

Those applications from  $\mathbb{R} \mapsto \mathbb{R}$ , are they injective, surjective?

$$x \rightarrow x^2, x \rightarrow x^3, x \rightarrow \sin x$$

$$\nexists x \in \mathbb{R} \mid x^2 = -1 \\ \Rightarrow x \rightarrow x^2 \text{ is not surjective}$$

$$\text{Let } (x, y) \in \mathbb{R}^2 \mid f(x) = f(y) \\ \Rightarrow x = -y \text{ or } x = y \\ \Rightarrow x \rightarrow x^2 \text{ is not injective}$$

$$\forall y \in \mathbb{R}, \exists x \in \mathbb{R} \mid x = \sqrt[3]{y} \text{ and } x^3 = y \\ \Rightarrow x \rightarrow x^3 \text{ is surjective}$$

$$\text{Let } (x, y) \in \mathbb{R}^2 \mid x^3 = y^3 \\ \Rightarrow x = y \\ \Rightarrow x \rightarrow y \text{ is injective}$$

$$\nexists x \in \mathbb{R} \mid \sin x = 2 \\ \Rightarrow x \rightarrow \sin x \text{ is not surjective}$$

$$\pi \neq 0, \sin(\pi) = \sin(0) \\ \Rightarrow x \rightarrow \sin x \text{ is not injective}$$