VE215 2022Fall Assignment 2

Due Date: 23:59, October 17th, 2022

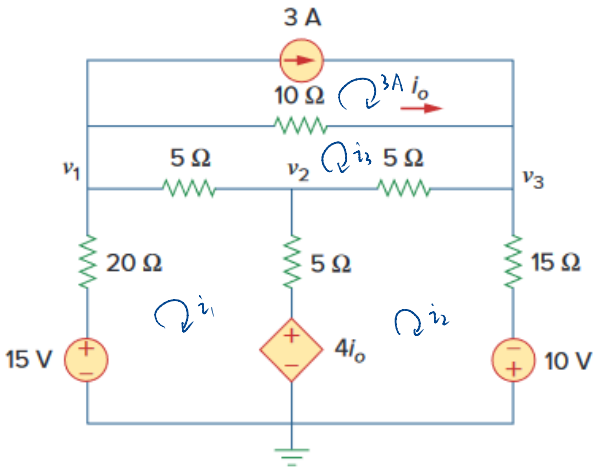
3.26.

Exercise 2.1 (45%)

(a) (15%) Calculate v_1, v_2 and v_3 in the following circuit using Nodal Analysis.

(b) (15%) Calculate i_0 in the following circuit using Mesh Analysis.

(c) (15%) Verify your result of i_0 by applying Superposition rule.



公式分类不多就结束吧！

(a)
$$\begin{cases} \frac{V_1-15}{20}+\frac{V_1-V_2}{5}+i_0+3=0 \\ \frac{V_2-4i_0}{5}+\frac{V_2-V_1}{5}+\frac{V_2-V_3}{5}=0 \\ \frac{V_3-V_2}{5}+\frac{V_3+10}{15}-i_0-3=0 \\ i_0=\frac{V_1-V_3}{10} \end{cases} \quad (10\%)$$

$$\Rightarrow \begin{cases} V_1=-7.19\ V \\ V_2=-2.78\ V \\ V_3=2.89\ V \\ i_0=-1.01\ A \end{cases} \quad (5\%)$$

(b)
$$\begin{cases} -15+20i_1+5(i_1-i_3)+5(i_1-i_2)+4i_0=0 \\ -4i_0+5(i_2-i_1)+5(i_2-i_3)+15i_2-10=0 \\ 5(i_3-i_1)+10(i_3-3)+5(i_3-i_2)=0 \\ i_0=i_3-3 \end{cases} \quad (10\%)$$

$$\Rightarrow \begin{cases} i_1=1.11\ A \\ i_2=0.86\ A \\ i_3=1.99\ A \\ i_0=-1.01\ A \end{cases} \quad (5\%)$$

(c) 15V:

$$\begin{cases} \frac{V_1-15}{20}+\frac{V_1-V_2}{5}+i_0=0 \\ \frac{V_2-V_1}{5}+\frac{V_2-4i_0}{5}+\frac{V_2-V_3}{5}=0 \\ \frac{V_3-V_2}{5}+\frac{V_3}{15}-i_0=0 \\ i_0=\frac{V_1-V_3}{10} \end{cases} \quad (5\%)$$

$i_{0_1}=0.176\ A \quad (\frac{90}{511})$

-10 V:

$$\begin{cases} \frac{V_1}{20}+\frac{V_1-V_2}{5}+i_0=0 \\ \frac{V_2-V_1}{5}+\frac{V_2-4i_0}{5}+\frac{V_2-V_3}{5}=0 \\ \frac{V_3-V_2}{5}+\frac{V_3+10}{15}-i_0=0 \\ i_0=\frac{V_1-V_3}{10} \end{cases} \quad (5\%)$$

$i_{0_2}=0.137\ A \quad (\frac{10}{73})$

Current source:

$$\begin{cases} \frac{V_1-V_2}{5}+3+i_0+\frac{V_1}{20}=0 \\ \frac{V_2-V_1}{5}+\frac{V_2-4i_0}{5}+\frac{V_2-V_3}{5}=0 \\ -i_0-3+\frac{V_3-V_2}{5}+\frac{V_3}{15}=0 \\ i_0=\frac{V_1-V_3}{10} \end{cases} \quad (5\%)$$

$(-\frac{675}{511})$

$i_{0_3}=-1.32\ A$

$i_0=-1.01\ A$

用了superposition就行，不一定要三个.

