes the area of the shaded rectangle inscribed in a right triangle below.

![Diagram of a right triangle with a shaded rectangle inscribed](image)

(1, y) 
\[ y = -\frac{1}{3}x + 4 \]

| a. $x = 6$ | b. $x = 4$ | c. $x = 2$ | d. $x = 5$ | e. $x = 3$ |

2. Consider the area of the region between the curve $f(x) = \sqrt{x - 1}$ and the $x$-axis on the interval $[1, 7]$. Find the right-endpoint approximation, $R_3$, to estimate the area of the region.

![Graph of $f(x) = \sqrt{x - 1}$](image)

| a. $\sqrt{3} + \sqrt{5} + \sqrt{7}$ | b. $2\sqrt{3} + 2\sqrt{5} + 2\sqrt{7}$ | c. $\sqrt{2} + 2$ |
| d. $\sqrt{2} + 2 + \sqrt{6}$ | e. $2\sqrt{2} + 4 + 2\sqrt{6}$ |

3. A particle moving along a line has acceleration function $a(t) = 6t - 2$ ft/sec$^2$. The initial velocity is 2 ft/sec and the initial displacement is 4 ft. Find its position after $t = 2$ seconds.

| a. 12 ft | b. 16 ft | c. 23 ft | d. 48 ft | e. 9 ft |
4. Find the general antiderivative of $e^{2x} + \frac{1}{x}$.

a. $2e^{2x} - \frac{1}{x^2} + C$  

b. $2e^{2x} + \frac{1}{x^2} + C$  

c. $\frac{1}{2}e^{2x} - \frac{1}{x^2} + C$

d. $\frac{1}{2}e^{2x} + \ln |x| + C$  

e. $2e^{2x} + \ln |x| + C$

5. Consider the area of the region between the curve $f(x) = \sqrt{x - 1}$ and the $x$-axis on the interval $[1, 10]$. Find the right-endpoint approximation, $R_3$, to estimate the area of the region.

![Graph of $f(x) = \sqrt{x - 1}$]

a. $3\sqrt{3} + 3\sqrt{6} + 9$  

b. $\sqrt{3} + \sqrt{6} + 3$  

c. $\sqrt{3} + \sqrt{6}$

d. $6 + 3\sqrt{7} + 3\sqrt{10}$  

e. $2 + \sqrt{7} + \sqrt{10}$

6. A particle moving along a line has acceleration function $a(t) = 6t + 2$ ft/sec$^2$. The initial velocity is 3 ft/sec and the initial displacement is 5 ft. Find its position after $t = 2$ seconds.

a. 12 ft  

b. 16 ft  

c. 23 ft  

d. 48 ft  

e. 9 ft
7. Find the $x$-value that maximizes the area of the shaded rectangle inscribed in a right triangle below.

![Diagram of a right triangle with a shaded rectangle](image)

$y = -\frac{1}{4}x + 2$

a. $x = 1$  
 b. $x = 2$  
 c. $x = 3$  
 d. $x = 4$  
 e. $x = 5$

8. Find the general antiderivative of $\frac{1}{x} + e^{3x}$.

a. $\frac{1}{x^2} + 3e^{3x} + C$  
 b. $\frac{1}{x^2} + 3e^{3x} + C$  
 c. $-\frac{1}{x^2} + \frac{1}{3}e^{3x} + C$

d. $\ln |x| + 3e^{3x} + C$  
 e. $\ln |x| + \frac{1}{3}e^{3x} + C$

9. Find the $x$-value that maximizes the area of the shaded rectangle that has its base on the positive $x$-axis and a vertex lying on the parabola as below.

![Diagram of a parabola with a shaded rectangle](image)

$y = 6 - x^2$

a. $x = 2$  
 b. $x = 4$  
 c. $x = \sqrt{2}$  
 d. $x = \sqrt{3}$  
 e. $x = 3$
10. If the slope of the tangent line to \( y = f(x) \) at any point is \( \sec^2 x \sqrt{\tan x} \) and the point \( \left( \frac{\pi}{4}, 1 \right) \) is on the curve, find \( f(0) \).

a. \(-\frac{1}{2}\)  

b. \(\frac{3}{2}\)  

c. 0  

d. \(\frac{1}{3}\)  

e. \(\frac{2}{3}\)

