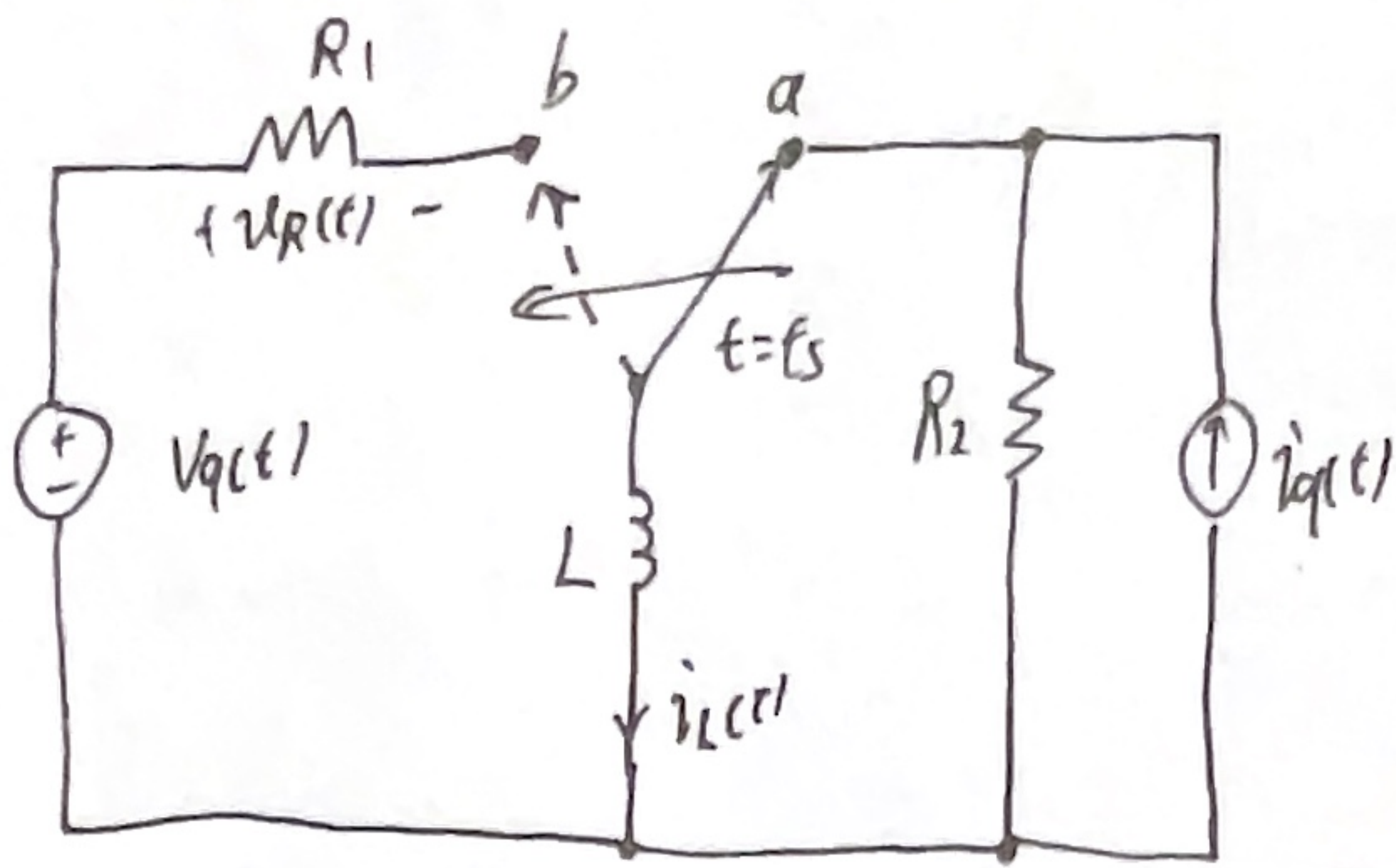


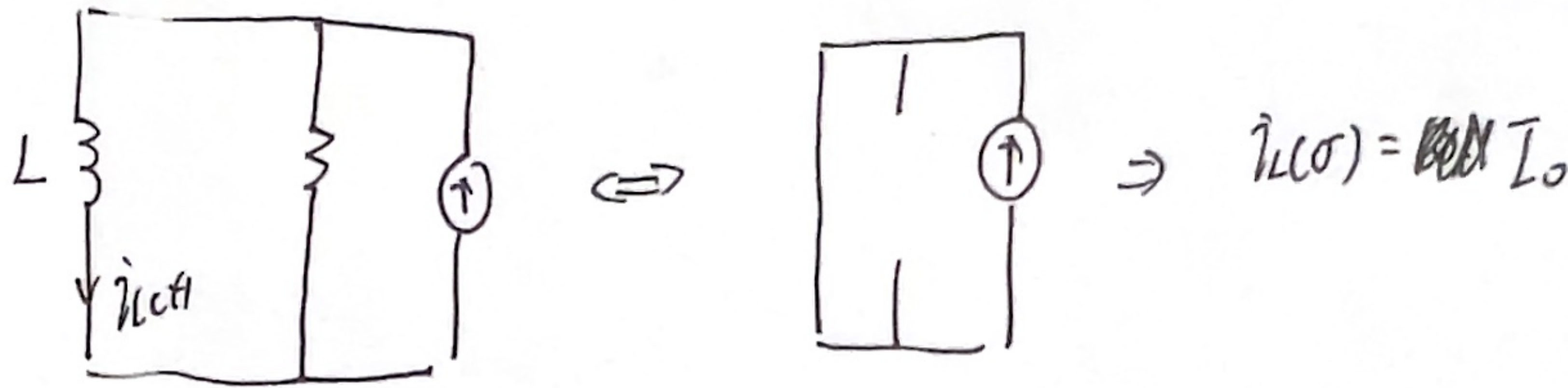
Zeitbereich



