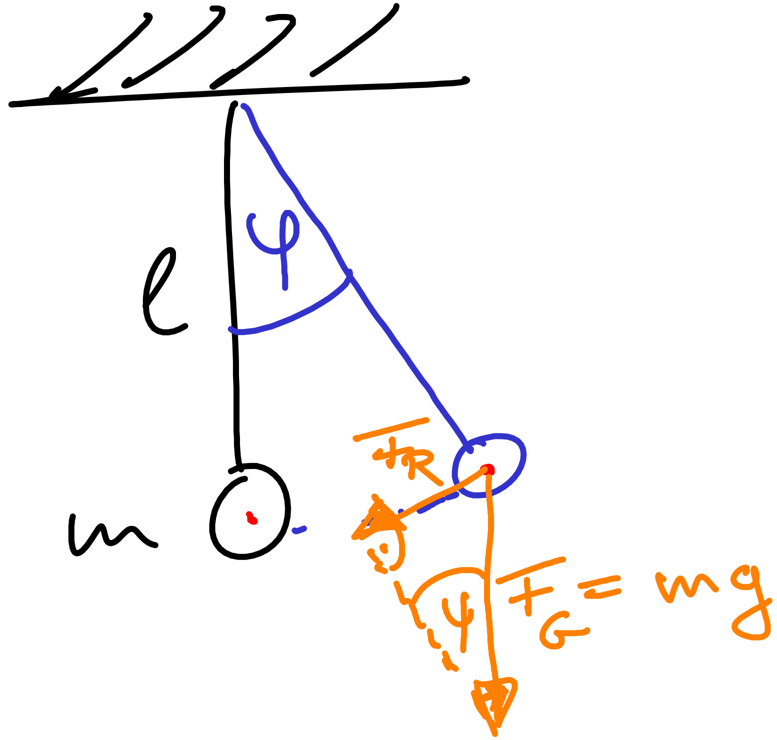



$$F_R = F_G \cdot \sin\varphi = mg\sin\varphi \underset{\varphi\ \text{klein}}{\approx} mg\varphi$$

Newton: $\cancel{m}\,\ell\ddot{\varphi} = -\cancel{m}\,g\varphi$

$$\ddot{\varphi} = -\omega^2\varphi\,, \quad \omega = \sqrt{\frac{g}{\ell}}$$

(i) $\boxed{\ddot{x} = -\omega^2 x}$ $\quad k=2,\ d=1$

$v = \dot{x}$

(ii) $\begin{cases} \dot{x} = v \\ \dot{v} = -\omega^2 x \end{cases}$ bzw. $\begin{pmatrix} x \\ v \end{pmatrix}^{\bullet} = \begin{pmatrix} v \\ -\omega^2 x \end{pmatrix}$ (iii)

übrigens linear

$$\frac{d}{dt}\begin{pmatrix} x \\ v \end{pmatrix} = \begin{pmatrix} 0 & 1 \\ -\omega^2 & 0 \end{pmatrix}\begin{pmatrix} x \\ v \end{pmatrix} \quad \text{(iv)}$$

