Check that this exam has 15 questions.

Important Instructions:

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7. When bubbling, make sure that the bubbled space is fully covered.

8. When erasing a bubble, make sure that you do not leave any trace of penciling.
1. The linearization $L$ of the function $f(x) = \sqrt{6x + 3}$ at $a = 1$ is given by

(a) $L(x) = \frac{7}{2} - x$

(b) $L(x) = 3 + x$

(c) $L(x) = \frac{5}{2} + \frac{1}{2}x$

(d) $L(x) = \frac{3}{2} + \frac{3}{2}x$

(e) $L(x) = 2 + x$

2. $\lim_{x \to 0} \frac{\cos(9x) - 1}{x^2} =$

(a) 0

(b) $\frac{81}{2}$

(c) $-\frac{81}{2}$

(d) 1

(e) $\frac{9}{2}$
3. Consider the function \( f(x) = x^2 + 2x + 1 \) on the interval \([1, 2]\). If ‘c’ is the number satisfying the conclusion of the Mean Value Theorem, then \( 4c + 2 = \)

(a) 8
(b) 1
(c) 10
(d) −1
(e) 9

4. \( \lim_{x \to \infty} \left( \sqrt{x^2 + 6x} - x \right) = \)

(a) \( \infty \)
(b) 3
(c) 6
(d) 0
(e) −3
5. A street light is mounted at the top of a 15-ft-tall pole. A man 6 ft tall walks away from the pole with a speed of 5 ft/s along a straight path. If he is 40 ft from the pole, then the tip of his shadow is moving at the rate of

(a) $\frac{5}{3}$ ft/s
(b) $8\frac{1}{3}$ ft/s
(c) $48\frac{1}{3}$ ft/s
(d) $333\frac{1}{3}$ ft/s
(e) 9 ft/s

6. The radius of a circular disc is given as 24 cm with a maximum error in measurement of 0.2 cm. Using differentials the percentage error in the measurement of area of the disc will be

(a) $0.4\pi$ %
(b) $9.4\pi$ %
(c) $1\frac{2}{3}$ %
(d) $\frac{1}{16}$ %
(e) $2\frac{1}{3}$ %
7. The absolute maximum of \( f(x) = \sqrt[3]{x}(8 - x) \) on \([0, 8]\) is

(a) \( 6\sqrt{2} \)
(b) \( 5\sqrt{3} \)
(c) \( 4\sqrt{4} \)
(d) 7
(e) 0

8. Square corners are cut out from a thin piece of cardboard of size 3 ft by 3ft, so that the sides can be folded up to make a box with open top. The largest volume that such a box can have is given by

(a) \( V = 4 \text{ ft}^3 \)
(b) \( V = 2 \text{ ft}^3 \)
(c) \( V = 3 \text{ ft}^3 \)
(d) \( V = 1 \text{ ft}^3 \)
(e) \( V = 5 \text{ ft}^3 \)
9. \[ \lim_{x \to 0^+} (1 + \sin(4x))^{\cot x} = \]

(a) \( e^{-1} \)

(b) \( e^4 \)

(c) \( e^{-2} \)

(d) \( e^{-4} \)

(e) \( e \)

10. The first derivative test tells that the function \( f(x) = \sqrt[3]{x^2 - x} \) has

(a) no local minimum and one local maximum

(b) one local minimum and no local maximum

(c) two local minima and one local maximum

(d) one local minimum and two local maxima

(e) neither local minimum nor local maximum
11. The sum of all critical points of the function

\[ f(x) = \cos^2 x - 2 \sin x \]

over the interval \( 0 \leq x < 2\pi \) is

(a) \( 2\pi \)
(b) \( \frac{5\pi}{2} \)
(c) \( \frac{\pi}{2} \)
(d) \( \frac{3\pi}{2} \)
(e) \( \pi \)

12. A particle moves along the curve \( y = \sqrt{1 + x^3} \). As it reaches the point \( (2, 3) \), the y-coordinate is increasing at a rate of 4 cm/s. How fast is the x-coordinate of the point changing at that instant?