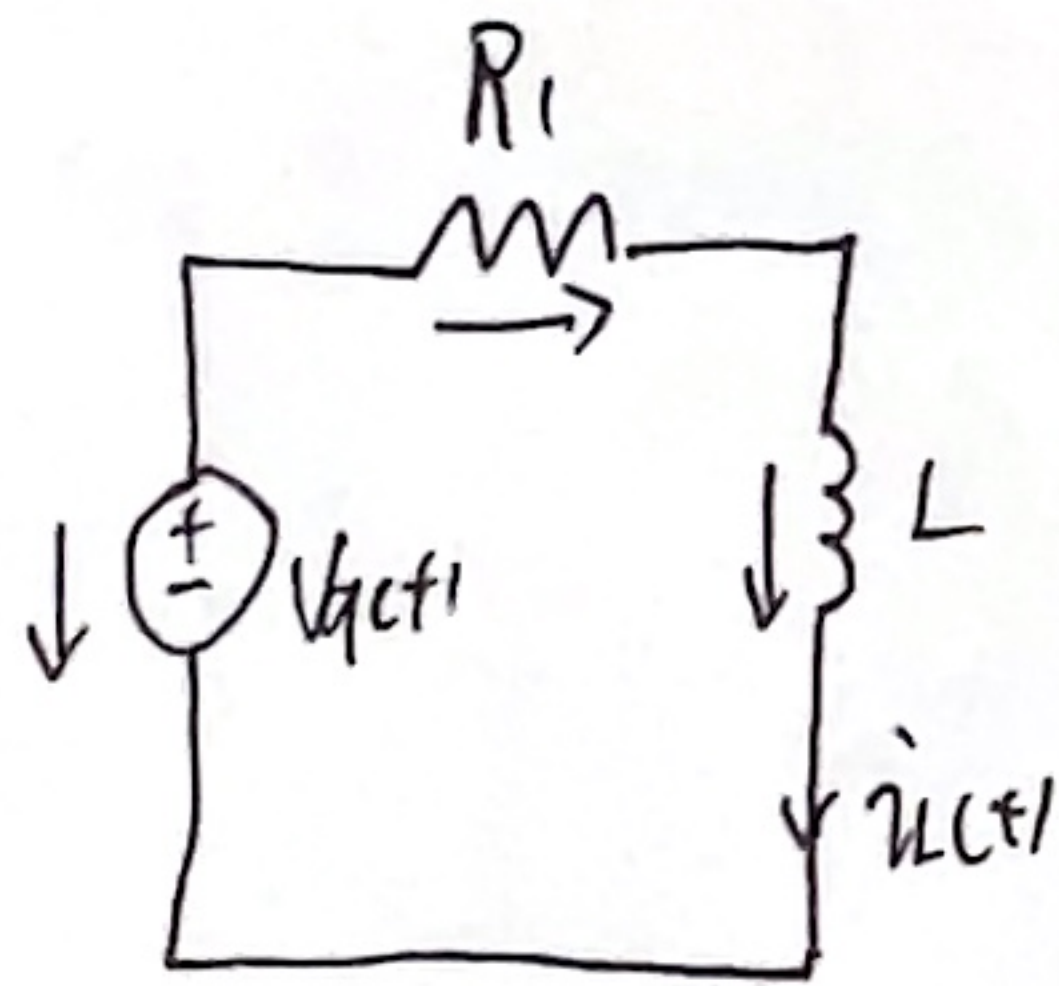
$$\begin{aligned} i_q(t) &= I_0 \\ V_q(t) &= V_0 \\ t = t_s &= 0 \end{aligned}$$

