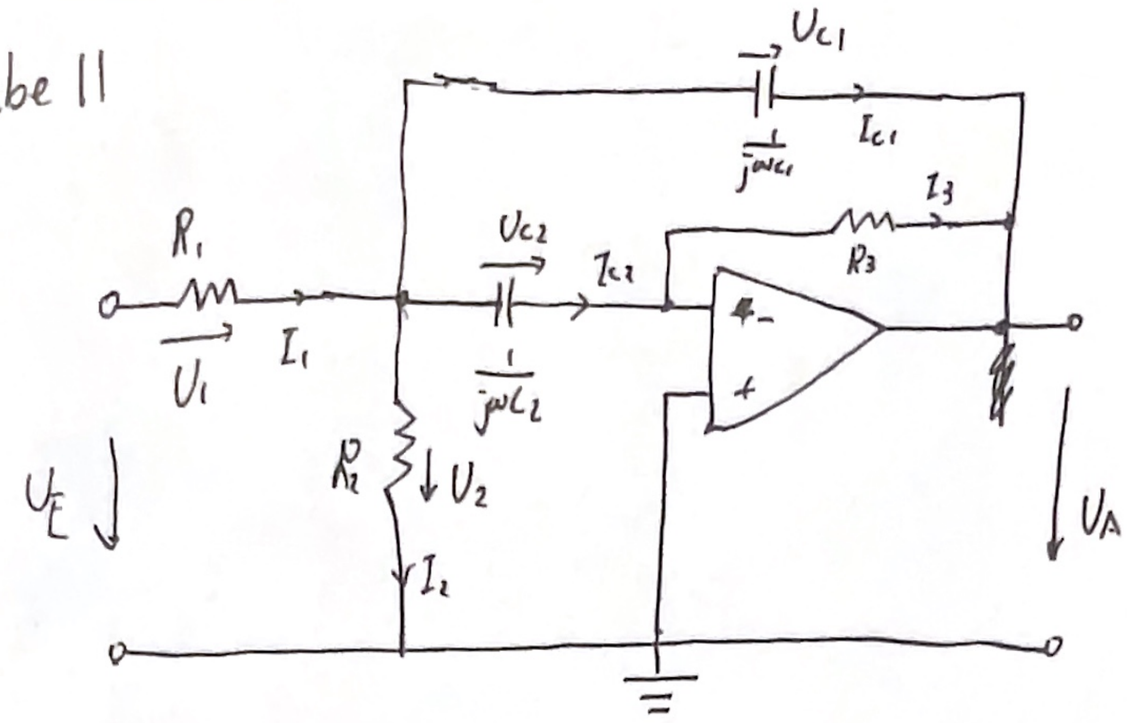
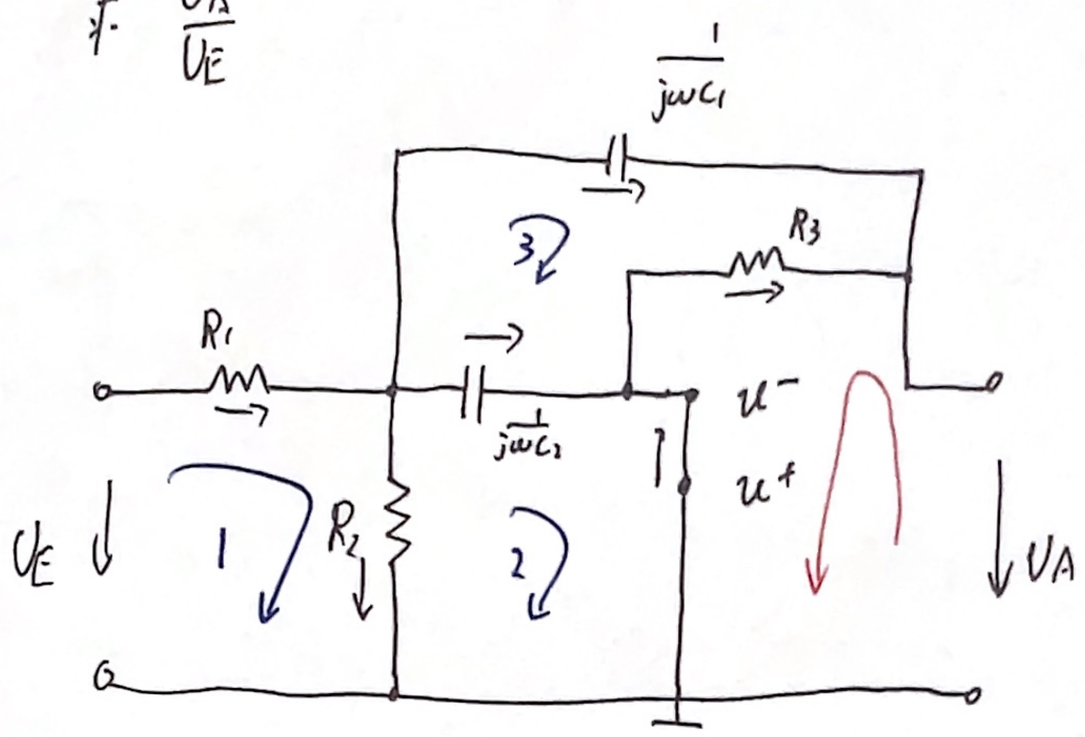
Aufgabe 11