(a) \( \frac{1}{4} \) cm/s
(b) 6 cm/s
(c) \( \frac{2}{3} \) cm/s
(d) \( \frac{1}{3} \) cm/s
(e) 2 cm/s
13. The derivative of \( f(x) \) is given by \( f'(x) = (1 - x)(7 - x) \). The intervals on which \( f(x) \) is increasing or decreasing are

(a) decreasing on \((1, 7)\) and increasing on \((-\infty, 1) \cup (7, \infty)\)

(b) decreasing on \((7, \infty)\) and increasing on \((-\infty, 1)\)

(c) decreasing on \((-\infty, 1) \cup (7, \infty)\) and increasing on \((1, 7)\)

(d) decreasing on \((-\infty, 1)\) and increasing on \((7, \infty)\)

(e) decreasing on \((-\infty, -1) \cup (-7, \infty)\) and increasing on \((-1, -7)\)

14. The graph of the first derivative \( f' \) of a function \( f \) is shown below. Which of the following statements is WRONG about \( f \)?

(a) \( f \) is concave up on \((1, 3)\), and \((8, \infty)\)

(b) \( f \) is concave down on \((6, 7)\)

(c) \( x = 1, x = 8 \) are inflection points of \( f \)

(d) \( f \) has local extrema at \( x = 2 \) and \( x = 6 \)

(e) \( f \) is increasing on \((6, \infty)\) and decreasing on \((0, 2)\)
15. Using the derivative tests and equations of asymptotes, the graph of the curve $xy = x^2 + 4$

(a)

(b)

(c)

(d)

(e)
Name: 

ID: ________________ Sec: ________________.

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8. When erasing a bubble, make sure that you do not leave any trace of penciling.
1. \( \lim_{x \to \infty} (\sqrt{x^2 + 6x} - x) = \)

(a) 0
(b) 3
(c) −3
(d) 6
(e) \( \infty \)

2. Consider the function \( f(x) = x^2 + 2x + 1 \) on the interval \([1, 2]\). If ‘c’ is the number satisfying the conclusion of the Mean Value Theorem, then \( 4c + 2 = \)

(a) 1
(b) 9
(c) 8
(d) 10
(e) −1
3. The linearization $L$ of the function $f(x) = \sqrt{6x + 3}$ at $a = 1$ is given by

(a) $L(x) = 3 + x$

(b) $L(x) = \frac{7}{2} - x$

(c) $L(x) = \frac{3}{2} + \frac{3}{2}x$

(d) $L(x) = 2 + x$

(e) $L(x) = \frac{5}{2} + \frac{1}{2}x$

4. $\lim_{x \to 0} \frac{\cos(9x) - 1}{x^2} =$

(a) 0

(b) 1

(c) $\frac{9}{2}$

(d) $\frac{81}{2}$

(e) $-\frac{81}{2}$
5. The radius of a circular disc is given as 24 cm with a maximum error in measurement of 0.2 cm. Using differentials the percentage error in the measurement of area of the disc will be

(a) $9.4\pi\%$
(b) $2\frac{1}{3}\%$
(c) $\frac{1}{16}\%$
(d) $1\frac{2}{3}\%$
(e) $0.4\pi\%$

6. A street light is mounted at the top of a 15-ft-tall pole. A man 6 ft tall walks away from the pole with a speed of 5 ft/s along a straight path. If he is 40 ft from the pole, then the tip of his shadow is moving at the rate of

(a) $333\frac{1}{3}$ ft/s
(b) $8\frac{1}{3}$ ft/s
(c) $5\frac{2}{3}$ ft/s
(d) $48\frac{1}{3}$ ft/s
(e) 9 ft/s
7. The first derivative test tells that the function \( f(x) = \sqrt[3]{x^2 - x} \) has

(a) one local minimum and no local maximum
(b) neither local minimum nor local maximum
(c) no local minimum and one local maximum
(d) two local minima and one local maximum
(e) one local minimum and two local maxima

8. The sum of all critical points of the function
\[
f(x) = \cos^2 x - 2 \sin x
\]
over the interval \( 0 \leq x < 2\pi \) is

(a) \( \frac{\pi}{2} \)
(b) \( 2\pi \)
(c) \( \frac{5\pi}{2} \)
(d) \( \pi \)
(e) \( \frac{3\pi}{2} \)
9. The **derivative** of \( f(x) \) is given by \( f'(x) = (1 - x)(7 - x) \).
   The intervals on which \( f(x) \) is increasing or decreasing are

   (a) decreasing on \((1, 7)\) and increasing on \((-\infty, 1) \cup (7, \infty)\)

   (b) decreasing on \((-\infty, 1)\) and increasing on \((7, \infty)\)

   (c) decreasing on \((7, \infty)\) and increasing on \((-\infty, 1)\)

