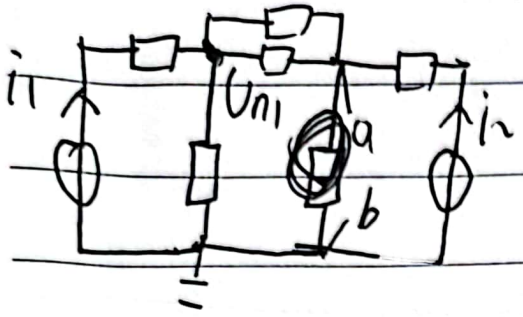
4-16.

1) 用结点电压法如图所示



$(U_{n1}(\frac{1}{10}+\frac{1}{10}+\frac{1}{30})=\frac{50}{10}+0\frac{50}{30}$

$U_{n1}=31.75V$

$U_{oc}=U_{ab}=\frac{50-U_{n1}}{30}\times 10+U_{n1}=37.5V$

将电压源置零后加

$R_{eq}=10\Omega$

∴当$R=R_{eq}=10\Omega$时

有$P_{max}=\frac{U_{oc}^2}{4R}$

(2). 当R以最大功率运行时.

流过电阻的电流

$I=i=\frac{U_{oc}}{2R}=1.875A$

把R替换成输出电流为1.875A的独立电流元.

当电流元作用时

$i_{11}=\frac{i}{4}=0.46875A$

$i_{21}=\frac{i}{4}=0.9375A$

当左侧电压源作用时

$i_{12}=\frac{50}{20+30}=1.5625A$

$i_{22}=i_{12}\times\frac{20}{20+30}=0.625A$

当右侧电压源作用时

$i_{23}=\frac{50}{30+10}=1.25A$

$i_{13}=\frac{i_{23}}{2}=0.625A$

$\therefore i_1=i_{11}+i_{12}+i_{13}=1.40625A$

$i_2=i_{21}+i_{22}+i_{23}=1.5625A$

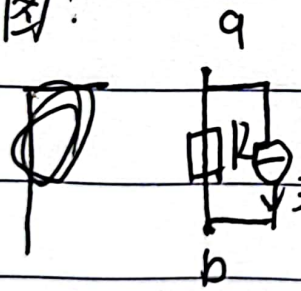
$P_1=UI_1=70.3125W$, $P_2=78.125W$

(3). ~~$U_{oc}=37.5V$~~

$\because i_{sc}=\frac{U_{oc}}{R_{eq}}=3.75A$

a,b间应并联一个由a流向b的大小为3.75A的独立电流源.

电路图:



4-17.

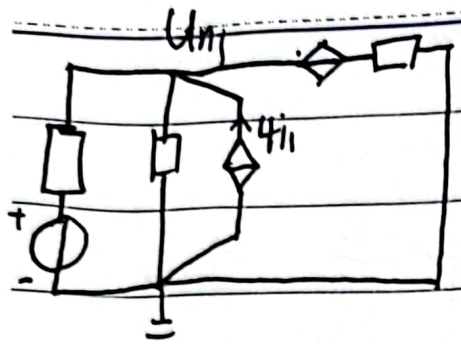
R_L处断开

$-6+2i_1+2.5i_1=0$

$i_1=0.5A$

$U_{oc}=5i_1\cdot 2=5V$, 求短路电流i_{sc}

用结点电压法如图所示.



$$\begin{cases} U_{n1}\left(\frac{1}{2}+\frac{1}{2}+\frac{1}{4}\right)=i_1+4i_1-\frac{2i_1}{4} \\ i_1=\frac{6-U_{n1}}{2} \end{cases}$$ 联立解得

$$\begin{cases} U_{n1}=\frac{27}{7}\,V \\ i_1=\frac{15}{14}\,A \end{cases}$$

$$i_{sc}=\frac{U_{n1}+2i_1}{4}=1.5A$$

$$\therefore R_{eq}=\frac{U_{oc}}{i_{sc}}=\frac{10}{3}\,\Omega$$

$\therefore$ 当 $R_L=R_{eq}=\frac{10}{3}\,\Omega$ 时

$$P_{max}=\frac{U_{oc}^2}{4R}=1.875W$$

4-18.

