邹佳驹 4班
12012127

《Fundamentals of Electric Circuits》 homework 3

4.14 Apply the superposition principle to find vo in the circuit of Fig. 4.82. (10')

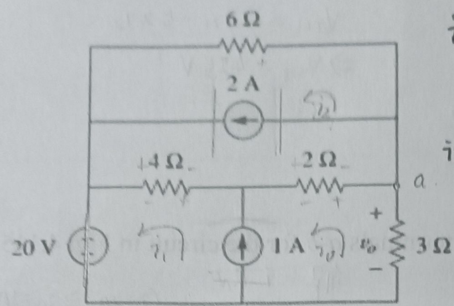


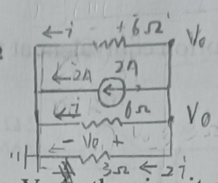
Figure 4.82

解：

i. 保留 20V

$V_o = 3 \times \frac{20}{6 \| 6 + 3} = 10V$ □

ii. 保留 2A



$+2 + i + i + 2i = 0 \Rightarrow i = -0.5A$

$V_o = 3 \times 2 \times (-0.5) = -3V$ □

iii. 保留 1A

$i_1 - i_0 = 1A$

$6i_2 + 4(i_2 - i_1) + 2(i_2 - i_0) = 0$

$4(i_1 - i_2) - V_0 + 2(i_0 - i_2) = 0$

$U_0 = -3i_0$

$\Rightarrow V_{o3} = +1V, \ i_0 = -\frac{1}{3}A$

$\therefore V_0 = 10 - 3 + 1 = 8V$

4.24 Use source transformation to find the voltage Vx in the circuit of Fig. 4.92. (10')

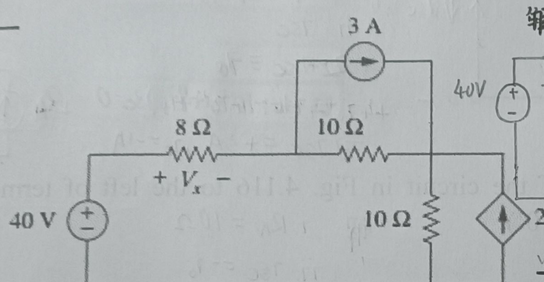
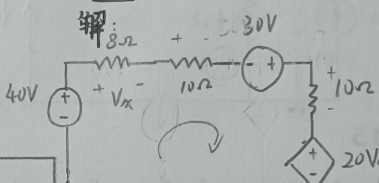


Figure 4.92

解：



$-40 + V_x + 10i - 30 + 10i + 20V_x = 0$

$\frac{V_x}{8} = i$

$\Rightarrow V_x = \frac{140}{47} V = 2.979 V$

4.44 For the circuit in Fig. 4.111, obtain the Thevenin equivalent as seen from terminals:
(a) a-b (b) b-c. (10')

a):

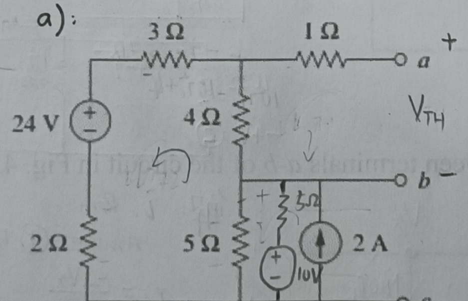


Figure 4.111

解: a) i. $R_{TH} = 1 + 10 \| 4 = \frac{54}{14} = \frac{27}{7} \Omega$

ii. V_{TH}

$+24 + 2i - 10 + 5i + 4i + 3i = 0, \ i = -1A$

$V_{TH} = -i \cdot 4 = 4V$

b) i. $R_{TH} = 5 \| (3+4+2) = \frac{45}{14} \Omega$

ii. V_{TH}

$+24 + 2i - 10 + 5i + 4i + 3i = 0, \ i = -1A$

$V_{TH} = 10 + 5(-1) = 5V$

4.X Find the Thevenin equivalent at terminals a-b of the circuit in Fig. 4.x.(10')