(i) – (iv) äquivalent

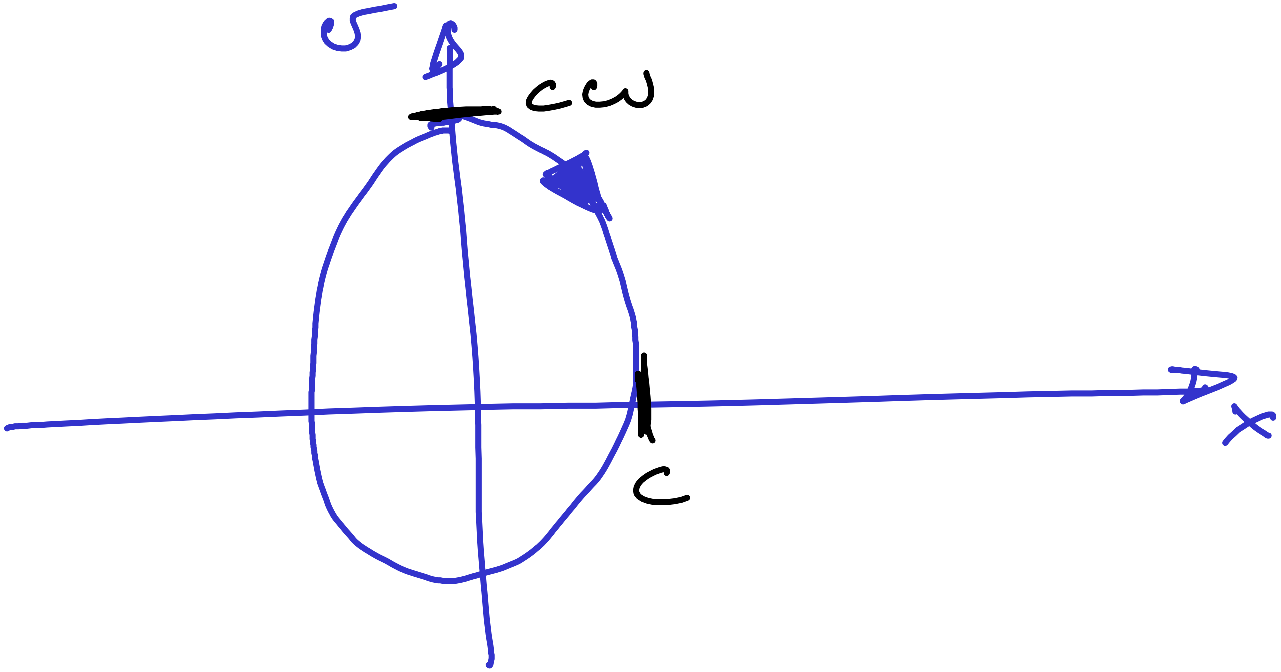
(ii) – (iv) : $k=1,\ d=2$

$$x(t) = c \sin(\omega t + \varphi)$$

$$v(t) = \dot{x}(t) = c\omega \cos(\omega t + \varphi)$$

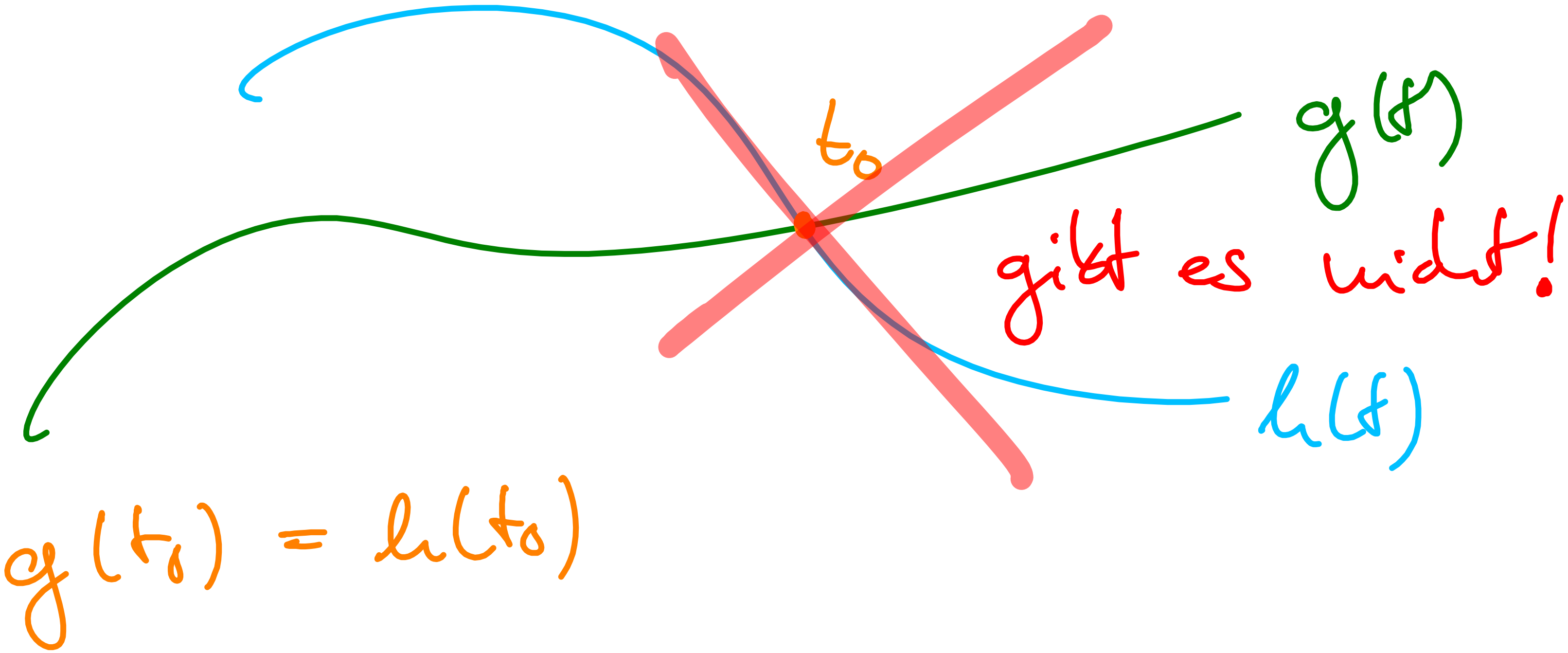
$$\left(\frac{x}{c}\right)^2 + \left(\frac{v}{c\omega}\right)^2 = \sin^2(\ldots) + \cos^2(\ldots) = \underline{1}$$

