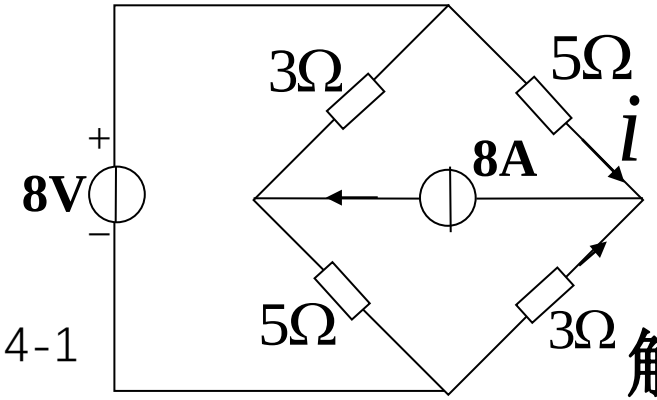
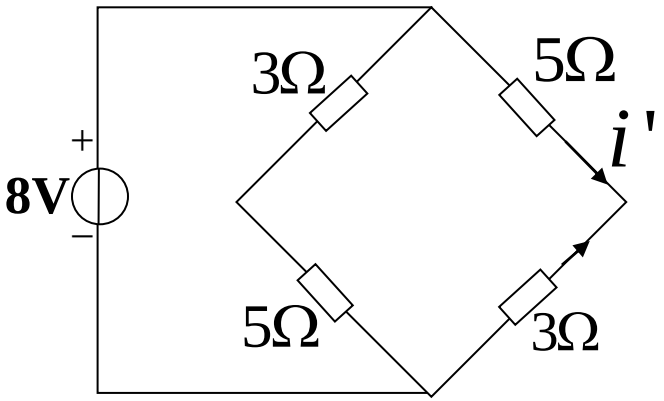
4-1. 电路如题图4-1所示，试用叠加定理求电流i。

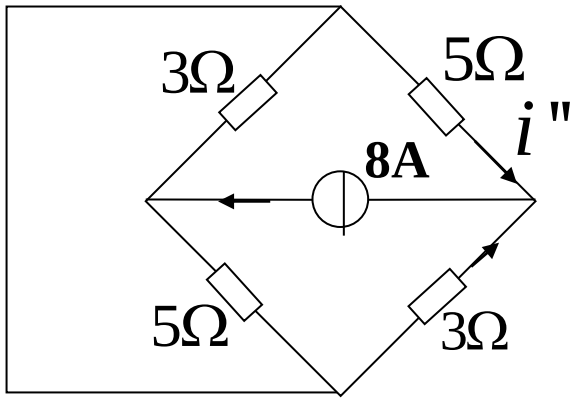


题图4-1

题图4-1(a)



题图4-1(b)



解：利用叠加定理：

（1）当电压源单独作用时，

$$i' = \frac{8}{3+5} = 1A$$

（2）当电流源单独作用时，

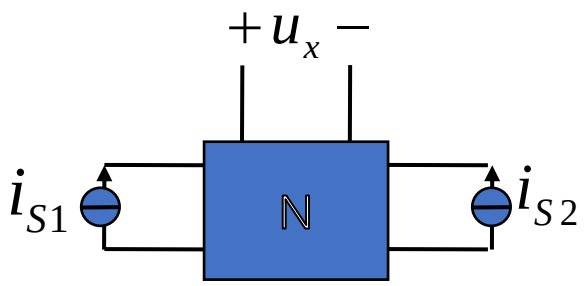
$$i'' = \frac{3}{3+5} \times 8 = 3A$$

（3） 总电流为：

$$i = i' + i'' = 4A$$

4-5　（1）题图 4-5 所示的线性网络 N 只含电阻。若 $i_{S1}=8\text{A}$，$i_{S2}=12\text{A}$ 时，$u_x=80\text{V}$；若 $i_{S1}=-8\text{A}$，$i_{S2}=4\text{A}$ 时，$u_x=0\text{V}$。当 $i_{S1}=i_{S2}=20\text{A}$ 时，u_x 为多少？（2）若所示网络 N 含有独立源，当 $i_{S1}=i_{S2}=0$ 时，$u_x=-40\text{V}$；所有（1）中的数据仍有效。当 $i_{S1}=i_{S2}=20\text{A}$ 时，电压 u_x 为多少？

