1. (16 points) Evaluate the limits. Please show all work.

(a) \[ \lim_{x \to 3} \frac{x^2 - 2x - 3}{x^2 - 5x + 6} \]

(b) \[ \lim_{h \to 0} \frac{\sqrt{4 + 9h} - \sqrt{4 - 3h}}{h} \]
2. (24 points) Suppose \( f(x) = \begin{cases} 
  x^2 + 3x - 4 & \text{if } x \leq 0 \\
  x^2 - 4 & \text{if } 0 < x \leq 2 \\
  4x - 8 & \text{if } x > 2. 
\end{cases} \)

(a) What is \( \lim_{x \to 0^-} f(x) \)?
(b) What is \( \lim_{x \to 0^+} f(x) \)?
(c) What is \( \lim_{x \to 2^-} f(x) \)?
(d) What is \( \lim_{x \to 2^-} f(x) \)?
(e) What is \( \lim_{x \to 2^+} f(x) \)?
(f) What is \( \lim_{x \to 2^+} f(x) \)?

(g) What is \( f'(x) \)? Are there any values of \( x \) for which \( f'(x) \) does not exist? Explain.
3. (19 points) The graph of a function $g(x)$ is sketched below. Sketch the graphs of $g'(x)$ and $g''(x)$ as well as you can. Correct graphs with no explanation will receive full credit, but it will be easier for me to award you partial credit if you include some explanation.
4. (21 points) Use the fact that \( \frac{d}{dx} |x| = \frac{|x|}{x} \), and whatever other derivative rules you may need, to calculate the following derivatives. Simplify your answers if possible.

(a) \( a(x) = x|x| \) 

(b) \( b(x) = \frac{|x|}{x} \) 

(c) \( c(x) = x^n|x| \)
5. (20 points) Calculate the derivatives of the following functions. **Do not try to simplify your answers!**

(i) \( d(x) = (x^{23} + 6x^{11} - 5x^2 + 3)^{12} (x^{15} - 9x^7 + 8x^{-2})^{13} \)

(ii) \( e(x) = \frac{(5e^x + 3x^2 + 41)^8}{(e^x - x^3 - 18)^5} \)