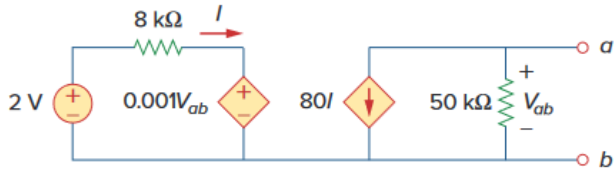
4.55

Exercise 2.2 (35%)

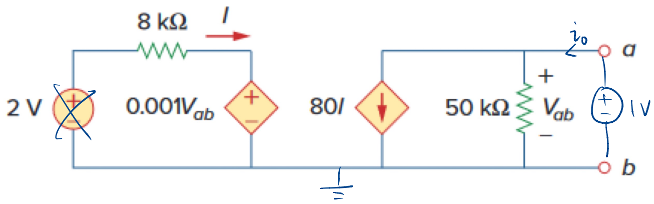
(a) (10%) Obtain the Norton equivalent circuit at the terminal a-b. Draw the circuit.

(b) (15%) Calculate the voltage V_{ab} if now a resistor of $10k\Omega$ connects between terminal a-b.

(c) (10%) Calculate the maximum power transferred to a resistor that connects between terminal a-b. Also calculate the resistance of that resistor.



(a)

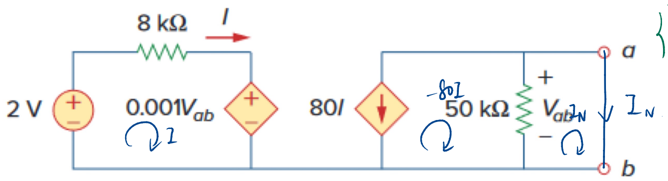


$i_0 = 80I + \frac{1}{50k}$

$I = -\frac{0.001}{8k}$

$i_0 = 1\times10^{-5}$ A

$R_{eq} = \frac{1}{i_0} = 1\times10^{5}\ \Omega$ (5%)



$-2 + 8k\cdot I + 0.001V_{th} = 0$

$V_{th} = -80I\cdot 50k$

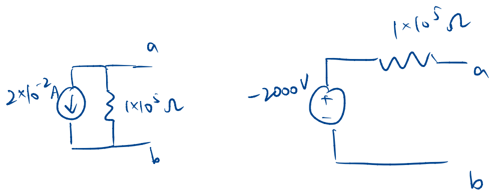
$V_{th} = -2000$ V

$V_{ab} = (-80I - I_N)\cdot 50k$

$-2 + 8k\cdot I + 0.001V_{ab} = 0$

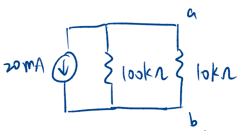
$I_N = -80I$

$I_N = -2\times10^{-2}$ A (同I的同时即可) $V_{th} = -2000$ V (同V+-对即可) (10%)



(5%)

(b)



$V_{ab} = -181.8$ V (5%) 正的 -2

(c) $R = 100k\Omega$ (5%)

$P = (10mA)^2 \times 100k\Omega = 10$ W. (5%)

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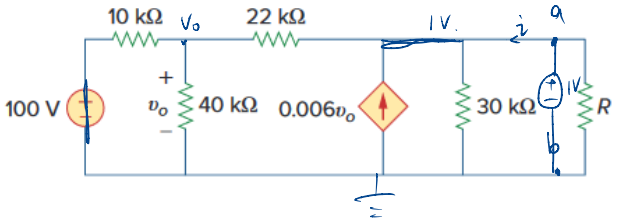
Exercise 2.3 (20%)
Calculate the maximum power that can be delivered to the variable resistor R in the following circuit.



R_{Th}:

$$\begin{cases} \frac{V_o}{10k} + \frac{V_o}{40k} + \frac{V_o - 1}{22k} = 0 \\ \frac{1 - V_o}{22k} - 0.006V_o + \frac{1}{30k} - i = 0 \end{cases}$$

$i = -0.00153$ A

$R_{Th} = \frac{1}{i} = -652\ \Omega < 0$ (15%)

$P = +\infty$ (5%)