The questions listed below are drawn from midterm and final exams from the last few years at OSU. As the text book and structure of the class have recently changed, it made more sense to list the questions in reference to where the material they cover comes from as opposed to presenting entire old exams. The exams that these were drawn from had 17 questions in an 80 minute format for midterms and had 20 questions in a 110 minute format for the final.
Questions from old mth 241 exams listed by chapter.

Chapter 1

1. Below is a table of revenue in thousands of dollars for the first 10 days a new product is on the market. What was the average rate of change of revenue from day 3 to day 9?

<table>
<thead>
<tr>
<th>Day</th>
<th>Revenue in thousands of $’s</th>
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<tbody>
<tr>
<td>1</td>
<td>4.62</td>
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<tr>
<td>2</td>
<td>4.78</td>
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<td>3</td>
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<td>4</td>
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<td>6.21</td>
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<td>9</td>
<td>7.34</td>
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<tr>
<td>10</td>
<td>8.01</td>
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a) 420 dollars/day  
b) 500 dollars/day  
c) 1500 dollars/day  
d) 339 dollars/day  
e) 2381 dollars/day

2. Recall that we defined the difference quotient for a function as: \( D.Q. = \frac{f(x+h) - f(x)}{h} \)

What is the difference quotient for the function \( f(x) = -2x^2 + x \) ?

a) \(-2x^2 + x + h\)  
b) \(-2x^2 + xh + h\)  
c) \(-4x - 2h + 1\)  
d) \(-2x - h + 1\)  
e) \(-h + 1\)

3. Given the graph of a line, find the line’s equation.

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a) \(y = \frac{5}{7}x + 7\)  
b) \(y = \frac{5}{7}x + 5\)  
c) \(y = -\frac{5}{7}x + 7\)  
d) \(y = -\frac{7}{5}x + 7\)  
e) \(y = -\frac{7}{5}x + 5\)
4. What is the equation of the line that goes through the point \( \left( -\frac{1}{2}, 5 \right) \) with a slope of \( \frac{4}{9} \)?

a) \( y = \frac{4}{9} x + \frac{47}{9} \)  

b) \( y = \frac{4}{9} x + \frac{52}{9} \)  

c) \( y = \frac{4}{9} x + 5 \)  

d) \( y = -\frac{9}{4} x + \frac{47}{9} \)  

e) \( y = -\frac{9}{4} x + 5 \)

5. Find the slope of the line with equation \( 12y - 9x - 13 = 5 \)

a) slope = \( \frac{3}{4} \)  

b) slope = \( -\frac{3}{4} \)  

c) slope = \( \frac{4}{3} \)  

d) slope = \( \frac{1}{2} \)  

e) slope = \( -\frac{1}{2} \)

6. Find the equation of the line that goes through (-6, 14) and is perpendicular to the line \( -8y + 6x - 13 = 0 \)

a) \( y = \frac{4}{3} x + 22 \)  

b) \( y = -\frac{4}{3} x + 6 \)  

c) \( y = -\frac{3}{4} x + \frac{19}{2} \)  

d) \( y = -\frac{4}{3} x + 22 \)  

e) \( y = \frac{3}{4} x + \frac{19}{2} \)

7. A car that sold for $16,800 in 1999, was worth $12,500.00 in 2002. Assuming that its value is decreasing in a linear fashion, what should it be worth in 2008?

a) $3,870.00  

b) $3,880.00  

c) $3,890.00  

d) $3,900.00  

e) $4,000.00

8. Find the equation for the straight line that goes through the points (2, -1) and (-3, 1).

a) \( 2x + 5y + 1 = 0 \)  

b) \( 2x - 5y - 1 = 0 \)  

c) \( 2x + 5y + 9 = 0 \)  

d) \( 2x - 5y - 9 = 0 \)  

e) none of them
9. Use the graph to find \( \lim_{x \to 1^-} f(x) \) if \( f(x) = \frac{1}{x+1} \).

\[ \lim_{x \to 1^-} f(x) \]  

a) 0  
b) 1  
c) \infty  
d) does not exist  
e) none of the above

10. Find the value(s) of \( x \) at which \( f(x) \) is discontinuous if \( f(x) = \frac{(2x - 5)(x + 7)}{(x - 5)(x + 1)} \).

\[ f(x) = \frac{(2x - 5)(x + 7)}{(x - 5)(x + 1)} \]

a) \{-7, 5/2\}  
b) \{-7, -1, 7/2, 5\}  
c) \{-5, 1\}  
d) \{-1, 5\}

e) \text{f}(x) \text{ is continuous over all reals}

11. A business had an annual retail sales of $100,000 in 1991 and $226,000 in 1994. Assuming that the annual sales followed a linear pattern, what were the retail sales in 1993?

\[ \text{a) } 182,000.00 \quad \text{b) } 195,000.00 \quad \text{c) } 184,000.00 \quad \text{d) } 187,000.00 \quad \text{e) none of the above} \]

12. Find all the points at which the graph of \( f(x) = -x^3 + 3x^2 - 2 \) has horizontal tangent lines.

\[ f(x) = -x^3 + 3x^2 - 2 \]

a) (0, -2) and (2, 2)  
b) (0, -2)  
c) (0, 0) and (2, 0)  
d) (-2, 0)  
e) none of the above
13. If \( f(x) = 2x^2 + 4 \), then which of the following will correctly calculate the derivative of \( f(x) \)?