ges: $\frac{U_A}{U_E}$



1) $U_E = U_{R1} + U_{R2}$

2) $U_{R2} = U_{C2} - U_D = U_{C2}$

$\Rightarrow U_E = U_{R1} + U_{R2} = U_{R1} + U_{C2}$

3) $U_{C1} = U_{C2} + U_{R3}$

$$\Leftrightarrow \begin{cases} U_{C2} = U_{C1} - U_{R3} = \dfrac{\frac{1}{j\omega C_2}}{\frac{1}{j\omega C_2} + R_3} U_{C1} = \dfrac{1}{1 + j\omega C_2 R_3} U_{C1} \\ U_{R3} = \dfrac{R_3}{\frac{1}{j\omega C_2} + R_3} U_{C1} = \dfrac{j\omega C_2 R_3}{1 + j\omega C_2 R_3} U_{C1} \end{cases}$$

$U_A = -U_{R3} - U_D = -U_{R3}$

$$\Rightarrow \frac{U_E}{U_A} = -\frac{U_{R1} + U_{C2}}{U_{R3}} = -\frac{I_1 R_1 + \frac{1}{1 + j\omega C_2 R_3} U_{C1}}{\frac{j\omega C_2 R_3}{1 + j\omega C_2 R_3} U_{C1}}$$

KCL: $I_1 = I_2 + I_{C1} + I_{C2}$

$I_2 = \frac{U_2}{R_2} \overset{2}{=} \frac{U_{C2}}{R_2}$

$I_{C1} = j\omega C_1 U_{C1}$

$I_{C2} = j\omega C_2 U_{C2}$

$$= -\frac{\left(\frac{1}{R_2} U_{C2} + j\omega C_1 U_{C1} + j\omega C_2 U_{C2}\right) R_1 + \frac{1}{1 + j\omega C_2 R_3} U_{C1}}{\frac{j\omega C_2 R_3}{1 + j\omega C_2 R_3} U_{C1}}$$

$$= -\frac{\left(\frac{1}{R_2} \frac{1}{1 + j\omega C_2 R_3} U_{C1} + j\omega C_1 U_{C1} + j\omega C_2 \frac{j\omega C_2}{1 + j\omega C_2 R_3} U_{C1}\right) R_1 + \frac{1}{1 + j\omega C_2 R_3} U_{C1}}{\frac{j\omega C_2 R_3}{1 + j\omega C_2 R_3} U_{C1}}$$

$$= -\frac{j\omega C_2 R_2 R_3}{(j\omega)^2 C_1 C_2 R_1 R_2 R_3 + j\omega (C_1 + C_2) R_1 R_2 + R_1 + R_2}$$