1. Find the slope of a line that goes through the points (1, 5) and (-3, 13).
   The slope is
   (A) Less than -1      (B) Between -1 and 1      (C) Between 1 and 3
   (D) More than 3       (E) Undefined

2. Estimate the slope of the line given below.

   The slope is
   (A) Between -3 and -1      (B) Between -1 and 1      (C) Between 1 and 3
   (D) Between 3 and 5       (E) Undefined
3. Determine the equation of the line that goes through the point \((-5, -\frac{7}{2})\) with slope \(-\frac{1}{2}\).

(A) \(y = -\frac{1}{2}x + 1\)  
(B) \(y = -\frac{1}{2}x - 6\)  
(C) \(y = -\frac{1}{2}x - \frac{7}{2}\)  
(D) \(y = -5x - \frac{7}{2}\)  
(E) None of these

4. Determine the equation of the line that goes through the points \((-2, \frac{3}{4})\) and \((\frac{2}{3}, \frac{5}{2})\).

(A) \(y = \frac{14}{3}x + \frac{121}{12}\)  
(B) \(y = \frac{14}{3}x + \frac{3}{4}\)  
(C) \(y = \frac{21}{32}x + \frac{5}{2}\)  
(D) \(y = \frac{21}{32}x + \frac{33}{16}\)  
(E) None of these
5. Determine the equation of the line that goes through the points $\left( \frac{2}{3}, 4 \right)$ and $\left( \frac{2}{3}, \frac{7}{2} \right)$.

(A) $y = -\frac{3}{8}x + \frac{17}{4}$  
(B) $y = \frac{2}{3}x$  
(C) $x = \frac{2}{3}$

(D) $y = \frac{2}{3}$  
(E) None of these

6. Determine the equation of the line given below.

(A) $y = -4$  
(B) $x = -4$  
(C) $y = x - 4$

(D) $y = -4x$  
(E) None of these
7. Determine the equation of the line given below.

(A) $y = x - 9$  
(B) $y = 9x - 9$  
(C) $y = x - 1$  
(D) $y = 9x - 1$  
(E) None of these
8. World grain production was 1241 million tons in 1975 and 2048 million tons in 2005, and has been increasing at an approximately constant rate. Answer parts (i) through (iii).

(i) Determine a linear equation that approximates world grain production, \( P \), in millions tons, in terms of \( t \), the number of years since 1975.

(ii) Using units, interpret the slope in terms of grain production.

(iii) According to the linear model, when is grain production predicted to reach 2500 million tons?
9. A ski resort charges a snowboard rental fee of $20 plus $9.25 per hour.

Answer parts (i) through (iii).

(i) Write a linear cost function \( C(t) \), where \( t \) is the time in hours, for the following situation.

\[
\begin{align*}
(A) & \quad C(t) = 20t + 9.25 \\
(B) & \quad C(t) = 9.25t + 20 \\
(C) & \quad C(t) = 20t + 29.25 \\
(D) & \quad C(t) = 9.25t + 29.95 \\
(E) & \quad \text{None of these}
\end{align*}
\]

(ii) Find \( C(5) \).

(iii) Interpret \( C(5) \) in the context of the problem.
10. The Dispatch Tool Works spends $9000 to produce 130 parts, achieving a marginal cost of $60. Find the linear cost function $C(x)$, where $x$ is the number of parts produced.

(A) $C(x) = 130x + 60$    
(B) $C(x) = 130x + 9000$    
(C) $C(x) = 60x + 1200$

(D) $C(x) = 60x + 9000$    
(E) None of these
11. The manager of a restaurant found that the cost to produce 300 cups of coffee is $28.95, while the cost to produce 600 cups is $56.55. Assume the cost $C(x)$ is a linear function of $x$, the number of cups produced. Answer parts (i) through (iii).

(i) Find the total cost of producing 1100 cups. The total cost is

(A) less than $90  
(B) between $90 and $100  
(C) between $100 and $110  
(D) between $110 and $120  
(E) more than $120

(ii) Find the marginal cost of a cup of coffee. The marginal cost is

(A) less than $0.10  
(B) between $0.10 and $0.20  
(C) between $0.20 and $0.30  
(D) between $0.30 and $0.40  
(E) more than $0.40

(iii) What does the marginal cost of a cup of coffee mean to the manager?