a) \( \frac{[2(x + \Delta x)^2 + 4] - (2x^2 + 4)}{\Delta x} \) 

b) \( \lim_{\Delta x \to 0} \frac{[2(x + \Delta x)^2 + 4] - (2x^2 + 4)}{\Delta x} \) 

c) \( \lim_{\Delta x \to 0} \frac{(2x^2 + 4 + \Delta x) - (2x^2 + 4)}{\Delta x} \) 

d) \( \lim_{\Delta x \to 0} \frac{(2x^2 + 4 + \Delta x) - (2x^2 + 4)}{\Delta x} \) 

e) none of the above

14. Find \( \lim_{x \to 2} \frac{x - 2}{x^2 - x - 2} \)

a) 0 

b) \( \infty \) 

c) \( 1/3 \) 

d) does not exist 

e) none of the above

15. Find the intervals in which the function is continuous: \( f(x) = \frac{x - 4}{(x - 2)(x + 1)} \)

a) \(( -\infty, 4) \) and \(( 4, \infty) \) 

b) \(( -\infty, -1), (-1, 2), (2, 4) \) and \(( 4, \infty) \) 

c) \(( -\infty, -1), (-1, 2) \) and \(( 2, \infty) \) 

d) \(( -\infty, -2), (-2, -1), (-1, 2) \) and \(( 2, \infty) \) 

e) none of the above

16. The height \( s \) (in feet) of an object fired straight up from ground level with an initial velocity of 150 feet per second is given by \( s = -16t^2 + 150t \), where \( t \) is time in seconds. How fast is the object moving after 5 seconds?

a) 350 ft/sec 

b) 150 ft/sec 

c) 0 ft/sec 

d) -10 ft/sec 

e) -50 ft/sec

17. A line has a slope of \( \frac{-4}{5} \) and goes through the point \(( 12, -7) \).

Which of the following points must the line also go through?

a) \(( 8, 12) \) 

b) \(( 16, 2) \) 

c) \(( 3, 7) \) 

d) \(( 16, 12) \) 

e) \(( -3, 5) \)
18. If \( f(x) = 5x^3 + 13x - \frac{1}{x} \) then \( f''(-1) = ? \)

a) \(-7\)  b) \(-1\)  c) \(4\)  d) \(8\)  e) \(12\)

19. The marketing research department for ACME Roadrunner Extermination Co. has determined that at a price of $5.79 per unit, monthly sales should be 2000 units.

They also determined that for every increase in price of $1.00, monthly sales will decrease by 400 units. Determine the demand function for this product.

Let \( P = \) price per unit and \( x = \) number of units sold.

a) \( P = -400x + 4316\)  b) \( P = -\frac{1}{400}x + 10.79\)  c) \( P = 400x - 799994.21\)

d) \( P = \frac{1}{400}x + 0.79\)  e) none of the above

20. If \( f(x) = \frac{5x}{1+x^2} \) then \( f(x + \Delta x) = ? \)

a) \(\frac{5x}{1 + x^2} + \Delta x\)  b) \(\frac{5x + \Delta x}{1 + x^2 + \Delta x}\)  c) \(\frac{5x + 5(\Delta x)}{1 + x^2 + (\Delta x)^2}\)

d) \(\frac{5x + 5(\Delta x)}{1 + x^2 + 2x(\Delta x) + (\Delta x)^2}\)  e) none of the above

21. Evaluate \( \lim \limits_{x \to -4} \frac{2x^2 + 7x - 4}{x + 4} = ? \)

a) \(0\)  b) \(1\)  c) \(-9\)  d) \(+\infty\)  e) the limit does not exist
22. Determine the intervals on which \( f(x) = \frac{x^2 - 2x - 15}{3x - 2} \) is continuous.

a) \((-\infty, -\frac{2}{3}) \cup (-\frac{2}{3}, +\infty)\)  
   b) \((-\infty, -3) \cup (-3, 5) \cup (5, +\infty)\)

\[ (-\infty, -3) \cup \left(-3, \frac{2}{3}\right) \cup \left(\frac{2}{3}, 5\right) \cup \{5\} \]

\[ (-\infty, -5) \cup (-5, 3) \cup (3, +\infty) \]

\[ (-\infty, -\frac{2}{3}) \cup \left(-\frac{2}{3}, +\infty\right) \]

Refer to graph below for questions 23 and 24

23. \( \lim_{x \to 4} g(x) = ? \)

   a) 6  
   b) 1  
   c) 2  
   d) does not exist  
   e) cannot be determined from the graph

24. \( \lim_{x \to 0} g(x) = ? \)

   a) -2  
   b) 2  
   c) 0  
   d) does not exist  
   e) cannot be determined from the graph
25. The position equation for the movement of a particle is given by \( s = (t^2 - 1)^3 \), where \( s \) is measured in feet and \( t \) is measured in seconds. Find the acceleration of the particle at time \( t = 2 \) seconds.

a) 342 feet/sec\(^2\)  

b) 18 feet/sec\(^2\)  

c) 288 feet/sec\(^2\)  

d) 90 feet/sec\(^2\)  

e) none of the above

26. Give the sign of the second derivative of \( f \) at the indicated point on the graph.

![Graph](image)

a) Positive  

b) Negative  

c) Zero  

d) The sign of the second derivative cannot be determined by looking at the graph of \( f \).  