   (d) decreasing on \((-\infty, -1) \cup (-7, \infty)\) and increasing on \((-1, -7)\)

   (e) decreasing on \((-\infty, 1) \cup (7, \infty)\) and increasing on \((1, 7)\)

10. \[
    \lim_{x \to 0^+} (1 + \sin(4x))^{\cot x} =
    \]

    (a) \(e^{-2}\)

    (b) \(e\)

    (c) \(e^4\)

    (d) \(e^{-4}\)

    (e) \(e^{-1}\)
11. A particle moves along the curve \( y = \sqrt{1 + x^3} \). As it reaches the point \((2, 3)\), the \( y \)-coordinate is increasing at a rate of 4 cm/s. How fast is the \( x \)-coordinate of the point changing at that instant?

(a) 6 cm/s  
(b) \( \frac{1}{4} \) cm/s  
(c) \( \frac{1}{3} \) cm/s  
(d) \( \frac{2}{3} \) cm/s  
(e) 2 cm/s

12. Square corners are cut out from a thin piece of cardboard of size 3 ft by 3 ft, so that the sides can be folded up to make a box with open top. The largest volume that such a box can have is given by

(a) \( V = 3 \) ft\(^3\)  
(b) \( V = 1 \) ft\(^3\)  
(c) \( V = 4 \) ft\(^3\)  
(d) \( V = 2 \) ft\(^3\)  
(e) \( V = 5 \) ft\(^3\)
13. The absolute maximum of \( f(x) = \sqrt[3]{x}(8-x) \) on \([0, 8]\) is

(a) \( 6\sqrt{2} \)
(b) \( 5\sqrt{3} \)
(c) \( 7 \)
(d) \( 4\sqrt{4} \)
(e) \( 0 \)

14. The graph of the first derivative \( f' \) of a function \( f \) is shown below. Which of the following statements is \textbf{WRONG} about \( f \)?

(a) \( f \) has local extrema at \( x = 2 \) and \( x = 6 \)
(b) \( f \) is increasing on \((6, \infty)\) and decreasing on \((0, 2)\)
(c) \( f \) is concave down on \((6, 7)\)
(d) \( f \) is concave up on \((1, 3)\), and \((8, \infty)\)
(e) \( x = 1, x = 8 \) are inflection points of \( f \)
15. Using the derivative tests and equations of asymptotes, the graph of the curve \( xy = x^2 + 4 \)

(a)

(b)

(c)

(d)

(e)
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1. Consider the function \( f(x) = x^2 + 2x + 1 \) on the interval \([1, 2]\). If \( c \) is the number satisfying the conclusion of the Mean Value Theorem, then \( 4c + 2 = \)

(a) 8  
(b) 9  
(c) −1  
(d) 1  
(e) 10

2. The linearization \( L \) of the function \( f(x) = \sqrt{6x + 3} \) at \( a = 1 \) is given by

(a) \( L(x) = 2 + x \)  
(b) \( L(x) = \frac{3}{2} + \frac{3}{2}x \)  
(c) \( L(x) = 3 + x \)  
(d) \( L(x) = \frac{7}{2} - x \)  
(e) \( L(x) = \frac{5}{2} + \frac{1}{2}x \)
3. \( \lim_{x \to 0} \frac{\cos(9x) - 1}{x^2} = \)

(a) \( \frac{9}{2} \)

(b) \( \frac{81}{2} \)

(c) \( \frac{-81}{2} \)

(d) 0

(e) 1

4. \( \lim_{x \to \infty} (\sqrt{x^2 + 6x} - x) = \)

(a) \( \infty \)

(b) 6

(c) -3

(d) 3

(e) 0
5. The sum of all critical points of the function
   
   \[ f(x) = \cos^2 x - 2\sin x \]
   
   over the interval \( 0 \leq x < 2\pi \) is

   (a) \( 2\pi \)
   
   (b) \( \frac{\pi}{2} \)
   
   (c) \( \frac{3\pi}{2} \)
   
   (d) \( \frac{5\pi}{2} \)
   
   (e) \( \pi \)

6. The radius of a circular disc is given as 24 cm with a maximum error in measurement of 0.2 cm. Using differentials the percentage error in the measurement of area of the disc will be

   (a) \( 9.4\pi \% \)
   
   (b) \( 2\frac{1}{3} \% \)
   
   (c) \( \frac{1}{16} \% \)
   
   (d) \( 0.4\pi \% \)
   
