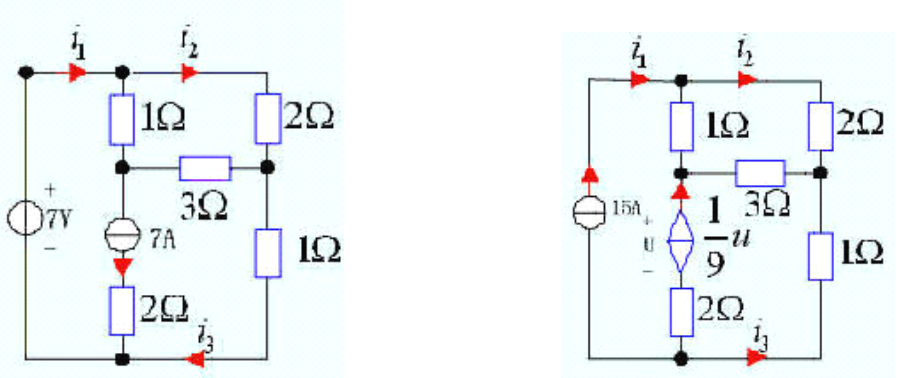
第三章　　线性电路分析的基本方法

3-1　　图题 3-1 所示电路求电流 i_1,i_2,i_3。



(a)　　(b)

图题 3-1

答案

解：(a)　以 i_1,i_2,i_3 **选作网孔电流回路电流,可列网孔电流方程：**

$$\left.\begin{aligned} 3i_1-i_2-2i_3&=7-U\\ -i_1+6i_2-3i_3&=0\\ -2i_1-3i_2+6i_3&=U\\ i_1-i_3&=7 \end{aligned}\right\}$$

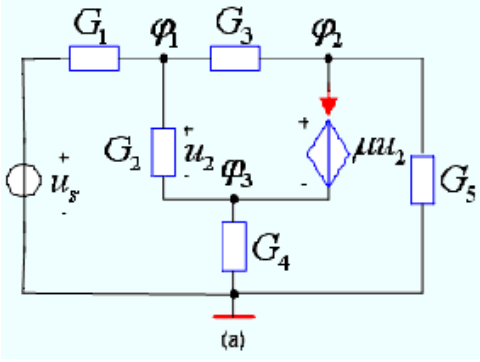
$$i_1=9A$$
$$i_2=2.5A$$
$$i_3=2A$$

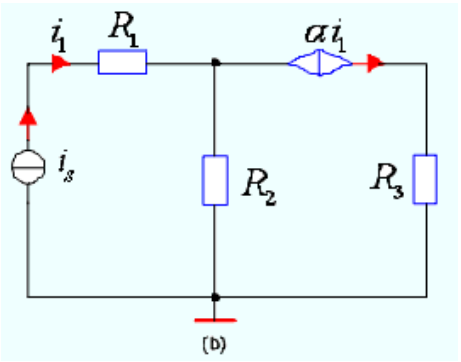
(b)　以 i_1,i_2,i_3 **选作网孔电流回路电流，有：**

$$i_1=15$$
$$-i_1+6i_2-3i_3=0$$
$$-2i_1-3i_2+6i_3=U$$
$$-i_1+i_3=\frac{1}{9}u$$
$$U=3(i_1-i_3)$$

$$i_1=11A$$
$$i_2=7A$$
$$i_3=15A$$

3-2　　列出图题 3-2 所示电路的节点方程。





图题 3-2

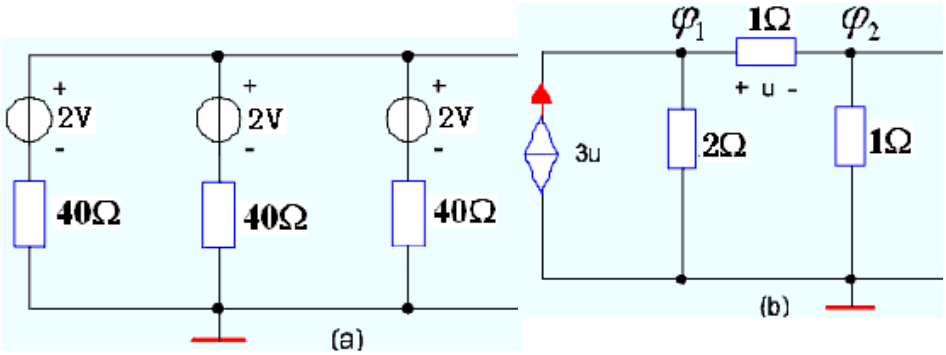
答案

解: 电路的节点方程为：

$$(a)(G_1+G_2+G_3)\varphi_1 - G_3\varphi_2 - G_3\varphi_3 = u_3 G_1 \quad \text{(b)}$$

$$\left.\begin{aligned} -G_3\varphi_1 + (G_3+G_5)\varphi_2 &= -I \\ -G_2\varphi_1 + (G_2+G_4)\varphi_3 &= I \\ \varphi_2 - \varphi_3 &= \mu u_2 \\ u_2 &= \varphi_1 - \varphi_3 \end{aligned}\right\} \qquad \left.\begin{aligned} \frac{1}{R_2}\varphi &= i_s - \alpha i_1 \\ i_1 &= i_3 \end{aligned}\right\}$$