e) none of the above

27. Find the equation of the line that is tangent to the graph of \( f(x) = \frac{4}{x^2} \) at the point \((-1,4)\).

a) \( y = \frac{1}{8}x + \frac{1}{8} \)  

b) \( y = \frac{1}{4}x + \frac{1}{4} \)  

c) \( y = 4x + 8 \)  

d) \( y = 8x + 12 \)  

e) none of the above

28. If \( y = f(x) \) is a differentiable function and \( f(7) = 14.20 \) and \( f'(7) = -0.03 \), then a good estimate for \( f(9) \) is:

a) -473.33  

b) -0.426  

c) 14.23  

d) 14.17  

e) 14.14
29. Which of the following will correctly calculate the derivative of the function \( w(x) = \frac{2}{x^2 + 4} \), using the definition of the derivative?

\[
\text{a) } \lim_{\Delta x \to 0} \frac{2(x + \Delta x) - 2}{x^2 + 4} \\
\text{b) } \lim_{\Delta x \to 0} \frac{2}{x^2 + 4 + \Delta x} - \frac{2}{x^2 + 4} \\
\text{c) } \lim_{\Delta x \to 0} \frac{2}{(x + \Delta x)^2 + 4} - \frac{2}{x^2 + 4} \\
\text{d) } \lim_{\Delta x \to 0} \frac{2(x + \Delta x) - 2}{x^2 + 4 + \Delta x} - \frac{2}{x^2 + 4} \\
\text{e) } \lim_{\Delta x \to 0} \frac{2}{x^2 + 4 + \Delta x} - \frac{2}{x^2 + 4}
\]

30. If \( y = f(x) \) is a differentiable function, then \( f'(\left(\frac{6}{5}\right)) = -\frac{7}{8} \) means:

\[a) \text{ The slope of the graph of } y = f(x) \text{ is } -\frac{7}{8} \text{ at the point where } x = \frac{6}{5} \]

\[b) \text{ The slope of the graph of } y = f(x) \text{ is } \frac{6}{5} \text{ at the point where } x = -\frac{7}{8} \]

\[c) \text{ The point } \left(\frac{6}{5}, -\frac{7}{8}\right) \text{ lies on the tangent line to the graph } y = f(x) \]

\[d) \text{ The point } \left(-\frac{7}{8}, \frac{6}{5}\right) \text{ lies on the tangent line to the graph } y = f(x) \]

\[e) \text{ none of the above} \]

31. The height in feet of a ball above ground at \( t \) seconds after being thrown straight upwards is given by the function \( h(t) = -16t^2 + 54t + 5 \). What is the velocity of the ball 3 seconds after it was thrown?

\[a) -42 \text{ ft/sec } \quad \text{b) 42 ft/sec } \quad \text{c) -10 ft/sec } \quad \text{d) -32 ft/sec } \quad \text{e) 32 ft/sec } \]
32. Given the graph of \( y = r(x) \), we can see that \( r(x) < 0 \) and \( r'(x) > 0 \) at the point labeled:

- a) A
- b) B
- c) C
- d) D
- e) E

33. Find \( \lim_{\Delta x \to 0} \frac{3(x + \Delta x)^2 - 7 - (3x^2 - 7)}{\Delta x} \)

- a) 0
- b) 6x
- c) -7
- d) +\infty
- e) Does not exist
Chapter 2

1. The demand function for a particular commodity is given by $p = 600 - 3x$. Find the marginal revenue when $x = 30$.
   
   a) $15,300.00  
   b) $420.00  
   c) $510.00  
   d) $3.00  
   e) none of the above

2. Find $f'(x)$ if $f(x) = \frac{x^2 - 4x}{\sqrt{x}}$.
   
   a) $f'(x) = \frac{3\sqrt{x}}{2} - \frac{2}{\sqrt{x}}$  
   b) $f'(x) = \frac{2x - 4}{\sqrt{x}}$  
   c) $f'(x) = 2\sqrt{x} \cdot (2x - 4)$  
   d) $f'(x) = \sqrt{x}^3 - 4\sqrt{x}$  
   e) none of the above

3. Find the derivative of $f(x)$ if $f(x) = (2x + 5)(x^2 - 3x + 1)$.
   
   a) $4x - 6$  
   b) $2x^2 + 10x - 17$  
   c) $6x^2 - 2x - 13$  
   d) $2x^2 - 2x - 13$  
   e) none of the above

4. A manufacturer determines that the revenue derived from selling $x$ units of a certain item is given by $R = 300x - \sqrt{x^2 + 81}$. Find the marginal revenue when $x = 40$.
   
   a) $11,959.00  
   b) $380.00  
   c) $12,258.02  
   d) $299.02  
   e) none of the above

5. Find $y'''$ if $y = 3x^3 - 2x^{-2}$.
   
   a) 0  
   b) 18  
   c) $18 + \frac{48}{x^5}$  
   d) $\frac{1}{48x^5}$  
   e) none of the above
6. Which of the following statements is true of \( f(x) = -x^3 - 6x^2 - 9x - 2 \)?

a) \( f \) is decreasing on \((-3, \infty)\)  

b) \( f \) is increasing on \((-\infty, -3)\)

c) \( f \) is increasing on \((-3, -1)\)  

d) \( f \) is decreasing on \((-2, \infty)\)

e) none of the above

7. The management of a large store has 1,600 feet of fencing to fence in a rectangular storage yard using the building as one side of the yard. If the fencing is used for the remaining three sides, find the area of the largest possible yard. Round answer to nearest whole square foot.