解：（1）由线性网络的齐次性和叠加性，可设：



$$u_x = k_1 i_{S1} + k_2 i_{S2}$$

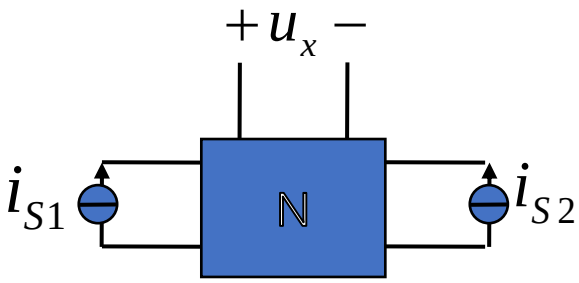
代入已知条件，有：

$$\begin{cases} 8k_1 + 12k_2 = 80 \\ -8k_1 + 4k_2 = 0 \end{cases} \quad \therefore k_1 = 2.5, k_2 = 5$$

当 $i_{S1} = i_{S2} = 20A$ **时，** $u_x = 2.5\times 20 + 5\times 20 = 150V$

（2）当网络N含有独立电源时，设其所有独立电源的作用为$\sum p_n e_n$，则：

$$u_x = p_1 i_{S1} + p_2 i_{S2} + \sum p_n e_n$$



将$i_{S1} = i_{S2} = 0A$时，$u_x = -40V$代入：

$$\sum p_n e_n = -40$$

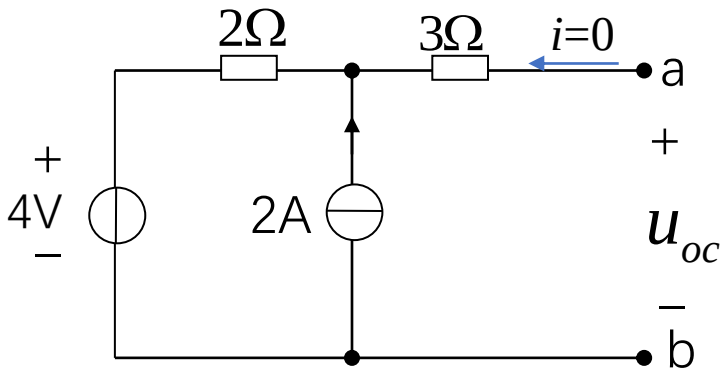
再将（1）中的条件代入，有：

$$\begin{cases} 8p_1 + 12p_2 - 40 = 80 \\ -8p_1 + 4p_2 - 40 = 0 \end{cases} \quad \therefore p_1 = 0, p_2 = 10$$