11. Find the absolute extreme values of \( f(x) = \sqrt{x^2 + 2} \) on \([-1, 2]\) first and then find the lower and upper bounds of the integral

\[ \int_{-1}^{2} \sqrt{x^2 + 2} \, dx \]

using the comparison property for integrals.

a. \(\sqrt{2} \leq \int_{-1}^{2} \sqrt{x^2 + 2} \, dx \leq \sqrt{6}\)  

b. \(0 \leq \int_{-1}^{2} \sqrt{x^2 + 2} \, dx \leq 3\sqrt{3}\)  

c. \(3\sqrt{2} \leq \int_{-1}^{2} \sqrt{x^2 + 2} \, dx \leq 3\sqrt{6}\)  

d. \(3\sqrt{3} \leq \int_{-1}^{2} \sqrt{x^2 + 2} \, dx \leq 3\sqrt{6}\)  

e. \(\sqrt{2} \leq \int_{-1}^{2} \sqrt{x^2 + 2} \, dx \leq \sqrt{3}\)

12. The population of Gainesville is changing at the rate of \( \frac{1000}{(2t + 1)^2} \) people per year, where \( t \) is the number of years since the year 2000. Find the net change of population in Gainesville from 2000 to 2002.

a. 400 more people  

b. 800 more people  

c. 1600 more people  

d. 400 fewer people  

e. 800 fewer people
13. Find \( \frac{d}{dx} \left( \int_0^{\sqrt{x}} \sec(1 + t^2) \, dt \right) \).

a. \( \frac{\sec(1 + x) \tan(1 + x)}{2\sqrt{x}} \)  
b. \( \frac{\sec(1 + x)}{2\sqrt{x}} \)  
c. \( \sec(1 + x) \tan(1 + x) \)  
d. \( \sec(1 + x^2) \)  
e. \( \frac{\sec(1 + x)}{\sqrt{x}} \)

14. Evaluate the integral: \( \int_1^3 \frac{\cos(\pi/x)}{x^2} \, dx \)

a. \( -\frac{1}{2\pi} \)  
b. \( -\frac{\sqrt{3}}{2\pi} \)  
c. \( -\frac{\sqrt{3}}{\pi} \)  
d. \( \frac{\sqrt{3}}{2\pi} \)  
e. \( \frac{\sqrt{3}}{\pi} \)

15. The integral \( \int_0^1 x(2x^2 + 1)^{1/3} \, dx \) can be converted to which of the following using substitution.

a. \( \int_0^1 u^{1/3} \, du \)  
b. \( \int_1^3 \frac{1}{4} u^{1/3} \, du \)  
c. \( \int_0^1 \frac{1}{4} u^{1/3} \, du \)  
d. \( \int_1^3 4u^{1/3} \, du \)  
e. \( \int_0^1 4u^{1/3} \, du \)
16. If $f$ is a continuous even function on $(-\infty, \infty)$ with

$$\int_{-3}^{3} f(x) \, dx = 4 \quad \text{and} \quad \int_{-4}^{4} f(x) \, dx = 3,$$

find $\int_{0}^{4} f(x) \, dx$. 

a. 1  b. 2  c. 0  d. $-2$  e. $-1$

17. Find the $x$-value that maximizes the area of the shaded rectangle that has its base on the positive $x$-axis and a vertex lying on the parabola as below.

\[
\begin{align*}
y &= 9 - x^2 \\
\end{align*}
\]

a. $x = 2$  b. $x = \sqrt{3}$  c. $x = \sqrt{2}$  d. $x = 4$  e. $x = 3$
18. Find the absolute extreme values of \( f(x) = \sqrt{x^2 + 4} \) on \([-2, 1]\) first and then find the lower and upper bounds of the integral

\[
\int_{-2}^{1} \sqrt{x^2 + 4} \, dx
\]

using the comparison property for integrals.

a. \(2 \leq \int_{-2}^{1} \sqrt{x^2 + 4} \, dx \leq 2\sqrt{2}\)  

b. \(0 \leq \int_{-2}^{1} \sqrt{x^2 + 4} \, dx \leq \sqrt{5}\)

c. \(\sqrt{5} \leq \int_{-2}^{1} \sqrt{x^2 + 4} \, dx \leq 2\sqrt{2}\)  

d. \(6 \leq \int_{-2}^{1} \sqrt{x^2 + 4} \, dx \leq 3\sqrt{5}\)

e. \(6 \leq \int_{-2}^{1} \sqrt{x^2 + 4} \, dx \leq 6\sqrt{2}\)

