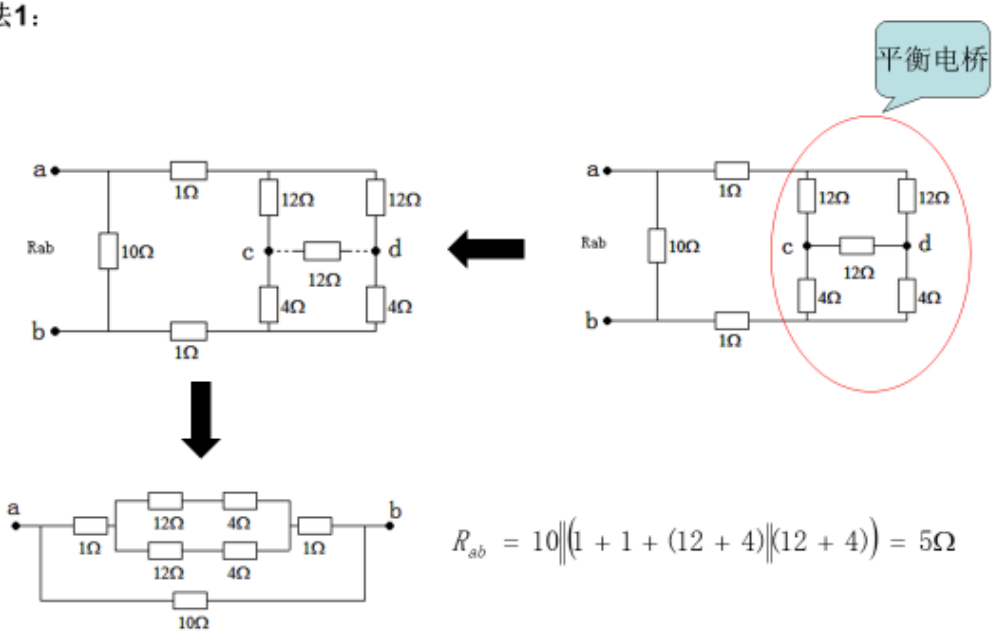
厦门大学《电路原理》课程
期中试题·答案

考试日期： 2014 信息学院自律督导部整理

一、【本题10分】求a,b中端口ab的等效电阻

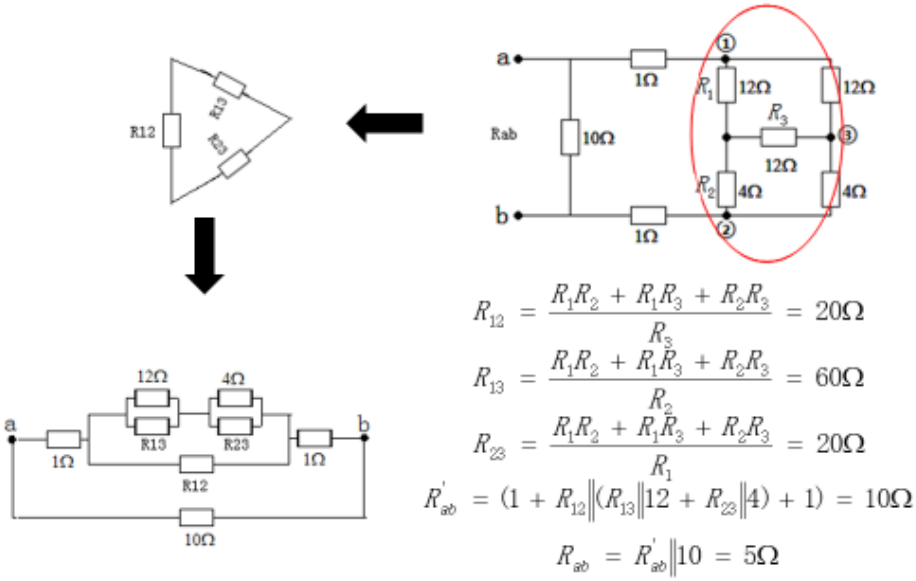
解法1：



$$R_{ab} = 10\left\|\left(1 + 1 + (12 + 4)\right\|(12 + 4)\right) = 5\Omega$$

解法2：

思路：人→△变换



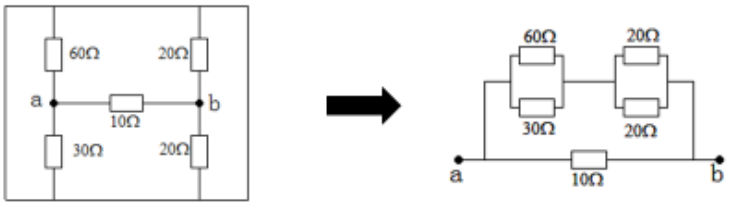
$$R_{12} = \frac{R_1R_2 + R_1R_3 + R_2R_3}{R_3} = 20\Omega$$