   (e) \( 1\frac{2}{3} \% \)
7. The absolute maximum of \( f(x) = \sqrt[3]{x}(8 - x) \) on \([0, 8]\) is

(a) \(5\sqrt{3}\)

(b) \(4\sqrt{4}\)

(c) 7

(d) \(6\sqrt{2}\)

(e) 0

8. \( \lim_{x \to 0^+} (1 + \sin(4x))^{\cot x} = \)

(a) \(e^{-2}\)

(b) \(e^{-4}\)

(c) \(e^4\)

(d) \(e\)

(e) \(e^{-1}\)
9. A particle moves along the curve \( y = \sqrt{1 + x^3} \). As it reaches the point \((2, 3)\), the y-coordinate is increasing at a rate of 4 cm/s. How fast is the x-coordinate of the point changing at that instant?

(a) \(\frac{1}{4}\) cm/s

(b) \(\frac{1}{3}\) cm/s

(c) \(\frac{2}{3}\) cm/s

(d) 2 cm/s

(e) 6 cm/s

10. A street light is mounted at the top of a 15-ft-tall pole. A man 6 ft tall walks away from the pole with a speed of 5 ft/s along a straight path. If he is 40 ft from the pole, then the tip of his shadow is moving at the rate of

(a) \(48\frac{1}{3}\) ft/s

(b) \(333\frac{1}{3}\) ft/s

(c) \(5\frac{2}{3}\) ft/s

(d) 9 ft/s

(e) \(8\frac{1}{3}\) ft/s
11. The first derivative test tells that the function \( f(x) = \sqrt[3]{x^2 - x} \) has

(a) one local minimum and two local maxima
(b) one local minimum and no local maximum
(c) neither local minimum nor local maximum
(d) two local minima and one local maximum
(e) no local minimum and one local maximum

12. The \textbf{derivative} of \( f(x) \) is given by \( f'(x) = (1 - x)(7 - x) \). The intervals on which \( f(x) \) is increasing or decreasing are

(a) decreasing on \((7, \infty)\) and increasing on \((-\infty, 1)\)
(b) decreasing on \((-\infty, -1) \cup (-7, \infty)\) and increasing on \((-1, -7)\)
(c) decreasing on \((-\infty, 1)\) and increasing on \((7, \infty)\)
(d) decreasing on \((1, 7)\) and increasing on \((-\infty, 1) \cup (7, \infty)\)
(e) decreasing on \((-\infty, 1) \cup (7, \infty)\) and increasing on \((1, 7)\)
13. Square corners are cut out from a thin piece of cardboard of size 3 ft by 3 ft, so that the sides can be folded up to make a box with open top. The largest volume that such a box can have is given by

\[ V = 5 \text{ ft}^3 \]

(a) \( V = 5 \text{ ft}^3 \)

(b) \( V = 3 \text{ ft}^3 \)

(c) \( V = 4 \text{ ft}^3 \)

(d) \( V = 1 \text{ ft}^3 \)

(e) \( V = 2 \text{ ft}^3 \)

14. The graph of the first derivative \( f' \) of a function \( f \) is shown below. Which of the following statements is \textbf{WRONG} about \( f \)?

(a) \( x = 1, x = 8 \) are inflection points of \( f \)

(b) \( f \) is increasing on \((6, \infty)\) and decreasing on \((0, 2)\)

(c) \( f \) has local extrema at \( x = 2 \) and \( x = 6 \)

(d) \( f \) is concave down on \((6, 7)\)

(e) \( f \) is concave up on \((1, 3)\), and \((8, \infty)\)
15. Using the derivative tests and equations of asymptotes, the graph of the curve $xy = x^2 + 4$

(a)

(b)

(c)

(d)

(e)
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ID: __________________ Sec: ________________

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1. \( \lim_{x \to 0} \frac{\cos(9x) - 1}{x^2} = \)

(a) \( -\frac{81}{2} \)
(b) 0
(c) 1
(d) \( \frac{9}{2} \)
(e) \( \frac{81}{2} \)

2. \( \lim_{x \to \infty} (\sqrt{x^2 + 6x - x}) = \)

(a) \( \infty \)
(b) 6
(c) -3
(d) 0
(e) 3
3. The linearization $L$ of the function $f(x) = \sqrt{6x + 3}$ at $a = 1$ is given by