a) 160,000 square feet  

b) 284,444 square feet

c) 320,000 square feet

d) 480,000 square feet

e) none of the above

8. Find the values of \( x \) that give relative extrema for the function \( f(x) = 3x^5 - 5x^3 \).

a) relative maximum at \( x = 0 \); relative minimum at \( x = \frac{\sqrt[5]{5}}{3} \)

b) relative maximum at \( x = -1 \); relative minimum at \( x = 1 \)

c) relative maximum at \( x = \pm 1 \); relative minimum at \( x = 0 \)

d) relative maximum at \( x = 0 \); relative minimum at \( x = \pm 1 \)

e) none of the above

9. Find the derivative of \( f(x) = \sqrt{x^2 - 2x + 5} \)

a) \( \sqrt{2x - 2} \)  

b) \( \frac{1}{2\sqrt{x^2 - 2x + 5}} \)

c) \( \frac{1}{2\sqrt{2x - 2}} \)

\( \frac{x - 1}{\sqrt{x^2 - 2x + 5}} \)

e) none of the above
10. The marketing research department for a computer company used a large city to test market their new product. They found that the demand equation was \( p = 1296 - 0.12x^2 \). If their cost equation is \( C = 830 + 396x \), find the number of units, \( x \), that will produce the maximum profit.

a) 16  b) 17  c) 50  d) 500  e) none of the above

11. Find all the critical numbers for \( f(x) = \frac{x^2 - 1}{x^3} \).

a) 0  b) \(-\sqrt{3}, 0, \sqrt{3}\)  c) \(-\sqrt{3}, \sqrt{3}\)  d) \(-1, 1\)

e) none of the above

12. Marketing research has shown that at a price of $49.95 sales of the ‘Fabulous Kitchen Gadget’ will be 15,000 units per month, and for every increase in price of $2.00 the sales will decline by 1,000 units per month.

Create a linear demand function based on this information, and from that create a revenue function.

What is the revenue associated with sales of 13,500 units per month?

a) $52.95  b) $714,825.00  c) $736,734.00  d) $750,049.95  e) $-911.18

13. Use the information from question 13, and the additional information that the cost function for the business is \( \text{Cost}(x) = 15x + 23,000 \), where \( x \) is the number of units sold per month and \( \text{Cost}(x) \) is in US dollars.

What is the marginal profit associated with sales of 13,500 units per month?

a) $8.95/unit  b) $9.95/unit  c) $10.95/unit

d) $11.95/unit  e) $12.95/unit

14. If \( g(t) = \sqrt{x^2 + 4} \), then \( g'(-2) = ? \)

a) 3  b) \(-\frac{1}{\sqrt{2}}\)  c) \(4\sqrt{2}\)  d) \(-\frac{1}{2\sqrt{2}}\)  e) \(-4\sqrt{2}\)
15. Find the interval(s) over which the function \( f(x) = x^3 + x^2 - x - 1 \) is increasing.

a) \((-\infty, -1)\)  

b) \((-\infty, \frac{1}{3})\)  

c) \((-1, \frac{1}{3})\)  

d) \((-\infty, -1) \text{ and } \left(\frac{1}{3}, +\infty\right)\)  

e) \((-1, +\infty)\)

16. Find the critical number(s) for the function \( r(x) = \frac{8}{3}x^3 - 2x + 5 \)

a) \(\pm \frac{1}{2}\)  

b) \(\pm \frac{1}{4}\)  

c) \(\pm 2\)  

d) \(\pm 4\)  

e) \(r(x)\) has no critical numbers

17. Locate the relative extrema for the function \( g(x) = -3x^4 - 4x^3 \)

a) \(g(x)\) has a relative minimum at: \(x = -1\) and NO relative maximum

b) \(g(x)\) has NO relative minimum and a relative maximum at \(x = -1\)

c) \(g(x)\) has a relative minimum at: \(x = -1\) and a relative maximum at \(x = 0\)

d) \(g(x)\) has a relative minimum at: \(x = 0\) and a relative maximum at \(x = -1\)

e) \(g(x)\) has NO relative minimum and a relative maximum at \(x = 0\)

18. Given the graph of \( y = f'(x) \) (the graph of the DERIVATIVE of \(f(x)\));
we can tell that the function \(f(x)\) increases on what interval(s)?

\[ \text{Graph Image} \]

a) \((-3, -1)\) and \((1, 3)\)  

b) \((-1, 1)\)  

c) \((-2.2, 0)\) and \((2.2, 3)\)  

d) \((-3, -2.2)\) and \((0, 2.2)\)

e) it is impossible to answer the question with the given information
19. Find the open interval on which the function is concave downward: \( y = x^4 - 6x^3 \)

a) There does not exist an interval for which \( y \) is concave downward.  
   b) \((-\infty,0)\)
   c) \((0,3)\)  
   d) \((3,\infty)\)  
   e) \((0,\infty)\)

20. Given the graph of \( y = h''(x) \), (the graph of the second derivative of the function \( h(x) \))

We can tell that the function \( h(x) \) is concave upward on the intervals:

a) the function is only concave downward at \( x = 11 \)  
   b) \((2, 5)\) and \((8, 11)\)
   c) \((0, 2)\) and \((5, 8)\) and \((11, 12.5)\)  
   d) \((3.75, 6)\) and \((9.7, 12.5)\)
   e) \((0, 3.75)\) and \((6, 9.7)\)