(A) The marginal cost of a cup of coffee is the cost of producing a given number of cups.  
(B) The marginal cost of a cup of coffee is the cost of producing the first cup.  
(C) The marginal cost of a cup of coffee is the cost of producing one additional cup.  
(D) The marginal cost of a cup of coffee is the cost of producing zero cups.  
(E) None of these.
12. A product has a production cost function \( C(x) = 460x + 6670 \) and a revenue function \( R(x) = 575x \). Find the break-even quantity.

The break-even quantity is

(A) between 20 units and 30 units

(B) between 30 units and 40 units

(C) between 40 units and 50 units

(D) between 50 units and 60 units

(E) between 60 units and 70 units

13. Joanne sells silk-screened T-shirts at community festivals and craft fairs. Her marginal cost to produce one T-shirt is $3.50. Her total cost to produce 42 T-shirts is $245, and she sells them for $7 each. How many T-shirts must she produce and sell in order to break even?

To break even, Joanne must produce and sell

(A) less than 25 T-shirts

(B) between 25 and 30 T-shirts

(C) between 30 and 35 T-shirts

(D) between 35 and 40 T-shirts

(E) more than 40 T-shirts
14. Let one week’s supply and demand functions for gasoline be given by

\[ p = D(q) = 300 - \frac{2}{5}q \]  and  \[ p = S(q) = \frac{4}{5}q, \]

where \( p \) is the price in dollars and \( q \) is the number of 42-gallon barrels. Answer parts (i) and (ii) below.

(i) Graph these equations on the same axes.

(ii) Find the equilibrium price.
15. Find the domain of the function \( f(x) = \frac{3}{x^2 - 4} \).

(A) \((-\infty, -2) \cup (-2, 2) \cup (2, \infty)\)  
(B) \((-\infty, \infty)\)  
(C) \((2, \infty)\)  
(D) \((-\infty, 0) \cup (0, \infty)\)  
(E) None of these
16. Let
\[ f(x) = \begin{cases} 
2x + 2 & \text{if } x \neq 9 \\
\frac{2}{x - 9} & \text{if } x = 9 \\
2 & \text{if } x = 9
\end{cases} \]

Answer parts (i) through (iii)

(i) Find the value of \( f(9) \). The value of \( f(9) \) is

(A) less than -1
(B) between -1 and 1
(C) between 1 and 3
(D) between 3 and 5
(E) more than 5

(ii) Find the value of \( f\left(-\frac{1}{2}\right) \). The value of \( f\left(-\frac{1}{2}\right) \) is

(A) between -3 and -1
(B) between -1 and 1
(C) between 1 and 3
(D) between 3 and 5
(E) between 5 and 7

(iii) Find the value of \( x \) such that \( f(x) = 1 \). The value of \( x \) is

(A) less than -5
(B) between -5 and 5
(C) between 5 and 15
(D) between 15 and 25
(E) more than 25
17. The graph of $g(x)$ is given below

Answer parts (i) through (iii)

(i) Find the value of $g(3)$.

(ii) Find the slope of $g(x)$ at $x = 1$.

(iii) Find the value(s) of $x$ such that $g(x) = 0$. 
18. Income tax brackets often take the form of piecewise linear functions. Consider the 2010 U.S. Rate Schedule for single persons, showing the income tax owed, $T$, as a function of adjusted income, $i$.

\[
T = \begin{cases} 
0.10i & \text{for } 0 \leq i \leq 8,375 \\
0.15(i - 8375) + 837.50 & \text{for } 8,375 < i \leq 34,000 \\
0.25(i - 34000) + 4,681.25 & \text{for } i > 34,000 
\end{cases}
\]

(i) If a single person earns an adjusted income of $30,000, how much income tax would the person owe?

(ii) If a person owes $3000 in income tax, what was their adjusted income?
19. Consider the parabola \( y = 2x^2 + 8x - 4 \).

Answer parts (i) through (iii)

(i) Find the vertex of the parabola. The \( x \)-coordinate of the vertex is

- (A) between -5 and -1
- (B) between -1 and 3
- (C) between 3 and 7
- (D) between 7 and 11
- (E) between 11 and 15

(ii) The \( y \)-coordinate of the vertex is

- (A) less than -10
- (B) between -10 and -5
- (C) between -5 and 0
- (D) between 0 and 5
- (E) more than 5

(iii) The vertex is

- (A) a maximum
- (B) a minimum
- (C) neither a max nor a min
20. Graph the function \( y = 2x^2 + 6x - 2 \) below. Give the values of the \( x \)-intercepts, the \( y \)-intercept, and the vertex.

\[ x \text{-intercepts:} \]

\[ y \text{-intercept:} \]

\[ \text{vertex:} \]
21. Let $C(x) = 3x + 4$ be the cost, in dollars, to produce $x$ widgets, and let $R(x) = -x^2 + 8x$ be the revenue, in dollars, from selling $x$ widgets. Answer parts (i) through (iii)

(i) Graph both functions. Choose the correct graph of both functions below.

