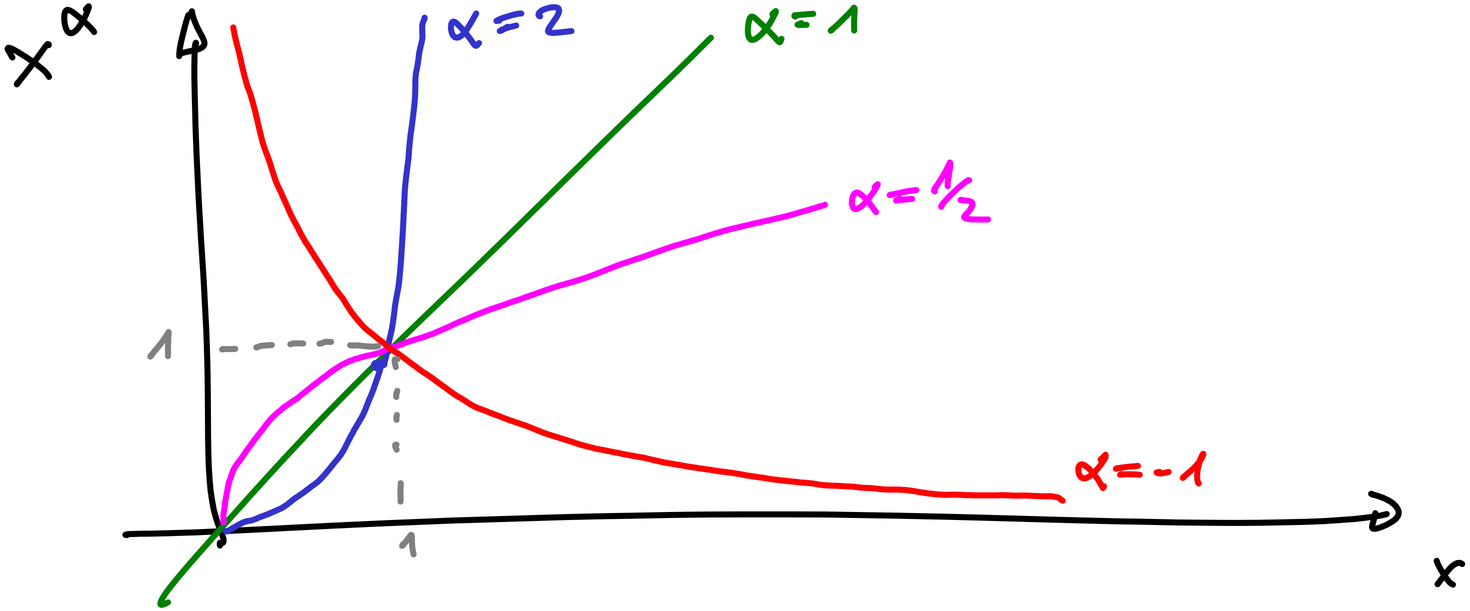
$$\sqrt[3]{9^{-2}\cdot 3} = \left((3^2)^{-2}\cdot 3\right)^{1/3}$$

$$= \left(3^{-4}\cdot 3\right)^{1/3} = \left(3^{-3}\right)^{1/3} = 3^{-1} = \frac{1}{3}$$



$G(0) = 100\,€$

$\alpha = 1{,}06$ (6% Zinsen)