解: i. $R_{TH} = 30 \| (8 \| 12 + 5.2) = 7.5\,\Omega$

ii. V_{TH}

i_1: $+500 + 12 i_1 + 8(i_1 - i_2) = 0$

i_2: $+300 + 30 i_2 + 8(i_2 - i_1) + 5.2 i_2 = 0$

$\Rightarrow i_1 = -30\,A$, $i_2 = -12.5\,A$

$V_{TH} = -12 i_1 - 5.2 i_2$

$\Rightarrow V_{TH} = 425\ V$

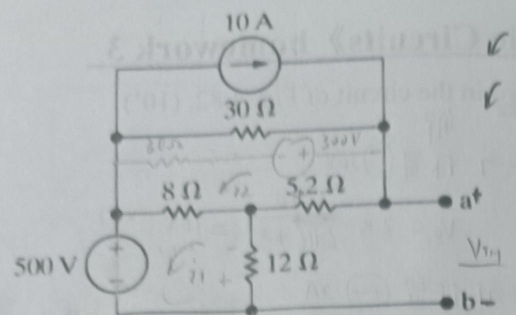


Figure. 4.x

4.48 Determine the Norton equivalent at terminals *a-b* for the circuit in Fig. 4.115.(10')

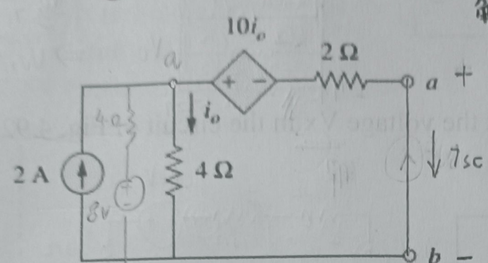


Figure 4.115

解: i. R_N

Assume ↑ 1A $\Rightarrow i_o = 1A$

$2 - 10 + 4 + 8 - V_{ab} = 0$, $V_{ab} = 4V$

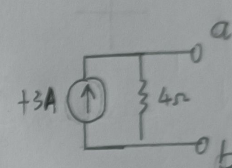
$R_{eq} = \frac{V_{ab}}{1} = 4\,\Omega$

ii. i_{sc}

$+2 - i_{sc} = i_o$

$+4 i_o = +10 i_o + 2(1 + i_{sc})$

$\Rightarrow i_{sc} = +3A$, $i_o = -1A$



4.50 Obtain the Norton equivalent of the circuit in Fig. 4.116 to the left of terminals *a-b* .Use the result to find current *i*. (10')

解: i. $R_N = 10\,\Omega$

ii. $i_{sc} = -i_o$

$-12 + 10 i_o + 8 = 0$, $i_o = 0.4A$, $i_{sc} = -0.4A$

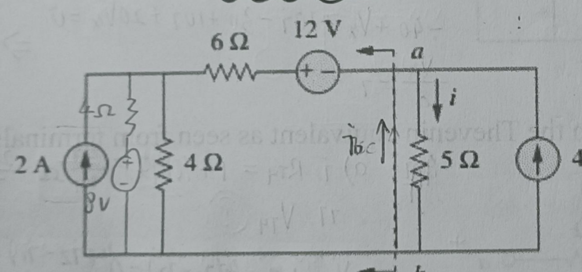
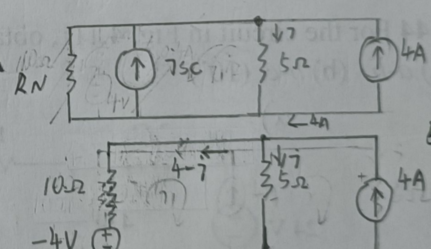


