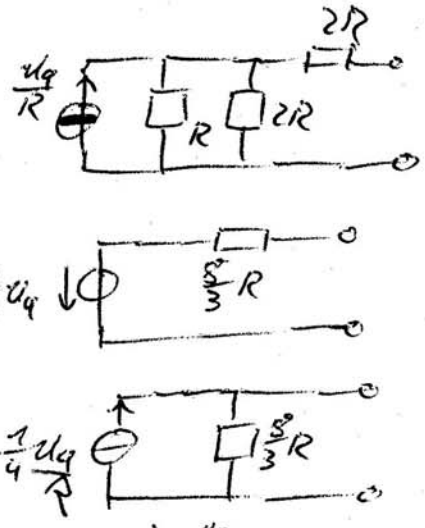
Aufgabe 3

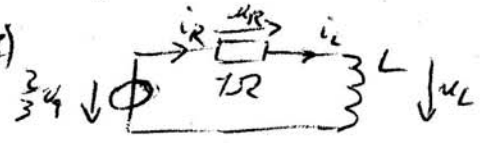
a)



$$R \| 2R = \frac{2R^2}{3R} = \frac{2}{3}R$$

b) Stromverlauf stetig. Strom ist Zustandsgröße.

c)



$$u_R(0) = \frac{2}{3}u_q(0) - u_L(0) = 0V$$
$$\Rightarrow i_R(0) = i_L(0) = \frac{u_R(0)}{R} = 0A$$

1. Zustandsgröße: i_L

2. DGL: $u_L = L\dot{i}_L$ mit $u_L = -R'i_L + \frac{2}{3}u_q$ $\quad R' = 7R$

$$-R'i_L + \frac{2}{3}u_q = L\dot{i}_L$$

3. Umformen: $\dot{i}_L = -\frac{R'}{L}i_L + \frac{2}{3L}u_q = -\frac{i_L}{L/R'} + \frac{\frac{2u_q}{3R'}}{L/R'}$

$$\Rightarrow \tau = \frac{L}{R'} \qquad \varphi = \frac{2u_q}{3R'}$$

φ stückweise konst.

4.1 $t_0 = 0$ $\quad i_L(0) = 0A$ $\quad \varphi = 4A$

5.1 a) $i_{L_1} = 4A + [0A - 4A]e^{-\frac{t}{L/R'}} = 4A(1 - e^{-\frac{tR'}{L}}) \qquad 0 < t < 3s$

$$u_{L_1} = L\dot{i}_{L_1} = L \cdot (-4A)e^{-\frac{t \cdot R'}{L}} \cdot (-\frac{R'}{L}) = 4Ve^{-\frac{t \cdot R'}{L}}$$

4.2 $t_0 = 3s$ $\quad i_{L_1}(t_0) = 4A(1 - e^{-\frac{t_0 R'}{L}}) = 1.54A$ $\quad \varphi = \frac{2}{3}\frac{u_q}{R'} = -4A$

5.2 a) $i_{L_2} = -4A + [i_{L_1}(t_0) + 4A]e^{-\frac{t - t_0}{L/R'}} = -4A + 5.59Ae^{-\frac{t-3s}{L/R'}} \qquad 3s < t < \overline{5s}$

$$i_{L_2}(\overline{5s}) \approx 0A$$

$$u_{L_2} = L\dot{i}_{L_2} = L \cdot (5.57A)(-\frac{R'}{L})e^{-\frac{t-3s}{L/R'}} = -5.57Ve^{-\frac{t-3s}{L/R'}}$$

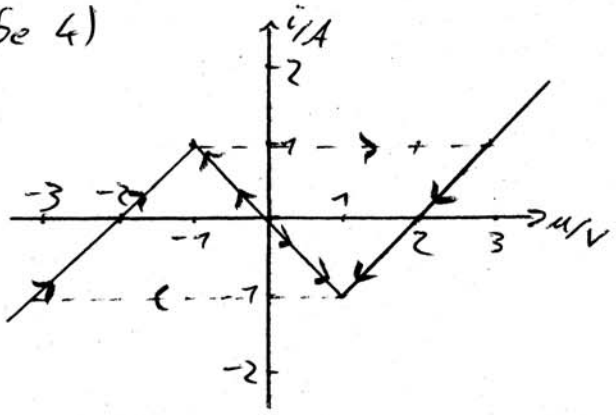
4.3 $t_0 = \overline{5s}$ $\quad i_{L_2}(t_0) \approx 0A$ $\quad \varphi = 4A$

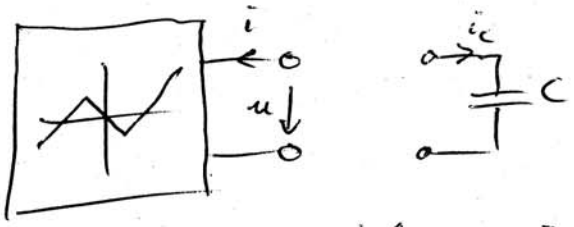
5.3 a) $\Rightarrow i_{L_3} = i_{L_1}$

5.4 a) $\Rightarrow i_{L_4} = i_{L_2}$

Aufgabe 4)

a)





Kapazität: $i_C = -i$ $\quad$ Induktivität: $i_L = -i$

$-\dot{i} = C\ddot{u}$ $\quad$ $-u = L\dot{i}$

$i > 0 \Rightarrow u$ fällt $\quad$ $u > 0 \Rightarrow i$ fällt

$i < 0 \Rightarrow u$ steigt $\quad$ $u < 0 \Rightarrow i$ steigt

$\Rightarrow$ Oszillation bei Beschaltung mit einer Induktivität

b) $t_0 = 0 \quad i(t_0) = 1A$

Kennlinien-Ast: $i = \frac{u - 2V}{R}$ $\quad -u = L\dot{i}$ $\quad$ mit $R = 1\Omega$

$\Rightarrow Ri + 2V = -L\dot{i}$

$\dot{i} = -\frac{i}{L/R} + \frac{-2V/R}{L/R}$

$\Rightarrow i(t) = -\frac{2V}{R} + \left[1A + \frac{2V}{R}\right] e^{-\frac{t}{L/R}} = -2A + 3A\, e^{-\frac{t}{L/R}}$

$i(t_1) = -2A + 3A\, e^{-\frac{t_1}{L/R}} \stackrel{!}{=} -1A$

$e^{-\frac{t_1}{L/R}} = \frac{1}{3} \quad \Rightarrow \quad t_1 = \frac{L}{R} \ln 3 \approx 1.1s$

aus Symmetriegründen: $t_2 = t_1$

$\Rightarrow T = 2t_1 \approx 2.2s$

$\Rightarrow f = \frac{1}{T} \approx 0.46\,Hz$