21. The graph of \( y = f(x) \) is given below.
At which of the labeled points are both the first and second derivative of \( f(x) \) positive?

a) point A  
   b) point B  
   c) point C  
   d) point D
   
   e) the first and second derivative are not both positive at any of those labeled points
22. A company’s cost function is \( C = 100 + 30x \) and its demand function is \( p = 90 - x \), where \( C \) and \( p \) are in dollars and \( x \) is the number of units produced and sold. Find the price \( p \) that yields the maximum profit.

a) $30.00  
   b) $60.00  
   c) $0.34  
   d) $2.83  
   e) $800.00

23. Find the equation of the line tangent to the graph of \( f(x) = \sqrt{x+1} \) at the point \((3,2)\)

   a) \( y = \frac{1}{4} x + \frac{5}{4} \)  
   b) \( y = -\frac{1}{2} x + \frac{7}{2} \)  
   c) \( y = \frac{1}{2} x + \frac{1}{2} \)  
   d) \( y = -\frac{1}{4} x + \frac{11}{4} \)  
   e) none of the above

24. The graph of the function \( f(x) = x^3 - 4x + 5 \) has:

   a) two relative extrema and one inflection point  
   b) one relative extremum and one inflection point  
   c) one relative extremum and two inflection points  
   d) two relative extrema and no inflection points  
   e) none of the above

25. If the cost function of a business is \( C = 100 + 40x \) and the demand function is \( p = 200 - 10x \), find the price \( p \) that maximizes profit.

   a) $8  
   b) $20  
   c) $120  
   d) $420  
   e) none of the above
1. Find the number of units, $x$, that will minimize then average cost function if the total cost function is $C = 3x^2 - 12x + 7500$.

a) 2  
 b) 5  
 c) 500  
 d) 50  
 e) none of the above

2. Use the product rule to find the derivative of the function $p(x) = (3x^4 + 5)(-4x^3 + x)$ do not simplify your answer.

a) $(12x^3)(-12x^2 + 1)$  
 b) $(3x^3)(-4x^2 + 1)$  
 c) $(12x^3)(-4x^3 + x) + (3x^4 + 5)(-12x^2 + 1)$  
 d) $(3x^3)(-4x^3 + x) + (3x^4 + 5)(-4x^2 + 1)$  
 e) $(3x^3 + 5)(-4x^3 + x) + (3x^4 + 5)(-4x^2 + x)$

3. Use the quotient rule to find the derivative of the function $q(x) = \frac{3x^4 + 5}{-4x^3 + x}$ do not simplify your answer.

a) $\frac{12x^3}{-12x^2 + 1}$  
 b) $\frac{12x^3 - (-12x^2 + 1)}{(-4x^3 + x)^2}$  
 c) $\frac{(-4x^3 + x)(3x^3) - (3x^4 + 5)(-4x^2 + 1)}{(-4x^3 + x)^2}$  
 d) $\frac{(-4x^3 + x)(12x^3) + (3x^4 + 5)(-12x^2 + 1)}{(-4x^3 + x)^2}$  
 e) $\frac{(-4x^3 + x)(12x^3) - (3x^4 + 5)(-12x^2 + 1)}{(-4x^3 + x)^2}$

4. The function $h(x)$ is defined in terms of the differentiable function $f(x)$.
Find an expression for $h'(x)$ given that $h(x) = (3x - 4x^3) \cdot f(x)$

a) $(3x - 4x^3) \cdot f'(x)$  
 b) $(3 - 12x^2) \cdot f'(x)$  
 c) $(3 - 12x^2) + f'(x)$  
 d) $(3 - 12x^2) \cdot f(x) + (3x - 4x^3) \cdot f'(x)$  
 e) $(3 - 12x^2) \cdot f'(x) + (3x - 4x^3) \cdot f(x)$
5. The function \( h(x) \) is defined in terms of the differentiable function \( f(x) \).

Find an expression for \( h'(x) \) given that \( h(x) = \frac{3x - 4x^3}{f(x)} \)

\[ \begin{align*}
\text{a)} & \quad \frac{3x - 4x^3}{f'(x)} \\
\text{b)} & \quad \frac{3 - 12x^2}{f'(x)} \\
\text{c)} & \quad \frac{f(x) \cdot (3x - 4x^3) - (3 - 12x^2) \cdot f'(x)}{(f'(x))^2} \\
\text{d)} & \quad \frac{f(x) \cdot (3 - 12x^2) - (3x - 4x^3) \cdot f'(x)}{(f(x))^2} \\
\text{e)} & \quad \frac{f(x) \cdot (3 - 12x^2) + (3x - 4x^3) \cdot f'(x)}{(f(x))^2}
\end{align*} \]

6. If \( f(x) \) and \( h(x) \) are differentiable functions such that \( f(3) = -2 \), \( f'(3) = 5 \), \( h(3) = 4 \) and \( h'(3) = -6 \); then find \( \frac{d}{dx} \left[ \frac{h(x)}{f(x)} \right]_{x=3} \)

\[ \begin{align*}
\text{a)} & \quad 1 \\
\text{b)} & \quad -1 \\
\text{c)} & \quad 2 \\
\text{d)} & \quad -2 \\
\text{e)} & \quad -\frac{6}{5}
\end{align*} \]

