1. Find an equation for the tangent to the curve at the given point.

(a). $y = \frac{1}{x^4}$ at $(2, \frac{1}{16})$

(b). $y = 2\sqrt{x-3}$ at $(7, 4)$

(c). $y = 3\sin(x - \frac{\pi}{6})$ at $(\frac{\pi}{3}, \frac{3}{2})$

2. Find the derivatives of the following functions

(a). $f(x) = x \cdot \sqrt{x}$

(b). $f(x) = \frac{x+3}{x-1}$

(c). $f(x) = \sqrt{x^2 - 1}$

3. Find the second derivatives of the following functions:

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

(b). $f(x) = \frac{x^2 - \tan x}{\sqrt{x^3 - 1}}$

4. Find the derivatives of the following functions:

(a). $f(x) = g(x + g(x))$

(b). $f(x) = g(x g(x))$

5. Show that $f(x) = \begin{cases} x^2 \sin\frac{1}{x} & x \neq 0 \\ 0 & x = 0 \end{cases}$ is differentiable at $x = 0$, but $f'(x)$ is not continuous at $x = 0$.

6. Suppose that $f(x)$ is differentiable at x_0, then

$$\lim_{h \to 0} \frac{f(x_0 + h) - f(x_0 - h)}{2h} = f'(x_0)$$

And show that even if the limit on the left hand side exists (not equal to ∞), $f(x)$ may not be differentiable.