1. Let

\[ f(x) = \begin{cases} 
  x^2 & \text{if } x \leq 2 \\
  mx + b & \text{if } x > 2
\end{cases} \]

Find values of \( m \) and \( b \) making \( f \) differentiable everywhere.

2. Find the equation of the line tangent to the curve \( y = \sqrt{x} - x \) at the point \((1, 0)\).

3. What is the relationship between a function \( f(x) \) being differentiable at a real number \( a \) and being continuous at \( a \)? In particular, is there a function \( f(x) \) and a real number \( a \) such that \( f(x) \) is continuous at \( a \) and not differentiable at \( a \)? What about a function \( f(x) \) and a real number \( a \) such that \( f(x) \) is differentiable at \( a \) and not continuous at \( a \)? If any answer is yes, provide such an example.

4. For what value of \( x \) does the graph of \( f(x) = e^x - 2x \) have a horizontal tangent?

5. Find the derivatives of the following functions. Use prime notation when a variable is indicated on the left-hand side; use Leibniz notation where no variable is indicated on the left-hand side.

(a) \( z = y^7 + 4y^3 + 109y \)
(b) \( f(x) = 3x^2 + 4x + 7 \)
(c) \( p(t) = (t^2 + 2)e^t \)
(d) \( g(r) = \frac{r^2 + 2}{r - 4} \)