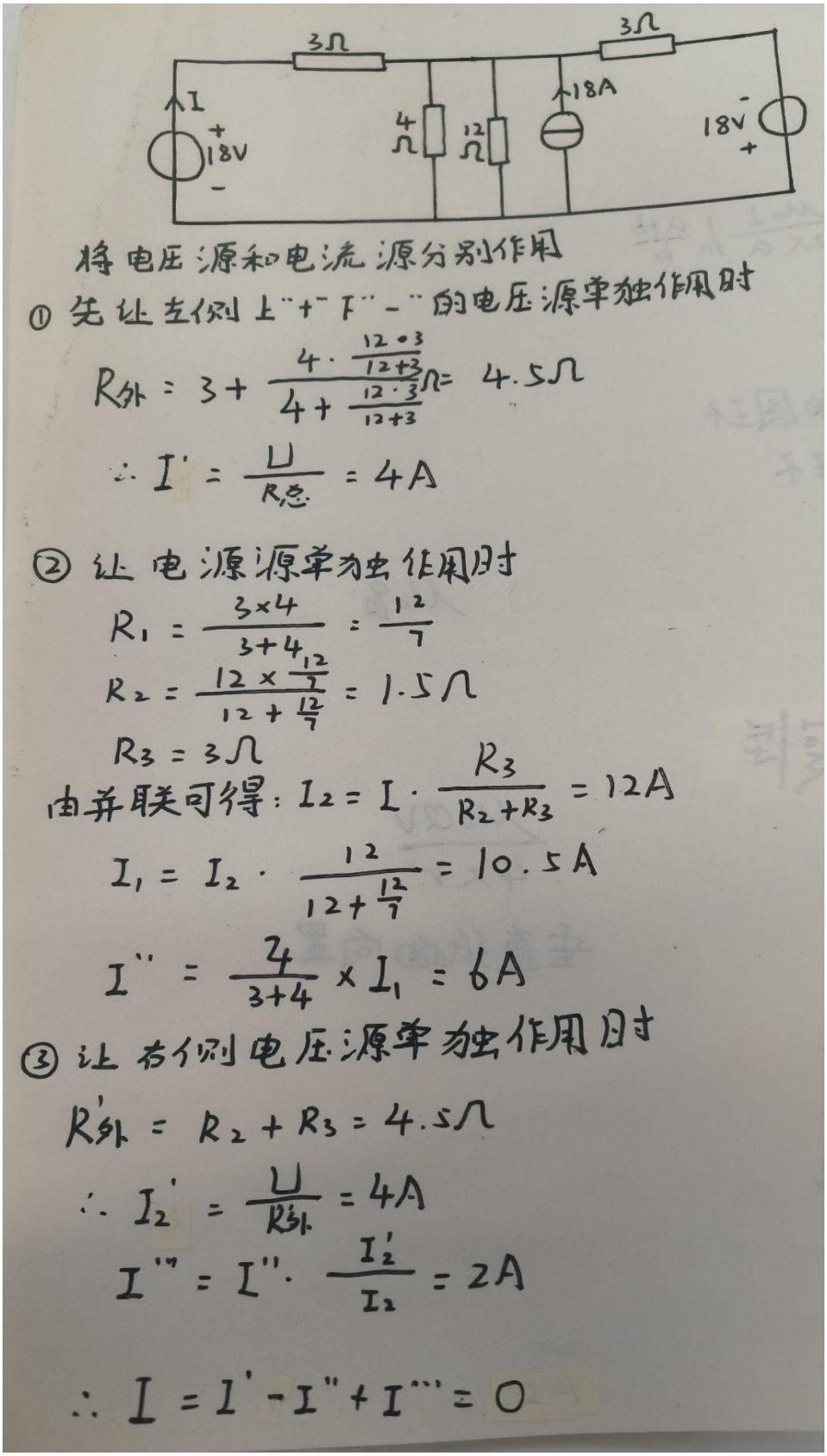
电路作业（四）

4—3



将电压源和电流源分别作用

① 先让左侧上"+"下"-"的电压源单独作用时

$$R_{外} = 3 + \frac{4 \cdot \frac{12 \cdot 3}{12+3}}{4 + \frac{12 \cdot 3}{12+3}}\Omega = 4.5\Omega$$

