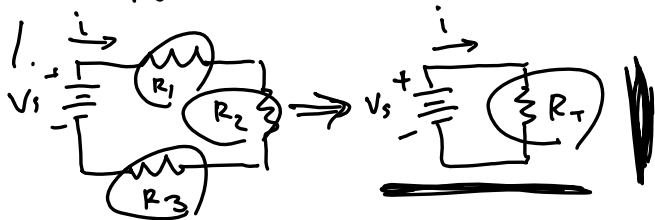


Oppgave 2

equivalent circuit



a) $R_1 = 10\Omega$, $R_2 = 20\Omega$, $V_s = 6V$, $i = 0.05A$

find R_3 $R_T \rightarrow R_3$

$$R_T = \frac{V_s}{i} = \frac{6V}{0.05A} = 120\Omega$$

$$R_3 = R_T - R_1 - R_2 = 120 - 10 - 20 = \boxed{90\Omega}$$

b) V_s given $R_3 = 150\Omega$, $i = 0.02A$

$$V_s = i \cdot R_T = 0.02A \cdot 180\Omega = \boxed{3.6V}$$

$$R_T = R_1 + R_2 + R_3 = 10\Omega + 20\Omega + 150\Omega = 180\Omega$$

c) same as a)

Useful:

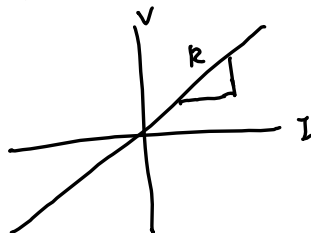
KVL ... $\sum V_{up} = \sum V_{down}$

KCL ... $\sum i_{in} = \sum i_{out}$

$R_T = \sum_{i=1}^N R_i$ in series

$\frac{1}{R_T} = \sum_{i=1}^N \frac{1}{R_i}$ in parallel

$R = \frac{V}{I}$

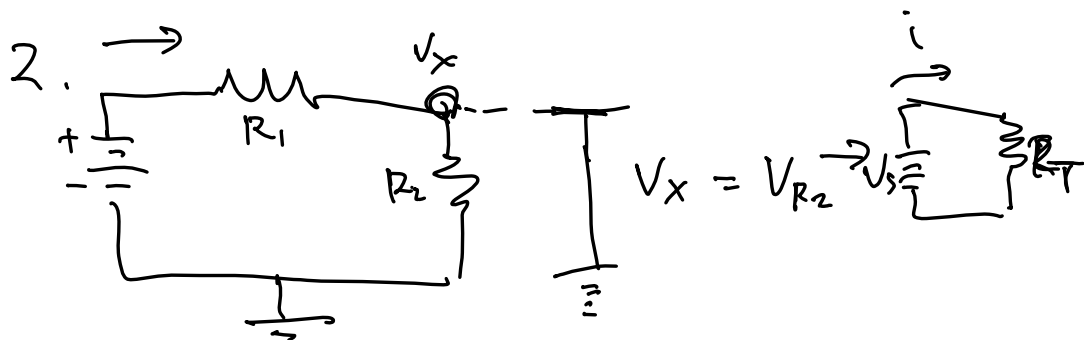


$V_s = V_1 = \dots$ parallel

$V_s = \sum_{i=1}^N V_i$ series

$i = \sum_{i=1}^N i_i$ parallel

$i_T = i_1 = \dots$ series.



a) V_x given $V_s = 6V$, $R_1 = 100k\Omega$
 $R_2 = 200k\Omega$

$$V_s = i \cdot R_T = i \cdot (R_1 + R_2) \Rightarrow i = \frac{V_s}{R_1 + R_2} \quad (1)$$

$$V_x = i \cdot R_2 \rightarrow i = \frac{V_x}{R_2} \quad (2)$$

$$(1) \wedge (2) = \frac{V_s}{R_1 + R_2} = \frac{V_x}{R_2} \rightarrow V_x = \frac{R_2}{R_1 + R_2} V_s$$

$$V_x = \frac{200k\Omega}{300k\Omega} \cdot 6V = \boxed{4V}$$

b) find V_{R_1} & V_{R_2}

$$V_{R_2} = V_x = \boxed{4V}$$

$$V_{R_1} = V_s - V_{R_2} = 6V - 4V = \boxed{2V}$$

c) find $i_{R_1} = i_T$

$$i = \frac{V_s}{R_T} = \frac{6V}{300k\Omega} = \boxed{20\mu A}$$

d) $V_x = 5V$, find V_s

$$\Rightarrow V_s = \frac{R_1 + R_2}{R_2} \cdot V_x = 5V \cdot \frac{300k\Omega}{200k\Omega} = \boxed{7.5V}$$