$$R_{13} = \frac{R_1R_2 + R_1R_3 + R_2R_3}{R_2} = 60\Omega$$

$$R_{23} = \frac{R_1R_2 + R_1R_3 + R_2R_3}{R_1} = 20\Omega$$

$$R'_{ab} = (1 + R_{12}\|(R_{13}\|12 + R_{23}\|4) + 1) = 10\Omega$$

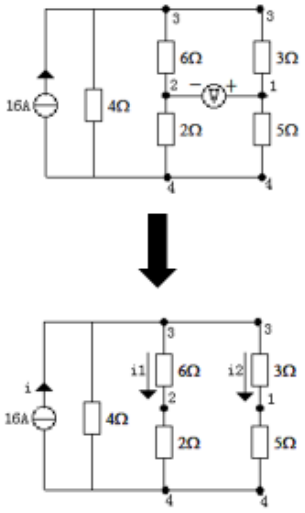
$$R_{ab} = R'_{ab}\|10 = 5\Omega$$



$$R_{ab} = 10 \| (60 \| 30 + 20 \| 20) = 7.5\Omega$$

二、【本题10分】每小题5分

（1）求图（a）所示电路中电压表读数（忽略电压表中电流）



思路：电压表读数=U_{12}

$$U_{12} = U_{32} - U_{31}$$

or $U_{12} = U_{14} - U_{24}$

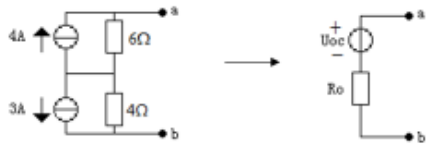
经计算：

$$\begin{cases} i_1 = 4A \\ i_2 = 4A \end{cases}$$

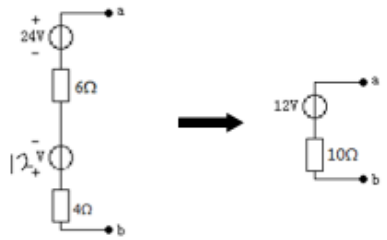
$$\begin{cases} U_{32} = 24V \\ U_{31} = 12V \end{cases} \text{ or } \begin{cases} U_{14} = 20V \\ U_{24} = 8V \end{cases}$$

$$\Rightarrow U_{12} = 12V$$

（2）求图（b）所示电路等效为一个电压源-电阻串联组合，求Uoc和Ro的值

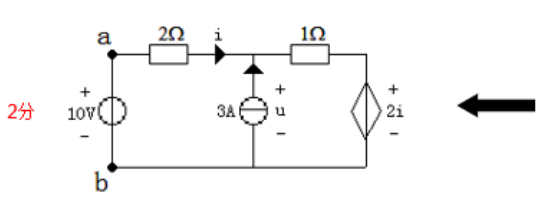


思路：①等效电源法
②戴维南等效电路

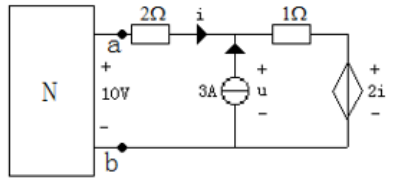


三、【本题20分】每小题10分

（1）如图（a）所示，Uab=10V,用替代定理、叠加定理结合求i,u;

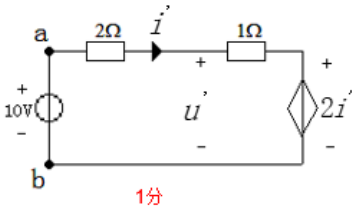


2分

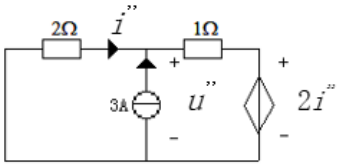


图（a）

叠加定理



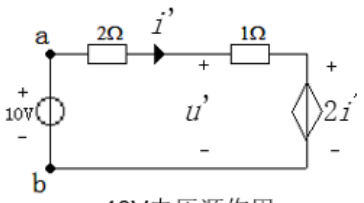
1分



1分

$$\begin{cases} 10 = (2+1)i' + 2i' \\ u' = 1 \cdot i' + 2i' \end{cases}$$

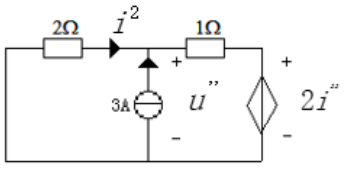
$$\Rightarrow \begin{cases} i' = 2A \\ u' = 6V \end{cases}$$



