S 120 1)a $f(x) = \frac{1}{3}x^3 - 4$ 4E ↓

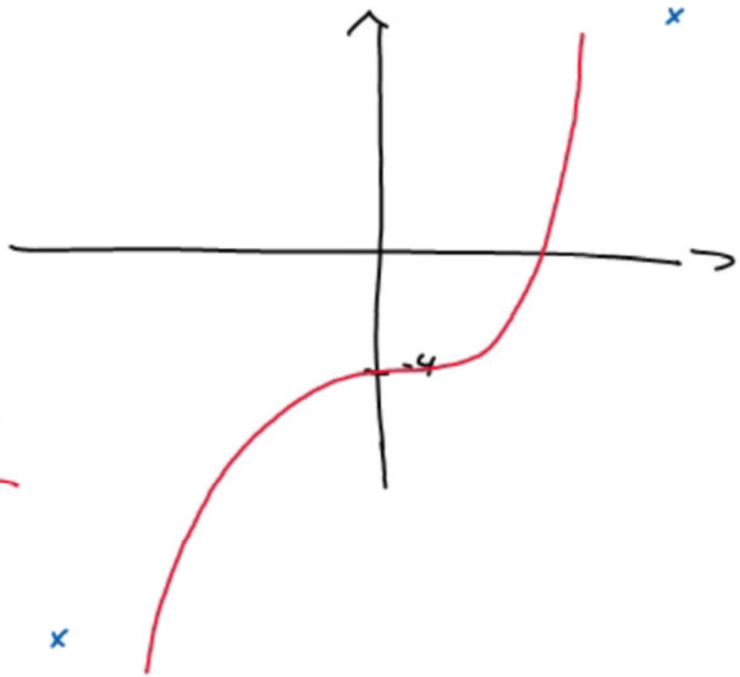
surjektiv

$\mathbb{W} = \mathbb{R}$

↳ ganzrationales Polynom vom Grade 3

$\lim_{x \to \infty} f(x) = \infty$ x^3 Punktsym.

