1. Find \( \lim_{x \to \pi} \frac{x}{\cos(x)} \).

A) 0  B) 1  C) \( \frac{1}{2} \)  D) \( \pi \)  E) \(-1\)  F) \(1/3\)  G) \(-\pi\)  H) \(-\frac{1}{2}\)  I) \(\infty\)  J) \(-\infty\)

2. At time \( t=0 \) (in seconds) a particle moves along a straight line. If the formula for its position is given by \( s = 16t^2 - 32t \) meters. What is its velocity after 3 seconds?

A) 16 m/s  B) 24 m/s  C) 32 m/s  D) 40 m/s  E) 48 m/s  F) 56 m/s  G) 64 m/s  H) 72 m/s  I) 80 m/s  J) 88 m/s
3. Find \( \lim_{x \to 0} \frac{\tan^{-1}(4x)}{\sin(3x)} \).

\( A) 0 \quad B) 1 \quad C) \frac{1}{2} \quad D) \frac{1}{3} \quad E) \frac{2}{3} \quad F) \frac{2}{3} \quad G) 2 \quad H) \frac{4}{3} \quad I) \infty \quad J) -\infty \)

4. Find the absolute maximum for the function \( f(x) = x^3 - 3x + 1 \) on the interval \([0, 3]\).

\( A) 11 \quad B) 13 \quad C) 15 \quad D) 17 \quad E) 19 \quad F) 21 \quad G) 23 \quad H) 25 \quad I) 29 \quad J) 27 \)
5. Suppose \( y = (3 + \cos(x))^2 \). Find the value of \( \frac{dy}{dx} \) at \( x = \frac{\pi}{2} \).

A) 0  B) 2  C) -2  D) 4  E) -4  F) 6  G) -6  H) 8  I) -8  J) 10

6. On what intervals is the function \( f(t) = t^3 - 27t + 12 \) decreasing?

A) \( t < 0 \)  B) \( -1 < t < 1 \)  C) \( t > 2 \)  D) \( -2 < t < 2 \)  E) \( t > 3 \)
F) \( t > 1 \)  G) \( -3 < t < 3 \)  H) \( t > 4 \)  I) \( -4 < t < 4 \)  J) \( t < -4 \)
7. If 2700 cm$^2$ of material is available to make a box with a square base and an open top, find the length of the base which gives the largest possible volume of the box.

A) 20 cm
B) 25 cm
C) 30 cm
D) 35 cm
E) 40 cm
F) 45 cm
G) 50 cm
H) 55 cm
I) 60 cm
J) 65 cm
8. What is the slope of the tangent line to the curve \( x^3y^3 + x = 2 \) at the point \( (1, 1) \).

A) 1  
B) \(-1\)  
C) \(\frac{2}{3}\)  
D) \(-\frac{2}{3}\)  
E) \(\frac{1}{4}\)  
F) \(-\frac{1}{4}\)  
G) \(\frac{3}{4}\)  
H) \(-\frac{3}{4}\)  
I) \(\frac{4}{3}\)  
J) \(-\frac{4}{3}\)
9. List all the critical numbers of the function $y = \sqrt[3]{x^3 - 3x}$.

A) $x = 0, 1$
B) $x = -1, 1$
C) $x = -1, 0, 1$
D) $x = 0, 1, 2$
E) $x = -\sqrt{2}, -1, 0, 1, \sqrt{2}$
F) $x = -\sqrt{2}, -1, 1, \sqrt{2}$
G) $x = -3, -1, 0, 1, 3$
H) $x = -\sqrt{3}, -1, 1, \sqrt{3}$
I) $x = -\sqrt{3}, 0, \sqrt{3}$
J) $x = -\sqrt{3}, -1, 0, 1, \sqrt{3}$
10. Use logarithmic differentiation to calculate $f'(2)$ for $y = f(x) = x^{1/x}$.

A) $\frac{\sqrt{2}}{4} (1 - \ln(2))$

B) $\frac{\sqrt{2}}{2} (2 - \ln(2))$

C) $\frac{\sqrt{2}}{\ln(2)} (\ln(2) - 2)$

D) $\frac{\ln(2)}{\sqrt{2}} (\ln(2) - 2)$

E) $\frac{3}{\sqrt{2}} (1 + \ln(2))$

F) $2\sqrt{2} (1 - \ln(2))$

G) $3\sqrt{2} (\ln(2) - 1)$

H) $4\sqrt{2} (2 - \ln(2))$

I) $\frac{3\sqrt{2}}{3} (1 + \ln(2))$

J) $\frac{4\sqrt{2}}{3} (\ln(2) - 1)$
11. If \( f(x) = \frac{e^x}{1 + x^2} \), find an equation for the tangent line at \( x = 0 \).