f. $i_L(t)$

1. $t < t_s$



2. $t > t_s$



$$U_L(t) = L \frac{di_L(t)}{dt}$$

$$\begin{aligned} V_q(t) &= U_{R_1}(t) + U_L(t) \\ &= i_L(t) \cdot R_1 + L \frac{di_L(t)}{dt} \quad \text{DGL} \end{aligned}$$

① homogen

$$i_L(t) R_1 + L \frac{di_L(t)}{dt} = 0$$

$$i_L(t) R_1 = -L \frac{di_L(t)}{dt}$$

$$\begin{aligned} -\frac{R_1}{L} \int_{t=0}^t i_L(t') dt' &= \int_{i_L(0)}^{i_L(t)} \frac{1}{i_L(t')} di_L(t') \\ -\frac{R_1}{L} \int_{t=0}^t i_L(t') dt' &= \ln \left[\frac{i_L(t)}{i_L(0)} \right] \end{aligned}$$

~~...~~

$$-\frac{R_1}{L} dt = \frac{1}{i_L(t)} di_L(t)$$

$$-\frac{R_1}{L} \int_0^t dt' = \int_{i_L(0)}^{i_L(t)} \frac{1}{i_L(t')} di_L(t')$$

$$-\frac{R_1}{L} t = \ln \frac{i_L(t)}{i_L(0)}$$

$$e^{-\frac{R_1}{L} t} = \frac{i_L(t)}{i_L(0)}$$

$$i_L(t) = i_L(0) e^{-\frac{R_1}{L} t}$$

$$\Rightarrow i_{L,h}(t) = i_L(0) e^{-\frac{R_1}{L} t}$$

② inhomogen

$$\text{sei } i_{L,p}(t) = K_p(t) e^{-\frac{R_1}{L}t}$$

$$i_{L,p}(t) R_1 + L \frac{di_{L,p}(t)}{dt} = V_a(t)$$

$$K_p(t) e^{-\frac{R_1}{L}t} R_1 + L \frac{d}{dt} [K_p(t) e^{-\frac{R_1}{L}t}] = V_0$$

$$K_p(t) e^{-\frac{R_1}{L}t} R_1 + L e^{-\frac{R_1}{L}t} \frac{d}{dt} K_p(t) - L K_p(t) \frac{R_1}{L} e^{-\frac{R_1}{L}t} = V_0$$

$$\cancel{K_p(t) e^{-\frac{R_1}{L}t} R_1} + L e^{-\frac{R_1}{L}t} \frac{d}{dt} K_p(t) - \cancel{K_p(t) R_1 e^{-\frac{R_1}{L}t}} = V_0$$

$$L e^{-\frac{R_1}{L}t} dK_p(t) = V_0 dt$$

$$dK_p(t) = \frac{V_0}{L} e^{\frac{R_1}{L}t} dt$$

$$\int_{K_p(0)}^{K_p(t)} dK_p(t') = \frac{V_0}{L} \int_{t=0}^{t=t} e^{\frac{R_1}{L}t'} dt'$$

$$K_p(t) - K_p(0) = \frac{V_0}{L} \frac{L}{R_1} \left[e^{\frac{R_1}{L}t'} \right]_0^t$$

$$K_p(t) - K_p(0) = \frac{V_0}{R_1} \left[e^{\frac{R_1}{L}t} - 1 \right]$$

wähle $K_p(0) = 0$, nur wenn $K_p(0) = 0$ erfüllt,

$$K_p(t) = \frac{V_0}{R_1} (e^{\frac{R_1}{L}t} - 1)$$

$$\Rightarrow i_{L,p}(t) = K_p(t) e^{-\frac{R_1}{L}t} = \frac{V_0}{R_1} (1 - e^{-\frac{R_1}{L}t})$$

$$\Rightarrow i_L(t) = i_{L,h}(t) + i_{L,p}(t)$$

$$= i_{L(0)} e^{-\frac{R_1}{L}t} + \frac{V_0}{R_1} (1 - e^{-\frac{R_1}{L}t})$$

$$= I_0 e^{-\frac{R_1}{L}t} + \frac{V_0}{R_1} (1 - e^{-\frac{R_1}{L}t})$$