1) Mary’s Fudge sells square bottomed tin containers of delicious holiday fudge. The sides and bottom of the tin cost $1 per square inch but the special lid costs $1.50 per square inch. Mary would like to sell her fudge in 80 cubic inch size containers. What are the dimensions of the tin which will minimize cost?

2) In a new book, the publisher wants the printed area of the page to be 24 square inches, with half-inch margins on the sides of the page, and one-inch margins on the top and bottom. However, the author wants the total page size to be as small as possible. What dimensions should the pages be?

3) A farmer wants to create a rectangular pasture that is separated for cows, horses, and pigs. All the sections will touch a river as one side. If the farmer has 2000 feet of fencing, what is the largest area the pastures can be?

4) The demand function for a particular item is \( p(x) = -\frac{1}{50}x + 20 \). It costs the company 10 dollars to make each item, and the operating cost of its factory is 1000 dollars each day.
   a) Find the profit function \( P(x) \).
   b) How much should the company sell its item for in order to maximize profit?
   c) What is the maximum profit in a day?

5) If it is know that for a given particle that the acceleration \( a(t) = 2t + 3 \) and the initial velocity \( v(0) = -4 \), where \( 0 \leq t \leq 3 \) then
   a) Find the velocity at time \( t \).
   b) Find the displacement traveled by the particle over the time interval.

6) Approximate \( 1.97^6 \) using differentials.

7) The radius of a circular sphere is given as 24 centimeters with a maximum error in measurement of 0.2 centimeters.
   a) Use differentials to estimate the maximum error in the calculated volume of the sphere.
   b) What is the relative error? What is the percentage error?

8) Find the absolute minimum and maximum values for each of the following functions.
   a) \( f(x) = \ln(x^2 + x + 1) \) over the interval \([-1,1]\)
   b) \( f(t) = t\sqrt{4 - t^2} \) over the interval \([-1,2]\)
9) The graph below represents the rate of change of a population of werewolves, \( W'(t) \) (in hundreds of werewolves) as a function of time, where \( t \) is measured in years. Use this graph to answer the following questions:

![Graph of \( W'(t) \)]

a) For what years after the first year and before the 7th year does the werewolf population reach a maximum? A minimum?

b) Depict number line charts for \( W' \) and \( W'' \). Use them to determine the intervals where \( W \) is increasing, decreasing, concave up, and concave down.

c) Give a possible graph for the werewolf population as a function of time.

10) How many inflection points does the function have over the entire real number line?
\[
g(x) = 3x^5 - 10x^4 + 10x^3
\]

11) If \( f''(x) = 3e^{2x} + 3x^2, f'(0) = 0 \) and \( f(0) = 1 \), find \( f(2) \).

12) Suppose the revenue for a company can be modeled by \( R(x) = x^3 - 6x^2 + 12x \) where \( x \) is the number of units sold for selling a particular product. The marginal cost corresponding to this product is given by \( C'(x) = 2x + 3 \). Find the Profit function for this product if you know the company takes a $400 loss for selling 10 units.

13) Suppose a particle, which for some reason only ever moves forward or backward in one direction, is traveling with a velocity given by the following function, \( v(t) = t^2 - 6t + 8 \). If the particle’s initial position was 2 units, what was the particle’s position when it was traveling the slowest between 1 second and 4 seconds? When is the particle speeding up or slowing down?

14) Evaluate all of the following integrals:

a) \( \int (\sqrt{x} - x)^2 \, dx \)

b) \( \int \frac{x}{x+2} \, dx \)

c) \( \int \frac{(1+2\ln u)^3}{u} \, du \)

d) \( \int \frac{4}{(2x+1)^3} \, dx \)

e) \( \int \frac{x+1}{x^2+2x+10} \, dx \)

f) \( \int e^x (1 + e^x)^3 \, dx \)

15) A small rocket consumes fuel at a rate given by \( \omega(t) = \frac{8+\sqrt{t}}{t^2} \), where \( \omega \) is measured in liters per minute and \( t \) is the number of minutes that have passed after liftoff. If 2 liters have been consumed after 1 minute, how many liters will be consumed after 4 minutes?