7. If \( f(x) \) and \( h(x) \) are differentiable functions such that \( f(3) = -2 \), \( f'(3) = 5 \), \( h(3) = 4 \) and \( h'(3) = -6 \); then find \( \frac{d}{dx} \left[ (f(x))' \cdot (h(x))' \right]_{x=3} \)

\[ \begin{align*}
\text{a)} & \quad 32 \\
\text{b)} & \quad 8 \\
\text{c)} & \quad -34 \\
\text{d)} & \quad 14 \\
\text{e)} & \quad -38
\end{align*} \]

8. The function \( h(x) \) is defined in terms of the differentiable function \( f(x) \).

Find an expression for \( h'(x) \) given that \( h(x) = \sqrt{f(3x^2)} \)

\[ \begin{align*}
\text{a)} & \quad \frac{3x}{\sqrt{f(3x^2)}} \\
\text{b)} & \quad \frac{1}{2\sqrt{f(3x^2)}} \\
\text{c)} & \quad \frac{f(3x^2)}{2} \\
\text{d)} & \quad f(3x^2) \cdot (6x) \\
\text{e)} & \quad f(3x^2) \cdot (3x)
\end{align*} \]
9. If \( f(x) \) and \( h(x) \) are differentiable functions such that \( f(1) = -2 \), \( f'(1) = 5 \), \( f'(4) = 3 \), 
\( h(4) = 4 \), \( h(-2) = 7 \), \( h'(-2) = -3 \) and \( h'(1) = -6 \); then find \( \frac{d}{dx} [h(f(x))] \) \( \bigg|_{x=1} \)

a) 21 b) -15 c) 6 d) 35 e) 12

10. When a company produces and sells \( x \) thousand units per month, its total monthly profit is \( P \) thousand dollars, where \( P = \frac{400x}{200 + x^2} \).

The production level at \( t \) months from the present is given by \( x = 1 + 2t \)

How fast (with respect to time) will profits be changing 2 months from now? (when \( t = 2 \))

Round your answer to the nearest whole dollar.

a) increasing at $1383/mo. b) decreasing at $785/ mo. c) increasing at $2765/mo.

d) decreasing at $1570/mo. e) problem cannot be solved with the given information

11. Find the absolute extrema on the interval \([0, 2]\) of \( f(x) = \frac{2x}{x^2 + 1} \).

a) Maximum: (1,1); Minimum: (0,0) b) Maximum: (1,3); Minimum: (0,1)

c) Maximum: (2, 4/5 ); Minimum: (-1, -1) d) Maximum: (2, 4/5 ); Minimum: (0,0)

e) none of the above

12. Find all intervals for which the function is concave upward: \( f(x) = \frac{x-1}{x+3} \).

a) \((-\infty, \infty)\) b) \((-\infty, -3)\) c) \((1, \infty)\) d) \((-3, \infty)\)

e) none of the above
13. If $y$ is related to $x$ according to the formula $y = \frac{30x}{x + 2}$, at what rate is $y$ changing with respect to $x$ when $x = 0$?

a) 0 units of $y$ per unit of $x$

b) 15 units of $y$ per unit of $x$

c) 25 units of $y$ per unit of $x$

d) 30 units of $y$ per unit of $x$

e) -15 units of $y$ per unit of $x$
Chapter 4

1. Match the graph shown with the correct function.

![Graph Image]

a) \( f(x) = e^{(x+3)} \)  

b) \( f(x) = e^{-x} - 3 \)  
c) \( f(x) = e^x - 3 \)  
d) \( f(x) = e^{-(x+3)} \)  
e) \( f(x) = e^{-x} + 3 \)

2. Find the derivative of the function \( f(x) = \ln(x^2 + 4x) \).

a) \( \frac{2x + 4}{x^2 + 4x} \)  
b) \( \frac{2x}{x^2 + 4x} \)  
c) \( \frac{1}{(2x + 4)(x^2 + 4x)} \)  
d) \( \frac{1}{2x + 4} \)  
e) \( e^{(x^2+4x)} \)

3. Expand the following expression using logarithm identities \( \ln\left(\frac{13z^3}{5x}\right) \).

a) \( \ln(13z^3) + \ln(5x) \)  
b) \( \ln 13 + 3\ln z - \ln 5 - \ln x \)  
c) \( 3\ln(13z) - \ln(5x) \)  
d) \( \frac{\ln 13 + 3\ln z}{\ln 5 - \ln x} \)  
e) \( 3\ln(13z - 5x) \)

4. Find the slope of the tangent line to the graph of \( y = (\ln x)e^x \) at the point where \( x = 2 \).

a) \( \frac{1}{2}e^2 \)  
b) \( e^2(\ln 2 + \frac{1}{2}) \)  
c) \( e \)  
d) \( e(2\ln 2 + 1) \)  
e) \( \ln(2) \cdot e^2 \)
5. Find the equation of the line tangent to the graph \( f(x) = \ln(x) + 1 \) at the point \((e, 2)\).

a) \( y = \frac{x}{2} + \frac{3e}{2} \)  

b) \( y = ex + e \)  

c) \( y = ex + 2 \)  

d) \( y = \frac{x}{e} + 1 \)  

e) \( y = \frac{x}{e} - 2 \)