$$\therefore I' = \frac{U}{R_{总}} = 4A$$

② 让电源源单独作用时

$$R_1 = \frac{3 \times 4}{3+4} = \frac{12}{7}$$

$$R_2 = \frac{12 \times \frac{12}{7}}{12 + \frac{12}{7}} = 1.5\Omega$$

$$R_3 = 3\Omega$$

由并联可得：$I_2 = I \cdot \frac{R_3}{R_2 + R_3} = 12A$

$$I_1 = I_2 \cdot \frac{12}{12 + \frac{12}{7}} = 10.5A$$

$$I'' = \frac{4}{3+4} \times I_1 = 6A$$

③ 让右侧电压源单独作用时

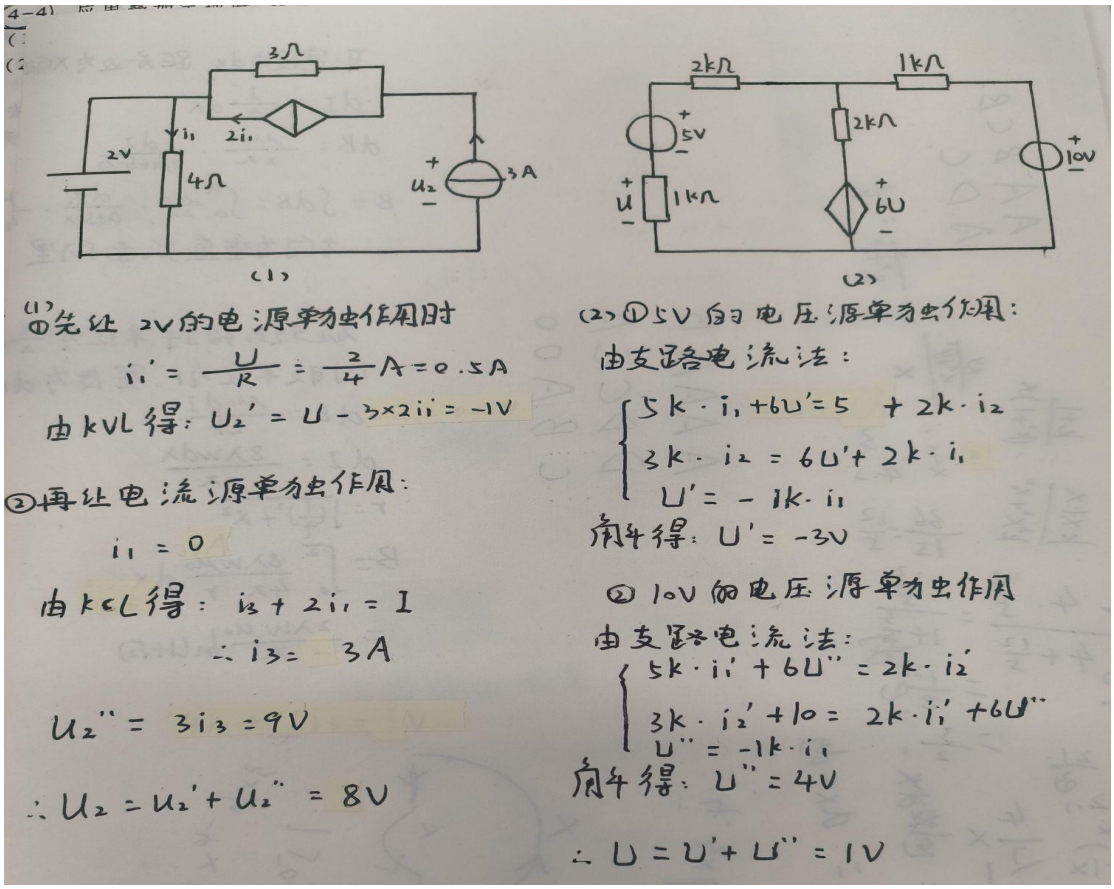
$$R'_{外} = R_2 + R_3 = 4.5\Omega$$

$$\therefore I_2' = \frac{U}{R_{外}} = 4A$$

$$I''' = I'' \cdot \frac{I_2'}{I_2} = 2A$$

$$\therefore I = I' - I'' + I''' = 0$$

4—4



(1) ①先让 2V 的电源单独作用时

$i_1' = \frac{U}{R} = \frac{2}{4}A = 0.5A$

由 KVL 得: $U_2' = U - 3\times 2i_1 = -1V$

②再让电流源单独作用:

$i_1 = 0$

由 KCL 得: $i_3 + 2i_1 = I$

$\therefore i_3 = 3A$

$U_2'' = 3i_3 = 9V$

$\therefore U_2 = U_2' + U_2'' = 8V$

(2) ①5V 的电压源单独作用:

由支路电流法:

$$\begin{cases} 5k\cdot i_1' + 6U' = 5 + 2k\cdot i_2' \\ 3k\cdot i_2' = 6U' + 2k\cdot i_1' \\ U' = -1k\cdot i_1' \end{cases}$$

解得: $U' = -3V$

②10V 的电压源单独作用

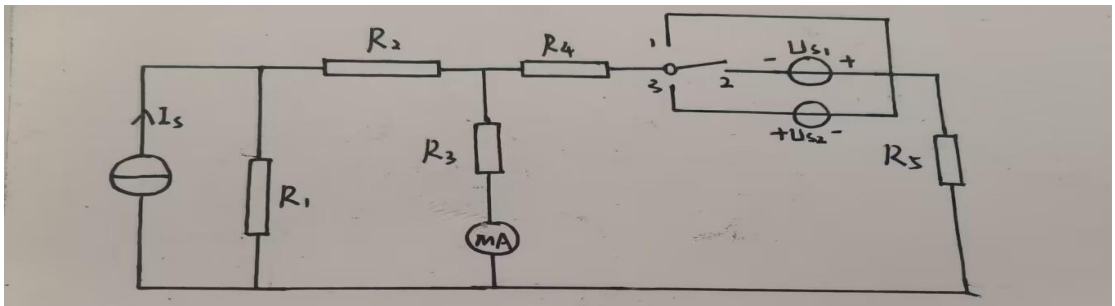
由支路电流法:

$$\begin{cases} 5k\cdot i_1'' + 6U'' = 2k\cdot i_2' \\ 3k\cdot i_2' + 10 = 2k\cdot i_1'' + 6U'' \\ U'' = -1k\cdot i_1'' \end{cases}$$

解得: $U'' = 4V$

$\therefore U = U' + U'' = 1V$

4—8



将电流源与开关看作激励,毫安表为响应

则 $I_m = k_1 I_s + k_2 U$

开关接 1 时, $U = 0 \Rightarrow k_1 I_s = 40mA$

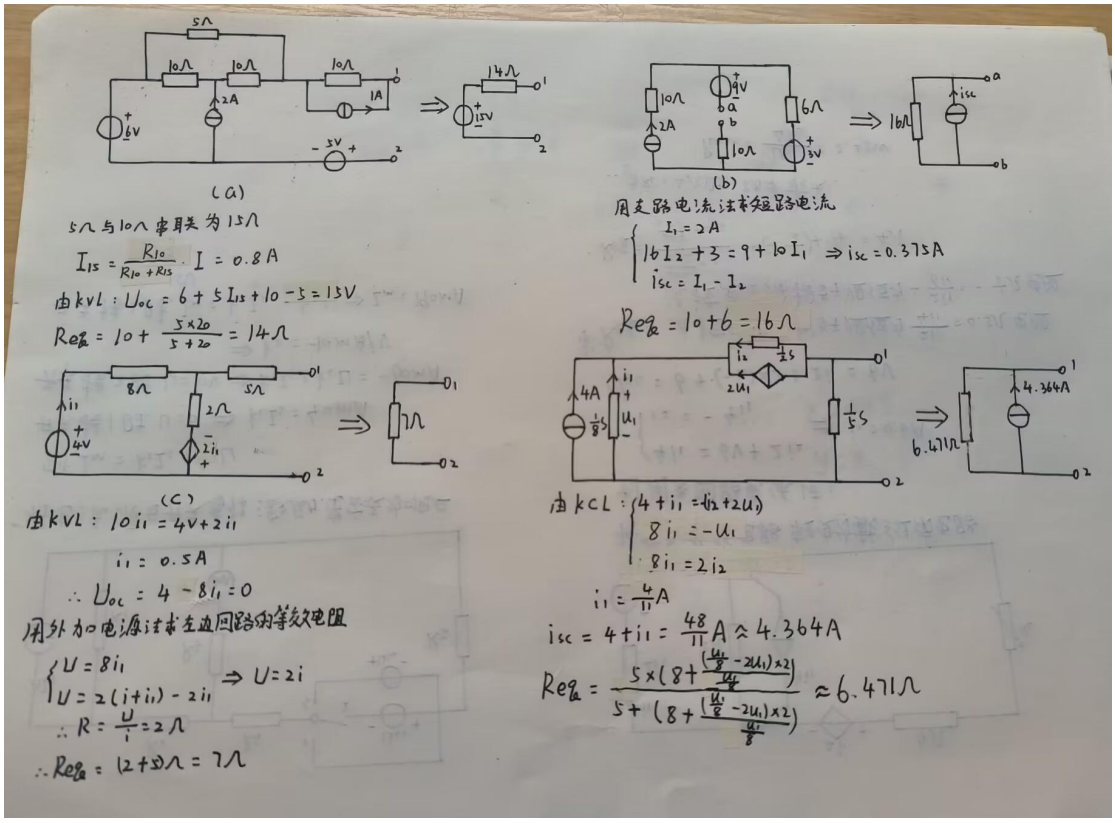
开关接 2 时, $U = 10V \Rightarrow k_1 I_s + k_2 U = -60mA$