e) choose R_1 & R_2 if $i = 0.1A$

$$V_s = 12V$$

find R_T

$$V_x = \frac{V_s}{4} = 3V$$

$$R_T = \frac{V_s}{i} = \frac{12V}{0.1A} = 120\Omega$$

$$R_1 + R_2 = 120\Omega$$

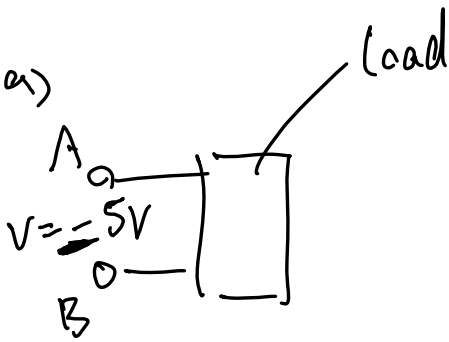
$$R_2 = \frac{V_x}{V_s} \cdot (R_1 + R_2) = \frac{1}{4} \cdot 120\Omega = \boxed{30\Omega}$$

$$R_1 = R_T - R_2 = 120 - 30 = \boxed{90\Omega}$$

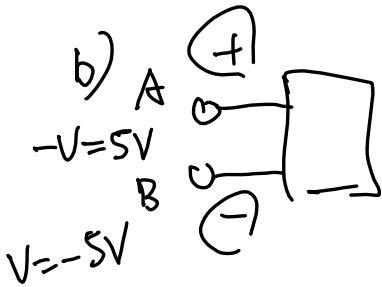
f) $i < 0.1A$ R_1 & R_2

$\downarrow i = \frac{V}{R} \uparrow$ R_1 & R_2 bigger

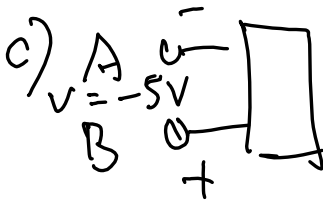
3. a)



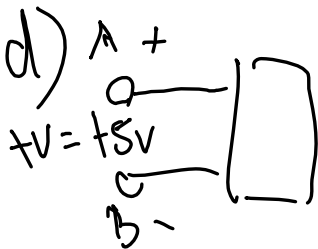
Don't know



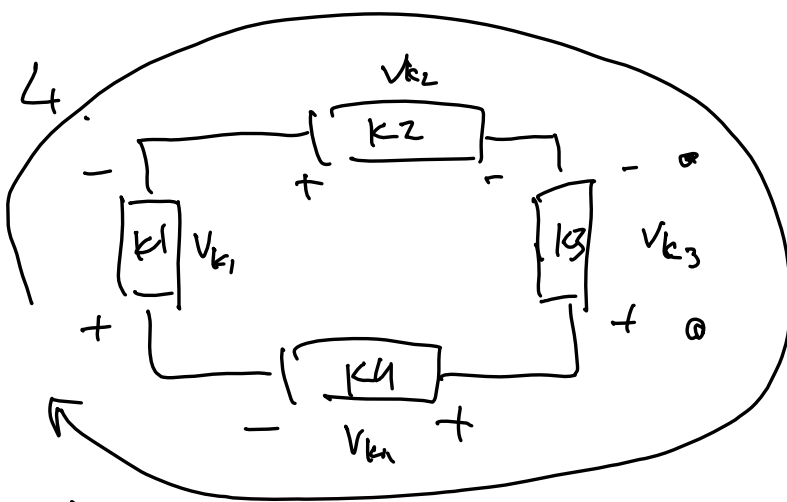
A is negative wrt B



A is positive w.r.t. B



A is positive wrt B.



a) $V_{K1} = 2V$, $V_{K2} = 5V$, $V_{K4} = -4V$

KVL: $V_{K1} + V_{K2} - V_{K3} + V_{K4} = 0$

$$V_{K3} = V_{K1} + V_{K2} - V_{K4}$$

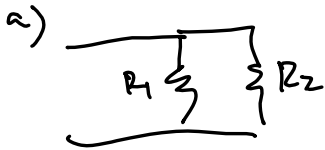
$$= 2V + 5V - (-4V) = \boxed{3V}$$

b) $-2V + (-4V) - 12V + 0V$

$$= -18V \neq 0 \rightarrow \text{KVL doesn't hold.}$$

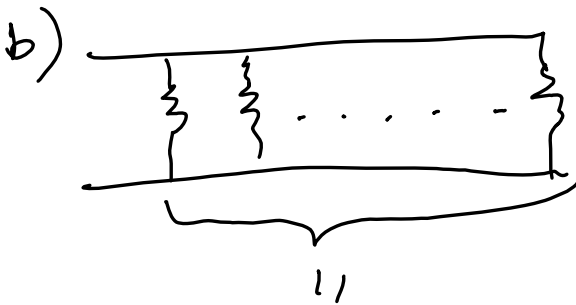
Short-circuit

5. find R_T



$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} \rightarrow R_T = \frac{R_1 R_2}{R_1 + R_2}$$

