1

1.1

$$C_{34} = c3 + c4 = 10\mu F + 20\mu F = 30\mu F \tag{1}$$

$$\frac{1}{C_{ab}} = \frac{1}{C_2} + \frac{1}{C_{34}} + \frac{1}{C_6} = \frac{1}{20\mu F} + \frac{1}{30\mu F} + \frac{1}{60\mu F} = \frac{1}{10\mu F} \Leftrightarrow C_{ab} = 10\mu F \tag{2}$$

1.2

$$U_1 = \frac{Q_1}{C_1} = \frac{5 \cdot 10^{-5} As}{40\mu F} = 1.25V \tag{3}$$

$$U_2 = \frac{Q_{ab}}{C_{ab}} = \frac{20 \cdot 10^{-5} As}{10\mu F} = 20V \tag{4}$$

1.3

$$C_{ges} = C_1 + C_{ab} = 50\mu F \tag{5}$$

$$Q_{ges} = Q_1 + Q_{ab} = 25 \cdot 10^{-5} As \tag{6}$$

$$U_{ges} = \frac{Q_{ges}}{C_{ges}} = \frac{25 \cdot 10^{-5} As}{50\mu F} = 5V \tag{7}$$

1.4

$$Q_1 = C_1 \cdot U_{ges} = 40\mu F \cdot 5V = 200\mu C \tag{8}$$

$$Q_{ab} = C_{ab} \cdot U_{ges} = 10\mu F \cdot 5V = 50\mu C \tag{9}$$

2

2.1

Teilsystem a

$$U_1 = U_{3a} = U_{5a} + U_{4a} \tag{10}$$

$$I_1 = I_{3a} + \underbrace{I_{5a}}_{=I_{4a}} \tag{11}$$

Teilsystem b

$$U_2 = U_{4b} = U_{5b} + U_{3b} \tag{12}$$

$$I_2 = I_{4b} + \underbrace{I_{5b}}_{=I_{3b}} \tag{13}$$

$$\frac{1}{R_{ges}} = \frac{1}{R} + \frac{1}{R+R} = \frac{3}{2}\frac{1}{R} \Leftrightarrow R_{ges} = \frac{2}{3}R \tag{14}$$

$$U_2 = R_{ges} \cdot I_2 = \frac{2}{3}RI_2$$

$$\begin{aligned} I_1 &= \frac{U_1}{R_{ges}} \\ &= \frac{U_1}{\frac{2}{3}R} \\ &= \frac{3}{2} \cdot \frac{U_1}{R} \end{aligned}$$

$$\begin{aligned} I_1 &= I_{3a} + I_{5a} \\ &= I_{3a} + \frac{U_1}{2R} \\ \Leftrightarrow I_{3a} &= I_1 - \frac{U_1}{2R} \\ &= \frac{U_1}{R_{ges}} - \frac{U_1}{2R} \\ &= \frac{U_1}{\frac{2}{3}R} - \frac{U_1}{2R} \\ &= \frac{2}{3} \cdot \frac{U_1}{R} - \frac{1}{2} \cdot \frac{U_1}{R} \\ &= \frac{1}{6} \cdot \frac{U_1}{R} \end{aligned}$$

$$
\begin{aligned}
I_2 &= I_{3b} + I_{4b} \\
\Leftrightarrow I_{3b} &= I_2 - I_{4b} \\
&= I_2 - \frac{U_2}{R} \\
&= I_2 - \frac{\frac{2}{3}RI_2}{R} \\
&= \frac{1}{3}I_2
\end{aligned}
$$

$$
\begin{aligned}
I_3 &= I_{3a} + I_{3b} \\
&= \frac{1}{6} \cdot \frac{U_1}{R} + \frac{1}{3}I_2
\end{aligned}
$$

$$
\begin{aligned}
I_1 &= I_{3a} + I_{5a} \\
\Leftrightarrow I_{5a} &= I_1 - I_{3a} \\
&= \frac{3}{2} \cdot \frac{U_1}{R} - \frac{1}{6} \cdot \frac{U_1}{R} \\
&=
\end{aligned}
$$

$$
\begin{aligned}
I_5 &= I_{5a} + I_{5b} \\
&= I_{5a} + I_{3b} \\
&= \frac{4}{3} \cdot \frac{U_1}{R} + \frac{1}{3}I_2
\end{aligned}
$$

$$
\begin{aligned}
U_5 &= R \cdot I_5 \\
&= \frac{4}{3} \cdot U_1 + \frac{1}{3}I_2R
\end{aligned}
$$

2.2

$$
\begin{aligned}
U_5 &= \frac{4}{3} \cdot U_1 + \frac{1}{3}I_2R \\
&= 2V
\end{aligned}
$$

$$
\begin{aligned}
I_5 &= \frac{4}{3} \cdot \frac{U_1}{R} + \frac{1}{3}I_2 \\
&= 2A
\end{aligned}
$$

3

3.1

$$
\begin{aligned}
u(t) &= U_0(1 - e^{-\frac{t}{\tau}}) \\
0.95U_0 &= U_0(1 - e^{-\frac{t}{\tau}}) \\
0.95 &= 1 - e^{-\frac{t}{\tau}} \\
e^{-\frac{t}{\tau}} &= 0.05 \\
t &\approx 2.996\tau
\end{aligned}
$$

$$
\begin{aligned}
u(t) &= U_0(1 - e^{-\frac{t}{\tau}}) \\
0.99U_0 &= U_0(1 - e^{-\frac{t}{\tau}}) \\
0.99 &= 1 - e^{-\frac{t}{\tau}} \\
e^{-\frac{t}{\tau}} &= 0.01 \\
t &\approx 4.605\tau
\end{aligned}
$$