3-3　　求图题 3-3 所示电路的 u。



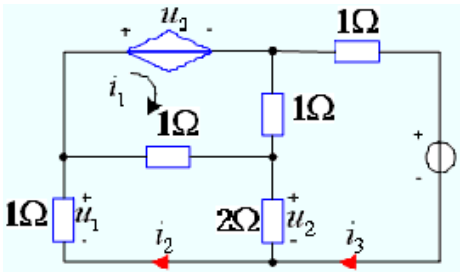
图题 3-3

答案

解：(a)　　$u = -\dfrac{2/40 + 2/40 + 2/40}{1/40 + 1/40 + 1/40 + 1/2} = \dfrac{6}{23} V$

(b)　$\left.\begin{aligned} 1.5\varphi_1 - \varphi_2 &= 3u \\ -\varphi_1 + 2\varphi_2 &= 2 \\ u &= \varphi_1 - \varphi_2 \end{aligned}\right\} \therefore \begin{aligned} \varphi_1 &= 4V \\ \varphi_2 &= 3V \end{aligned}$

3-4　　图题 3-4 所示电路，求 u_1。



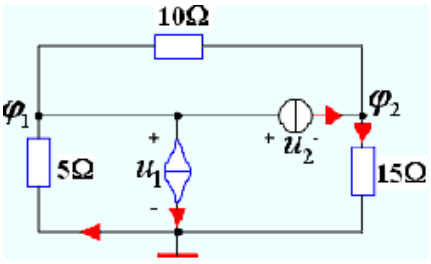
图题 3-4

答案

解：网孔回路电流方程为：

$$\left.\begin{aligned} &2\dot{I}_1-\dot{I}_2-\dot{I}_3=-2u_2\\ &-\dot{I}_1+4\dot{I}_2-2\dot{I}_3=0\\ &-\dot{I}_1-2\dot{I}_2+4\dot{I}_3=-5\\ &u=\varphi_1-\varphi_2 \end{aligned}\right\} \quad \therefore \dot{I}_2=-3.75A \qquad u_1=-\dot{I}_2=3.75V$$

3-5　图题 3-4 所示电路，求电流 $\dot{I}_1$。



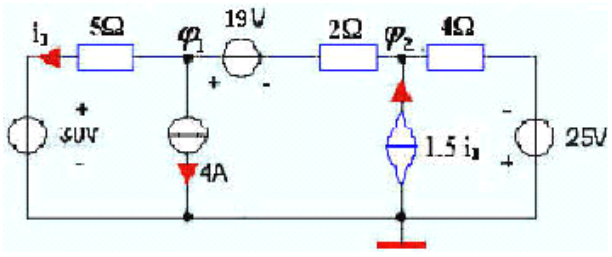
图题 3-5

答案

解：节点方程为：

$$\left.\begin{aligned} &-\frac{1}{10}\varphi_2+(\frac{1}{10}+\frac{1}{5})\varphi_1=-6-0.4\dot{I}_1\\ &-\frac{1}{10}\varphi_1+(\frac{1}{10}+\frac{1}{15})\varphi_2=6\\ &\dot{I}_1=\varphi_2/15 \end{aligned}\right\} \qquad \varphi_2=28.125V \qquad \dot{I}_1=1.875A$$

3-6　图题 3-6 所示电路，求电流 $\dot{I}_1$。



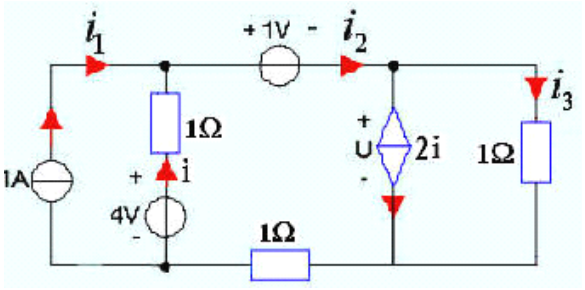
图题 3-6

答案

解：节点电位方程为：

$$\left.\begin{aligned} &0.7\varphi_1-0.5\varphi_2=11.5\\ &-0.5\varphi_1+0.75\varphi_2=-15.75+1.5i_1\\ &i_1=(\varphi_1-30)/5 \end{aligned}\right\} \quad \therefore \quad \varphi_1=-30V \qquad i_1=-12A$$