Figure 4.116



$5i = +(-4) + 10(4 - i)$

$\Rightarrow i = 2.4A$

4.54 Find the Thevenin equivalent between terminals *a-b* of the circuit in Fig. 4.120. (10')

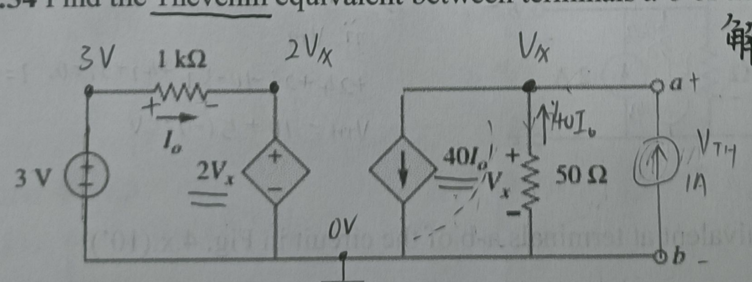


Figure 4.120

解: i. R_{TH}

Assume ↑ 1A

$I_o = \frac{-2V_x}{1000}$

$+1 - \frac{V_x}{50} - 40 I_o = 0$

$\Rightarrow I_o = \frac{1}{30}$, $V_x = -\frac{50}{3}V$

$\Rightarrow V_{ab} = -\frac{50}{3}V$

$R_{TH} = \frac{+\frac{50}{3}}{+1} = \frac{50}{3}\,\Omega = 16.67\,\Omega$

ii. V_{TH}

4.Y Determine the Norton equivalent at terminals a-b for the circuit in Fig. 4.

$I_o = \frac{3-2V_x}{1000}$

$40 I_o = \frac{-V_x}{50}$

$\Rightarrow V_x = 2V$

$V_{ab} = 2V = V_{TH}$

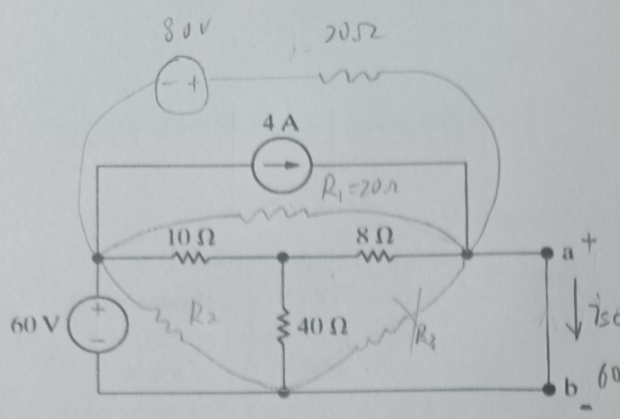


Figure. 4.y

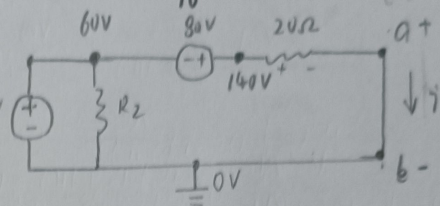
解: i. $R_N = 8 + 10 \| 40 = 16\Omega$

ii. i_{sc}

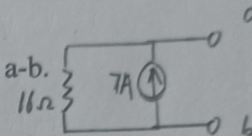
$R_1 = \frac{10\times40+40\times8+10\times8}{40} = 20\Omega$

$R_2 = \frac{800}{8} = 100\Omega$

$R_3 = \frac{800}{10} = 80\Omega$



$i_{sc} = \frac{+140}{20} = +7A$



V_{TH} ?

4.72 (a) For the circuit in Fig. 4. 138, obtain the Thevenin equivalent at terminals a-b.
(b) Calculate the current in $R_L = 8\Omega$.
(c) Find R_L for maximum power deliverable to R_L.
(d) Determine that maximum power.
(10')

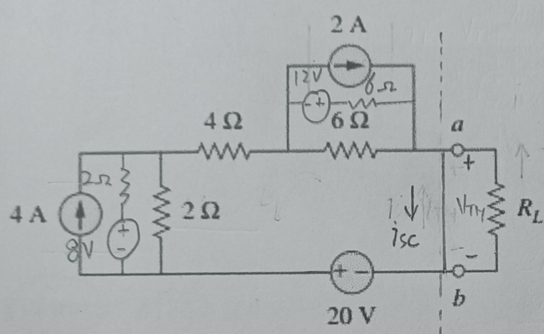


Figure 4.138

解:

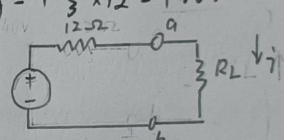
a) i. $R_{TH} = 2+4+6 = 12\Omega$

ii. $V_{TH} = +i_{sc}\cdot R_{TH}$

$6i_{sc} - 12 + 4i_{sc} + 2i_{sc} - 8 - 20 = 0$

$i_{sc} = +\frac{10}{3}A$

$V_{TH} = +\frac{10}{3}\times 12 = +40V$



b) $i = \frac{40}{12+8} = 2A \downarrow$

c) $P = R_L\left(\frac{40}{R_L+12}\right)^2 = \frac{1600}{R_L + \frac{144}{R_L} + 24}$

当 $R_L = 12\Omega$ 时, P_{max}

d) $P_{max} = \frac{1600}{12+12+24} = \frac{100}{3}W = 33.33W$

4.74 For the bridge circuit shown in Fig. 4.140, find the load R_L for maximum power transfer and the maximum power absorbed by the load. (10')

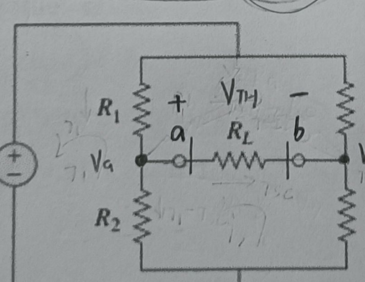
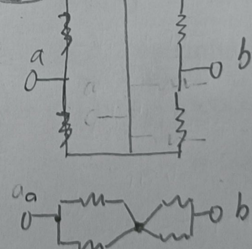


Figure 4.140



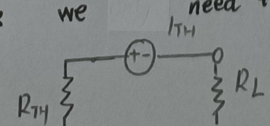
解: $R_{TH} = R_1 \| R_2 + R_3 \| R_4$

$V_{TH} = i_{sc}\cdot R_{TH}$

$$\left.\begin{aligned} V_s + R_2(i_1 - i_3) + R_1(i_1 - i_2) &= 0 \\ R_1(i_2 - i_1) + R_3 i_2 &= 0 \\ R_2(i_3 - i_1) + R_4 i_3 &= 0 \end{aligned}\right\} \Rightarrow \begin{aligned} i_1 &= \\ i_2 &= \frac{-V_s R_1(R_2+R_4)}{} \\ i_3 &= \end{aligned}$$

since we need to find R_L

so



load absorbed: $P_L = R_L\left(\frac{V_{TH}}{R_{TH}+R_L}\right)^2$ ①

$= R_L\cdot\frac{V_{TH}^2}{R_{TH}^2+R_L^2+2R_L\cdot R_{TH}}$

$= \frac{V_{TH}^2}{\frac{R_{TH}^2}{R_L}+R_L+2R_{TH}}$, P_L max

$\Downarrow$

$R_L = R_{TH} = R_1\|R_2 + R_3\|R_4 = \frac{R_1R_2}{R_1+R_2} + \frac{R_3R_4}{R_3+R_4}$ □

$V_{TH} = V_a - V_b$

$= \frac{V_s}{R_1+R_2}\cdot R_1 - \frac{V_s}{R_3+R_4}\cdot R_3 = V_s\cdot\left(\frac{R_1}{R_1+R_2} - \frac{R_3}{R_3+R_4}\right)$

代入①式得: $P_L = \frac{V_s^2\cdot\left(\frac{R_1}{R_1+R_2}-\frac{R_3}{R_3+R_4}\right)^2}{4\left(\frac{R_1R_2}{R_1+R_2}+\frac{R_3R_4}{R_3+R_4}\right)}$