$\lim_{x \to (-\infty)} f(x) = -\infty$



$\mathbb{D} = \mathbb{R}$

→ total

$y = \frac{1}{3}x^3 - 4 \quad | +4 \quad \cdot 3$

$3 \cdot (y+4) = 3y + 12 = x^3 \quad | \sqrt[3]{\ }$

$x = \sqrt[3]{3y+12}$ $\quad \Rightarrow f^{-1}(x) = \sqrt[3]{3x+12}$

$\mathbb{D} = \mathbb{R} \; ; \; \mathbb{W} = \mathbb{R}$

rechtseindeutig: $\quad f(x) = y_1 \wedge f(x) = y_2 \Rightarrow y_1 = y_2$

$\sqrt[3]{3y_1+12} = \sqrt[3]{3y_2+12} \quad | ()^3$

$3y_1 + 12 = 3y_2 + 12 \quad | -12 \quad \cdot \frac{1}{3}$

$y_1 = y_2$

$\Rightarrow$ rechtseindeutige Relation = Funktion

Linkseindeutig $\quad f(x_1)=y \wedge f(x_2)=y \Rightarrow x_1=x_2$

$\downarrow$

injektiv

$$y = \tfrac{1}{3}x_1^3 - 4 = \tfrac{1}{3}x_2^3 - 4 \qquad |+4 \quad |\cdot 3$$

$$x_1^3 = x_2^3 \qquad |\sqrt[3]{\ }$$

$$x_1 = x_2$$

bijektiv

$$f(-x) = \tfrac{1}{3}\cdot(-x)^3 - 4 = -\tfrac{1}{3}x^3 - 4 \qquad \lightning$$

$(0\,|\,a)$

$f(x) - a = -[f(-x) - a]$

$$(0\,|-4): \quad f(x)+4 = -[f(-x)+4]$$

$$\tfrac{1}{3}x^3 = -[(\tfrac{1}{3}\cdot(-x)^3 - 4) + 4]$$

$$= -(-\tfrac{1}{3}x^3) = \tfrac{1}{3}x^3$$

S 110

1) 5) $f(x) = 3 \cdot \sqrt[5]{x} + 5 \qquad \mathbb{D} = \mathbb{R}$

$f(x) = y_1 \wedge f(x) = y_2 \Rightarrow y_1 = y_2$

$y = 3 \cdot \sqrt[5]{x} + 5 \quad | -5$

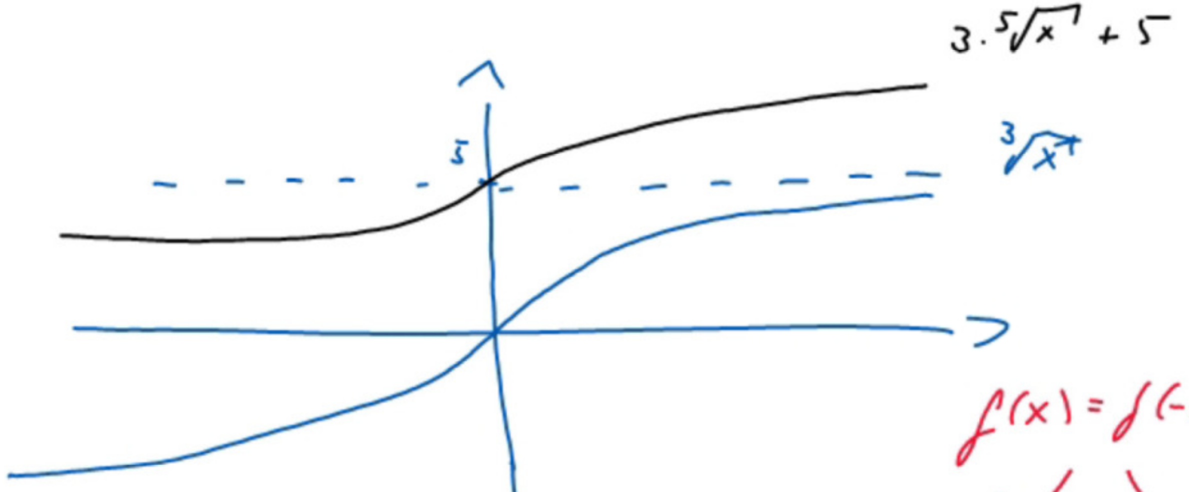
$y - 5 = 3 \cdot \sqrt[5]{x} \quad | \cdot \frac{1}{3}$

$\frac{1}{3}(y-5) = \sqrt[5]{x} \quad |\,^5 \Rightarrow \sqrt[5]{\frac{1}{3}(y-5)} = x \qquad f^{-1}(x)$

$x = \sqrt[5]{\frac{1}{3}(y_1-5)} = \sqrt[5]{\frac{1}{3}(y_2-5)} \quad |\,^5$

$\frac{1}{3}(y_1-5) = \frac{1}{3}(y_2-5) \quad | \cdot 3 + 5$

$y_1 = y_2 \Rightarrow$ rechtseindeutig Funktion



$$f(x) = \frac{x^2+4}{x}$$

$$f(-x) = \frac{(-x)^2+4}{(-x)} = \frac{x^2+4}{-x}$$

$$-f(-x) = (-1) \cdot \frac{x^2+4}{-x} = \frac{x^2+4}{x} = f(x)$$

$f(x) = f(-x)$

J → Achsensym.

N → $f(x) = -f(-x)$ $\quad \cdot(-1)$

J → Punktsym.

N → $\{\}$

$f(x) = 3 \cdot \sqrt[5]{x} + 5$ Punktsym. $(0|5)$

$f(x) - 5 = 3 \cdot \sqrt[5]{x}$

$-[f(-x) - 5] = -[\underbrace{(3 \cdot \sqrt[5]{(-x)} + 5)}_{f(-x)} - 5]$

$= -[3 \cdot \sqrt[5]{-x}] = -[3 \cdot \sqrt[5]{-1} \cdot \sqrt[5]{x}]$

$= -(-3 \cdot \sqrt[5]{x})$

$= 3 \cdot \sqrt[5]{x}$