3-7　图题 3-7 所示电路，求电流 i。



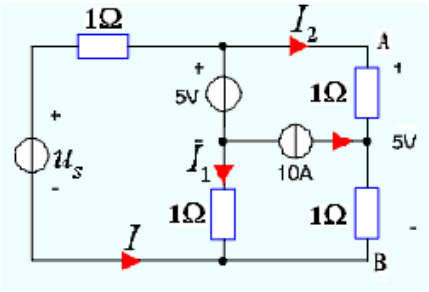
图题 3-7

答案

解：网孔电流方程为：

$$\left.\begin{aligned} &i_1 = 1 \\ &-i_1 + 2i_2 = 4 - 1 - U \\ &i_2 - i_1 = 2i \\ &i = i_2 - i_1 \end{aligned}\right\} \qquad \therefore \quad i_2 = 2A \qquad i = 1A$$

3-8　图题 3-8 所示电路，$u_{AB} = 5V$，求 u_s。



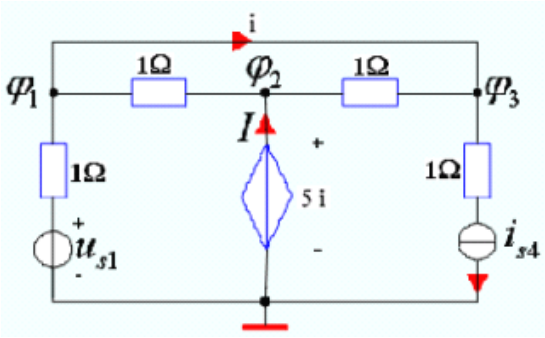
图题 3-8

答案

解：$\because \quad u_{AB} = 5V \qquad \therefore \quad I_1 = 0$

又 $\because \left.\begin{aligned} &I_2 + I = -10 \\ &I_2 - I = 5 \end{aligned}\right\} \qquad \therefore \quad \begin{aligned} &I = -7.5A \\ &u_s = u_{AB} - I = 12.5V \end{aligned}$

3-9　列写出图题 3-9 所示电路节点方程。



图题 3-9

答案

解：节点方程：

$$\left.\begin{aligned} 2\varphi_1-\varphi_2&=u_{s1}-i\\ \varphi_2&=5i\\ -\varphi_2+\varphi_3&=i-i_{s4}\\ \varphi_1&=\varphi_3 \end{aligned}\right\}$$

或：

$$\left.\begin{aligned} 2\varphi_1-\varphi_2&=u_{s1}-i\\ \varphi_1+2\varphi_2-\varphi_3&=I\\ -\varphi_1+\varphi_3&=i-i_{s4}\\ \varphi_2&=5i\\ \varphi_1-\varphi_3&=0 \end{aligned}\right\}$$

3-10　若网孔方程为

$$\begin{aligned} (R_1+R_2)i_1-R_2i_2-0i_3&=u_s,\\ -R_1i_1+(R_2+R_3+R_4)i_2-R_4i_3&=0,\\ 0i_1-R_4i_2+(R_4+R_5)i_3&=0. \end{aligned}$$

试画出其电路图。

答案

解： 对应电路图如图 3-10 所示。

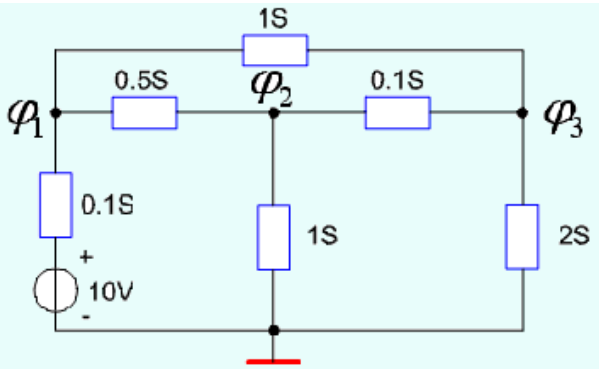


图 题3-10

3-11 若节点方程为

$$
\begin{aligned}
&1.6\varphi_1 - 0.5\varphi_2 - \varphi_3 = 1,\\
&-0.5\varphi_1 + 1.6\varphi_2 - 0.1\varphi_3 = 0,\\
&-\varphi_1 - 0.1\varphi_2 + 3.1\varphi_3 = 0。
\end{aligned}
$$

试画出其电路图。

答案

解： 对应电路图如图 3-11 所示。

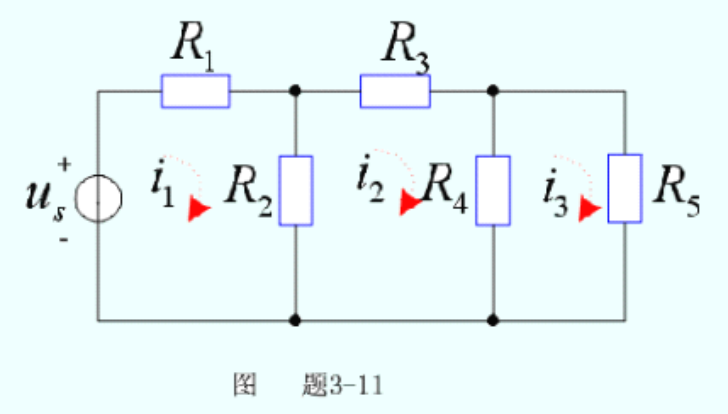


图　　题3-11