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) 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?

4) 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:

   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.

5) 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]\]

6) How many inflection points does the function have over the entire real number line? Where are they?
\[ g(x) = 3x^5 - 10x^4 + 10x^3 \]
7) Suppose a particle, which for some reason only ever moves forward or backward in one
direction, is traveling with a position given by the following function, \( s(t) = t^2 - 6t + 8 \). 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?

8) Gravel is being dumped from a conveyor belt at a rate of 30 ft³/min. As it falls from the conveyor
belt, it forms a pile in the shape of a cone whose base diameter and height are always equal.
How fast is the height of the pile increasing when the pile is 10 ft high?

9) Differentiate the following functions:
   a. \( f(x) = 3(4x^2 + 2) \)
   b. \( g(x) = \log_5 \sqrt{x^2 + 2} \)
   c. \( r(t) = 5(2^{t-2}) \)
   d. \( q(x) = \ln \left( \frac{x}{2x-1} \right) \)

10) Consider the following function,
\[
f(x) = \frac{x^2}{(x - 2)^2}
\]
List the locations of...
   a) The vertical and horizontal asymptotes
   b) The critical numbers, and the intervals where the function is increasing, decreasing, concave
      up, and concave down.
   c) Local Minimum, local Maximum, and Points of Inflection
   d) Sketch a graph of \( f(x) \).

11) Consider the following function
\[
f(x) = 8x^3 + 5x^3
\]
   a) Find the absolute extrema on \([0,8] \)
   b) Use the second derivative test to classify the type of the critical points for the function
      across the whole real line.
   c) List the locations of the following:
      a. Vertical and Horizontal Asymptotes
      b. Critical numbers, and the intervals where the function is increasing,
         decreasing, concave up, and concave down
      c. Inflection Points
   d) Sketch a graph of \( f(x) \).

12) Find the derivative of:
\[
f(x) = \ln \left( e^{x-1} \sqrt{x + 3} \right)
\]

13) Assume that the revenue function \( R \) and the cost function \( C \) for a business are given as:
\[
R(x) = 1163x - 9x^2
\]
\[
C(x) = 45x + 22
\]

where \( x \) is the daily production and sales. Assume that business is currently producing/selling
12 units per day and that production/selling are currently increasing 1 unit per day. Find the
rate of change in profit per day.