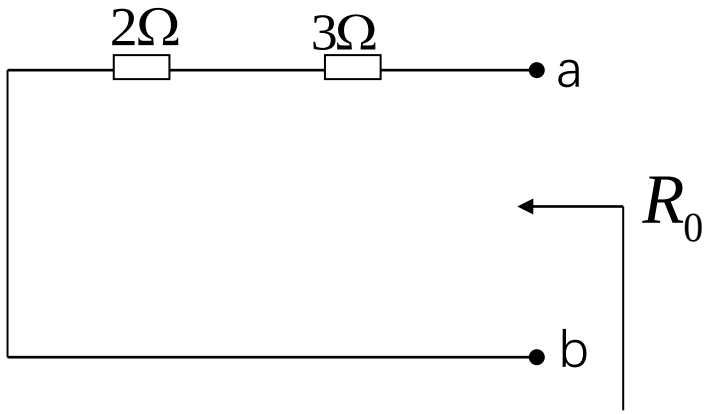
故，当 $i_{S1} = i_{S2} = 20A$

$$u_x = 0 \times 20 + 10 \times 20 - 40 = 160V$$

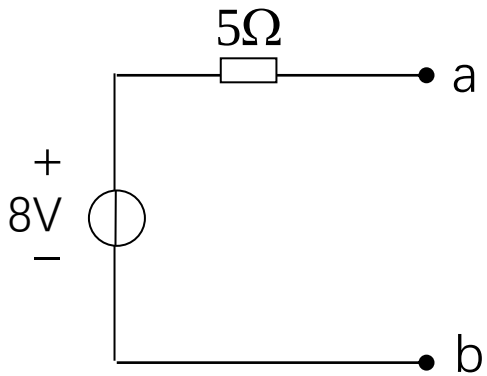
4-9(a). 试求题图4-9所示二端网络的戴维南等效电路。



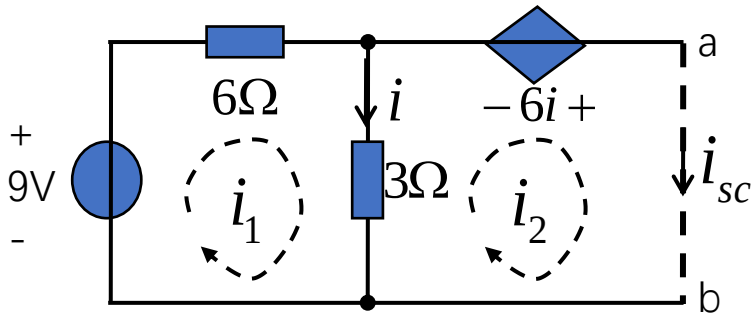
解：根据戴维南定理： $u_{oc} = 2\times 2 + 4 = 8V$



$R_0 = 5\Omega$



4-10(b)试求题图4-10所示二端网络诺顿等效电路。

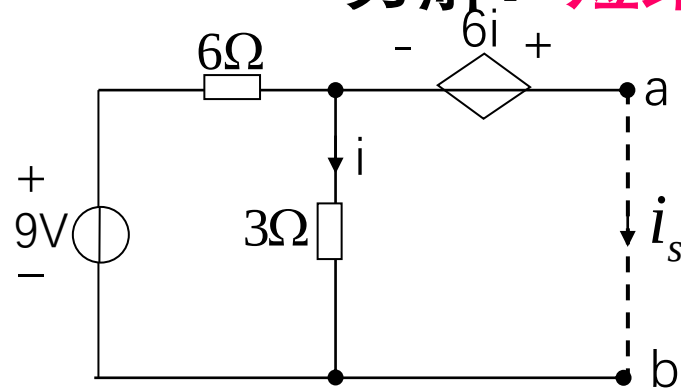


解：（1）先求短路电流 i_{sc}：令端口ab短路, 网孔法有：

$$\begin{cases} 9i_1 - 3i_2 = 9 \\ -3i_1 + 3i_2 = 6i \\ i = i_1 - i_2 \end{cases}$$

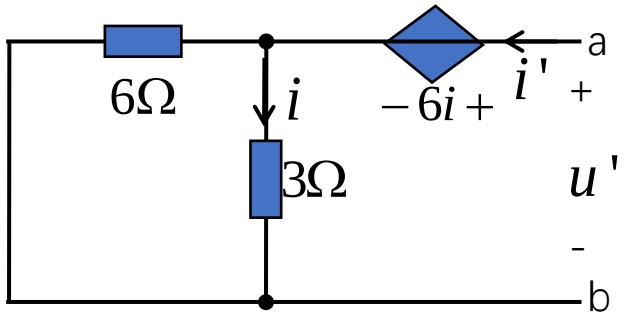
$$\therefore i_{sc} = i_2 = 1.5A$$

另解：短路电流 i_{sc}：



$$\because 6i = -3i \qquad \therefore i = 0$$

$$\therefore i_{sc} = \frac{9}{6} = 1.5A$$



（2）求输出电阻 R_0：　令独立电压源短路：

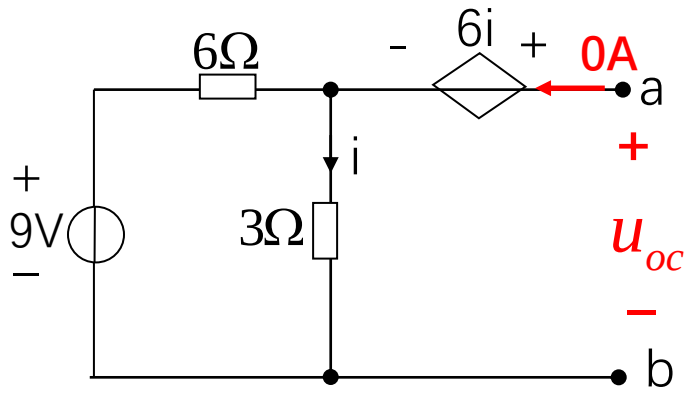
加压求流法，设端口电压为u',电流为i'

