Show all relevant work!

**You may not use a calculator on this examination**

1. Show (prove) that \( \frac{d}{dx} \ln x = \frac{1}{x} \)

2. Consider the curve \( \ln(xy) = x - y \). Show that \( y' = \frac{y(x-1)}{x(y+1)} \)

3. Find \( g''(x) \) if \( g(x) = \ln(x^2 - 1) \)

4. Suppose \( h(x) = \ln \left( \frac{f(x)}{g(x)} \right) \) and \( f(1) = 3, \ g(1) = -5, \ f'(1) = 4, \ g'(1) = 2 \). Find \( h'(1) \).

5. Find the \( n^{th} \) derivative \( (y^{(n)}) \) of \( y = xe^x \).

6. Find and simplify the derivative of each function.
   
   (a) \( f(x) = \frac{\sqrt{x}}{\ln \sqrt{x}} \)

   (b) \( y = x^{1-2x} \)

   (c) \( \frac{d}{dx} \left( \frac{x^3 - 2x}{\sqrt{x}} \right) \)

   (d) \( \frac{d^{79}}{dx^{79}} (x^{100}) \)