CHAPTER 2

1. Find the following limit without using a graphing calculator or making a table:
\[ \lim_{x \to 3} (3x^2 - 8x + 1) \] 2.1.13

2. Find the following limit without using a graphing calculator or making a table:
\[ \lim_{t \to 49} (t + 3)t^{-1/2} \] 2.1.19

3. Find the following limit without using a graphing calculator or making a table:
\[ \lim_{x \to (-2)} \frac{2x^3 - 4x^2 - 16x}{x^2 + 2x} \] 2.1.27

4. For the piecewise linear function \( f(x) \) graphed below, find the following:

\[ \begin{align*}
\lim_{x \to 2^-} f(x) &= \underline{\phantom{0000}} \\
\lim_{x \to 2^+} f(x) &= \underline{\phantom{0000}} \\
\lim_{x \to 2} f(x) &= \underline{\phantom{0000}} 
\end{align*} \] 2.1.33
5. Use limits involving $\pm \infty$ to describe the asymptotic behavior of the function $f(x) = \frac{1}{3-x}$ from its graph.

\[ \lim_{x \to \infty} f(x) = \ldots \]
\[ \lim_{x \to -\infty} f(x) = \ldots \]
\[ \lim_{x \to 3} f(x) = \ldots \]

6. The temperature in an industrial pasteurization tank is $f(x) = x^2 - 6x + 103$ degrees centigrade after $x$ minutes (for $0 \leq x \leq 12$).

a. Find $f'(x)$ by using the definition of the derivative.

b. Use your answer to part (a) to find the instantaneous rate of change of the temperature after 2 minutes.

c. Use your answer to part (a) to find the instantaneous rate of change of the temperature after 9 minutes.

7. Find the derivative of the function $f(x) = \frac{1}{10} x^5 + \frac{1}{8} x^2 + x + 1$.

8. Find the derivative of the function $f(x) = \frac{x^6 + x^8}{x}$.

9. Find the indicated derivative. Round your answer to two decimal places.

If $f(x) = \frac{14}{\sqrt{x}} + 2\sqrt{x}$ find $\frac{df}{dx}$ when $x = 25$.

10. Find the equation of the tangent line to $f(x) = x^3 - 2x^2 + 3x - 2$ at $x = 1$.

11. Find the derivative of the function. Simplify your answer. $f(x) = (x^7 + 1)(x^7 - 1)$.

12. Find the derivative of the function. Simplify your answer. $f(x) = x^3(x^2 + 5x - 9)$.
13. Find the derivative of the function. Simplify your answer. \( f(t) = 5t^{6/5} \left( 9t^{4/5} + 2 \right) \).  

14. Find the derivative of the function. Simplify your answer. \( f(x) = \frac{x^8 + 1}{x^7} \).  

15. Find the derivative of the function. Simplify your answer. \( f(x) = \frac{x^6 + x^2 + 1}{x^3 + 1} \).  

16. A rocket can rise to a height of \( h(t) = t^3 + 0.7t^2 \) feet in \( t \) seconds.
   
   a. Find its velocity after 8 seconds. Round your answer to the nearest whole number.
   b. Find its acceleration after 8 seconds. Round your answer to the nearest whole number.  

17. Find the derivative of the function \( g(x) = (3x^5 - 8x + 9)^3 \).  

18. Find the derivative of the function \( f(x) = \sqrt{x^4 - 6x + 1} \).  

19. For the function graphed below, find the \( x \)-values at which the derivative does not exist. 

![Graph](image1)

20. For the function graphed below, find the \( x \)-values at which the derivative does not exist. 

![Graph](image2)

CHAPTER 3

1. Find the interval(s) where the function is increasing and the intervals where it is decreasing for \( f(x) = 3x^4 - 8x^3 + 6x^2 \).  

2. Find the relative maxima and relative minima, if any, of the function \( f(x) = x^3 - 3x^2 - 9x + 10 \).  

3. For the function \( f(x) = x(x - 9)^2 \), complete the following:
   
   a. Make a sign diagram for the first derivative.
   b. Make a sign diagram for the second derivative.  