(ii) Find the minimum break-even quantity. The minimum break-even quantity is

(A) less than 0.5  
(B) between 0.5 and 1.5  
(C) between 1.5 and 2.5  
(D) between 2.5 and 3.5  
(E) more than 3.5

(iii) Find the maximum profit. The maximum profit is

(A) between -$0.50$ and $0.50$  
(B) between $0.50$ and $1.50$  
(C) between $1.50$ and $2.50$  
(D) between $2.50$ and $3.50$  
(E) between $3.50$ and $4.50
22. The manager of a 60-unit apartment complex is trying to decide what rent to charge. Experience has shown that at a rent of $900, all the units will be full. On the average, one additional unit will remain vacant for each $50 increase in rent.

(i) Let \( x \) represent the number of $50 increases. Find an expression for the total revenue from all rented apartments.

(ii) What value of \( x \) leads to maximum revenue?

(iii) What is the maximum revenue?
23. A charter boat charges a fare of $120 per person plus $3 for each unsold seat on the boat. The boat holds 80 passengers. Let \( x \) represent the number of unsold seats. Answer parts (i) and (ii)

(i) Find an expression for the total revenue received for the boat.

(A) Revenue = 9600 + 3\( x \)  
(B) Revenue = (120 + 3\( x \))(80 - \( x \))  
(C) Revenue = 80(120 + 3\( x \))  
(D) Revenue = 120\( x \) + 3\( x \)(80 - \( x \))  
(E) None of these

(ii) Find the maximum revenue. The maximum revenue is

(A) between $8,000 and $9,000  
(B) between $9,000 and $10,000  
(C) between $10,000 and $11,000  
(D) between $11,000 and $12,000  
(E) between $12,000 and $13,000
24. The graph below is the graph of a polynomial. Give the possible degree of the polynomial, and give the sign (positive or negative) of the leading coefficient.

(A) degree 4 with negative leading coefficient  
(B) degree 4 with positive leading coefficient  
(C) degree 5 with negative leading coefficient  
(D) degree 5 with positive leading coefficient  
(E) None of the above
25. Let \( y = \frac{3 - 2x}{2x + 17} \). Answer parts (i) through (iii)

(i) What is the vertical asymptote?

(A) \( x = -1 \)  
(B) \( x = -\frac{17}{2} \)  
(C) \( y = \frac{3}{2} \)

(D) \( y = -1 \)  
(E) There is no vertical asymptote

(ii) What is the horizontal asymptote?

(A) \( x = -1 \)  
(B) \( x = -\frac{17}{2} \)  
(C) \( y = \frac{3}{2} \)

(D) \( y = -1 \)  
(E) There is no horizontal asymptote

(iii) Graph the function. Choose the correct graph below.
26. Suppose a cost-benefit model is given by

\[ y = \frac{6.6x}{100 - x} \]

where \( x \) is a number of percent and \( y \) is the cost, in thousands of dollars, of removing \( x \) percent of a given pollutant.

(i) Find the cost of removing 95% of the given pollutant.

(ii) Is it possible, according to this function, to remove all the pollutant?

(iii) Graph the function.
27. Graph the function $f(x) = 5 - 2^{-x}$. Choose the correct graph.

28. Solve for $x$:

$$e^{-3x} = (e^8)^{2-x}.$$

$x$ is

(A) between 1 and 2  
(B) between 2 and 3  
(C) between 3 and 4

(D) between 4 and 5  
(E) between 5 and 6
29. Leigh Jacks plans to invest $6,000 into a money market account. Find the interest rate that is needed for the money to grow to $45,000 in 30 years if the interest is compounded quarterly.

The interest rate is

(A) between 6.65% and 6.75%  (B) between 6.75% and 6.85%

(C) between 6.85% and 6.95%  (D) between 6.95% and 7.05%

(E) between 7.05% and 7.15%

30. An item costs $5000 today. What will the item cost in 6 years assuming an inflation rate of 4.2% compounded continuously?

