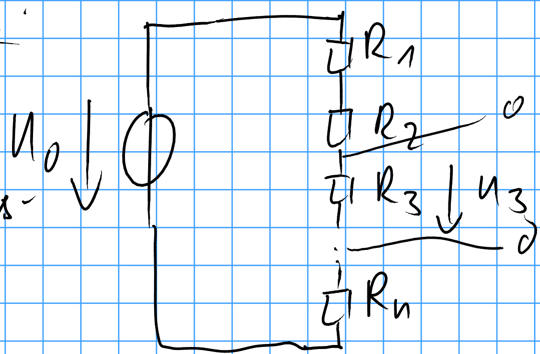
ST 1 – Tutorübung Blatt 2 (10.11.09)

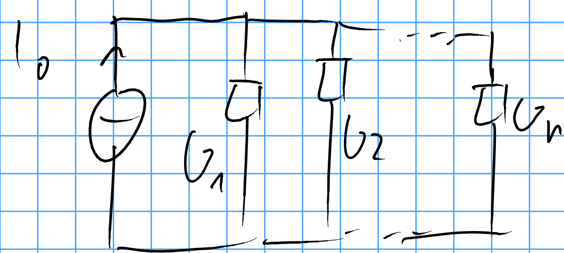
Wdh.

Spannungs-teiler



$$u_i = U_0 \cdot \frac{R_i}{\sum_{k=1}^{n} R_k}$$

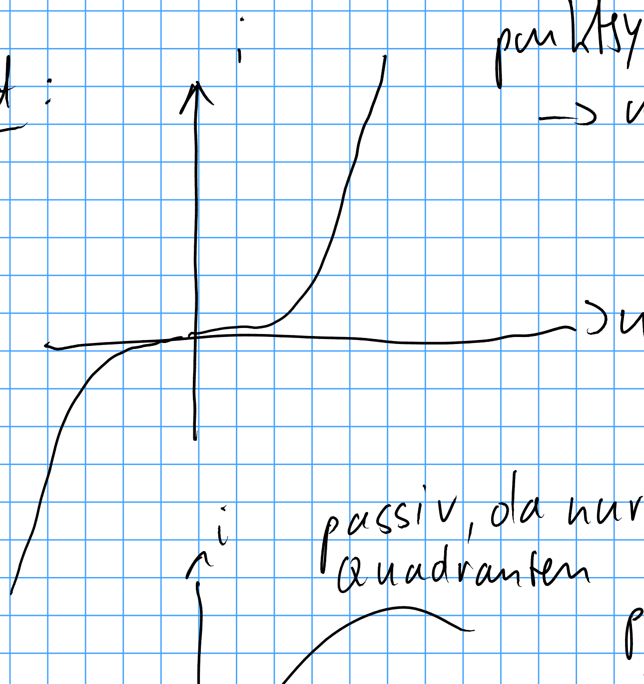
Strom-teiler



$$i_i = I_0 \cdot \frac{G_i}{\sum_{k=1}^{n} G_k}$$

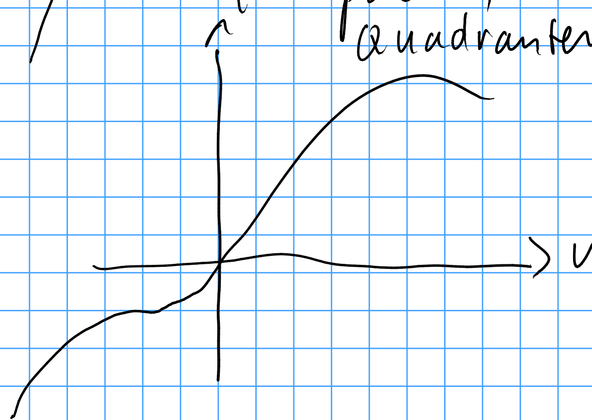
Eigenschaften von Eintoren

→ gepolt / ungepolt:



punktsymmetrisch → ungepolt

→ aktiv / passiv



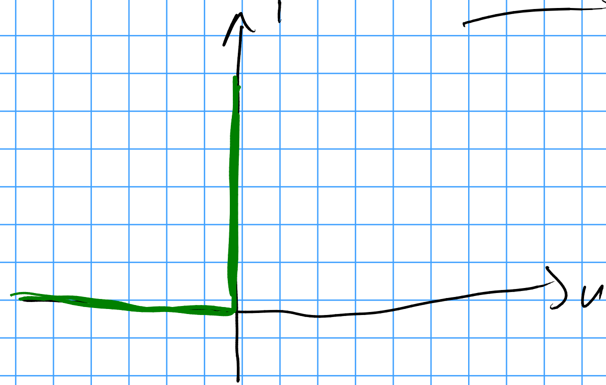
passiv, da nur im 1. und 3. Quadranten

passiv: $\forall (u,i) \in F: u \cdot i \geq 0$

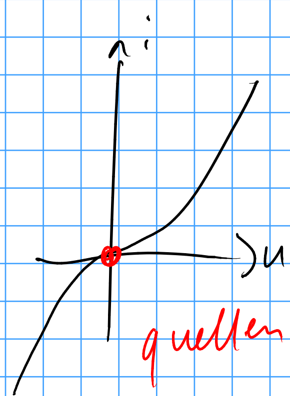
aktiv: $\exists (u,i) \in F: u \cdot i < 0$