6. Find the derivative of \( y = e^{-x^2} \).

a) \( -x^2 e^{-x^2 - 1} \)  

b) \( -2xe^{-x^2} \)  

c) \( \frac{1}{x^2 e^{x^2 - 1}} \)  

d) \( e^{-2x} \)  

e) \( e^{-2x} \cdot e^{-x^2} \)

7. Choose the expression equivalent to: \( \ln \left( \frac{9x^2}{2y} \right) \)

a) \( \ln(9x^2) + \ln(2y) \)  

b) \( 2 \ln(9x) - \ln(2y) \)  

c) \( \ln 9 + 2 \ln x - \ln 2 - \ln y \)  

d) \( \frac{\ln 9 + \ln x^2}{\ln 2 + \ln y} \)  

e) none of the above

8. Find the critical number(s) of the function \( f(x) = x^2 - \ln x \).

a) 0  

b) \( -\sqrt{2} \), 0, \( \sqrt{2} \)  

c) \( \sqrt{\frac{1}{2}} \)  

d) \( -\sqrt{\frac{1}{2}} \)  

e) none of the above

9. If the point \((-4, \frac{1}{6})\) is a point on the graph of the function \( f(x) = a^x \). Then \( a = ? \)

a) \( \frac{1}{3} \)  

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

c) 16  

d) 3  

e) 9

10. Write the equivalent logarithmic equation to the equation \( 7 = e^{5x} \).

a) \( \ln 7 = 5x \)  

b) \( \ln 7 = e^{5x} \)  

c) \( \ln e^{5x} = 5x \)  

d) \( \ln x = 35 \)  

e) \( \ln 5x = 7 \)
11. Use logarithmic identities to write the following expression as a single logarithm.

\[ 7 \log(x - y) + \frac{1}{2} \log(2x - 1) - 3 \log 4 \]

a) \( \log \left( \frac{(x - y)^7 \cdot \sqrt{2x - 1}}{64} \right) \)

b) \( \log \left( \frac{\sqrt[3]{x - y} \cdot (2x - 1)^2}{\sqrt{4}} \right) \)

cia) \( \log \left( \frac{7x - 7y}{x - \frac{1}{2}} - 12 \right) \)

d) \( \log (8x - 7y - 12.5) \)

e) \( \log \left( \frac{7(x - y) \cdot (2x - 1)}{128} \right) \)

12. Solve for \( x \): \( 3 \ln 2 + \ln(x^2 + 1) = \ln 16 \).

a) \( e \)

b) \( \pm 2 \)

cia) \( -2 \)

d) \( \pm 1 \)

e) none of the above

13. Solve for \( x \): \( 5^{3x} - 4 \cdot 5^x + 3 = 0 \)

a) \( \{1, 3\} \)

b) \( \{0, \ln(3)\} \)

cia) \( \left\{ 0, \ln \left( \frac{5}{3} \right) \right\} \)

d) \( \left\{ 0, \frac{\ln(3)}{\ln(5)} \right\} \)

e) none of the above

14. Evaluate \( \frac{d^2}{dx^2} \left( \frac{e^x}{x} \right) \bigg|_{x=1} \)

a) \( -e \)

b) \( -1 \)

cia) \( 0 \)

d) \( 1 \)

e) \( e \)
15. The value of a computer $t$ years after its purchase is $v(t) = 2200 \cdot e^{-0.33t}$ dollars. 

At what rate will the computer’s value be changing 4 years after its purchase?

a) decreasing at $216.47$ per year 
    b) decreasing at $193.94$ per year  
    c) its value will not be changing after 4 years  
    d) increasing at $193.94$ per year  
    e) increasing at $216.47$ per year

16. Solve for $x$: $\ln(x^4) - 2\ln x = 2$ 

a) 0 
    b) 1  
    c) $e$ 
    d) $e^2$  
    e) none of the above

17. Given $y = \ln(x+2) \cdot \ln(3x+1)$; evaluate $\frac{dy}{dx}$ at $x=0$ 

a) $3\ln(2)$  
    b) $2\ln(3)$  
    c) 2  
    d) 3  
    e) 6
Chapter 5

1. The balance in an account triples in 13 years. Assuming that the interest is compounded continuously, what is the annual percentage rate?
   a) 6.89%  b) 8.45%  c) 8.65%  d) 5.33%  
e) none of the above

2. A radio-active substance has a half-life of 80,000 years.
   You obtain some of this substance, how many years must pass for there to be 30% remaining?
   Carry 5 significant digits during all calculations, then round answer to the nearest whole year.
   a) 138,958 years  b) 152,592 years  c) 127,596 years  
d) 149,327 years  e) not enough information is given to solve the problem

3. An account is opened with a principal of $600 paying 3.5% interest compounded monthly. How long will it take for the balance to reach $1000? (Round your answer to the nearest tenth)
   a) 2.0 years  b) 20.4 years  c) 14.6 years  d) 1.7 years  e) 1.6 years

4. A town currently, in 2008, has a population of 10,000 people.
   The population is expected to grow exponentially, and will double in ten years, 2018.
   Which of the following functions models this population growth, where \( t = 0 \) corresponds to the year 2008, and \( Pop(t) \) is the population of the town in thousands?
   a) \( Pop(t) = t + 10 \)  b) \( Pop(t) = 10 \cdot \ln(0.13863 \cdot t) \)  c) \( Pop(t) = 10 \cdot e^{0.034657 \cdot t} \)  
d) \( Pop(t) = 10 \cdot e^{0.069315 \cdot t} \)  e) \( Pop(t) = 10 \cdot e^{0.13863 \cdot t} \)
5. The decay constant for a radioactive element is .015 when time is measured in years. Find the half-life of this element. Round your answer to the nearest tenth of a year.