Schuld nach halben Jahr

$$G(\tfrac{1}{2}) = (1{,}06)^{1/2} \cdot 100\,€$$

$$\approx 1{,}0296 \cdot 100\,€ = 102{,}96\,€$$

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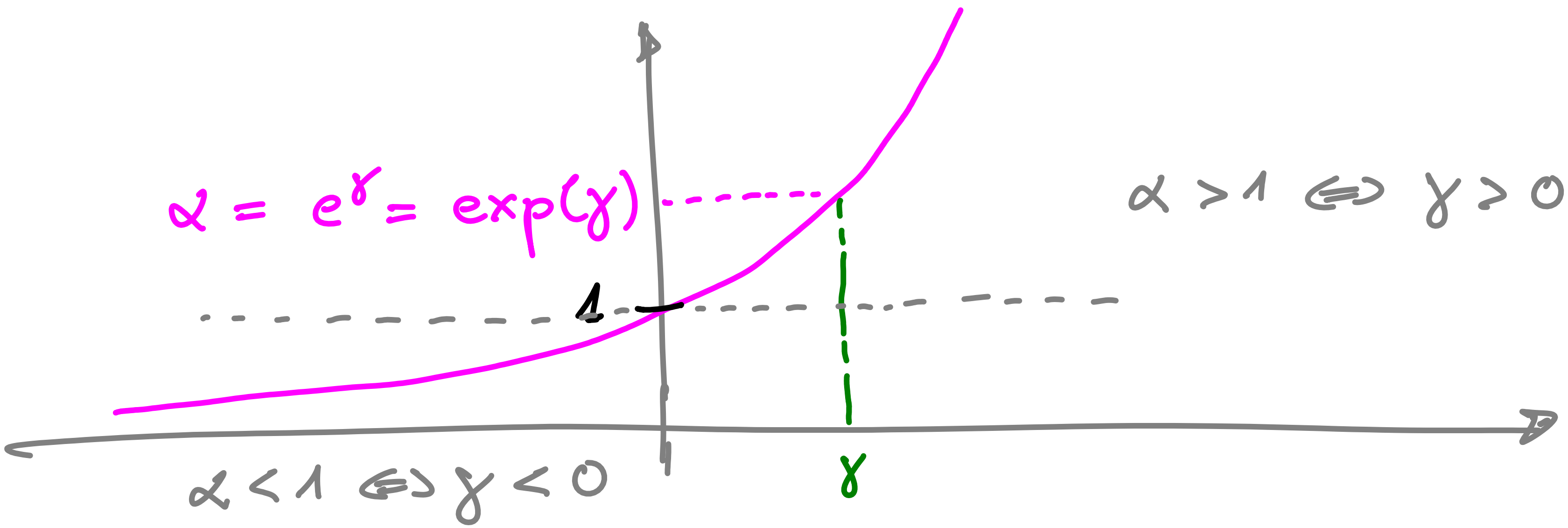
$$\alpha^t = e^{\gamma t} = (e^{\gamma})^t \quad \text{also} \quad e^{\gamma} = \alpha$$



$$\alpha^{t/T} \underset{\alpha = e^{\gamma}}{=} \left(e^{\gamma}\right)^{t/T} = e^{\frac{\gamma}{T} \cdot t} \underset{\frac{\gamma}{T} = \lambda}{=} e^{\lambda t}$$

$$G(t) = e^{\lambda t} G(0)$$

$$G\left(\frac{1}{\lambda}\right) = e^{\lambda \cdot \frac{1}{\lambda}} G(0) = e \cdot G(0)$$

$\lambda > 0$

$\frac{1}{\lambda} > 0$

$\lambda < 0, -\frac{1}{\lambda} > 0$

$$G\left(-\frac{1}{\lambda}\right) = e^{\lambda\left(-\frac{1}{\lambda}\right)} G(0) = e^{-1} G(0) = \frac{1}{e} G(0)$$

# Radioaktiver Zerfall

$G(t)$ Menge zu Beginn des Zeitintervalls $[t, t+T]$

$G(t+T)$ " am Ende ——— " ———

$[G]$ = Anzahl Atome

Zerfälle im Intervall $[t, t+T]$

$$Z(t) = G(t) - G(t+T) = e^{-\lambda t} G(0) - e^{-\lambda(t+T)} G(0)$$

$$= e^{-\lambda t} \underbrace{\underbrace{\left[1 - e^{-\lambda T}\right] G(0)}_{\text{Anzahl Zerfälle im Intervall } [0,T]}}_{=: Z(0)}$$

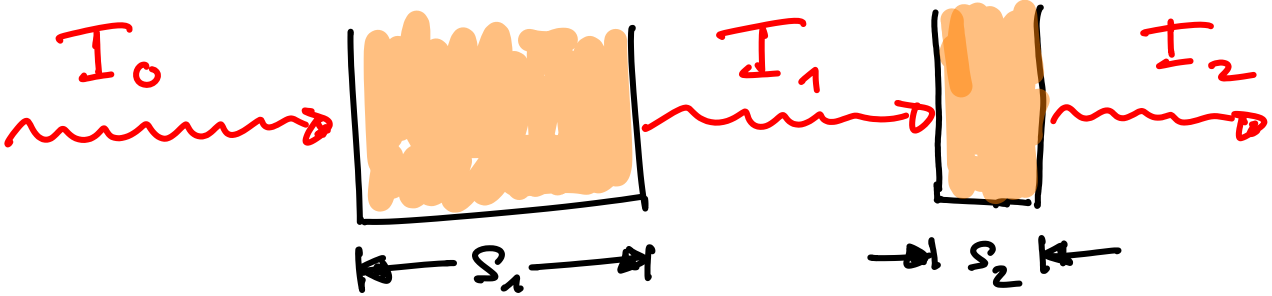
Zerfallene Menge bezogen auf Anfangsmenge $\hat{=}\; G(t)$