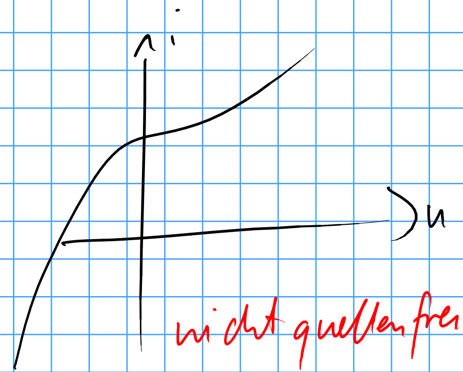
→ verlustlos: $u \cdot i = 0$

wichtig: verlustlose Bauteile sind immer passiv

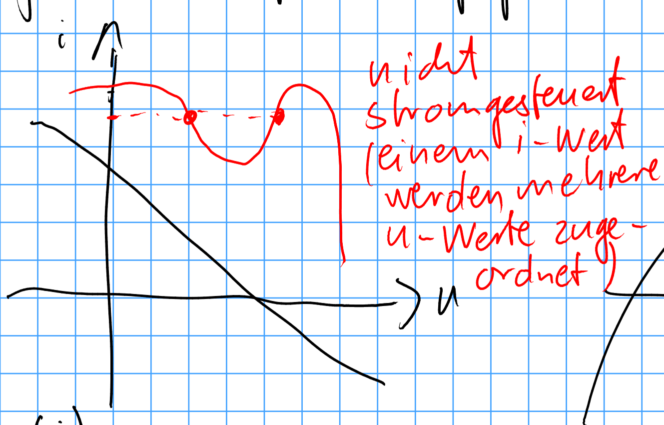


→ quellenfrei: $\Leftrightarrow$ $(u = 0V, i = 0A) \in \mathcal{F}$

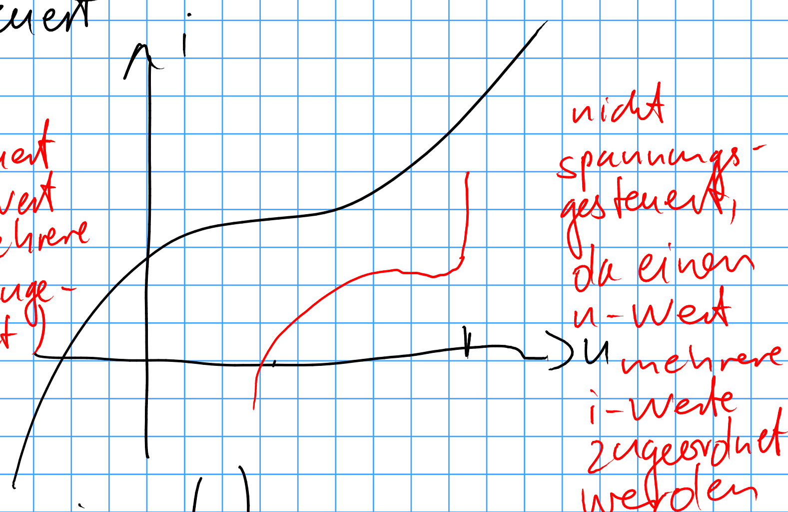




→ stromgesteuert / spannungsgesteuert



$u = r(i)$



$i = g(u)$

→ Linearität

stückweise linear

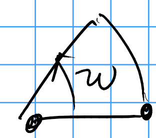
Eintorbeschreibungen

→ explizit: $u = Ri$

$i = Gu$

$i_D = I_S \left(e^{\frac{u}{u_T}} - 1\right)$

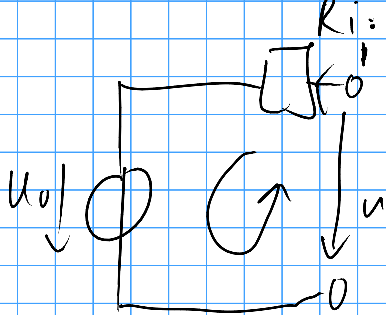
→ implizit: $u - Ri = 0$



→ parametrisierte: $u = u_F(\lambda)$

$i = i_F(\lambda)$

Quellenwandlung

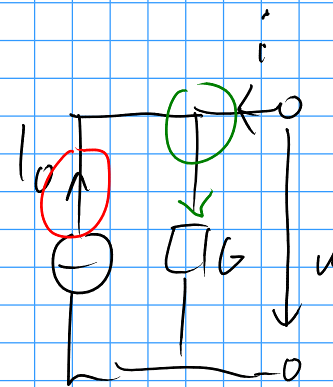


Helmholtz-Thévenin

$u = Ri + U_0$

$u - U_0 = Ri \quad | : R$

$i = \frac{u}{R} - \frac{U_0}{R} = Gu - I_0$, mit $\frac{U_0}{R} = I_0$



KCL:

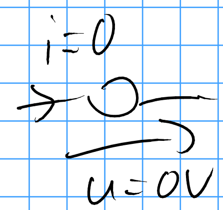
$-I_0 - i + u \cdot G = 0$

$i = uG - I_0$

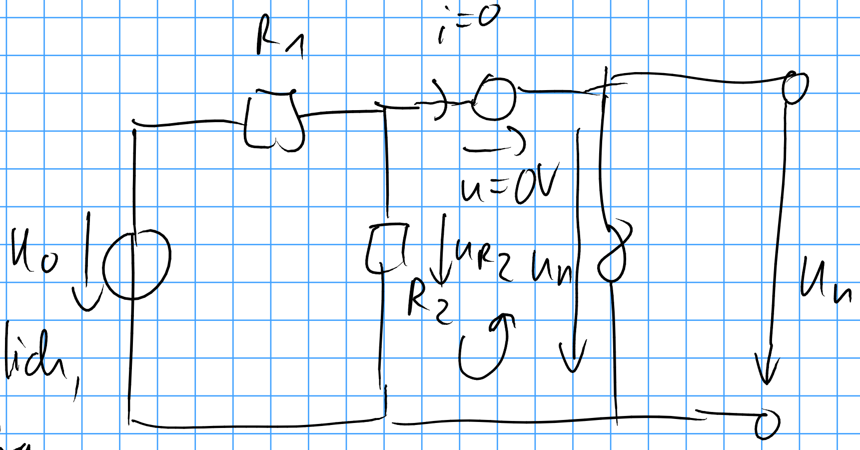
Mayer-Norton-ESB

Blatt 2

1\.



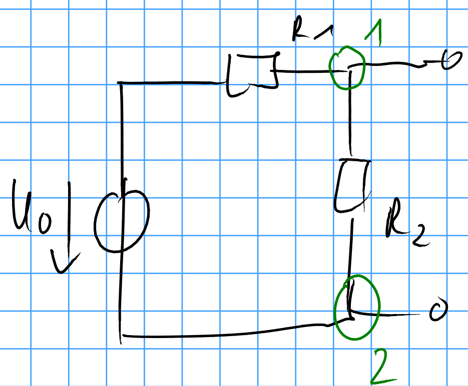
getrennte Betrachtung möglich, da Entkoppelung durch Nullator und Norator erfolgt