（注：**设的端口电流与受控源控制量i不能相同**）

$$\begin{cases} u' = 6i + 3i = 9i \\ i = \dfrac{6}{6+3} i' \end{cases} \qquad \therefore u' = 9 \times \frac{6}{6+3} i' = 6i'$$

$$R_0 = 6\Omega$$

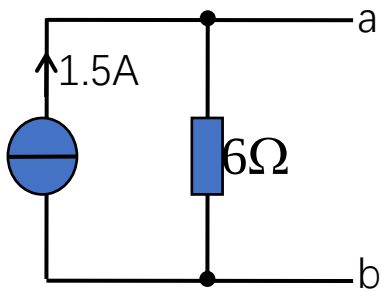
另解 开短路法，求开路电压 Uoc，方向为a➔b：



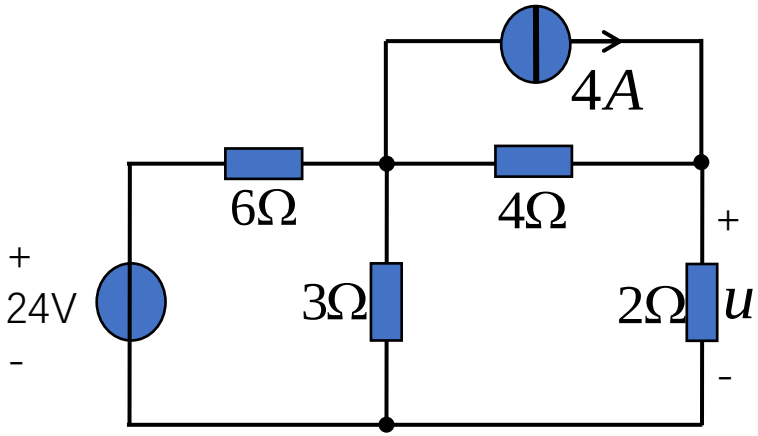
$$u_{oc} = 6i + 3i = 9i$$

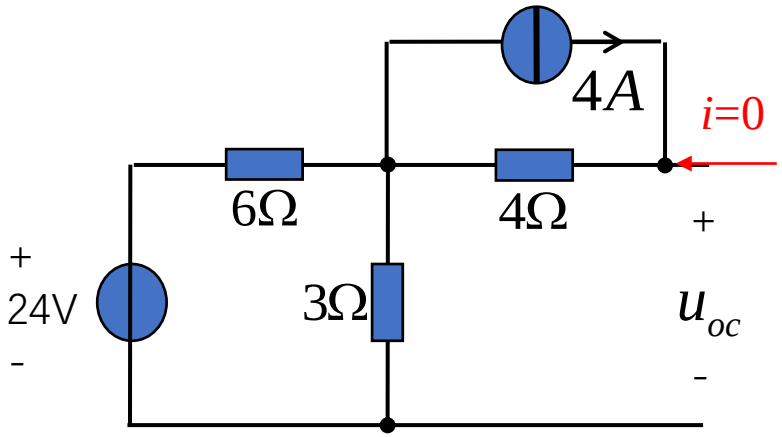
$$i = \frac{9}{6+3} = 1A \qquad \therefore u_{oc} = 9V$$

$$\therefore R_0 = \frac{u_{oc}}{i_{sc}} = 6\Omega$$



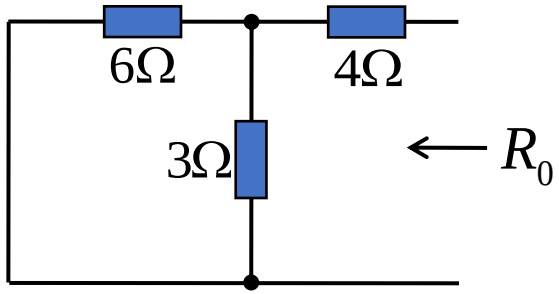
4-11 用戴维南定理求题图4-11电路的电压 u。





解（1）求开路电压 u_{oc}

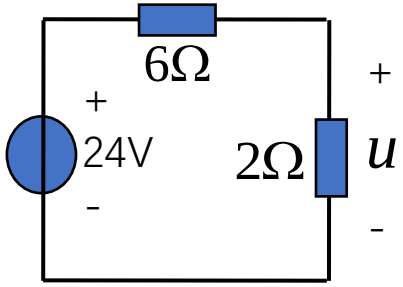
$$u_{oc}=4\times4+24\times\frac{3}{6+3}=24V$$



