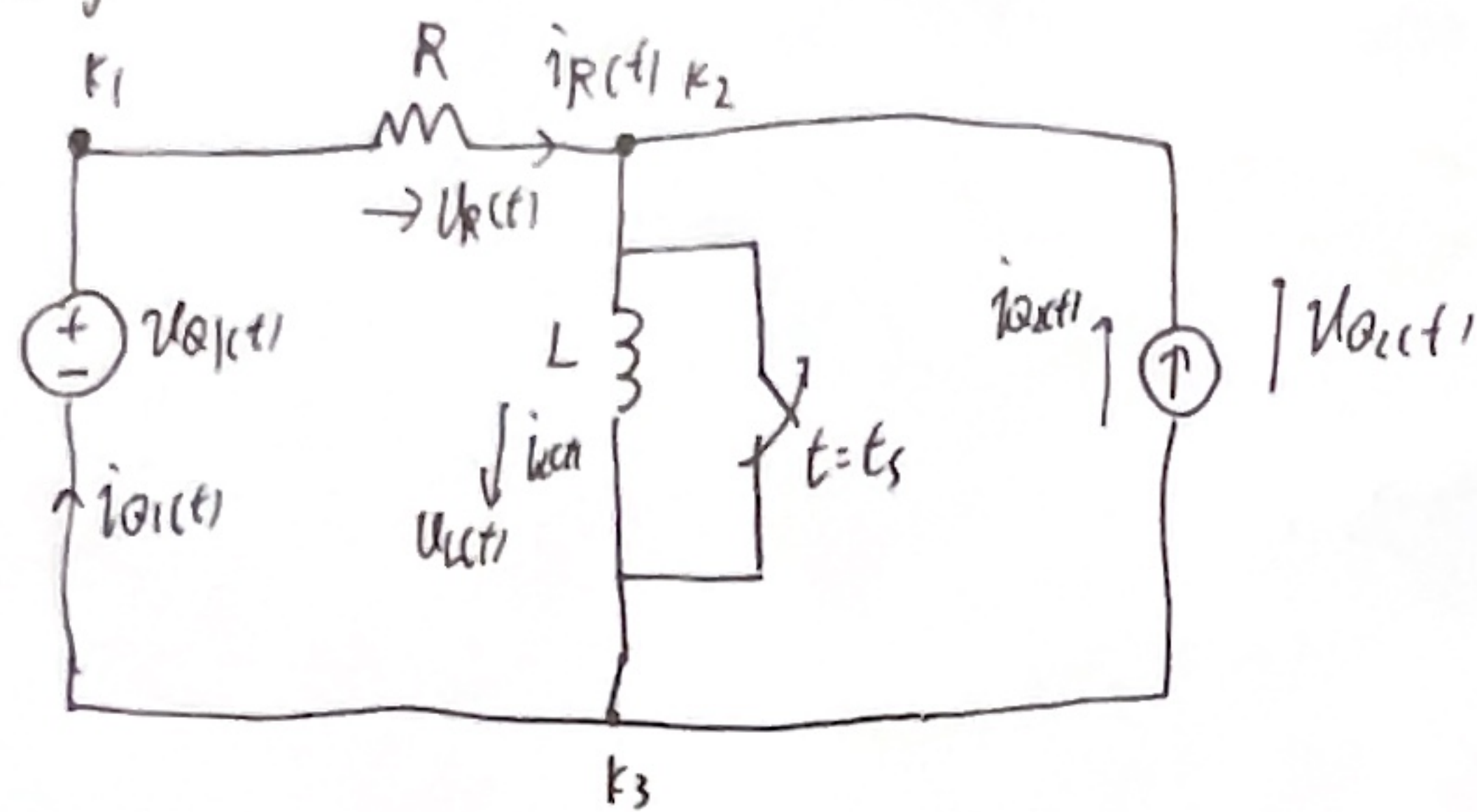
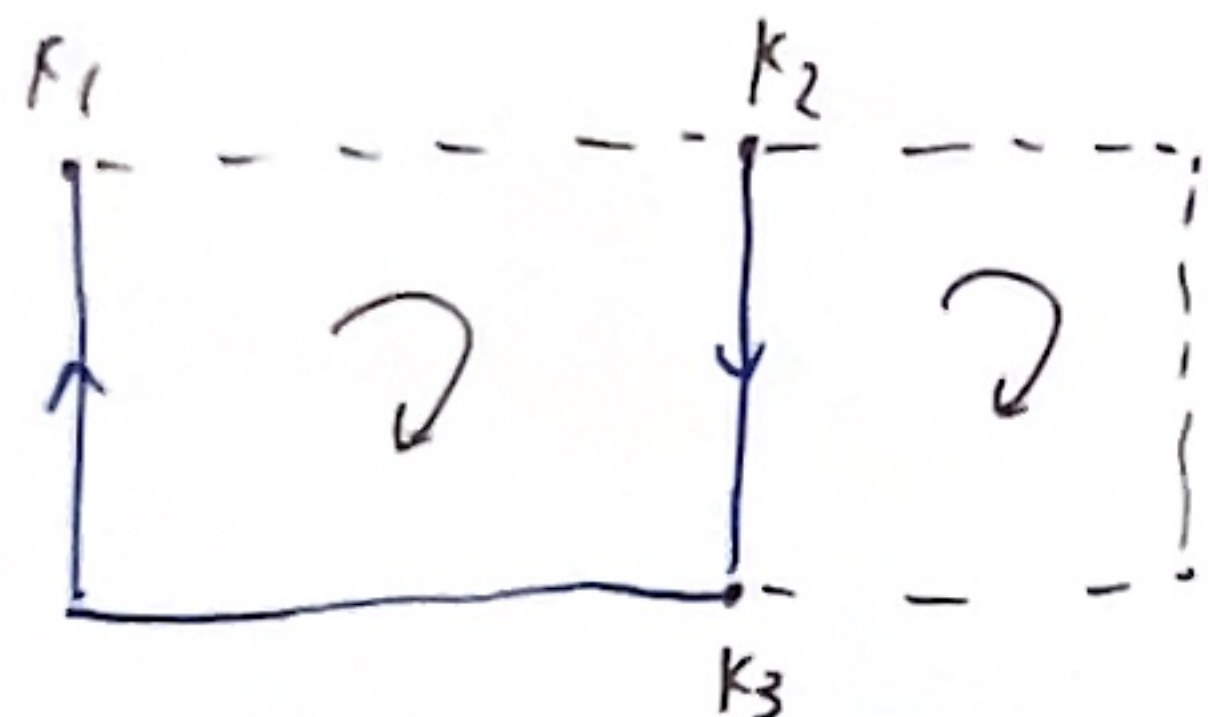