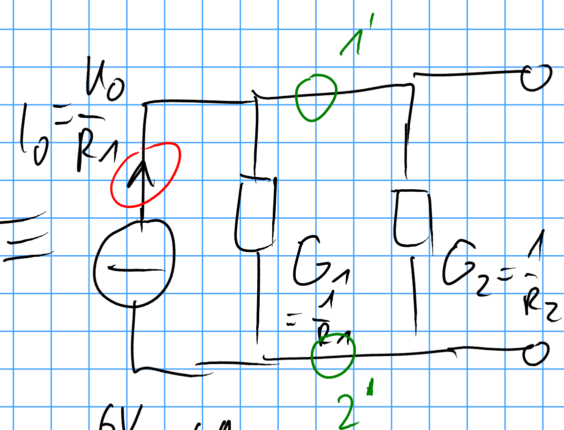
$u_{R_2} - U_n = 0 \Leftrightarrow u_{R_2} = U_n$

2\. $U_n = u_{R_2} = U_0 \cdot \frac{R_2}{R_1 + R_2}$ (✱) (Spannungsteilerformel)

3\. Quellenwandlung



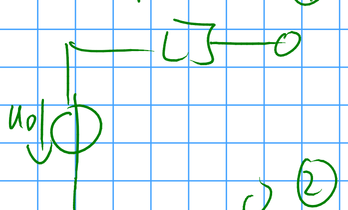
$\equiv$



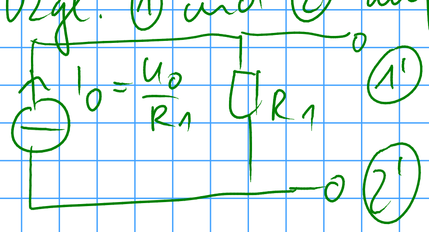
$I_0 = \frac{6V}{1\Omega} = 6A$

weiterführende Erklärung:

Eintor

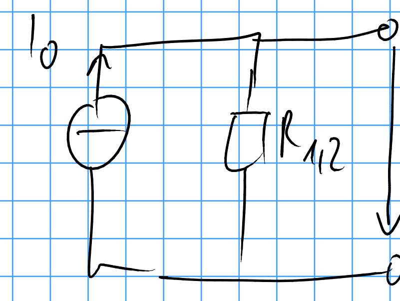


weist komplett gleiches Klemmenverhalten bzgl. ① und ② auf wie



bzgl. ①' u. ②'

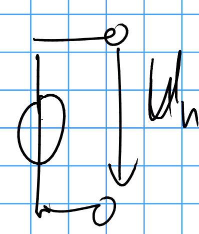
$\equiv$



$R_{1,2} = R_1 \| R_2 = \frac{R_1 \cdot R_2}{R_1 + R_2} = \frac{1 \cdot 2}{1+2} = \frac{2}{3}\Omega$

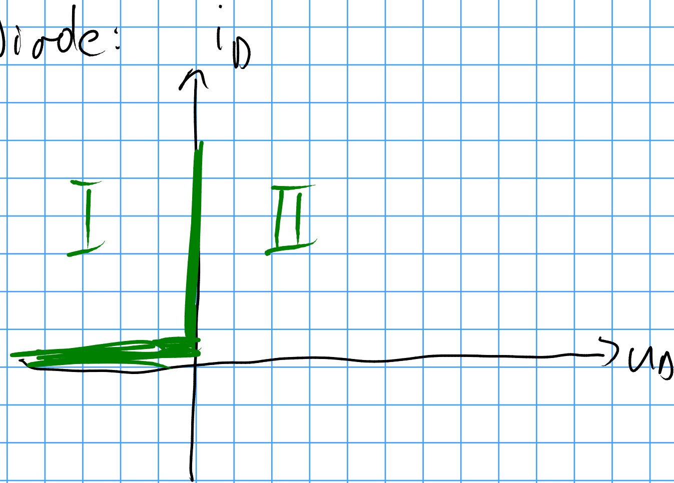
$U_n = R_{1,2} \cdot I_0 = \frac{R_1 \cdot R_2}{R_1 + R_2} \cdot \frac{U_0}{R_1} = \boxed{U_0 \cdot \frac{R_2}{R_1 + R_2}}$

$\equiv$



gleiches Ergebnis wie unter (✱)!