It will cost

(A) between $6424 and $6426  (B) between $6426 and $6428  (C) between $6428 and $6430

(D) between $6430 and $6432  (E) between $6432 and $6434
31. Find the interest earned on $25,000 invested for 3 years at 4\% interest compounded as follows.

(i) Annually:

(ii) Monthly:

(iii) Continuously:
32. Use natural logarithms to evaluate \( \log_6 50 \).

\( \log_6 50 \) is

(A) between 1 and 2  
(B) between 2 and 3  
(C) between 3 and 4

(D) between 4 and 5  
(E) between 5 and 6

33. Solve for \( x \):

\[ 3^{2x-1} = 187. \]

\( x \) is

(A) between 1 and 2  
(B) between 2 and 3  
(C) between 3 and 4

(D) between 4 and 5  
(E) between 5 and 6

34. May Klingman invests $15,000 in an account paying 3% per year, compounded quarterly. How many years are required for the compound amount to at least double?

The time it takes for the compound amount to at least double is

(A) less than 5 years  
(B) between 5 and 10 years  
(C) between 10 and 15 years

(D) between 15 and 20 years  
(E) more than 20 years
35. What is the difference between stated interest rate and effective rate? Choose the correct answer below.

(A) The stated interest rate is the rate used to calculate future value based on the present value. The effective interest rate is the rate used to calculate present value based on future value.

(B) The stated interest rate is the percentage per compounding period. The effective interest rate is the stated interest rate multiplied by the number of compounding periods.

(C) The stated interest rate is the annual interest rate before adjusting for compounding. The effective interest rate is the actual percentage increase after compounding.

(D) The stated interest rate is the annual yield. The effective interest rate is the yield from continuous compounding.

36. Find the effective rate corresponding to a nominal rate of 9% compounded continuously.

The effective rate is

(A) between 9.1% and 9.2%  (B) between 9.2% and 9.3%  (C) between 9.3% and 9.4%

(D) between 9.4% and 9.5%  (E) between 9.5% and 9.6%
37. Find the effective rate corresponding to a nominal rate of 5.3% compounded quarterly.
The effective rate is

(A) less than 5.3%       (B) between 5.3% and 5.5%       (C) between 5.5% and 5.7%
(D) between 5.7% and 5.9%  (E) more than 5.9%

38. Frank Steek must make a balloon payment of $25,000 in 7 years. Find the present value of the payment if it includes annual interest of 5.2% compounded monthly.
The present value is

(A) less than $17,350       (B) between $17,350 and $17,375
(C) between $17,375 and $17,400       (D) between $17,400 and $17,425
(E) more than $17,425

39. Southwest Dry Cleaners believes that it will need new equipment in 11 years. The equipment will cost $175,000. What lump sum should be invested today at 4.21% compounded continuously, to yield $175,000?
The lump sum is

(A) between $109,800 and $109,900       (B) between $109,900 and $110,000
(C) between $110,000 and $110,100       (D) between $110,100 and $110,200
(E) between $110,200 and $110,300
40. Christine O’Brien, who is self-employed, wants to invest $80,000 in a pension plan. One investment offers 6% compounded quarterly. Another offers 5.75% compounded continuously.

(i) Which investment will earn the most interest in 4 years?

(ii) How much more will the better plan earn?

(iii) What is the effective rate in each case?

(iv) If Ms. O’Brien chooses the plan with continuous compounding, how long will it take for her $80,000 to grow to $90,000? (Round to two decimal places.)
41. Sales of a new model of compact disc player are approximated by the function

\[ S(x) = 1100 - 800e^{-x} , \]

where \( S(x) \) is in appropriate units and \( x \) represents the number of years the disc player has been on the market.

(i) Find the sales during year 0.

(ii) In how many years will sales reach 900 units? (Round to two decimal places.)

(iii) Will sales ever reach 1,100 units?

(iv) Is there a limit on sales for this product? If so, what is it?
42. Use the table of values to answer parts (i) and (ii).

<table>
<thead>
<tr>
<th>$x$</th>
<th>6.9</th>
<th>6.99</th>
<th>6.999</th>
<th>6.9999</th>
<th>7</th>
<th>7.0001</th>
<th>7.001</th>
<th>7.01</th>
</tr>
</thead>
<tbody>
<tr>
<td>$f(x)$</td>
<td>9.9</td>
<td>9.99</td>
<td>9.999</td>
<td>9.9999</td>
<td>18</td>
<td>10.001</td>
<td>10.001</td>
<td>10.01</td>
</tr>
</tbody>
</table>

(i) Estimate $\lim_{x \to 7} f(x)$.

