Mathematics in Life Sciences **Winter Semester 2024**

List of Exercises 5

1. Calculate the following derivatives using **the definition.**

$$f(x) = 3x^2 \text{ on x} = 3 \qquad g(x) = 4x^3 \text{ on x} = 1$$

$$h(x) = 2x^2 + 5x \text{ on x} = \text{-1} \quad k(x) = \sqrt{4x} \text{ on x} = 2$$

2. Get a formula for the derivative of the following functions.

$f(x) = 2x^3 - 5x^2 + 3x + 1$	$g(x) = \frac{1}{x^2+1}$	$h(x) = \frac{1}{\sqrt{x+5}}$
$k(x) = \frac{x^2+3x-2}{x+1}$	$m(x) = \frac{\tan(x)}{x^2+1}$	$n(x) = \frac{3x}{\cos(x)}$
$p(x) = \sqrt{x^2 + 4\sin(x)}$	$q(x) = x^4 - 2(\tan(3x))^2 + 1$	$r(x) = \frac{2x^3-x}{x^2+2}$
$s(x) = \sin^2(x) + \cos^2(x)$	$t(x) = \frac{\lvert x\rvert}{x}$	$u(x) = \frac{x^3-4x^2+5x}{x^2-3x+2}$
$v(x) = \frac{\sin(x)}{x}$	$w(x) = \frac{\cos^2(x)}{\sin(x)}$	$y(x) = (2x^2 - 5x + 1)^3$

3. Calculate the second and the third derivatives of the following functions.

$f(x) = 4x^3 + 6x^2 - 2x + 1$	$g(x) = \frac{1}{x^2+1}$	$h(x) = \cos(2x)$
$k(x) = \sin(2x) + x^3$	$m(x) = \frac{x^2-2x+1}{x-1}$	$n(x) = \sqrt[3]{x^2 + 4x}$

4. Are the following functions derivable at the given point? If so, calculate the derivative.

- $f(x) = \begin{cases} x^2, & \text{if } x \leq 0 \\ 2x, & \text{if } x > 0 \end{cases}$ in $x = 0$.
- $g(x) = \begin{cases} \sin(x), & \text{if } x < 0 \\ x^2, & \text{if } x \geq 0 \end{cases}$ in $x = 0$.
- $h(x) = \begin{cases} \frac{1}{x}, & \text{if } x < 0 \\ x^2, & \text{if } x \geq 0 \end{cases}$ in $x = 0$.
- $k(x) = \begin{cases} \sqrt{x}, & \text{if } x \leq 1 \\ x^2, & \text{if } x > 1 \end{cases}$ in $x = 1$.
- $m(x) = \begin{cases} \sqrt{x}, & \text{if } x \leq 4 \\ 2x, & \text{if } x > 4 \end{cases}$ in $x = 4$.