4. ideale Diode:



I: Leerlauf $u_D \le 0V$

$i_d = 0A$

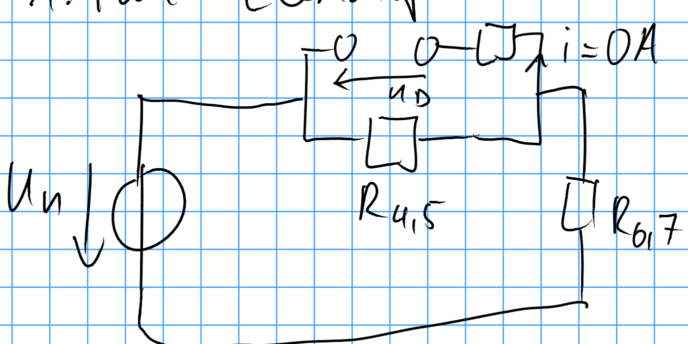
II: Kurzschluss $u_D = 0V$

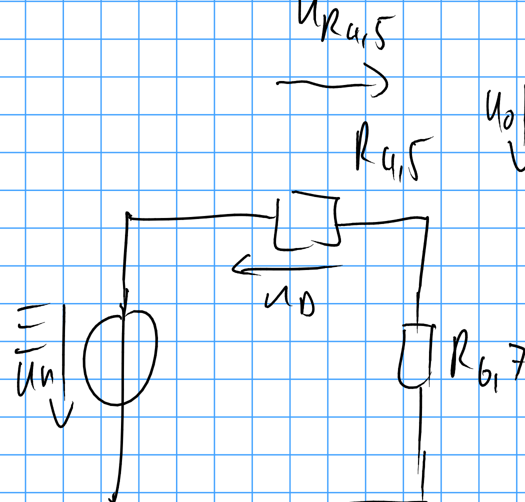
$i_D \ge 0A$

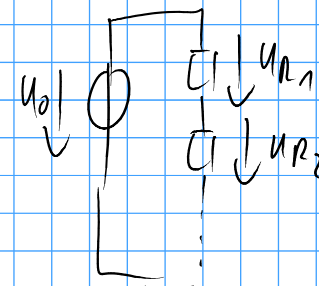
$$R_{4,5} = R_4 || R_5 = \frac{R_4 \cdot R_5}{R_4 + R_5} = 1\,\Omega$$

$$R_{6,7} = R_6 + R_7 = 2\,\Omega$$

1. Fall: Leerlauf







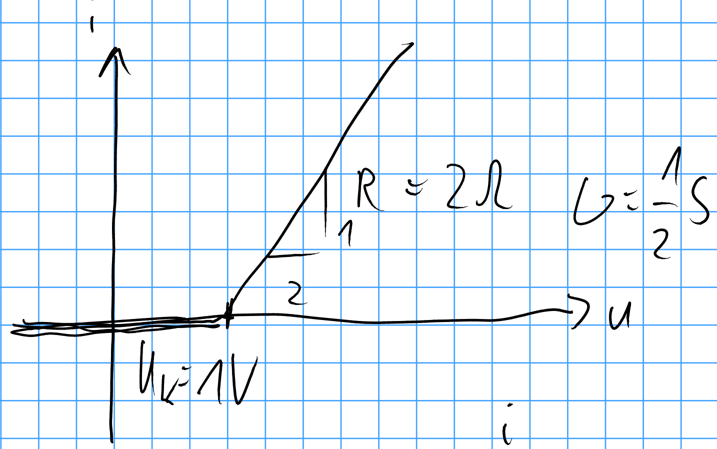
$$u_{R_{4,5}} = U_n \cdot \frac{R_{4,5}}{R_{4,5} + R_{6,7}} = \frac{4}{3} V$$