(A) 7  
(B) 10  
(C) 9.9  
(D) 18  
(E) the limit does not exist

(ii) Evaluate $f(7)$.

(A) 7  
(B) 10  
(C) 9.9  
(D) 18  
(E) the value does not exist

43. Suppose $\lim_{x \to 5^-} f(x) = 9$, and $\lim_{x \to 5^+} f(x) = 9$, but $f(5)$ does not exist. What can you say about $\lim_{x \to 5} f(x)$?

(A) $\lim_{x \to 5^-} f(x) = 9$  
(B) $\lim_{x \to 5^+} f(x) = -9$  
(C) $\lim_{x \to 5} f(x)$ does not exist

(D) $\lim_{x \to 5} f(x) = \infty$  
(E) None of these
44. Let \( f(x) = \frac{x^2 - 1}{x + 1} \). Answer parts (i) through (iii)

(i) Complete the table below.

<table>
<thead>
<tr>
<th>( x )</th>
<th>-1.1</th>
<th>-1.01</th>
<th>-1.001</th>
<th>-0.999</th>
<th>-0.99</th>
<th>-0.9</th>
</tr>
</thead>
<tbody>
<tr>
<td>( x^2 - 1 )</td>
<td>( \frac{x^2 - 1}{x + 1} )</td>
<td>( \frac{x^2 - 1}{x + 1} )</td>
<td>( \frac{x^2 - 1}{x + 1} )</td>
<td>( \frac{x^2 - 1}{x + 1} )</td>
<td>( \frac{x^2 - 1}{x + 1} )</td>
<td>( \frac{x^2 - 1}{x + 1} )</td>
</tr>
</tbody>
</table>

(ii) Calculate \( \lim_{x \to -1} \frac{x^2 - 1}{x + 1} \).

(A) -2  (B) -1  (C) \( \infty \)  (D) 2  (E) the limit does not exist

(iii) Verify your answer by using a graphing calculator. Choose the correct graph below. The graph below is displayed on a \([-4, 4, 1]\) by \([-4, 4, 1]\) window.

[Graph options A, B, C, D]
45. Calculate \( \lim_{x \to -2} (x^2 - x + 4) \).

46. Calculate \( \lim_{x \to 3} \frac{x^2 - 9}{x - 3} \).

(A) \( \lim_{x \to 3} \frac{x^2 - 9}{x - 3} = 3 \)  
(B) \( \lim_{x \to 3} \frac{x^2 - 9}{x - 3} = 6 \)  
(C) \( \lim_{x \to 3} \frac{x^2 - 9}{x - 3} = 9 \)

(D) \( \lim_{x \to 3} \frac{x^2 - 9}{x - 3} = \infty \)  
(E) \( \lim_{x \to 3} \frac{x^2 - 9}{x - 3} \) does not exist
47. The graph of \( f(x) \) is given below.

Use the graph to find \( \lim_{x \to 3} f(x) \).

(A) 4    (B) 3    (C) 3.5    (D) 0    (E) the limit does not exist

48. Use the graph of \( f(x) = e^x \) below to find \( \lim_{x \to -\infty} e^x \).

(A) \( \lim_{x \to -\infty} e^x = e \)    (B) \( \lim_{x \to -\infty} e^x \) does not exist    (C) \( \lim_{x \to -\infty} e^x = \infty \)

(D) \( \lim_{x \to -\infty} e^x = 0 \)    (E) None of these
49. The graph of $f(x) = e^{-x} + 2$ is given below.

Use the graph to find $\lim_{x \to \infty} f(x)$, if it exists.

(A) the limit does not exist  (B) $\infty$  (C) 5  (D) 3  (E) 2

50. Find $\lim_{x \to \infty} \frac{3}{2x - 1}$.

(A) $\lim_{x \to \infty} \frac{3}{2x - 1} = \frac{3}{2}$  (B) $\lim_{x \to \infty} \frac{3}{2x - 1}$ does not exist  (C) $\lim_{x \to \infty} \frac{3}{2x - 1} = \infty$

(D) $\lim_{x \to \infty} \frac{3}{2x - 1} = 0$  (E) None of these
51. Find \( \lim_{x \to \infty} \frac{2x + 1}{3x - 4} \).