$$U_1=-U_S+U_{R_1}$$
$$=-4V$$
$$U_1=-U_S+U_{R_1}$$
$$=-4.8V$$

$$\dot{I}_2=\frac{\dot{U}_2}{R_2}=1A$$

互易定理可得:

$$\begin{cases} \dot{U}_1\dot{I}_1+\dot{U}_2\dot{I}_2=\dot{U}_1'\dot{I}_1+\dot{U}_2'\dot{I}_2 \\ \dot{U}_2=0.8\dot{I}_2 \end{cases} \Rightarrow \begin{cases} -4\times3+2\times\dot{I}_2=-4.8\times2+\dot{U}_2\times1 \\ \dot{U}_2=0.8\dot{I}_2 \end{cases}$$

解得：$\dot{I}_2=2A, \dot{U}_2=1.6V$

4-20.

(1) $U_1\dot{I}_1+U_2\dot{I}_2=Q_{i1}+Q_{i2}$

$U_1=30V, U_2=20V$

$i_1=\frac{U_1}{20}-10=-8.5A$

$i_2=\frac{U_2}{8}=2.5A$

$\dot{I}_1=\frac{\dot{U}_1}{20}-10$

$\dot{I}_2=\frac{\dot{U}_2}{8}-5$

代入解得 $\dot{U}_1=40V$

5-3.

$$\begin{cases}(G_1+G_2+G_4+G_5)U_{n1}-G_4U_{n2}-G_5U_2=G_1U_1\\ -G_4U_{n1}+(G_3+G_4)U_{n2}-G_3U_2=0\\ U_{n2}=0\end{cases}$$

$$\begin{cases}(G_1+G_2+G_4+G_5)U_{n1}=G_5U_2+G_1U_1\\ -G_4U_{n1}=G_3U_2\end{cases}$$

$U_{n1}=-\frac{G_3U_2}{G_4}$

联立解得：$\frac{U_2}{U_1}=-\frac{G_1G_4}{G_3(G_1+G_2+G_4+G_5)+G_4+G_5}$

5-4. 设第二个放大器的输入端为 U_0'

$\frac{U_1}{R_1}=\frac{0-U'}{R_2}+\frac{0-U_0}{R_3}$

$\frac{U'}{R_4}=\frac{U_0}{R_4+R_5}$

解得: $\frac{U_2}{U_1} = -\frac{R_2R_3(R_4+R_5)}{R_1[R_3R_4+R_2(R_4+R_5)]}$

5-6.

设 R_L 两端电压 U，输出端电压 U_2.

$$\begin{cases} \frac{U_1-U}{R_1} = \frac{U-U_2}{R_L} \\ \frac{U_2-U}{R_4} = \frac{U}{R_L} + \frac{U}{R_3} \end{cases}$$

消去 U_2

$$\frac{R_3R_4+R_LR_4+R_3R_L}{R_3R_L}U = \frac{U(R_1+R_2)-U_1R_2}{R_1}$$

$$R_1R_4R_3U + R_1R_4R_LU + R_1R_3R_LU = R_1R_3R_LU + R_2R_3R_LU - R_2R_3R_LU_1$$

$$R_1R_4(R_3U+R_LU) = R_2R_3(R_LU - R_LU_1)$$

$$R_1R_4 = R_2R_3 \neq 0$$

$$\therefore R_3U + R_LU = R_LU - R_LU_1$$

$$\therefore R_3U = -R_LU_1$$

$$U = \frac{-R_LU_1}{R_3}$$

$$i_L = \frac{U}{R_L} = \frac{-U_1}{R_3}$$

∴ 电流 i_L 仅决定于 U_1 而与负电阻 R_L 无关

5-7.

设运放输入端电压为 U_1

$$\therefore \begin{cases} \dfrac{U_{S1}-U_1}{R_1}=\dfrac{U_1-U_0}{R_4} \\ \dfrac{-U_{S2}-U_1}{R_3}=\dfrac{U_1-U_0}{R_4} \end{cases}$$

消去 U_1 联立解得.

$$U_0=\frac{R_2R_3+R_1R_4}{R_2R_3-R_1R_4}U_{S1}+\frac{R_1R_4+R_2R_3}{R_2R_3-R_1R_4}U_{S2}$$