1. Evaluate the limit if it exists, or explain why the limit does not exist.
   a. \( \lim_{x \to 2} (x^2 - 4) \)
   b. \( \lim_{x \to \infty} \frac{x^3}{(x + 1)^2} \)
   c. \( \lim_{x \to 1^+} \frac{|x-1|}{x - 1} \)

2. Find the derivatives of the following functions.
   a. \( y = (x^3 + 7x^2 - x + 1)^4 \)
   b. \( y = \frac{\log_2 x}{1+x^2} \)
   c. \( y = (1 + e^x)\ln(2x + 4) \)

3. Find \( dh \) if \( h = x^{1.5}, \ x = 4 \), and the change in the \( x \) is 0.1.

4. The total cost (in dollars) of producing \( x \) HDTVs is:
   \[ C(x) = 10,000 + 200x - \frac{1}{10}x^2 \]
   a. Find the total cost and the marginal cost at a production level of 100 TV's.
   b. Use the marginal cost to approximate the cost of producing the 101\(^{st} \) TV.
   c. Find the exact cost of producing the 101\(^{st} \) TV.

5. Given the price-demand equation:
   \[ p = 60 - 0.02x \]
   a. Find the elasticity of demand, \( E(p) \).
   b. Find the values of \( p \) for which the demand is elastic, inelastic and unit elastic.
   c. How will the revenue be affected by each of the following scenarios?
      i. If the price increases and the demand is inelastic.
      ii. If the price decreases and the demand is elastic.
      iii. If the demand is unit elastic.
6. Let $f(x) = x^4 - 2x^3$.
   a. Find the intervals where $f(x)$ is increasing and where it is decreasing. Also, find the critical points (if any) and state what each represent.
   b. Find the intervals where $f(x)$ is concave upward and where it is concave downward. Also, find the inflection points (if any).
   c. Using the results parts a. & b. above, sketch the graph.
      \textbf{Hint} Feel free to use the domain of $f(x)$ as well as its intercepts in your sketch.

7. Compute the following anti-derivatives:
   a. $\int 2x(x^2 + 4)^3 \, dx$
   b. $\int \frac{x^2e^x - 2x}{x^2} \, dx$

8. Suppose that a country has a Lorentz curve of the form $f(x) = x^6$ and a Gini Index of 0.268. Find $a$.

\textbf{NOTE [REFERENCES]:}
Some questions in this document have been selected from final exams and midterms at Concordia University.
**ANSWER KEY:**

1.  
   a. 0  
   b. $\infty$  
   c. -1

2.  
   a. \[ \frac{dy}{dx} = 4(x^3 + 7x^2 - x + 1)^3(3x^2 + 14x - 1) \]
   b. \[ \frac{dy}{dx} = \frac{(1 + x^2) \left( \frac{1}{x \ln 2} \right) - 2x \log_2 x}{(1 + x^2)^2} \]
   c. \[ \frac{dy}{dx} = e^x \ln(2x + 4) + \frac{1 + e^x}{x + 2} \]

3. \( dh = 0.3 \)

4.  
   a. \( C(100) = $29000 \), \( C'(100) = $180 \)
   b. *Approximate cost* = \( C'(100) = $180 \)
   c. *Exact cost* = \( C(101) - C(100) = $179.9 \)

5.  
   a. \( E(p) = \frac{p}{60 - p} \)
   b.  
      - \textit{inelastic}: \( 0 < p < 30 \)
      - \textit{unit elastic}: \( p = 30 \)
      - \textit{elastic}: \( 30 < p < 60 \)
   c.  
      i. Revenue will increase
      ii. Revenue will increase
      iii. It will not affect revenue
6. \[ a = 1.732 \]

**increasing:** \( \left( \frac{3}{2}, \infty \right) \) ; \[ decreasing: \ (-\infty, 0), \left( 0, \frac{3}{2} \right) \]

**critical points:** at \( x = 0 \) (saddle) \[ \rightarrow x = \frac{3}{2} \) (where local minimum occurs)

**concave up:** \( (-\infty, 0), (1, \infty) \) ; \[ concave down: \ (0,1) \]

**inflection points:** at \( x = 0 \) and \( x = 1 \)

7. \[ a. \ ans = \frac{1}{4} (x^2 + 4)^4 + C \]

\[ b. \ ans = e^x - 2ln|x| + C \]

8. \[ a = 1.732 \]