(A) \( \lim_{x \to \infty} \frac{2x + 1}{3x - 4} = \frac{2}{3} \)

(B) \( \lim_{x \to \infty} \frac{2x + 1}{3x - 4} \) does not exist

(C) \( \lim_{x \to \infty} \frac{2x + 1}{3x - 4} = \infty \)

(D) \( \lim_{x \to \infty} \frac{2x + 1}{3x - 4} = 0 \)

(E) None of these
52. Let \( f(x) = 7x^3 + 7 \). Answer parts (i) through (iii)

(i) Find the average rate of change of the function \( f(x) = 7x^3 + 7 \) over the interval \([5, 7]\).

The average rate of change is

(A) less than 600  (B) between 600 and 650  (C) between 650 and 700

(D) between 700 and 750  (E) more than 750

(ii) Find the average rate of change of the function \( f(x) = 7x^3 + 7 \) over the interval \([-1, 1]\).

The average rate of change is

(A) less than -10  (B) between -10 and 0  (C) between 0 and 10

(D) between 10 and 20  (E) more than 20

(iii) Find the instantaneous rate of change of the function \( f(x) = 7x^3 + 7 \) at \( x = 5 \).

The instantaneous rate of change is

(A) less than 600  (B) between 600 and 650  (C) between 650 and 700

(D) between 700 and 750  (E) more than 750
53. Find the instantaneous rate of change of \( g(t) = 5 - t^2 \) at \( t = -5 \).

The instantaneous rate of change is

(A) less than -15  
(B) between -15 and -5  
(C) between -5 and 5  
(D) between 5 and 15  
(E) more than 15

54. Suppose customers in a hardware store are willing to buy \( N(p) \) boxes of nails at \( p \) dollars per box, as given by

\[
N(p) = 80 - 5p^2; \quad 1 \leq p \leq 4.
\]

Find the instantaneous rate of change of demand when the price is $2.

The instantaneous rate of change of demand when the price is $2 is

(A) less than -15  
(B) between -15 and -5  
(C) between -5 and 5  
(D) between 5 and 15  
(E) more than 15
55. Use the graph below to estimate the average rate of change of the percentage of new employees from 2000 to 2006.

The average rate of change is

(A) between 0% and 1% per year
(B) between 1% and 2% per year
(C) between 2% and 3% per year
(D) between 3% and 4% per year
(E) between 4% and 5% per year
56. Suppose that the total profit in hundreds of dollars from selling $x$ items is given by $P(x) = 2x^2 - 7x + 5$. Answer parts (i) through (iii)

(i) Find the average rate of change of profit as $x$ changes from 3 to 5.

The average rate of change is

(A) less than $650 per item  
(B) between $650 and $750 per item  
(C) between $750 and $850 per item  
(D) between $850 and $950 per item  
(E) more than $950 per item

(ii) Find and interpret the instantaneous rate of change of profit with respect to the number of items produced when $x = 3$. (This number is called the marginal profit at $x = 3$.)

(A) When items are sold for $500, the profit is decreasing at the rate of $3 per item.

(B) When items are sold for $500, the profit is increasing at the rate of $3 per item.

(C) When 3 items are sold, the profit is increasing at the rate of $500 per item.

(D) When 3 items are sold, the profit is decreasing at the rate of $500 per item.

(E) None of these.

(iii) Find the marginal profit when 5 items are sold.

The marginal profit is

(A) less than $650 per item  
(B) between $650 and $750 per item  
(C) between $750 and $850 per item  
(D) between $850 and $950 per item  
(E) more than $950 per item
57. Estimate the slope of the tangent line to the curve at the point \((-3, 2)\).

The slope is

(A) less than \(-\frac{1}{2}\)  
(B) between \(-\frac{1}{2}\) and 0  
(C) between 0 and \(\frac{1}{2}\)

(D) between \(\frac{1}{2}\) and 1  
(E) more than 1

58. Find \(f'(3)\) for the function \(f(x) = 2e^x\), if the derivative exists.

\(f'(3)\) is

(A) less than 35  
(B) between 35 and 45  
(C) between 45 and 55

(D) more than 55  
(E) does not exist
59. List the points in the graph in the interval \(-1 < x < 6\) at which the function is not differentiable.

(A) \(x = 1\) only
(B) \(x = 1, x = 3, x = 5\)
(C) \(x = 1, x = 3\) only
(D) \(x = 5\) only
(E) None of these
60. For the function shown in the graph below, answer parts (i) through (iii)

(i) Choose the interval(s) on which the rate of change is positive.