$\Rightarrow k_2 = -10mA/V$

开关接 3 时, $I_m = k_1 I_s - k_2 U \Rightarrow I_m = 190mA$

$U = 15V$

4—12



(a)

5Ω与10Ω串联为15Ω

$I_{1S}=\frac{R_{10}}{R_{10}+R_{1S}}\cdot I=0.8A$

由KVL：$U_{oc}=6+5I_{1S}+10-3=13V$

$Req=10+\frac{5\times20}{5+20}=14\Omega$

(c)

由KVL：$10i_1=4V+2i_1$

$i_1=0.5A$

$\therefore U_{oc}=4-8i_1=0$

用外加电源法求左边回路的等效电阻

$\begin{cases}U=8i_1\\U=2(i+i_1)-2i_1\end{cases}\Rightarrow U=2i$

$\therefore R=\frac{U}{i}=2\Omega$

$\therefore Req=12+5\Omega=7\Omega$

(b)

用支路电流法求短路电流

$\begin{cases}I_1=2A\\16I_2+3=9+10I_1\\i_{sc}=I_1-I_2\end{cases}\Rightarrow i_{sc}=0.375A$

$Req=10+6=16\Omega$

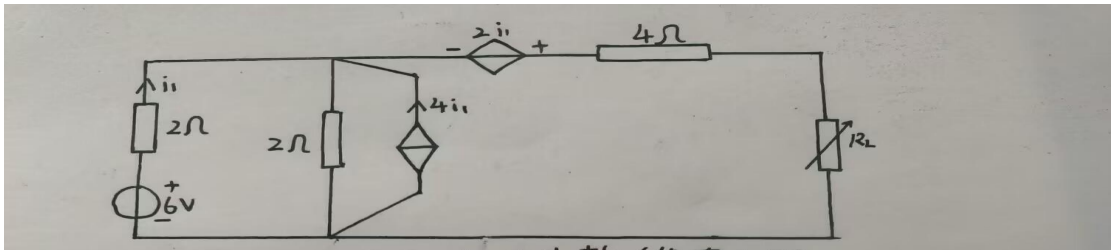
由KCL：$\begin{cases}4+i_1=i_2+2U_1\\8i_1=-U_1\\8i_1=2i_2\end{cases}$

$i_1=\frac{4}{11}A$

$i_{sc}=4+i_1=\frac{48}{11}A\approx4.364A$

$Req=\frac{5\times(8+\frac{(\frac{4i_1}{8}-2U_1)\times2}{\frac{4i_1}{8}})}{5+(8+\frac{(\frac{4i_1}{8}-2U_1)\times2}{\frac{4i_1}{8}})}\approx6.471\Omega$

4—17



将除R_L外的电路等效为戴维南电路

利用叠回路电流法：

$\begin{cases}4i_1=6V+2i_2\\i_2=-4i_1\end{cases}\Rightarrow i_1=0.6A$

$U_{oc}=6+(-i_1)\times2+2i_1=6V$

求Req：流控电流源相当于阻值为$\frac{2i_1}{4i_1}=0.5\Omega$电阻

流控电压源相当于阻值为$-\frac{2i_1}{6i_1}=-\frac{1}{3}\Omega$电阻

$\therefore Req=\frac{\frac{2\times2}{2+2}\times0.5}{\frac{2\times2}{2+2}+0.5}+(-\frac{1}{3})+4=4\Omega$

$\therefore$当$R_L=4\Omega$时，功率最大。

$P_{Lmax}=\frac{U_{oc}^2}{4R_L}=2.25W$