1. 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) \( g(r) = \frac{r^2 + 2}{r - 4} \)
(e) \( h(u) = (u - 1)(u^4 + u^3 + u^2 + u + 1) \)
(f) \( y = \frac{\sin t}{1 + \tan t} \)
(g) \( g(v) = \frac{e^v}{\sqrt{v}} \)
(h) \( u = \frac{x}{x^2 - 1} \)
(i) \( g(x) = x(2x + 2)(2x - 2) \)

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

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

4. Find the derivatives of the following functions. Follow the same notation instructions as the first problem.

(a) \( f(x) = (x - 1)^3 \)
(b) \( w = e^{x^2 - x} \)
(c) \( g(t) = \cos^2 t \)
(d) \( g(t) = t \sin \pi t \)
(e) \( h(x) = 3^{3x + 2x^2 + 2\ln 3} \)
(f) \( h(u) = ue^u \cot u \)
(g) \( p(\theta) = \frac{\tan \theta}{\csc \theta + \sec \theta} \)
(h) \( F(x) = (1 + x + x^2)^{99} \)
(i) \( y = 2^{3x^x} \)
(j) \( G(y) = e^{\sin 2y} + \sin(e^{2y}) \)
(k) $y = \sqrt{x + \sqrt{x + \sqrt{x}}}$

5. Find an equation of the tangent line to the curve $y = e^x \cos x$ at the point $(0, 1)$.

6. Recall that $e$ is defined as the real number satisfying $\lim_{h \to 0} \frac{e^h - 1}{h} = 1$. Using this, prove that the derivative of $e^x$ is $e^x$.

7. Find the second derivative of $a_1x + a_0$, the third derivative of $a_2x^2 + a_1x + a_0$, and the fourth derivative of $a_3x^3 + a_2x^2 + a_1x + a_0$. What is the $(n + 1)$-st derivative of a polynomial of degree $n$? Why?

8. Derive the quotient rule using only the product rule. (Hint: Let $F(x) = f(x)/g(x)$ and try to rewrite it in a way that you can apply the product rule.)