(a) $L(x) = 2 + x$

(b) $L(x) = \frac{7}{2} - x$

(c) $L(x) = \frac{5}{2} + \frac{1}{2}x$

(d) $L(x) = \frac{3}{2} + \frac{3}{2}x$

(e) $L(x) = 3 + x$

4. Consider the function $f(x) = x^2 + 2x + 1$ on the interval $[1, 2]$. If ‘$c$’ is the number satisfying the conclusion of the Mean Value Theorem, then $4c + 2 =$

(a) 1

(b) 9

(c) 10

(d) 8

(e) −1
5. A street light is mounted at the top of a 15-ft-tall pole. A man 6 ft tall walks away from the pole with a speed of 5 ft/s along a straight path. If he is 40 ft from the pole, then the tip of his shadow is moving at the rate of

(a) $48\frac{1}{3}$ ft/s
(b) $5\frac{2}{3}$ ft/s
(c) 9 ft/s
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6. The first derivative test tells that the function $f(x) = \sqrt{x^2 - x}$ has

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7. Square corners are cut out from a thin piece of cardboard of size 3 ft by 3ft, so that the sides can be folded up to make a box with open top. The largest volume that such a box can have is given by

(a) \( V = 3 \text{ ft}^3 \)
(b) \( V = 2 \text{ ft}^3 \)
(c) \( V = 5 \text{ ft}^3 \)
(d) \( V = 1 \text{ ft}^3 \)
(e) \( V = 4 \text{ ft}^3 \)

8. \( \lim_{x \to 0^+} (1 + \sin(4x))^{\cot x} = \)

(a) \( e^{-2} \)
(b) \( e^{-4} \)
(c) \( e^4 \)
(d) \( e \)
(e) \( e^{-1} \)
9. The sum of all critical points of the function

\[ f(x) = \cos^2 x - 2 \sin x \]

over the interval \( 0 \leq x < 2\pi \) is

(a) \( \frac{5\pi}{2} \)

(b) \( \frac{\pi}{2} \)

(c) \( \frac{3\pi}{2} \)

(d) \( \pi \)

(e) \( 2\pi \)

10. The derivative of \( f(x) \) is given by \( f'(x) = (1 - x)(7 - x) \).

The intervals on which \( f(x) \) is increasing or decreasing are

(a) decreasing on \(( -\infty, 1) \) and increasing on \(( 7, \infty) \)

(b) decreasing on \(( -\infty, 1) \cup (7, \infty) \) and increasing on \(( 1, 7) \)

(c) decreasing on \(( 1, 7) \) and increasing on \(( -\infty, 1) \cup (7, \infty) \)

(d) decreasing on \(( -\infty, -1) \cup (-7, \infty) \) and increasing on \(( -1, -7) \)

(e) decreasing on \(( 7, \infty) \) and increasing on \(( -\infty, 1) \)
11. A particle moves along the curve \( y = \sqrt{1 + x^3} \). As it reaches the point \((2, 3)\), the y-coordinate is increasing at a rate of 4 cm/s. How fast is the x-coordinate of the point changing at that instant?

(a) 6 cm/s

(b) \( \frac{2}{3} \) cm/s

(c) \( \frac{1}{4} \) cm/s

(d) 2 cm/s

(e) \( \frac{1}{3} \) cm/s

12. The radius of a circular disc is given as 24 cm with a maximum error in measurement of 0.2 cm. Using differentials the percentage error in the measurement of area of the disc will be

(a) \( 0.4\pi \) %

(b) \( \frac{1}{16} \) %

(c) \( 1\frac{2}{3} \) %

(d) \( 2\frac{1}{3} \) %

(e) \( 9.4\pi \) %
13. The absolute maximum of \( f(x) = \sqrt[3]{x}(8 - x) \) on \([0, 8]\) is

(a) \( 5\sqrt{3} \)
(b) 7
(c) \( 4\sqrt{4} \)
(d) 0
(e) \( 6\sqrt{2} \)

14. The graph of the first derivative \( f' \) of a function \( f \) is shown below. Which of the following statements is **WRONG** about \( f \)?

(a) \( f \) is increasing on \((6, \infty)\) and decreasing on \((0, 2)\)
(b) \( x = 1, x = 8 \) are inflection points of \( f \)
(c) \( f \) is concave up on \((1, 3)\), and \((8, \infty)\)
(d) \( f \) has local extrema at \( x = 2 \) and \( x = 6 \)
(e) \( f \) is concave down on \((6, 7)\)
15. Using the derivative tests and equations of asymptotes, the graph of the curve \( xy = x^2 + 4 \)

(a) 
(b) 
(c) 
(d) 
(e)
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