DERIVATIVES — BASIC FORMULAE AND RULES

Constant, power function.

$$(C)' = 0 \qquad (C \in \mathbb{R}), \quad x \in \mathbb{R},$$
$$(x^\alpha)' = \alpha x^{\alpha-1} \qquad (\alpha \in \mathbb{R}), \quad x \in (0, \infty) \quad (\text{or } x \in \mathbb{R} \text{ or } x \in \mathbb{R} \setminus \{0\}).$$

Especially:

$$(\sqrt{x})' = (x^{1/2})' = \tfrac{1}{2} x^{-1/2} = \frac{1}{2\sqrt{x}}, \qquad x \in (0, \infty).$$

Exponential and logarithmic functions.

$$(e^x)' = e^x, \quad (a^x)' = a^x \ln a \qquad (a > 0, a \neq 1), \quad x \in \mathbb{R},$$
$$(\ln x)' = \tfrac{1}{x}, \quad (\log_a x)' = \tfrac{1}{x \ln a} \qquad (a > 0, a \neq 1), \quad x \in (0, \infty).$$

Trigonometric and circular functions.

$(\sin x)' = \cos x, \qquad x \in \mathbb{R},$

$(\operatorname{tg} x)' = \frac{1}{\cos^2 x}, \qquad x \in \mathbb{R}, x \neq (2k+1)\frac{\pi}{2}, k \in \mathbb{Z},$

$(\arcsin x)' = \frac{1}{\sqrt{1-x^2}}, \qquad x \in (-1, 1),$

$(\operatorname{arctg} x)' = \frac{1}{1+x^2}, \qquad x \in \mathbb{R},$

$(\cos x)' = -\sin x, \qquad x \in \mathbb{R},$

$(\operatorname{cotg} x)' = \frac{-1}{\sin^2 x}, \qquad x \in \mathbb{R}, x \neq k\pi, k \in \mathbb{Z},$

$(\arccos x)' = \frac{-1}{\sqrt{1-x^2}}, \qquad x \in (-1, 1),$

$(\operatorname{arccotg} x)' = \frac{-1}{1+x^2}, \qquad x \in \mathbb{R}.$

Rules for differentiation.

- derivative of a sum: $(f+g)' = f' + g'$;
- derivative of a difference: $(f-g)' = f' - g'$;
- product rule: $(fg)' = f'g + fg'$,
  especially: $(cf)' = cf'$ (c constant);
- quotient rule: $\left(\frac{f}{g}\right)' = \frac{f'g - fg'}{g^2}$,
  especially: $\left(\frac{f}{c}\right)' = \frac{f'}{c}$ (c constant).
- chain rule: $\big[f(g(x))\big]' = f'\big(g(x)\big)\, g'(x)$.