4. For the function \( f(x) = x^4 - 4x^3 + 4x^2 + 9 \), find all critical numbers and then use the second-derivative test to determine whether the function has a relative maximum or minimum at each critical number.  

5. Determine where the function \( g(x) = x^3 + 3x^2 - 9x + 5 \) is concave upward and where it is concave downward.
6. Find the inflection point(s), if any, of the function \( g(x) = x^4 + 4x^3 + 15 \).

7. The average pollen count on a certain city on day \( x \) of the pollen season is \( P(x) = 8x - 0.2x^2 \) for \( (0 < x < 40) \). On what day is the pollen count highest?

8. A farmer wants to make three identical rectangular enclosures along a straight river, as in the diagram shown below. If he has 1200 yards of fencing, and if the sides along the river need no fence, what should be the dimensions of each enclosure if the total area is to be maximized?

![Diagram of three enclosures along a river]

9. An open box is to be made from a twelve-inch by twelve-inch square piece of material by cutting equal squares from the corners and turning up the sides. Find the volume of the largest box that can be made.

![Diagram of an open box]

10. An airline finds that if it prices a cross-country ticket at $900, it will sell 300 tickets per day. It estimates that each $30 price reduction will result in 50 more tickets sold per day. Find the ticket price and the number of tickets sold that will maximize the airline’s revenue.

11. For the equation \( y^4 - x^3 = 8x \), use implicit differentiation to find \( \frac{dy}{dx} \).

12. For the equation \( x(y - 6)^2 = 7 \) use implicit differentiation to find \( \frac{dy}{dx} \).

13. A company’s revenue from selling \( x \) units of an item is given as \( R = 1000x - x^2 \) dollars. If sales are increasing at the rate of 80 per day, find how rapidly revenue is growing (in dollars per day) when 390 units have been sold.

14. The radius of a spherical tumor is growing by \( \frac{1}{2} \) centimeter per week. Find how rapidly the volume is increasing at the moment when the radius is 4 centimeters.
CHAPTER 4

1. Find the derivative of the function: $f(x) = x^6 \ln(x)$ 4.3.1

2. Find the derivative of the function: $f(x) = \frac{e^x}{x^8}$ 4.3.11

3. Find the derivative of the function: $f(x) = \ln(x^9 + 1) - 6e^{x/2} - x$ 4.3.27

4. Find the derivative of the function: $f(t) = \sqrt{t^8 + 6\ln(t)}$ 4.3.37

5. The weekly sales (in thousands) of a new product are predicted to be $S(x) = 700 - 600e^{-0.1x}$ after $x$ weeks. Find the rate of change of sales after the following amounts of time. (Round your answers to one decimal place.)
   a. 1 week
   b. 7 weeks

6. If the national debt of a country (in trillions of dollars) $t$ years from now is given by the indicated function, find the relative rate of change of the debt 10 years from now. (Round your answer to three decimal places.)
   $N(t) = 0.4 + 1.2e^{0.01t}$ 4.4.13

7. For the demand function $D(p) = 2600 - p^2$,
   a. find the elasticity of demand.
   b. Determine whether the demand is elastic, inelastic, or unit-elastic at the price $p = 30$.

8. For the demand function $D(p) = 2000e^{-0.04p}$,
   a. find the elasticity of demand.
   b. Determine whether the demand is elastic, inelastic, or unit-elastic at the price $p = 30$.

9. The manager of a city bus line estimates the demand function to be
   $D(p) = 170,000\sqrt{2.5 - p}$, where $p$ is the fare in dollars. The bus line currently charges a fare of $1.50, and it plans to raise the fare to increase its revenues. Will this strategy succeed?