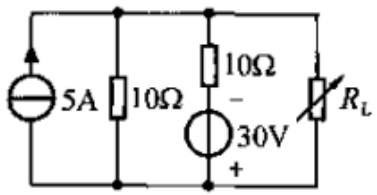
（2）求输出电阻 R_0

$$R_0=6//3+4=6\Omega$$

$$\therefore u=24\times\frac{2}{6+2}=6V$$



4-14 电路如题图 4-14 所示，其中电阻 R_L 可调，试问 R_L 为何值时能获得最大功率？最大功率为多少？



(a)

题图 4-14

(a) 解： 先求 R_L 以左部分电路的戴维南等效电路。首先求开路电压 u_{oc}，如解图 4-14 (a) - (1) 所示，有

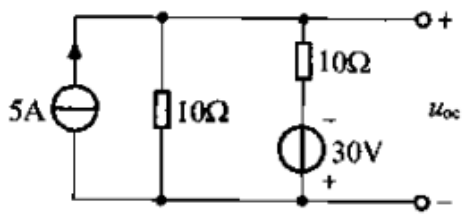
$$u_{oc} = 5 \times (10 \,//\, 10) - 30 \times \frac{10}{10+10} = 10\text{V}$$

再求等效电阻 R_o，如解图 4-14 (a) - (2) 所示，有

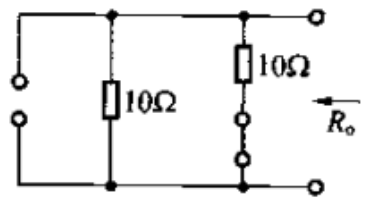
$$R_o = 10 \,//\, 10 = 5\Omega$$

题图 4-14 (a) 负载 R_L 以左部分电路可用其对应的戴维南等效电路替代，如解图 4-14 (a) - (3) 所示。因此，当 $R_L = R_o = 5\Omega$ 时可获得最大功率，此最大功率为

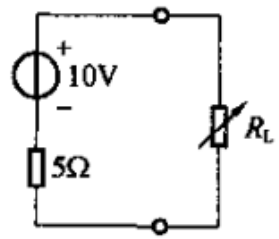
$$P_{max} = \frac{u_{oc}^2}{4R_o} = \frac{10^2}{4 \times 5} = 5\text{W}$$



解图 4-14 (a) - (1)

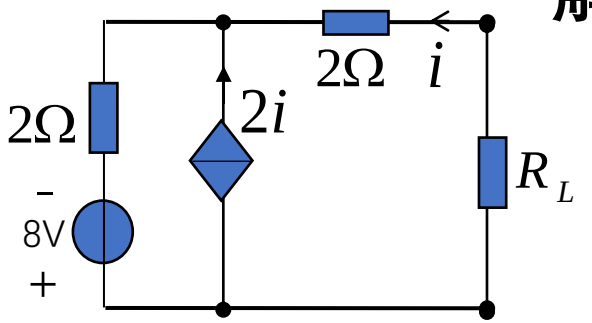


解图 4-14 (a) - (2)



解图 4-14 (a) - (3)

