1. Find the derivative of each of the following functions. Do not simplify your answers.

a) \( f(x) = \sqrt[4]{\ln(7x^2 - 5)} \left[ \log(x^3 + 9^x) \right] \)

b) \( f(x) = \frac{\log_8(6x^2 + \pi)}{7(e^x - 3)} \)

c) \( f(x) = \sqrt[3]{(e^{3x^2} \ln x)^2} \)
2. List the three conditions necessary for a function $f(x)$ to have a relative maximum or minimum at $x = c$.

1.

2.

3.

3. A local coffee shop has a weekly price demand equation of $p = 30 - \frac{x}{20}$, where $p$ is the price (in dollars) for a cup of coffee and $x$ is the number of cups sold.

a) If the current price for a cup of coffee is $5.00, describe the effect on demand if price increases by 12%. Is demand elastic, inelastic, or unit elastic at the current price level?

b) At what price level is the shop’s revenue maximized?

c) On what interval of $p$ is demand elastic?
4. For each of the following functions, find any critical values, the intervals where the function is increasing/decreasing, and any relative extrema. Be sure to classify the type of each extrema.

a) \( f(x) = x - \ln x \)

b) \( f(x) = x^2 e^{-x} \)
c) \( f(x) = \frac{3x^2 - 2x}{(x - 4)^2} \)

5. Suppose a company that makes deluxe toasters has a weekly demand equation given by \( p(x) = 150e^{-0.02x} \), where \( p \) is the price in dollars when \( x \) toasters are sold. Determine where the company’s revenue is increasing.
6. Briefly state the difference between partition numbers and critical values of a function $f$.

7. Doc and Marty’s Skateboard Shop has determined the price-demand equation for its “futuristic” skateboards to be $x + 0.10p = 37.5$, where $x$ is the number of skateboards that can be sold at a unit price of $p$ dollars. The current price for a skateboard is $150. In order to increase their revenue, what should the Doc and Marty do?

8. Consider a function $f$ that is smooth and continuous on its domain of $(-\infty, 2) \cup (2, \infty)$. Also, $f'(x) = \frac{8(x + 4)}{(x - 2)^4}$. Find any critical values of $f(x)$, the intervals where $f(x)$ is increasing/decreasing, as well as where any relative extrema occur (be sure to specify the type of any relative extrema).
9. The elasticity of demand for a certain commodity is \( E(p) = \frac{2p^2}{1200 - p^2} \), where \( p \) is the unit price in dollars. The current price per item is $30.

a) If this price is increased by $1.20, describe the effect on demand.

b) For what values of \( p \) will a percentage change in price cause a smaller percentage change in demand?

c) Given the current price is $30, what should the company do to increase revenue?

10. Sketch an example of a function that has a critical value at \( x = 3 \) such that \( f'(3) \) does not exist and there is a relative maximum at \( x = 3 \).

11. If a function has a critical value at \( x = 5 \), does that mean it has a relative max or min at \( x = 5 \)? Explain graphically.