10V电压源作用

$$\begin{cases} 2i'' + 1 \cdot (3 + i'') + 2i'' = 0 \\ u'' = 1 \cdot (3 + i'') + 2i'' \end{cases}$$

$$\Rightarrow \begin{cases} i'' = -0.6A & 1分 \\ u' = 1.2V & 1分 \end{cases}$$

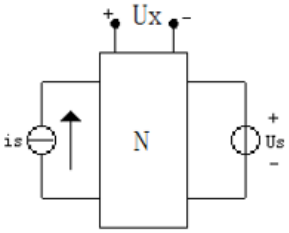


3A电流源作用

$$\begin{aligned} u &= u' + u'' = 7.2V \\ i &= i' + i'' = 1.4A \end{aligned}$$

（2）如图（b）所示，N为线性含源网络，已知当is=4A,us=6V时，响应Ux=12V;当is=-2A,us=15V时，响应Ux=0V;当is=0A,us=0V时，响应Ux=-20V;求当is=2A,us=10V时，响应Ux为多少。

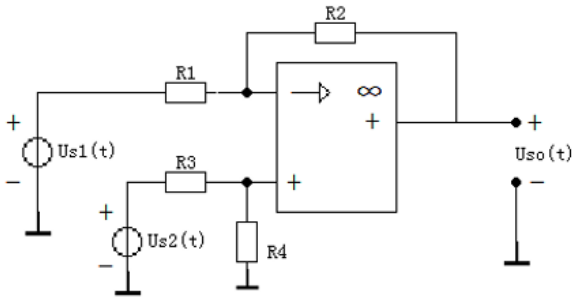
$$u_x = k_1 i_s + k_2 u_s + k_3 \quad 2分$$



$$\begin{cases} 12 = 4k_1 + 6k_2 + k_3 & 2分 \\ 0 = -2k_1 + 5k_2 + k_3 & 2分 \\ -20 = k_3 & 2分 \end{cases}$$

$$\Rightarrow \begin{cases} k_1 = 5 \\ k_2 = 2 \\ k_3 = -20 \end{cases} \Longrightarrow \begin{aligned} u_x &= 5i_s + 2u_s - 20 \\ &= 5 \times 2 + 2 \times 10 - 20 \\ &= 10V \quad 2分 \end{aligned}$$

四、【本题10分】求Uso(t)



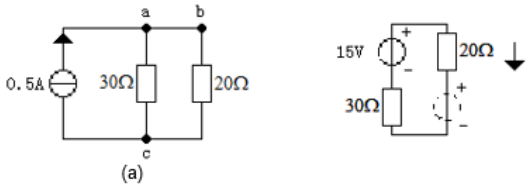
$$\begin{cases} \dfrac{u_{s1} - u_-}{R_1} = \dfrac{u_- - u_{so}}{R_2} & ① \quad 3分 \\ \dfrac{u_{s2} - u_+}{R_3} = \dfrac{u_+}{R_4} & ② \quad 3分 \\ u_+ = u_- & ③ \quad 2分 \end{cases}$$

注：不一定等于0

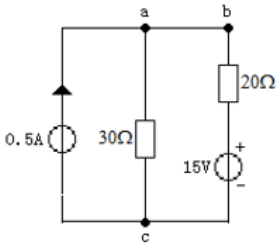
$$u_{so} = \frac{(R_1 + R_2)R_4 u_{s2} - (R_3 + R_4)R_2 u_{s1}}{R_1(R_3 + R_4)} \quad 2分$$

五、【本题10分，每小题5分】

（1）求图（a）所示电路中支路abc的电流I=0，请问应在此支路中串接入何种电源元件？其参数是多少？并画出示意图。



串接一个电压源，参数为15V，接线图如下：



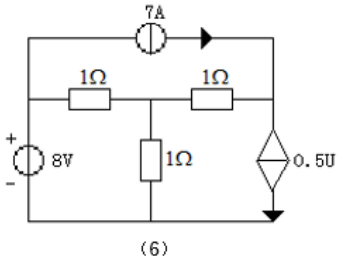
（1）求图（b）所示电路中电流i为5A，求电压Us

结点电压法：

$$\begin{cases} \left(\frac{1}{2}+\frac{1}{2}\right)u_1 = \frac{12}{2}+\frac{18}{2}-5 & \text{2分} \\ \frac{u_1-u_s}{1.2} = i & \text{2分} \end{cases}$$

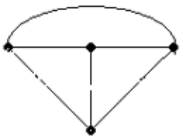
$$\Rightarrow \begin{cases} u_1 = 10V \\ u_s = 4V \end{cases} \quad \text{1分}$$

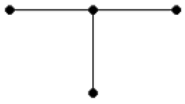
六、【本题10分】分析图6所示电路，（1）画出电路的图的结构，选择一棵树，画出该树所对应的基本回路；（2）列出回路电流方程，求电压U