CHAPTER 5

1. Find the indefinite integral: $\int (24x^3 - 3x^2 + 8)dx$ 5.1.15

2. Find the indefinite integral: $\int \left(\frac{4}{x^2} + \frac{1}{\sqrt{x}}\right)dx$ 5.1.23

3. Find the indefinite integral: $\int \frac{x^2-49}{x+7}dx$ 5.1.37

4. A company’s marginal cost function is $MC = 10x^{3/2} - 15x^{2/3} + 6$, where $x$ is the number of units, and fixed costs are $1000$. Find the cost function, $C(x)$.

5. Find the indefinite integral: $\int \frac{5}{4v}dv$ 5.2.17

6. Find the indefinite integral: $\int (4e^{2x} - 8x)dx$ 5.2.19
7. Find the indefinite integral: \[ \int \left( e^{2x} - \frac{2}{x} \right) dx \]

8. Find the indefinite integral: \[ \int (x^6 + x + 1 + x^{-1} + x^{-6}) dx \]

9. A real estate investment, originally worth $5000, grows continuously at the rate of $600e^{0.04t}$ dollars per year, where \( t \) is the number of years since the investment was made.
   a. Find a formula \( V(t) \) for the value of the investment after \( t \) years.
   b. Use your formula to find the value of the investment after 9 years.
      (Round your answer to the nearest whole number.)

10. For the function, complete the following: \( f(x) = 6x \) from \( a = 2 \) to \( b = 3 \)
   a. Approximate the area under the curve from \( a \) to \( b \) by calculating a Riemann sum with 5 rectangles. Use the method described in Example 1 in the text, rounding to three decimal places.
   b. Find the exact area under the curve from \( a \) to \( b \).

11. Use a definite integral to find the area under the curve between the given \( x \)-values: \( f(x) = 8x^3 \) from \( x = 1 \) to \( x = 3 \)

12. Use a definite integral to find the area under the curve between the given \( x \)-values: \( f(x) = 8e^x \) from \( x = 0 \) to \( x = \ln(4) \)

13. Evaluate the definite integral: \[ \int_0^1 (x^{199} + x^{19} + 1) \, dx \]

14. On a hot summer afternoon, a city’s electricity consumption is \(-3t^2 + 18t + 10\) units per hour, where \( t \) is the number of hours after noon (\( 0 \leq t \leq 6 \)). Find the total consumption of electricity between the hours of 4 p.m. and 5 p.m.

15. The price of a double-dip ice cream cone is increasing at the rate of \( 18e^{0.06t} \) cents per year, where \( t \) is measured in years and \( t = 0 \) corresponds to 2000. Find the total change in price between the years 2000 and 2002. (Round your answer to two decimal places.)

16. Find the average value of the function over the given interval: \( f(x) = 52 - x^2 \) on \([-2, 2]\)

17. The amount of pollution in a lake \( x \) years after the closing of a chemical plant is \( P(x) = 200/x \) tons (for \( x \geq 1 \)). Find the average amount of pollution between 1 and 3 years after the closing. (Round your answer to one decimal place.)

18. Find the area bounded by the given curves: \( y = x^6 - 2 \) and \( y = 4 - 5x^2 \)

19. Find the area bounded by the given curves: \( y = 3x^2 \) and \( y = 12 \)
20. A country's annual imports are \( I(t) = 35e^{0.2t} \) and its exports are \( E(t) = 20e^{0.1t} \), both in billions of dollars, where \( t \) is measured in years and \( t = 0 \) corresponds to the beginning of 2000. Find the country's accumulated trade deficits (imports minus exports) for the 10 years beginning with 2000. (Round your answer to the nearest whole number.)

\[ \text{Imports: } I(t) = 35e^{0.2t} \]
\[ \text{Exports: } E(t) = 20e^{0.1t} \]

21. For the demand function \( d(x) \) and supply function \( s(x) \), complete the following:

\[ d(x) = 900 - 0.8x, \quad s(x) = 0.4x \]

a. Find the market demand.
b. Find the consumers' surplus at the market demand found in part a.
c. Find the producers' surplus at the market demand found in part a.