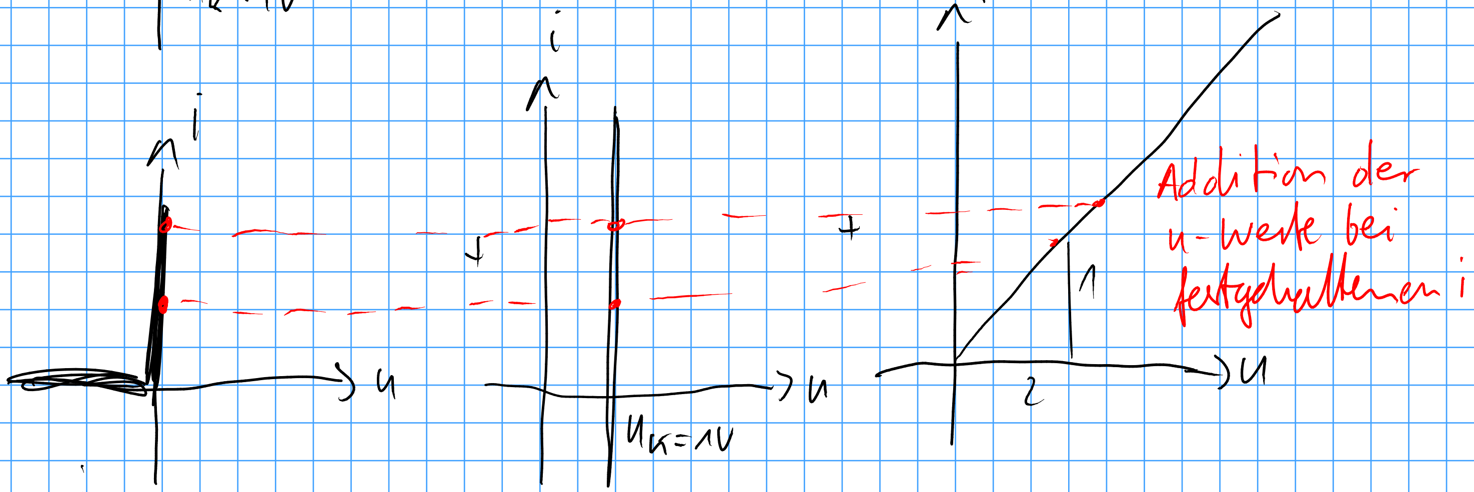
$$u_D = -u_{R_{4,5}} = -\frac{4}{3} V < 0V$$

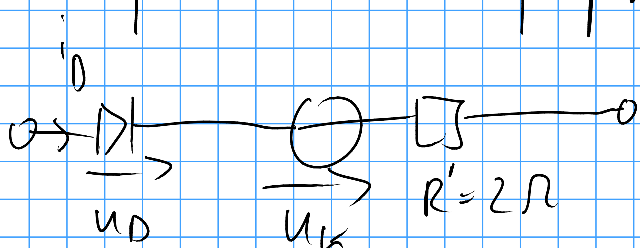
=) Annahme Leerlauf ist gerechtfertigt!

Ergänzung: nicht-zutreffender Fall 2) "KS" siehe Ende

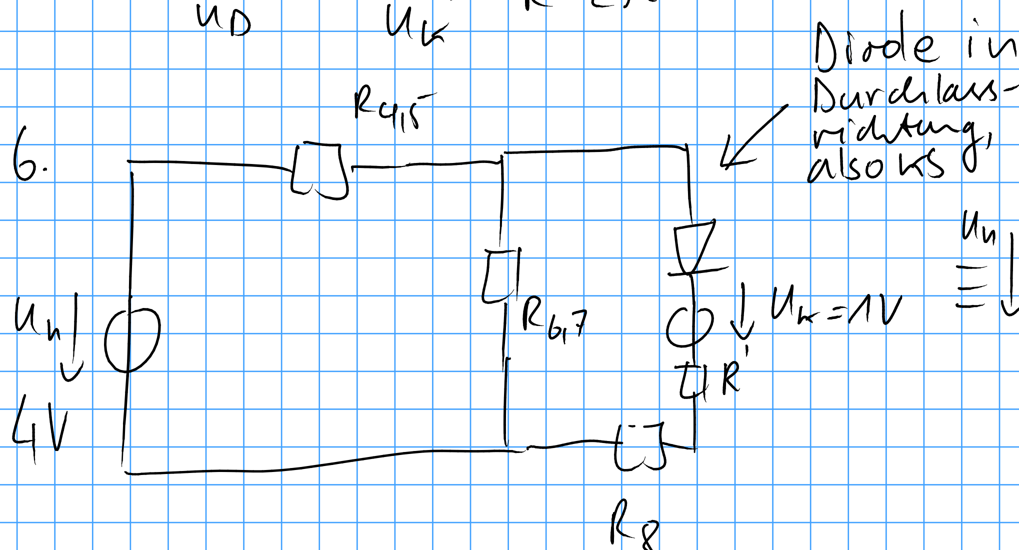
5.