im Intervall $[t, t+T]$

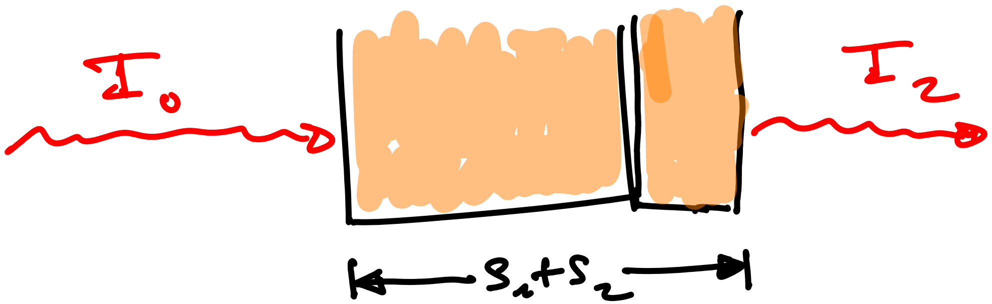
$$\frac{G(t) - G(t+T)}{G(t)} = \frac{e^{-\lambda t} - e^{-\lambda(t+T)}}{e^{-\lambda t}} = 1 - e^{-\lambda T}$$

hängt nicht von $t$ ab!

# zu Lambert-Beer

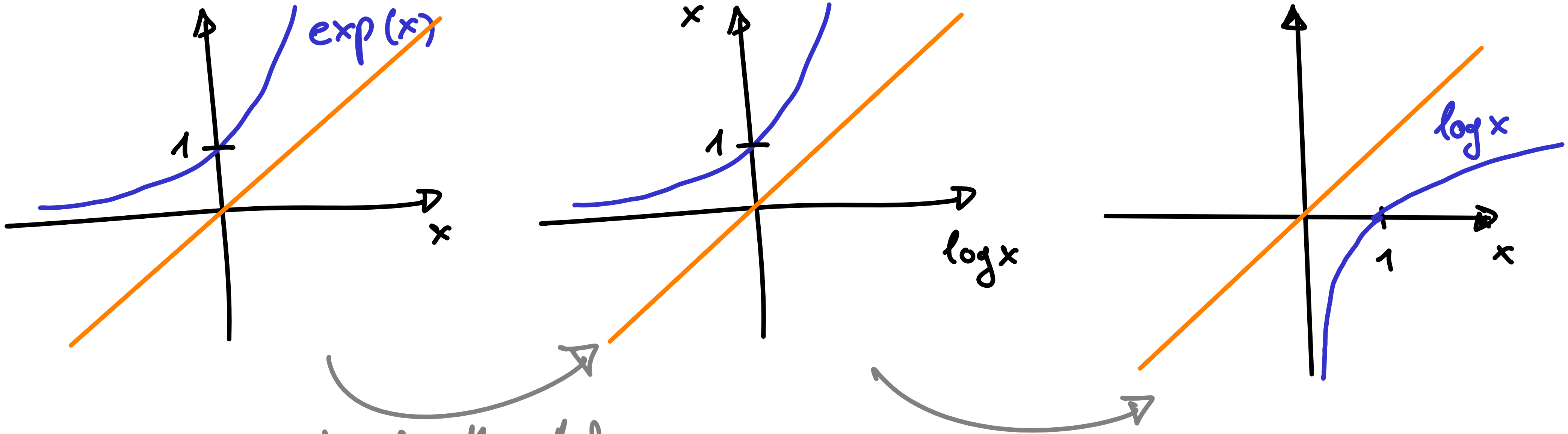



$$I_1 = \alpha_{s_1} \cdot I_0 \quad , \quad I_2 = \alpha_{s_2} \cdot I_1 = \alpha_{s_1} \cdot \alpha_{s_2} \cdot I_0$$




$$I_2 = \alpha_{s_1+s_2} \cdot I_0$$

$$\alpha_{s_1+s_2} = \alpha_{s_1} \cdot \alpha_{s_2}$$ also **exponentieller Zerfall**




beschrifte Achse anders

spiegle an 1. W-Halbierende

$$\log(\exp(x)) = \log(e^x) = x$$

$$e^{\log x} = \exp(\log x) = x$$

log-Rechenregeln, z.B.

① $$\log(xy) = \log x + \log y$$

$$x = e^{a},\; y = e^{b} \Leftrightarrow \log x = a,\; \log y = b$$

$$\log(xy) = \log(e^{a}\cdot e^{b}) \overset{P.R.}{=} \log(e^{a+b}) = a+b = \log x + \log y$$

log ist Umkehrfkt.