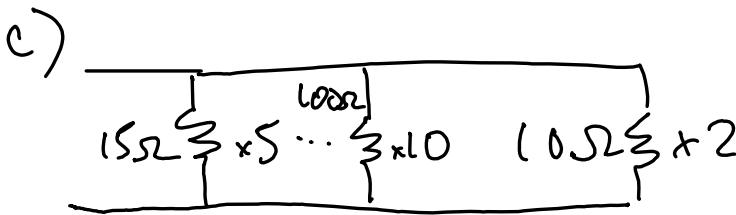
$$R_T = \frac{(4.7k\Omega)(2.2k\Omega)}{4.7k\Omega + 2.2k\Omega} = 1.5k\Omega$$



$$\frac{1}{R_T} = \frac{1}{22k\Omega} + \dots + \frac{1}{22k\Omega} = \frac{11}{22k\Omega}$$

$$R_T = \frac{22k\Omega}{11} = \boxed{2k\Omega}$$

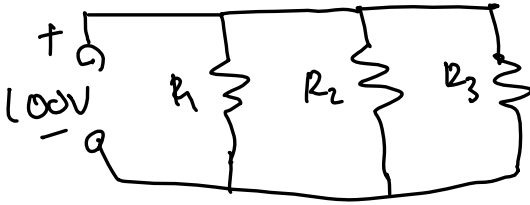
$$\left(\frac{1}{R_T}\right)^{-1} = \left(\frac{11}{22k\Omega}\right)^{-1}$$



$$\frac{1}{R_T} = \frac{5}{15\Omega} + \frac{10}{10\Omega} + \frac{2}{10\Omega} = \frac{10+3+6}{30\Omega}$$

$$R_T = \frac{30\Omega}{19} = \boxed{1.58\Omega}$$

6.



find V_{R_1} , V_{R_2} , V_{R_3}

$$V_{R_1} = V_{R_2} = V_{R_3} = V_S = 100V$$

7.



$$R_1 = R_2 = R_3$$

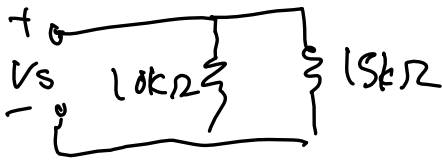
$$V_{R_1} = 10V$$

a) find i_{R_1} , i_{R_2} , i_{R_3}

$$\underline{i} = \frac{V}{R} \quad i_{R_1} = \frac{V_{R_1}}{R} = \frac{10V}{33k\Omega} = \boxed{\frac{10}{33} \text{ mA}}$$

$$= i_{R_2} = i_{R_3}$$

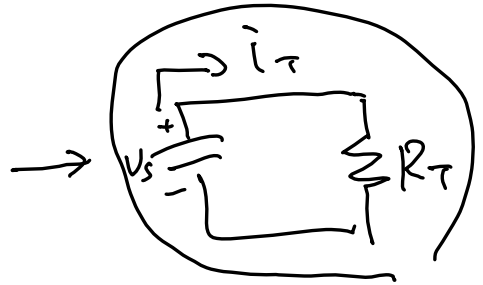
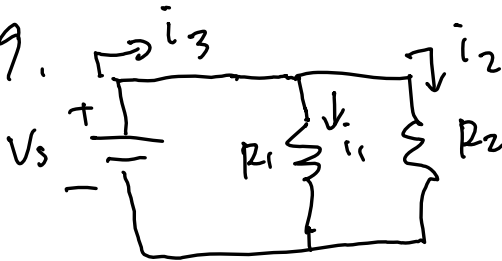
8.



$10k\Omega$ has
higher i

$$\uparrow i \propto \frac{V}{R} \downarrow$$

9.



$$i_3 = 3A$$

$$R_1 = 1k\Omega$$

$$R_2 = 2.7k\Omega$$

$$R_T = \frac{R_1 R_2}{R_1 + R_2} = \frac{(1k\Omega)(2.7k\Omega)}{1k\Omega + 2.7k\Omega} = 730\Omega$$

find i_1 & i_2

$$V_s = i_T R_T = i_1 R_1 = i_2 R_2$$

$$\rightarrow i_1 = i_T \cdot \frac{R_T}{R_1} = 3A \cdot \frac{730\Omega}{1k\Omega} = \boxed{2.19A}$$

$$\text{KCL: } i_T = i_1 + i_2$$

$$\rightarrow i_2 = i_T - i_1 = 3A - 2.19 = \boxed{0.81A}$$

$$\star i_1 = i_T \cdot \frac{R_T}{R_1} = i_T \cdot \frac{1}{R_1} \cdot \frac{R_1 R_2}{R_1 + R_2} = i_T \cdot \frac{R_2}{R_1 + R_2}$$