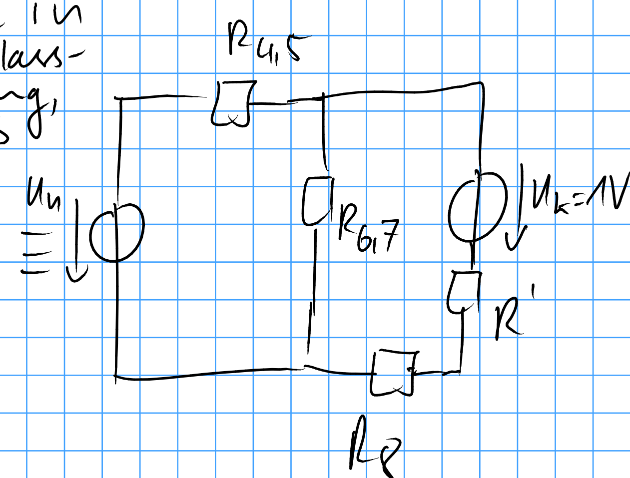






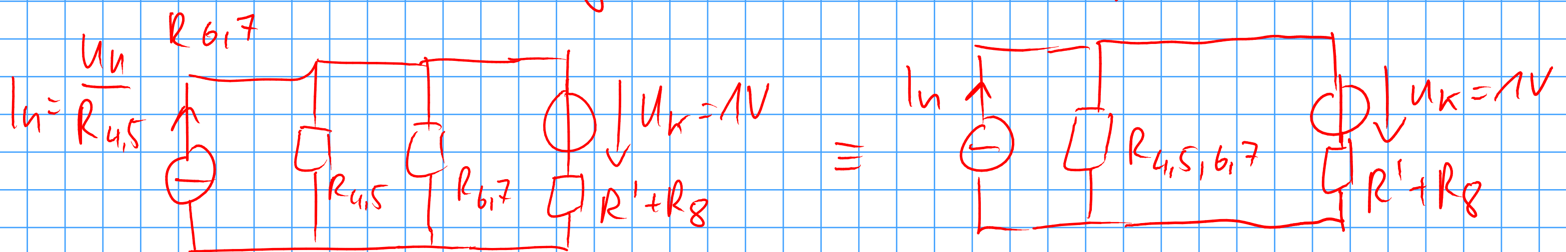
6.





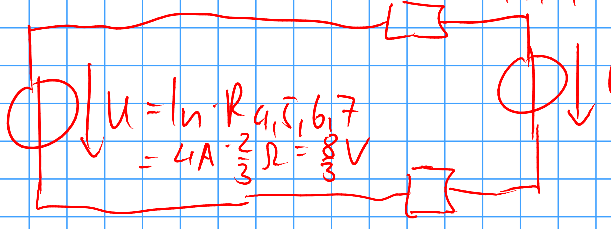
Weitere mögliche Vereinfachungen (nicht in TÜ besprochen:)

-> Quellenwandlung zum Zusammenfassen von $R_{4,5}$ u. $R_{6,7}$



$R_{4,5,6,7} = \frac{R_{4,5} \cdot R_{6,7}}{R_{4,5} + R_{6,7}} = \frac{1\Omega \cdot 2\Omega}{3\Omega} = \frac{2}{3}\Omega$; $I_n = \frac{4V}{1\Omega} = 4A$

→ Wiederum Quellenwandlung



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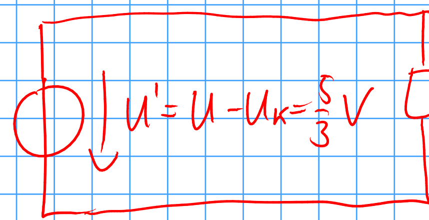

Interessante, weiterführende Fragestellung: Was passiert, falls $U_K = 5V$?

Aufgabe 2

nur Kreislinie (nicht Fläche!) → ③

Graph	①	②	③	④	⑤
ungepolt			X	X	X
gepolt	X	X			
aktiv	X	X	X	X	
passiv					X
verlustfrei					
quellenfrei				X	X
streng linear				X	
stückweise linear		X			X
nicht linear	X		X		