# Aufgabe 4



$u_{01}(t), i_{01}(t)$  是直流  
 $t = t_s = 0$  时, 开关打开  
 $i_L(0^-) = i_L(0^+) = i_L(0)$   
 $i_L(t), t > 0$

此题可用叠加定理, 但是引入了回路  
 在时域不行  $\Rightarrow$  会有两个 homogeneous Lösung



$$2BZ, 2VZ, 3K \\ \Rightarrow m = 2 - k + 1 = 4 - 3 + 1 = 2 \\ p = k - 1 = 2$$

KVL:  $\overset{2KZ}{u_{01}(t)} = u_{R(t)} + u_{L(t)}$   
 $u_{02(t)} = u_{L(t)}$  ~~不是~~

电感特性  
 $\int u_L(t) dt = L \frac{di_L(t)}{dt}$

KCL:  $i_{01(t)} + i_{R(t)} = i_{L(t)}$

$$\Rightarrow u_{01(t)} = u_{R(t)} + u_{L(t)} = R \cdot i_{R(t)} + L \frac{di_{L(t)}}{dt} = R [i_{L(t)} - i_{02(t)}] + L \frac{di_{L(t)}}{dt}$$

$$\Leftrightarrow \frac{di_{L(t)}}{dt} = \frac{1}{L} u_{01(t)} - \frac{R}{L} [i_{L(t)} - i_{02(t)}] = \frac{1}{L} u_{01(t)} + \frac{R}{L} i_{02(t)} - \frac{R}{L} i_{L(t)}$$

$$DGL: \frac{di_{L(t)}}{dt} = \frac{1}{L} u_{01(t)} + \frac{R}{L} i_{02(t)} - \frac{R}{L} i_{L(t)}$$

