Simple function (without mapping) used inside a paragraph $f : \mathbb{R} \to \mathbb{R}$ as inline math.

Simple function (with mapping) used inside a paragraph $f : \mathbb{R} \to \mathbb{R}, \quad x \mapsto f(x)$ as inline math.

Simple function as rendered in display math:

$$\begin{aligned} f : \mathbb{R} &\to \mathbb{R} \\ x &\mapsto f(x) \end{aligned}$$

Simple function with definition:

$$\begin{aligned} f : \mathbb{R} &\to \mathbb{R} \\ x &\mapsto f(x) := x^2 \end{aligned}$$

Function with alternative writing:

$$\begin{aligned} \exp : \mathbb{R} &\to \mathbb{R} \\ x &\mapsto e^x \end{aligned}$$

Function with alternative notation and definition:

$$\begin{aligned} \exp : \mathbb{R} &\to \mathbb{R} \\ x &\mapsto e^x := \lim_{n\to\infty} \left(1 + \tfrac{x}{n}\right)^n \end{aligned}$$

Or forcing display math inside the definition:

$$\begin{aligned} \exp : \mathbb{R} &\to \mathbb{R} \\ x &\mapsto e^x := \lim_{n\to\infty} \left(1 + \frac{x}{n}\right)^n \end{aligned}$$

Function with different domain and codomain:

$$\begin{aligned} \text{sqrt} : \mathbb{N} &\to \mathbb{R} \\ n &\mapsto \sqrt{n} \end{aligned} \qquad \begin{aligned} \text{sqrt} : \mathbb{N} &\to \mathbb{R} \\ n &\mapsto \sqrt{n} \end{aligned} \qquad \begin{aligned} \text{sqrt} : \mathbb{N} &\to \mathbb{R} \\ n &\mapsto \sqrt{n} \end{aligned}$$

Functions with multiple variables

$$\begin{aligned} f : A \times B &\to C \\ (a, b) &\mapsto f(a, b) \end{aligned}$$

Unitary operator

$$\begin{aligned} \exp : \mathbb{R} &\to \mathbb{R} \\ x &\mapsto \exp x := \lim_{n\to\infty} \left(1 + \tfrac{x}{n}\right)^n \end{aligned}$$

Binary operator

$$\begin{aligned} + : \mathbb{R} \times \mathbb{R} &\to \mathbb{R} \\ (x, y) &\mapsto x + y \end{aligned}$$

Using macros in definition:

$$\begin{aligned} \langle\ ,\ \rangle : \mathbb{R}^2 \times \mathbb{R}^2 &\to \mathbb{R} \\ (x, y) &\mapsto \langle x, y \rangle \end{aligned} \qquad \begin{aligned} \|\ \| : \mathbb{R}^2 &\to \mathbb{R} \\ x &\mapsto \|x\| := \sqrt{\langle x, x \rangle} \end{aligned}$$

More complex definitions, requiring a third line:

$$\begin{aligned} + : \mathbb{R}^{\mathbb{R}} \times \mathbb{R}^{\mathbb{R}} &\to \mathbb{R}^{\mathbb{R}} \\ (f, g) &\mapsto f + g \\ \forall x \in \mathbb{R} : (f + g)(x) &= f(x) + g(x) \end{aligned}$$