1. Find an equation for the line tangent to the curve at the point defined by the given value of t.

(a). $x = \sec^2 t - 1$ $\quad y = \tan t$ $\quad t = -\frac{\pi}{4}$

(b). $x = -\sqrt{t+1}$ $\quad y = \sqrt{3t}$ $\quad t = 3$

2. Find dy

(a). $y = x + 2x^2 - \frac{1}{3}x^3 + x^4$

(b). $y = x \cdot \cot x$

3. The curve $L: y = y(x)$ is defined by the equation $y^3 + y^2 = 2x^2$. Find the equation for the line tangent to L at $(1, 1)$.

4. Let $f(x)$ be a differentiable function on $\mathbb{R}$, $g(x) = f(x^2)$, $h(x) = f(x)^2$, and $\frac{d}{dx}g(x) = \frac{d}{dx}h(x)$ when $x = 1$, prove that: $f'(1) = 0$ or $f(1) = 1$.

5. Let $f(x) = \dfrac{x^2 - 2}{x^2 - x - 2}$, find $f^{(n)}(x)$.

6. Let $f(x)$ be a twice-differentiable function on $[-2, 2]$, and $|f(x)| < 1$, $f(0)^2 + f'(0)^2 = 4$.

Prove: There exist $\lambda \in [-2, 2]$, such that $f(\lambda) + f''(\lambda) = 0$.

Hint: Consider $F(x) = f(x) \cdot \sin x + f'(x) \cdot \cos x$, and use the first derivative theorem for local extreme values.