4-14(b) 电路如题图4-14所示，其中电阻 R_L 可调，试问 R_L 为何值时能获得最大功率？最大功率为多少？

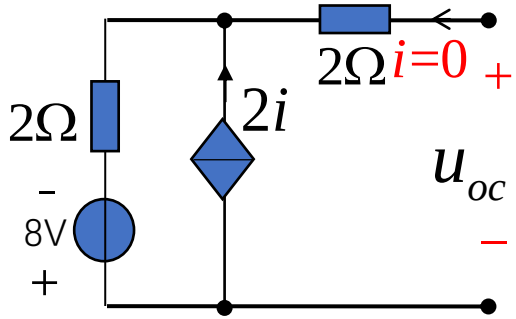


解：将 R_L 左端电路化为戴维南等效电路：

（1）先求开路电压 u_{oc}

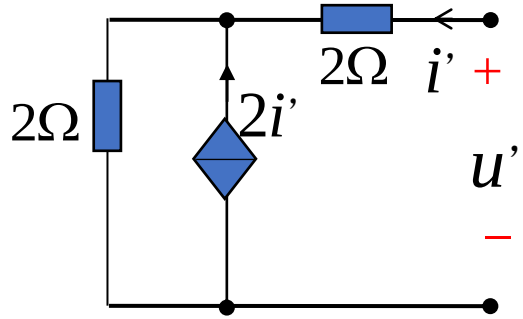
$\because \quad i=0$

2i的受控电流源为0相当于开路



$$u_{oc}=-8V$$

（2）求输出电阻 R_0 令电压源短路，则：



$$u'=2i'+(2i'+i')\times 2=8i'$$

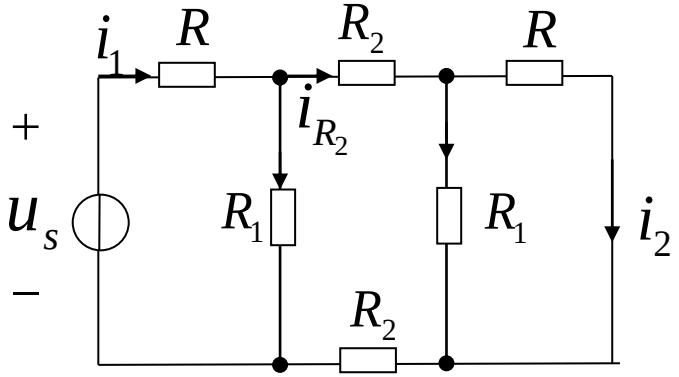
$$\therefore R_0=8\Omega$$

(3) 求最大功率：当 $R_L=R_0$ 时有最大功率，为：

$$p_{\max}=\frac{u_{oc}^2}{4R_0}=\frac{(-8)^2}{4\times 8}=2W$$

没布置，可以看一下。

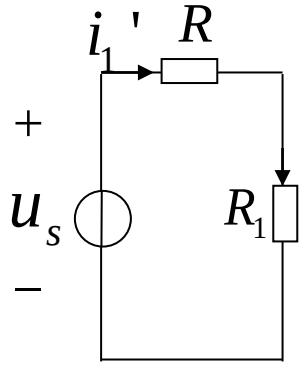
4-19 在题图4-19电路中，已知 $i_1 = 2A, i_2 = 1A$，若把电路中间的R_2支路断开，试问此时电流 i_1 为多少？