22. Find the indefinite integral:
\[ \int (x^5 - 20)^6 x^4 \, dx \]

23. Find the indefinite integral:
\[ \int \sqrt{z^7 + 128z^6} \, dz \]

24. Find the indefinite integral:
\[ \int \frac{x^5 + x^4}{5x^4 + 6x^2} \, dx \]

25. Evaluate the definite integral:
\[ \int_0^3 e^{x^2} x \, dx \]
(Round your answer to two decimal places.)

26. A real estate office is selling condominiums at the rate of \( 150e^{-x/4} \) per week after \( x \) weeks. How many condominiums will be sold during the first 8 weeks? (Round your answer to the nearest whole number.)

\[ \text{Rate of sale: } 150e^{-x/4} \]

CHAPTER 7

1. It costs an appliance company $220 to manufacture each washer and $160 to manufacture each dryer, and fixed costs are $4,400. Find the company's cost function \( C(x, y) \), using \( x \) and \( y \) for the numbers of washers and dryers, respectively.

\[ f(x, y) = 9x^2 - 8x^2y^2 - 7y^2 \]

2. For the function, evaluate the stated partials:

a. \( f_x(-1, 1) \)
b. \( f_y(-1, 1) \)

3. For the function \( f(x, y) = 9x^3 - 4x^2y^3 + 8y^4 \), find the second-order partials

a. \( f_{xx} \)
b. \( f_{xy} \)
c. \( f_{yx} \)
d. \( f_{yy} \)
4. For the function \( f(x,y) = ye^x - x \ln(y) \), find the second-order partials
   a. \( f_{xx} \)
   b. \( f_{xy} \)
   c. \( f_{yx} \)
   d. \( f_{yy} \)

5. An electronics company’s profit \( P(x,y) \) from making \( x \) DVD players and \( y \) CD players per day is given by
   \( P(x,y) = 4x^2 - 8xy + 8y^2 + 1036x + 75y + 250 \).
   a. Find the marginal profit function for DVD players.
   b. Evaluate your answer to part “a” at \( x = 200 \) and \( y = 300 \) and interpret the result.
   c. Find the marginal profit function for CD players.
   d. Evaluate your answer to part “c” at \( x = 200 \) and \( y = 100 \) and interpret the result.

6. Find the relative extreme values of the function:
   \( f(x,y) = x^2 + 2y^2 + 2xy + 2x + 4y + 5 \)

7. Find the relative extreme values of the function:
   \( f(x,y) = 3xy - 2x^2 - 2y^2 + 42x - 21y - 6 \)

8. A company manufactures two products. The price function for product A is \( p = 20 - \frac{1}{2} x \) (for \( 0 \leq x \leq 40 \)), and for product B is \( q = 37 - y \) (for \( 0 \leq y \leq 37 \)), both in thousands of dollars, where \( x \) and \( y \) are the amounts of products A and B, respectively. If the cost function is \( C(x,y) = 11x + 20y - xy + 4 \) thousands of dollars, find the quantities and the prices of the two products that maximize profit. Also find the maximum profit.

9. In order to treat a certain bacterial infection, a combination of two drugs is being tested. Studies have shown that the duration of the infection in laboratory tests can be modeled by the function shown below, where \( x \) is the dosage in hundreds of milligrams of the first drug and \( y \) is the dosage in hundreds of milligrams of the second drug.
   \( D(x,y) = x^2 + 7y^2 - 22x - 58y + 2xy + 119 \)
   Find the amount of each drug necessary to minimize the duration of the infection.

10. Use Lagrange multipliers to maximize the function \( f(x,y) = 2xy \) subject to the constraint \( x + 2y = 4 \).

11. Use Lagrange multipliers to maximize the function \( f(x,y) = 5x^2 - y^2 + 6 \) subject to the constraint \( 10x + y = 76 \).

12. A parking lot, divided into two equal parts, is to be constructed against a building, as shown in the diagram. Only 5400 feet of fence are to be used, and the side along the building needs no fence. What are the dimensions of the largest area that can be so enclosed? (This problem should be able to be solved by using Lagrange multipliers and by using the techniques from Chapter 3.)