19. Find \( \frac{d}{dx} \left( \int_{0}^{\sqrt{x}} \tan(1 + t^2) \, dt \right) \).

a. \(\frac{\sec^2(1 + x)}{2\sqrt{x}}\)  

b. \(\tan(1 + x)\)  

c. \(\tan(1 + x^2)\)

d. \(\frac{\tan(1 + x)}{2\sqrt{x}}\)  

e. \(\frac{\tan(1 + x)}{\sqrt{x}}\)

20. Evaluate the integral: \( \int_{2}^{3} \frac{\sin(\pi/x)}{x^2} \, dx \)

a. \(-\frac{1}{\pi}\)  

b. \(\frac{1}{\pi}\)  

c. \(\frac{1}{2\pi}\)  

d. \(-\frac{\sqrt{3}}{2\pi}\)  

e. \(-\frac{\sqrt{3}}{\pi}\)
21. The population of Gainesville is changing at the rate of \( \frac{1000}{(3t + 1)^2} \) people per year, where \( t \) is the number of years since the year 2000. Find the net change of population in Gainesville from 2000 to 2003.

a. 300 fewer people  
   b. 900 fewer people  
   c. 600 fewer people  
   d. 300 more people  
   e. 900 more people

22. If the slope of the tangent line to \( y = f(x) \) at any point is \( \frac{1}{2} \sec^2 x \sqrt{\tan x} \) and the point \( \left( \frac{\pi}{4}, -1 \right) \) is on the curve, find \( f(0) \).

a. \(-\frac{4}{3}\)  
   b. \(\frac{3}{4}\)  
   c. \(-\frac{7}{4}\)  
   d. \(\frac{1}{3}\)  
   e. 0
23. If $f$ is a continuous odd function on $(-\infty, \infty)$ with
\[ \int_{-3}^{0} f(x) \, dx = -5 \quad \text{and} \quad \int_{4}^{3} f(x) \, dx = 1, \]
find $\int_{0}^{4} f(x) \, dx$.

a. 1  b. 2  c. 3  d. 4  e. 0

24. The integral $\int_{0}^{1} x(3x^2 + 1)^{1/5} \, dx$ can be converted to which of the following using substitution.

a. $\int_{1}^{4} \frac{1}{6} u^{1/5} \, du$  
   b. $\int_{1}^{4} 6u^{1/5} \, du$  
   c. $\int_{0}^{1} \frac{1}{6} u^{1/5} \, du$

d. $\int_{0}^{1} u^{1/5} \, du$  
   e. $\int_{0}^{1} 6u^{1/5} \, du$
1a. A cylindrical tube is to be constructed of heavy cardboard with two plastic ends having a volume of $48\pi$ cubic feet. What radius and height will minimize the cost of the tube if cardboard is $2$ per square foot and plastic is $6$ per square foot?

Primary function: ________________________________

Constraint: ________________________________

$r = \underline{\hspace{2cm}}$ ft

$h = \underline{\hspace{2cm}}$ ft

Use either the First Derivative Test or the Second Derivative Test to confirm your result.
1b. A cylindrical tube with open top is to be constructed of heavy cardboard with plastic bottom having a volume of \(128\pi\) cubic feet. What radius and height will minimize the cost of the tube if cardboard is $2 per square foot and plastic is $4 per square foot?

Primary function: 

Constraint: 

\[ r = \underline{\hspace{2cm}} \text{ ft} \]

\[ h = \underline{\hspace{2cm}} \text{ ft} \]

Use either the First Derivative Test or the Second Derivative Test to confirm your result.
2a. Consider the area of the region between the curve $f(x) = x^2 + 2$ and the $x$-axis on the interval $[0, 2]$.
Find the Riemann sum $R_n$ (right endpoint approximation with $n$ subintervals of equal width).

\[ \Delta x = \ldots \; ; \; x_i = \ldots \; ; \; R_n = \sum_{i=1}^{n} \ldots \]

2b. Consider the area of the region between the curve $f(x) = x^2 + 1$ and the $x$-axis on the interval $[0, 3]$.
Find the Riemann sum $R_n$ (right endpoint approximation with $n$ subintervals of equal width).

\[ \Delta x = \ldots \; ; \; x_i = \ldots \; ; \; R_n = \sum_{i=1}^{n} \ldots \]