解一：（1）断开前：

$$i_1 - \frac{u_s - i_1 R}{R_1} = i_{R_2} = i_2 + \frac{i_2 R}{R_1}$$

$$\therefore u_s = R_1 + R$$

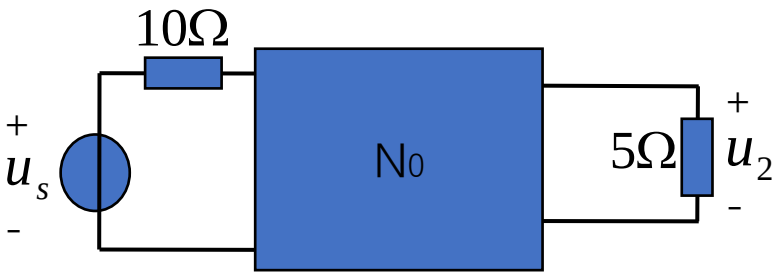


（2）断开后：

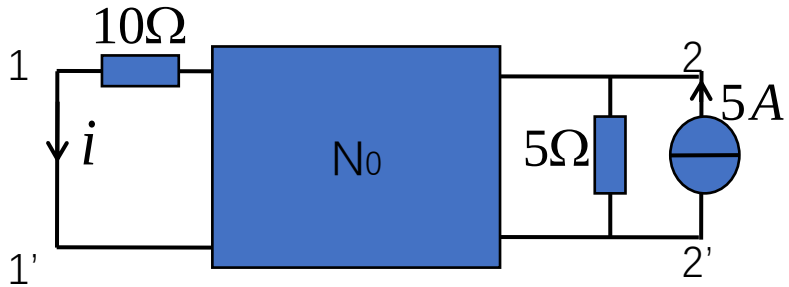
$$u_s = i_1'(R_1 + R)$$

$$\therefore i_1' = 1A$$

4-20 线性无源二端网络N_0仅由电阻组成，如4-20(a)所示。当 $u_s=100$时，　$u_2=20V$，求当电路改为图(b)时的电流i 。

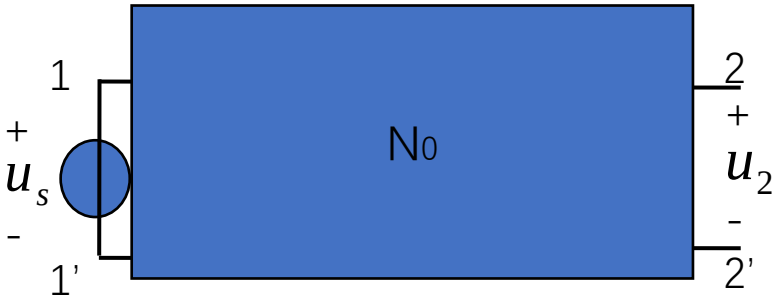


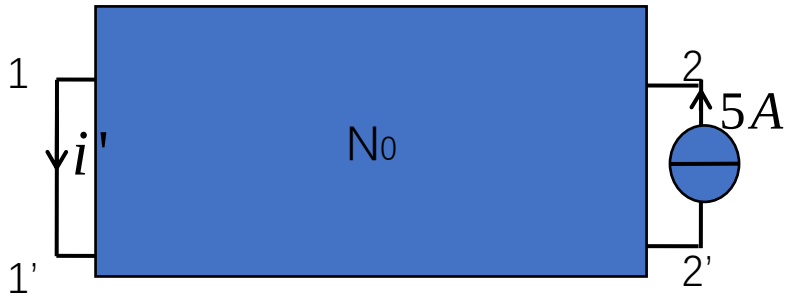
(a)



(b)

解：应用互易定理形式三+线性网络的齐次性，有：

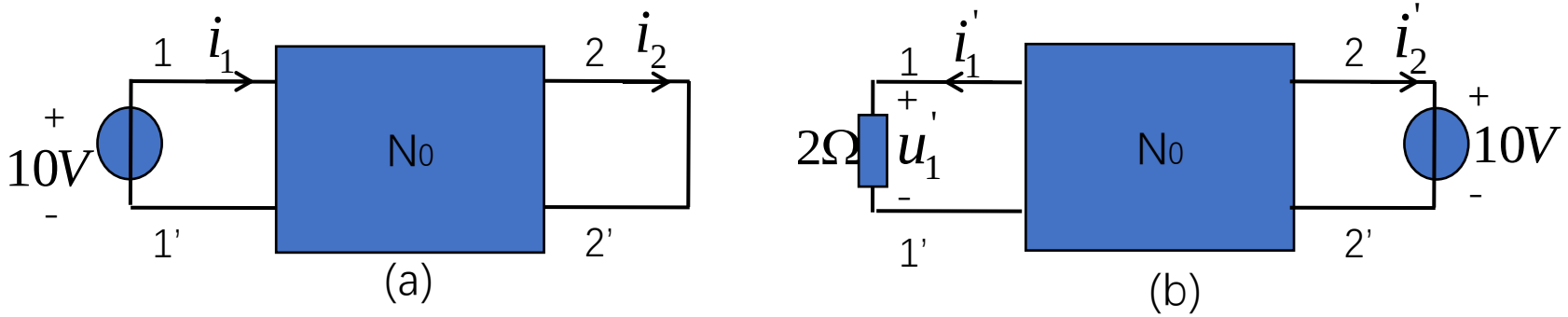




$$\frac{u_2}{u_s}=\frac{i'}{i_s'} \qquad \therefore i=i'=i_s'\cdot\frac{u_2}{u_s}=1A$$

特勒根定理

4-21 题图4-21(a)中 N_0 为仅由电阻组成的无源线性网络，当10V电压源与1,1’端相接，测得输入电流 $i_1=5A$，输出电流 $i_2=1A$；若把电压源移至2、2’端，且在1、1’跨接2Ω电阻如图(b)所示，试求2Ω电阻上的电压 u_1'



解：根据特勒根第二定理，有：

$$u_s i_1' + u_2 i_2' = u_1'(-i_1) + u_s' i_2$$

$$\because u_2 = 0, u_1' = 2i_1', u_s = u_s' = 10, i_1 = 5A, i_2 = 1A$$

$$\therefore 10i_1' = 2i_1'(-5) + 10 \times 1$$

$$\therefore i_1' = 0.5A \quad \text{则：} \quad u_1' = 1V$$