A) \( y = x \)
B) \( y = x + 1 \)
C) \( y = 2x + e \)
D) \( y = e x + 1 \)
E) \( y = \frac{1}{2} x + e \)
F) \( y = \frac{1}{2} x - e \)
G) \( y = 2x - 1 \)
H) \( y = \frac{1}{2} x + 1 \)
I) \( y = e x - e \)
J) \( y = 2x + 1 \)
12. Find the slope of the tangent line to the curve \( y = 10^{1-x^2} \) at \( x = 1 \).

A) \( \ln(10) \)
B) 2 \( \ln(10) \)
C) 3 \( \ln(10) \)
D) - \( \ln(10) \)
E) - 2 \( \ln(10) \)
F) 1/\( \ln(10) \)
G) 2/\( \ln(10) \)
H) 3/ \( \ln(10) \)
I) -2/ \( \ln(10) \)
J) -3/ \( \ln(10) \)
13. Approximate \( \int_{0}^{6} \frac{1}{x+1} \, dx \), by using the Riemann Sum with \( n = 3 \) and sample points being the midpoints.

\[ A) \frac{13}{7} \quad B) \frac{15}{8} \quad C) \frac{11}{6} \quad D) \frac{9}{7} \quad E) \frac{13}{5} \quad F) \frac{12}{7} \quad G) \frac{15}{9} \quad H) \frac{12}{9} \quad I) \frac{11}{9} \quad J) \frac{12}{5} \]
14. Suppose we take the interval \([1, 3]\) and partition it into \(n\) equal subintervals. Then we choose sample points, \(x_i^*\), in each of the intervals. If \(\Delta x\) represents the width of each interval then calculate the exact value of

\[
\lim_{n \to \infty} \sum_{i=1}^{n} \frac{3}{2} (x_i^*)^2 \Delta x,
\]

by viewing it as a definite integral.

\[\begin{align*}
A) 9 \frac{1}{2} & \quad B) 10 & \quad C) 10 \frac{1}{2} & \quad D) 11 & \quad E) 11 \frac{1}{2} & \quad F) 12 & \quad G) 12 \frac{1}{2} & \quad H) 13 & \quad I) 13 \frac{1}{2} & \quad J) 14
\end{align*}\]
15. The graph of $f(x)$ is shown below. Using the interpretation of the definite integral in terms of area, evaluate \[ \int_{0}^{7} f(x) \, dx. \]

A) 0  
B) $\frac{1}{2}$  
C) 1  
D) $1 \frac{1}{2}$  
E) 2  
F) $2 \frac{1}{2}$  
G) 3  
H) $3 \frac{1}{2}$  
I) 4  
J) $4 \frac{1}{2}$
16. Evaluate \( \int_1^4 \frac{2t^2 + 3t^2 \sqrt{t} - 4}{t^2} \, dt \).

A) 1 B) 3 C) 5 D) 7 E) 9 F) 11 G) 13 H) 15 I) 17 J) 19
17. If \( h(x) = \int_{1/x}^{1} \sqrt{1 + t^3} \, dt \), then evaluate \( h'(1/2) \), by using part 1 of the Fundamental Theorem of Calculus.

\[
A) \frac{4}{\sqrt{3}} \\
B) -5 \\
C) \frac{6}{\sqrt{3}} \\
D) -7 \\
E) \frac{7}{\sqrt{2}} \\
F) -8 \\
G) \frac{9}{\sqrt{2}} \\
H) -10 \\
I) \frac{11}{\sqrt{2}} \\
J) -12
\]
18. A particle moves along a straight line and its velocity at time \( t \) is given by \( v(t) = t^2 - t - 2 \) \( \text{m/s} \). Find the displacement, in meters, of the particle in the time period \( 0 \leq t \leq 3 \) seconds.

A) 1/2  
B) 3/2  
C) 1/6  
D) 7/6  
E) 13/6  
F) - 1/2  
G) - 3/2  
H) - 1/6  
I) - 7/6  
J) - 13/6

19. Find the total distance traveled, in meters, by the particle in problem 18, above, over the same time period.

A) 1/2  
B) 3/2  
C) 5/2  
D) 5/6  
E) 11/6  
F) 31/6  
G) 17/6  
H) 11/3  
I) 13/3  
J) 17/3
20. Evaluate \( \int_{e^4}^e \frac{dx}{x \sqrt{\ln(x)}} \).

A) 1  
B) \(-1\)  
C) 1 + \(\frac{1}{c}\)  
D) 2  
E) \(-2\)  
F) \(e\)  
G) \(\frac{1}{e}\)  
H) \(2e\)  
I) \(\frac{1}{2}\)  
J) \(\frac{1}{2e}\)