a) 40.6 years    b) 42.4 years    c) 44.1 years    d) 46.2 years    e) 49.6 years

6. Radioactive cobalt has a half-life of 5.3 years. Find its decay constant. Round your answer to the nearest thousandth.

a) 0.131    b) 0.168    c) 0.182    d) 0.203    e) 0.224

7. The demand function for a product is \( q = \frac{77}{p^2} + 3 \)

Find \( E(2) \), the elasticity of demand at price \( p = 2 \) for this product. Round your answer to the nearest hundredth.

a) -1.03    b) 0    c) 1.73    d) 1.86    e) 2.03

8. The demand function for a product is \( q = \frac{77}{p^2} + 3 \)

At a price of \( p = 1 \), this product is

a) elastic    b) inelastic    c) both elastic and inelastic    d) neither elastic nor inelastic    e) the question cannot be answered with the given information

9. Given the function \( f(x) = 10 - 10e^{-1x} \) where its domain is \( x \geq 0 \), we can tell that the graph will be

a) increasing and concave up on its domain    b) decreasing and concave up on its domain

b) increasing and concave down on its domain    d) decreasing and concave down on its domain

e) none of the above
10. Given the function \( g(t) = e^{-0.02t} \) at \( t = 10 \), find the percent rate of change of the function at the point indicated.

a) increasing at a rate of 2%  
b) decreasing at a rate of 2%  
c) increasing at a rate of 20%  
d) decreasing at a rate of 20%  
e) none of the above

11. A rumor spreads among 10,000 people in such a way that \( t \) days after the start of the rumor, the number of people who have heard the rumor is given by \( f(t) \), where

\[
f(t) = \frac{10000}{1 + 50e^{-0.4t}}
\]

How quickly will the rumor be spreading after 5 days?

Round your answer to the nearest whole number.

a) 441 people/day  
b) 445 people/day  
c) 449 people/day  
d) 553 people/day  
e) 557 people/day
Chapter 6

1. Find the cost function if the marginal cost function is \( \frac{dC}{dx} = 2x + 50 \), and the fixed costs are $150.00.

   a) \( C = 2x^2 + 50x + 150 \)  
   b) \( C = x^2 + 50x + 150 \)  
   c) \( C = 2x^2 + 50x - 150 \)  
   d) \( C = x^2 + 50x - 150 \)  
   e) \( C = x^2 + 50x - 100 \)

2. The marginal revenue for a certain product is given by: \( \frac{dR}{dx} = 0.2x - 50 \). 
   Find the change in revenue when sales increase from 400 to 500 units.

   a) $20.00  
   b) $4,000.00  
   c) $9,000.00  
   d) $13,000.00  
   e) $17,000.00

3. Find the cost function if the marginal cost function is \( \frac{dC}{dx} = .03x^2 + .6x \) and fixed costs are $3000.

   a) \( C = .06x + .6 + \frac{3000}{x} \)  
   b) \( C = .01x^3 + .3x^2 - 3000 \)  
   c) \( C = .06x + .6 - \frac{3000}{x} \)  
   d) \( C = .01x^3 + .3x^2 + 3000 \)  
   e) none of the above

4. The marginal revenue for a certain product is given by: \( \frac{dR}{dx} = 20 - .2x \). 
   Find the change in revenue when sales increase from 50 to 60 units.

   a) $90  
   b) $2  
   c) $65  
   d) -$20  
   e) none of the above
5. Evaluate: \[ \int \left( \frac{5}{x} - x^2 \right) dx \]

\[ a) \ 5 - x^3 + C \quad b) \ -\frac{5}{x^2} - 2x + C \quad c) \ 5\ln x - \frac{x^3}{3} + C \quad d) \ 5e^x - \frac{x^3}{3} + C \]

\[ e) \ \text{none of the above} \]

6. Find the value of \( k \) that makes the anti-differentiation formula true for:

\[ \int 4e^{\sqrt{x}} dx = ke^{\sqrt{x}} + C \]

\[ a) \ k = 4 \quad b) \ k = 12 \quad c) \ k = \frac{4}{3} \quad d) \ k = \frac{3}{4} \quad e) \ \text{none of the above} \]

7. Find the function \( h(x) \) that has the following 2 properties:

i) \( h'(x) = 2\sqrt{x} + 3 \) and ii) \( h(0) = 4 \)

\[ a) \ h(x) = \frac{2}{3} \sqrt{x^3} + 4 \quad b) \ h(x) = 2\sqrt{x} + 4 \quad c) \ h(x) = 2\sqrt{x^3} + 3x + 4 \]

\[ d) \ h(x) = \frac{4}{3} \sqrt{x^3} + 3x + 4 \quad e) \ \text{none of the above} \]

8. Evaluate the following definite integral: \[ \int_{-1}^{3} (2x^2 - x + 3) dx \]

The graph of \( f(x) = 2x^2 - x + 3 \) is below.

\[ a) \ 22\frac{1}{4} \quad b) \ 24\frac{2}{3} \quad c) \ 25\frac{1}{3} \quad d) \ 26\frac{2}{3} \quad e) \ 27\frac{1}{4} \]