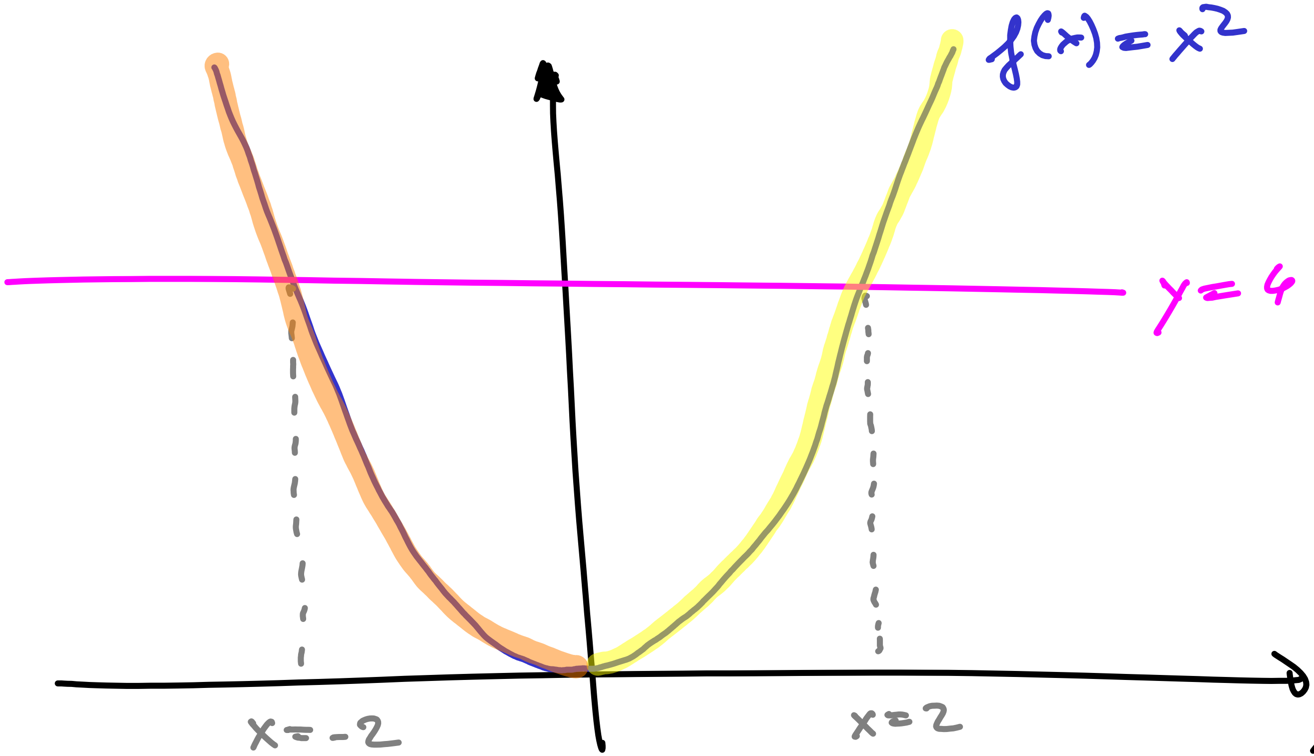
② $$\log(x^{\alpha}) = \alpha\cdot\log x \quad , \quad x = e^{\gamma} \Leftrightarrow \log x = \gamma$$

$$\log(x^{\alpha}) = \log((e^{\gamma})^{\alpha}) \overset{P.R.}{=} \log(e^{\gamma\cdot\alpha}) = \gamma\cdot\alpha = \alpha\cdot\log x$$

log ist Umkehrfkt.

③ $\log\left(\frac{1}{x}\right) = -\log x$ aus ② und $\alpha = -1$

④ $\log(1) = \log(e^0) = 0$



$$f: \mathbb{R} \to \mathbb{R}_0^+ = [0, \infty)$$
$$x \mapsto x^2$$

<u>nicht</u> injektiv

also <u>nicht</u> umkehrbar

$$\tilde{f}: \mathbb{R}_0^+ \to \mathbb{R}_0^+$$
$$x \mapsto x^2$$

ist injektiv (und umkehrbar)

mit $\tilde{f}^{-1}(y) = \sqrt{y}$

$$\tilde{\tilde{f}}: \mathbb{R}_0^- \to \mathbb{R}_0^+$$
$$x \mapsto x^2$$

ebenfalls injektiv und damit

umkehrbar $\tilde{\tilde{f}}^{-1}(x) = -\sqrt{x}$