Question 1 (5 points). Solve for $x$.

$$\log_{3}(5 + x) - \log_{3}(x - 4) = \log_{3} 2$$

Question 2 (5 points). Find the interest earned on $7000 invested for 8 years at 3% interest compounded monthly. Round your answer to the nearest cent.

Question 3 (5 points). Evaluate the following limit or reply "DNE" if the limit does not exist.

$$\lim_{x \to 5} \frac{x^2 - 25}{x^2 - 3x - 10}$$
**Question 4** (5 points). Evaluate the following limit or reply “DNE” if the limit does not exist.

\[
\lim_{x \to \infty} \frac{7x^3 + 4x - 3}{-2x^4 - x^2 + 1}
\]

**Question 5** (5 points). Suppose that the total profit (in dollars) from selling \(x\) handcrafted wagons is 
\(P(x) = 90 + 2x - x^2 + 5x^3\). Find the marginal profit when \(x = 7\).

**Question 6** (5 points). Use the definition of the derivative \(\lim_{h \to 0} \frac{f(x+h) - f(x)}{h}\) to find the derivative of the following function. (Do not use the “easy” differentiation rules for this problem.)

\(f(x) = \frac{1}{x}\)
Question 7. Let \( f(x) = \begin{cases} 
  x & \text{if } x < -1 \\
  x^2 - 2 & \text{if } -1 \leq x < 2 \\
  \frac{1}{2}x - 2 & \text{if } 2 \leq x
\end{cases} \)

Find the following limits or values. Write "DNE" for a limit or value that does not exist.

(a) (1 point) \( \lim_{x \to -1^-} f(x) = \)

(b) (1 point) \( \lim_{x \to -1^+} f(x) = \)

(c) (1 point) \( \lim_{x \to -1} f(x) = \)

(d) (1 point) \( f(-1) = \)

(e) (1 point) Is \( f(x) \) continuous at \( x = -1 \)? Explain your answer.

(f) (1 point) \( \lim_{x \to 2^-} f(x) = \)

(g) (1 point) \( \lim_{x \to 2^+} f(x) = \)

(h) (1 point) \( \lim_{x \to 2} f(x) = \)

(i) (1 point) \( f(2) = \)

(j) (1 point) Is \( f(x) \) continuous at \( x = 2 \)? Explain your answer.
**Question 8** (5 points). Find the derivative \( \frac{dy}{dx} \). Show all work. NO credit will be awarded for an unsupported answer.

\[
y = (x^3 - 8)^2
\]

**Question 9** (5 points). Find the derivative \( \frac{dy}{dx} \). Show all work. NO credit will be awarded for an unsupported answer.

\[
y = 3x^2 - 5^{4x}
\]

**Question 10** (5 points). Find the derivative \( \frac{dy}{dx} \). Show all work. NO credit will be awarded for an unsupported answer.

\[
y = x^2 \ln(x^2)
\]
Question 11. Consider the graph of the function \( f(x) = x^3 - 9x^2 + 100 \).

(a) (3 points) Find all interval(s) on which \( f(x) \) is increasing and all interval(s) on which \( f(x) \) is decreasing.

(b) (2 points) Find the coordinates of any point(s) where \( f(x) \) has a local maximum and the coordinates of any point(s) where \( f(x) \) has a local minimum.

(c) (3 points) Find all interval(s) on which \( f(x) \) is concave up and all interval(s) on which \( f(x) \) is concave down.

(d) (2 points) Find the coordinates of any inflection points of \( f(x) \).
**Question 12** (5 points). Find \( \frac{dy}{dx} \) using implicit differentiation.

\[
x^3 + 3x^2y - 2y^3 = 11
\]

**Question 13** (5 points). Suppose that the area of a square is increasing at a rate of 40 square inches per second. Find the rate of change of the length of the sides when the sides are 8 inches long.
Question 14 (5 points). Evaluate the indefinite integral. Show all work. NO credit will be awarded for an unsupported answer.

\[ \int (t^3 + 2e^{5t}) \, dt \]

Question 15 (5 points). Evaluate the indefinite integral. Show all work. NO credit will be awarded for an unsupported answer.

\[ \int \frac{10x^4}{(3 + x^5)^4} \, dx \]
**Question 16** (5 points). Approximate the area under the graph of \( f(x) = x^2 + 2 \) and above the \( x \)-axis from \( x = 0 \) to \( x = 6 \) using \( n = 3 \) rectangles and left endpoints.

**Question 17** (5 points). Evaluate the definite integral. Show all work. NO credit will be awarded for an unsupported answer.

\[
\int_{1}^{2} \frac{y^6 - y^2}{y^4} \, dy
\]
Question 18 (5 points). *Find the enclosed area between the graphs of \( y = x^3 \) and \( y = x^2 \).*