Lösung:  $i_{L(t)} = i_{L,h(t)} + i_{L,p(t)}$

für homogen

$u_{01(t)} = i_{02(t)} = 0$  无外部激励

$$\frac{di_{L(t)}}{dt} = -\frac{R}{L} i_{L(t)}$$

$$\frac{1}{i_{L(t)}} di_{L(t)} = -\frac{R}{L} dt$$

$$\int_{i_{L(0^+)}}^{i_{L(t)}} \frac{1}{i_{L(t')}} di_{L(t')} = \int_0^t -\frac{R}{L} dt$$

$$\ln \frac{i_{L(t)}}{i_{L(0^+)}} = -\frac{R}{L} t$$

$$\Rightarrow \text{homog } i_{L,h(t)} = i_{L(0)} e^{-\frac{R}{L} t}$$

für inhomogen

根据通解  $i_{L(0)} e^{-\frac{R}{L} t}$

$$\Rightarrow i_{L,p(t)} = k_{p(t)} e^{-\frac{R}{L} t}$$

$$\frac{d}{dt} i_{L,p(t)} = e^{-\frac{R}{L} t} \frac{d}{dt} k_{p(t)} - \frac{R}{L} k_{p(t)} e^{-\frac{R}{L} t}$$

$$= \frac{1}{L} u_{01(t)} + \frac{R}{L} i_{02(t)} - \frac{R}{L} k_{p(t)} e^{-\frac{R}{L} t}$$

$$\Rightarrow e^{-\frac{R}{L} t} \frac{d}{dt} k_{p(t)} = \frac{1}{L} u_{01(t)} + \frac{R}{L} i_{02(t)}$$

$$dk_{p(t)} = \left[ \frac{1}{L} u_{01(t)} + \frac{R}{L} i_{02(t)} \right] e^{\frac{R}{L} t} dt$$

$$\int_{k_{p(0^+)}}^{k_{p(t)}} dk_{p(t')} = \int_0^t \left[ \frac{1}{L} u_{01(t')} + \frac{R}{L} i_{02(t')} \right] e^{\frac{R}{L} t'} dt'$$



$$K_{p(t)} - K_{p(0)} = \int_0^t \frac{1}{L} U_{Q1}(t') e^{\frac{R}{L}t'} dt' + \int_0^t \frac{R}{L} i_{Q2}(t') e^{\frac{R}{L}t'} dt'$$

↑

Anfangswert  $i_{L,p}(0^+) = 0 \Rightarrow K_{p(0)} = 0$

$$\Rightarrow i_{L,p}(t) = K_{p(t)} e^{-\frac{R}{L}t}$$

$$= \int_0^t \frac{1}{L} U_{Q1}(t') e^{\frac{R}{L}t'-t} dt' + \int_0^t \frac{R}{L} i_{Q2}(t') e^{\frac{R}{L}t'-t} dt'$$

$$= \frac{1}{L} U_{Q1}(t') \frac{L}{R} \left[ e^{\frac{R}{L}t'-t} \right]_0^t + \frac{R}{L} i_{Q2}(t') \frac{L}{R} \left[ e^{\frac{R}{L}t'-t} \right]_0^t$$

$$= \frac{U_{Q1}(t')}{R} (1 - e^{-\frac{R}{L}t}) + i_{Q2}(t') (1 - e^{-\frac{R}{L}t})$$

$$\Rightarrow i_{L(t)} = i_{L,h(t)} + i_{L,p(t)} = i_{L(0)} e^{-\frac{R}{L}t} + \left[ \frac{U_{Q1}(t')}{R} + i_{Q2}(t') \right] [1 - e^{-\frac{R}{L}t}]$$

$U_{Q1}(t)$  &  $i_{Q2}(t)$  sind fixe Quelle

ungesteuert, d.h. Gleichstrom

$$\Rightarrow i_{L(t)} = i_{L(0)} e^{-\frac{R}{L}t} + \int_0^t \frac{1}{L} U_{Q1}(t') e^{-\frac{R}{L}t-t'} dt' + \int_0^t \frac{R}{L} i_{Q2}(t') e^{-\frac{R}{L}t-t'} dt'$$