(A) \((-\infty, 2)\) and \((4, \infty)\)  
(B) \((2, 5)\) only  
(C) \((5, \infty)\) only  
(D) \((4, \infty)\) only  
(E) \((2, 4)\) only

(ii) Choose the interval(s) on which the rate of change is negative.

(A) \((-\infty, 2)\) and \((4, \infty)\)  
(B) \((2, 5)\) only  
(C) \((5, \infty)\) only  
(D) \((4, \infty)\) only  
(E) \((2, 4)\) only

(iii) Choose the values at which the rate of change is 0.

(A) \(x = 2\) only  
(B) \(x = 2\) and \(x = 4\)  
(C) \(x = 2\) and \(x = 5\)  
(D) \(x = 5\) only  
(E) None of these
61. Suppose the demand for a certain item is given by \( D(p) = -3p^2 - 5p + 200 \), where \( p \) represents the price of the item in dollars. Answer parts (i) and (ii)

(i) Find the rate of change of demand with respect to price. The rate of change with respect to price is

(A) \(-6p - 5\)  \hspace{1cm} (B) \(-3p^2 - 5p + 200\)  \hspace{1cm} (C) \(-3p\)

(D) \(-6p + 195\)  \hspace{1cm} (E) None of these

(ii) The rate of change of demand when the price is $11 is -71. Choose the correct interpretation below.

(A) When the price is $11, demand is decreasing at a rate of about 71 items for each increase in price of $11.

(B) When the price is $11, demand is increasing at a rate of about 71 items for each increase in price of $11.

(C) When the price is $11, demand is increasing at a rate of about 71 items for each increase in price of $1.

(D) When the price is $11, demand is decreasing at a rate of about 71 items for each increase in price of $1.
62. For \( f(x) = x^2 + x \), find the equation of the tangent line when \( x = -4 \).

The tangent line is

(A) \( y = -4(x - 7) + 12 \)  \quad (B) \( y = -7(x - 4) - 20 \)  \quad (C) \( y = -4(x + 7) - 20 \)

(D) \( y = -7(x + 4) + 12 \)  \quad (E) does not exist

63. The cost of recycling \( q \) tons of paper is given in the following table.

<table>
<thead>
<tr>
<th>( q ) (tons)</th>
<th>1000</th>
<th>1500</th>
<th>2000</th>
<th>2500</th>
<th>3000</th>
<th>3500</th>
</tr>
</thead>
<tbody>
<tr>
<td>( C(q) ) (dollars)</td>
<td>2500</td>
<td>3200</td>
<td>3640</td>
<td>4060</td>
<td>4270</td>
<td>4415</td>
</tr>
</tbody>
</table>

Estimate the marginal cost at \( q = 2000 \).

(A) between $0.00 per ton and $1.00 per ton  \quad (B) between $1.00 per ton and $2.00 per ton

(C) between $2.00 per ton and $3.00 per ton  \quad (D) between $3.00 per ton and $4.00 per ton

(E) between $4.00 per ton and $5.00 per ton
Let \( f(x) = x^2 - 2x \). We will work through the 4-step process for finding the derivative \( f'(x) \).

(i) Evaluate \( f(x + h) \).

(A) \( f(x + h) = x^2 + h^2 - 2x - 2h \)

(B) \( f(x + h) = x^2 + xh + h^2 - 2x - 2h \)

(C) \( f(x + h) = x^2 + 2xh + h^2 - 2x - 2h \)

(D) \( f(x + h) = 2x + 2h - 2 \)

(E) \( f(x + h) = x^2 - 2x + h \)

(ii) Simplify \( f(x + h) - f(x) \).

(A) \( f(x + h) - f(x) = h \)

(B) \( f(x + h) - f(x) = 2xh + h^2 - 2h \)

(C) \( f(x + h) - f(x) = h^2 - 2h \)

(D) \( f(x + h) - f(x) = xh + h^2 - 2h \)

(E) \( f(x + h) - f(x) = 2h \)

(iii) Simplify \( \frac{f(x + h) - f(x)}{h} \).

(A) \( \frac{f(x + h) - f(x)}{h} = 2x + h - 2 \)

(B) \( \frac{f(x + h) - f(x)}{h} = 2xh - 2h + h^2 \)

(C) \( \frac{f(x + h) - f(x)}{h} = x^2 + h - 2x - 2 \)

(D) \( \frac{f(x + h) - f(x)}{h} = h - 2 \)

(E) \( \frac{f(x + h) - f(x)}{h} = 2 \)

(iv) Evaluate \( \lim_{h \to 0} \frac{f(x + h) - f(x)}{h} \).

