1. (12 points) If \( f(x) = \ln(e^x) \), calculate \( f'(x) \). Simplify your answer if possible.
2. (26 points) Suppose \( g(x) = \begin{cases} 
  x^2 - 5x + 6 & \text{if } x \leq 1 \\
  4 - x - x^2 & \text{if } 1 < x \leq 2 \\
  x^2 - 3x & \text{if } x > 2.
\end{cases} \)

(a) Is \( g(x) \) continuous at \( x = 1 \)? At \( x = 2 \)? Explain.
(b) Calculate \( g'(x) \). Does \( g'(1) \) exist? Does \( g'(2) \) exist? Explain.
(c) Calculate \( g''(x) \). Does \( g''(1) \) exist? Does \( g''(2) \) exist? Explain.
3. (22 points) The graph of a function $h(x)$ is sketched below, with some points labelled. Sketch the graphs of $h'(x)$ and $h''(x)$ as well as you can, with any corresponding points labelled. Correct graphs with no explanation will receive full credit, but an explanation may help with partial credit.
4. (18 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) \( a(x) = |x| x^{-1} \)

(b) \( b(x) = \ln |x| \)
5. (22 points) Calculate the derivatives of the following functions. **Do not try to simplify your answers!**

(i) \( c(x) = \left( x^{11} + 7x^4 - 6x^{-2} \right)^9 \left( x^8 + 8 + x^{-8} \right)^8 \)

(ii) \( d(x) = e^{c(x)} \), where \( c(x) \) is the function in (i). (Use your answer to (i) in this answer if you like.)