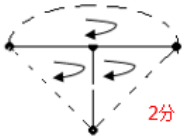


（6）

(1)

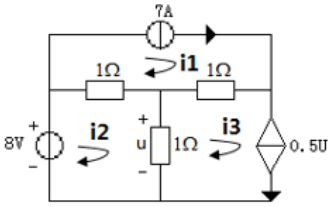

电路的图 1分


树 1分


2分

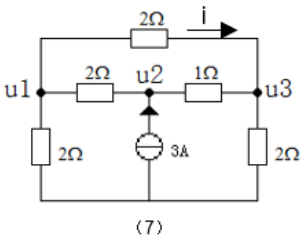
(2)

$$\begin{cases} i_1 = 7A & \text{1分} \\ (1+1)i_2 - i_1 - i_3 = 8V & \text{1分} \\ i_3 = 0.5u & \text{1分} \\ u = i_2 - i_3 & \text{1分} \end{cases} \Rightarrow \begin{cases} i_2 = 9A \\ i_3 = 3A \\ u = 6V \end{cases} \quad \text{2分}$$



七、【本题10分】采用结点电压法求图（7）中的电流

$$\begin{cases} \left(\frac{1}{2}+\frac{1}{2}+\frac{1}{2}\right)u_1 - \frac{1}{2}u_2 - \frac{1}{2}u_3 = 0 \\ -\frac{1}{2}u_1 + \left(1+\frac{1}{2}\right)u_2 - u_3 = 3 \\ -\frac{1}{2}u_1 - u_2 + \left(1+\frac{1}{2}+\frac{1}{2}\right)u_3 = 0 \end{cases}$$



（7）

$$\Rightarrow \begin{cases} u_1 = \frac{36}{13}V \\ u_2 = \frac{66}{13}V \\ u_3 = \frac{42}{13}V \end{cases} \Rightarrow i = \frac{u_1 - u_3}{2} = -\frac{3}{13}$$

八、【本题20分】试求RL为多大时，可获得最大功率？最大功率为多少？求此时电流源，电压源和RL电阻元件的功率，注明吸收还是发出。

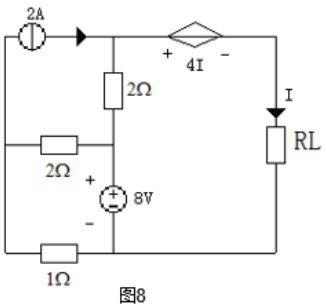
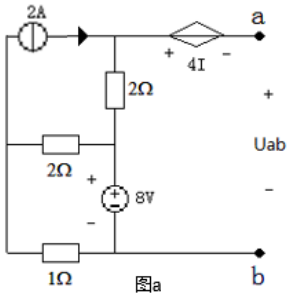
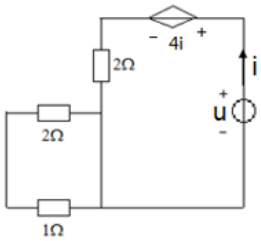


图8



图a

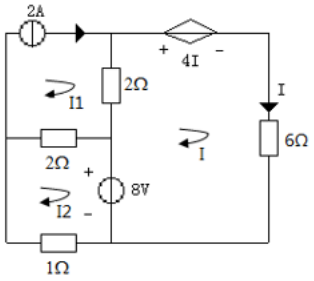


图b

开路电压Uab(图a): $u_{ab} = 2 \times 2 + 8 = 12V$

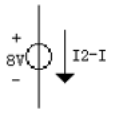
等效电阻Req: $u = 4i + 2i; \quad R_{eq} = \frac{u}{i} = 6\Omega$

当RL=Req=6Ω是可获得最大功率，最大功率 $p_{\max} = \frac{u_{ab}^2}{4R_{eq}} = 6w$

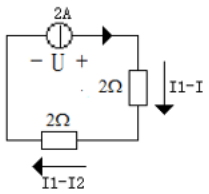


$$\begin{cases} I_1 = 2A \\ (2+1)I_2 - 2I_1 + 8 = 0 \\ (6+2)I - 2I_1 + 8 + 4I = 0 \end{cases} \Longrightarrow$$

$$\begin{cases} I_1 = 2A \\ I_2 = -\frac{4}{3}A \\ I = 1A \end{cases}$$



$P_{\text{电压源}} = 8 \times (I_2 - I) = -\frac{56}{3}W = 18.67w$(发出)



$$\begin{cases} u = 2(I_1 - I) + 2(I_1 - I_2) = \frac{26}{3}v \\ P_{\text{电流源}} = 2u = \frac{52}{3}W = 17.33W\text{(发出)} \end{cases}$$

$p_L = 6w$