Ellipsengleichung



# Lösungen $g(t)$, $h(t)$ einer DGL

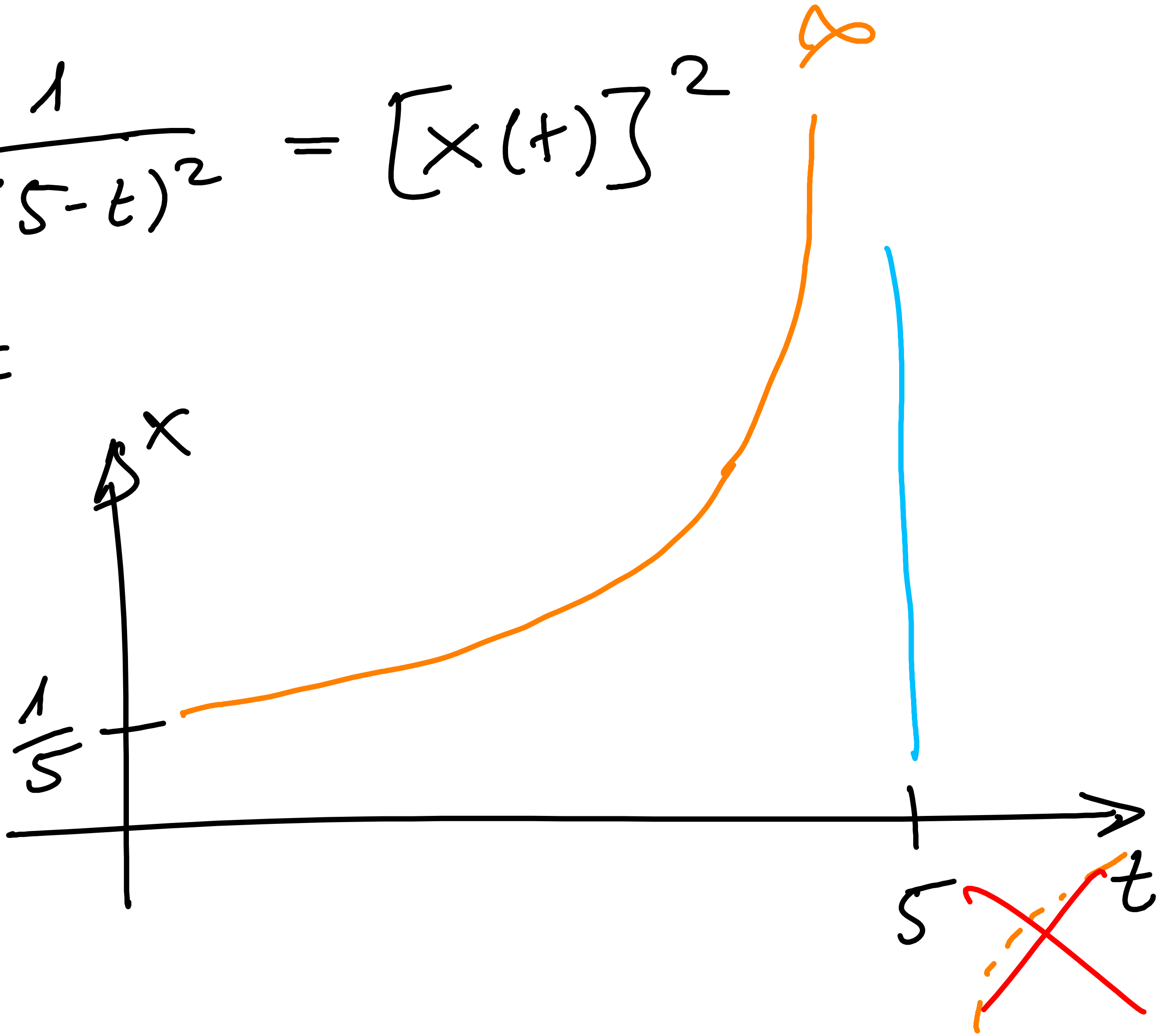
im Phasenraum



Lösung der DGL

$$x(t) = \frac{1}{5-t}$$

$$\begin{cases} \dot{x}(t) = +\frac{1}{(5-t)^2} = [x(t)]^2 \\ x(0) = \frac{1}{5} \end{cases}$$



$$S + E \underset{k_{-1}}{\overset{k_1}{\rightleftharpoons}} SE$$

$$\frac{ds}{dt} = -k_1 se + k_{-1} c$$