(A) \( \lim_{h \to 0} \frac{f(x + h) - f(x)}{h} = -2 \)

(B) \( \lim_{h \to 0} \frac{f(x + h) - f(x)}{h} = 0 \)

(C) \( \lim_{h \to 0} \frac{f(x + h) - f(x)}{h} = -2x - 2 \)

(D) \( \lim_{h \to 0} \frac{f(x + h) - f(x)}{h} = 2 \)

(E) \( \lim_{h \to 0} \frac{f(x + h) - f(x)}{h} = 2x - 2 \)

(v) What is \( f'(x) \)?

(A) \( f'(x) = -2 \)

(B) \( f'(x) = 0 \)

(C) \( f'(x) = 2x - 2 \)

(D) \( f'(x) = 2 \)

(E) \( f'(x) = -2x - 2 \)
65. If \( f(x) = x^2 + 3 \), use the definition of the derivative to find \( f'(x) \).
Formulas You Might Find Useful

\[ I = Prt \]

\[ A = P \left( 1 + \frac{r}{m} \right)^{mt} \]

\[ A = Pe^{rt} \]

\[ r_E = \left( 1 + \frac{r}{m} \right)^{m} - 1 \]

\[ r_E = e^r - 1 \]

\[ f'(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h} \]
1. A
2. C
3. B
4. D
5. C
6. B
7. A
8. (i) \( P = 26.9t + 1241 \)
   (ii) World grain production increased at a rate of 26.9 million tons per year from 1975 to 2005.
   (iii) In late 2021
9. (i) B
   (ii) $66.25
   (iii) It will cost $66.25 to rent a snowboard for 5 hours.
10. C
11. (i) C
    (ii) A
    (iii) C
12. D
13. B
14. (i)
    (ii) $200
15. A
16. (i) C
    (ii) B
    (iii) A
17. (i) -1/2
    (ii) \(-1/2\)
    (iii) \(x = 2, x = 4\)
18. (i) $4081.25
    (ii) $22,791.67
19. (i) A
    (ii) A
    (iii) B
20.

x-intercepts: $\approx -3.30 \& 0.30$

y-intercept: -2

vertex: $(-1.5, -6.5)$

21. (i) A
   (ii) B
   (iii) C

22. (i) Total Revenue = $(900 + 50x)(60 - x)$
   (ii) 21
   (iii) $76,050$

23. (i) B
   (ii) C

24. B

25. (i) B
   (ii) D
   (iii) A

26. (i) $125,400$
   (ii) No
   (iii) A

27. A

28. C

29. B

30. E

31. (i) $3121.60$
   (ii) $3181.80$
   (iii) $3187.42$

32. B
33. B
34. E
35. C
36. D
37. B
38. C
39. D

40. (i) 6% compounded quarterly
   (ii) $830.84
   (iii) 6% compounded quarterly: 6.14%, 5.75% compounded continuously: 5.92%
   (iv) 2.05 years

41. (i) 300 units
   (ii) 1.39 years
   (iii) No
   (iv) 1100 units

42. (i) B
   (ii) D

43. A

44. (i) \[
\begin{array}{c|cccccc}
  x & -1.1 & -1.01 & -1.001 & -0.999 & -0.99 & -0.9 \\
  \frac{x^2 - 1}{x + 1} & -2.1 & -2.01 & -2.001 & -1.999 & -1.99 & -1.9 \\
\end{array}
\]
   (ii) A
   (iii) B

45. 10
46. B
47. E
48. D
49. E
50. D
51. A
52. (i) E
   (ii) C
   (iii) A

53. D
54. A
55. A
56. (i) D  
    (ii) C  
    (iii) E  
57. C  
58. B  
59. $x = 1, 3, 5$  
60. (i) A  
    (ii) E  
    (iii) B  
61. (i) A  
    (ii) D  
62. D  
63. A  
64. (i) C  
    (ii) B  
    (iii) A  
    (iv) E  
    (v) C  
65. \[ f'(x) = \lim_{h \to 0} \frac{(x+h)^2 + 3 - (x^2 + 3)}{h} = \lim_{h \to 0} \frac{x^2 + 2xh + h^2 + 3 - (x^2 + 3)}{h} \]
    \[= \lim_{h \to 0} \frac{2xh + h^2}{h} = \lim_{h \to 0} (2x + h) = 2x \]