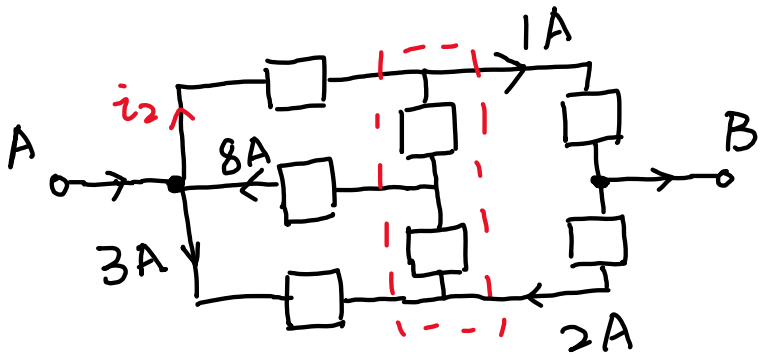
习题课一

2023.4.22

Raiiyf

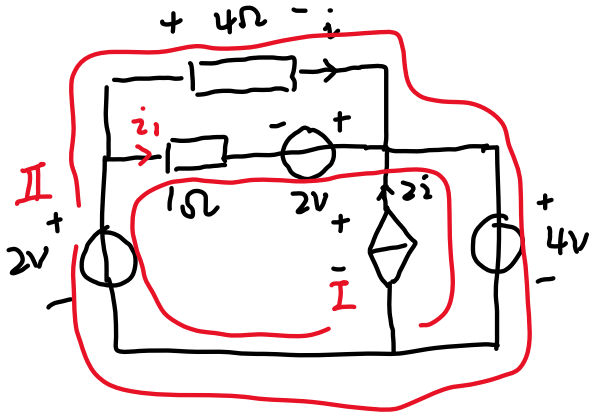
1.6



$i_2 + 3 + 2 = 1 + 8$

扩展的KCL：流入（或流出）电路中任意孤立部分电流代数和为零

1.18



求P受控源.

$i_1 = 0$

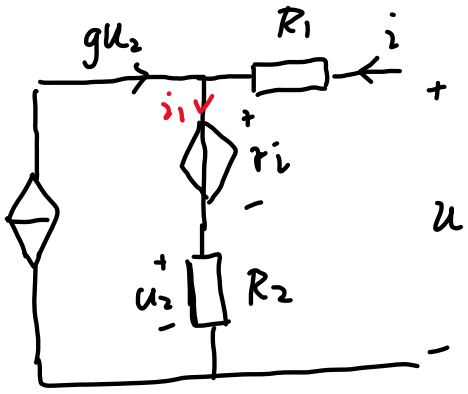
$i \cdot 4 + 4 = 2$ (KVL)

$i = -\frac{1}{2}$ A

$P = 4 \cdot 2i = -4W$ (u.a.r.d)

释放

1.19 (c)



$$\begin{cases} i_1 = gu_2 + i \\ u_2 = i_1 \cdot R_2 \end{cases} \quad i_1 = \frac{1}{1-gR_2} i_2$$

$$u = iR_1 + ri + i_1R_2$$

$$= i\left(R_1 + r + \frac{R_2}{1-gR_2}\right)$$

3.2

3.2

2A电流源单独作用：$I_1' = -4A$ ， $I' = -5A$

4V 电压源单独作用：$I_1'' = -6A$ ， $I'' = -5A$

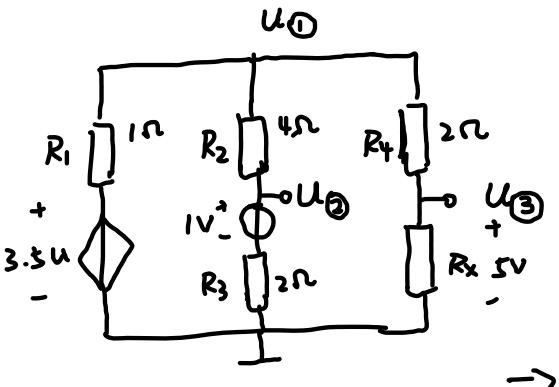
叠加：$I = I' + I'' = -10A$

$I_1 = I_1' + I_1'' = -10A$ $\quad P = I_1^2 R = 100W$

功率不可以直接叠加

3.3

置换 + 等效

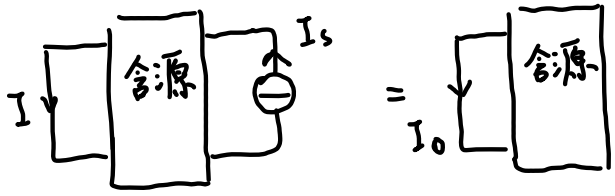


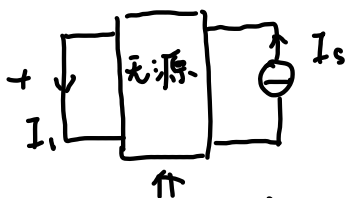
$$\begin{pmatrix} 1+\frac{1}{4}+\frac{1}{2} & -\frac{1}{4} & -\frac{1}{2} \\ -\frac{1}{4} & \frac{1}{4}+\frac{1}{2} & 0 \\ -\frac{1}{2} & 0 & \frac{1}{2}+\frac{1}{R_x} \end{pmatrix} \begin{pmatrix} U_① \\ U_② \\ U_③ \end{pmatrix} = \begin{pmatrix} 3.5U_1 \\ \frac{1}{2} \\ 0 \end{pmatrix}$$

以及 $U = U_②$ ， $U_③ = 5V$

$\Rightarrow U_① = 10V$， $U_② = 4V$， $U_③ = 5V$ ， $R_x = 2\Omega$

3.5





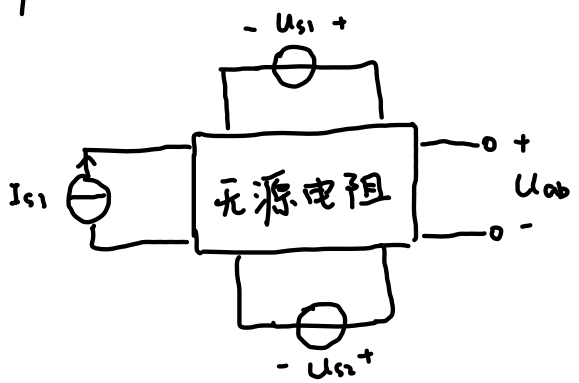
对 I_s 满足齐性定理.

$I = I_0 + I_1 = I_0 + kI_s$

$$\begin{cases} -1 = I_0 + 2k \\ 0 = I_0 + 4k \end{cases} \Rightarrow k = \frac{1}{2} \ , \ I_0 = -2$$

若 $I = 1A$ ， $I_1 = 3A \Rightarrow kI_s = 3A \Rightarrow I_s = 6A$

3.14



$U_{ab} = k_1 U_{S1} + k_2 U_{S2} + k_3 I_{S1}$

I_{S1}、U_{S1}反向，U_{S2}不变，$U_{ab}' = 0.5 U_{ab}$

叠加：$2U_{S2} \Rightarrow 1.5 U_{ab}$

$U_{S2} \Rightarrow 0.75 U_{ab}$

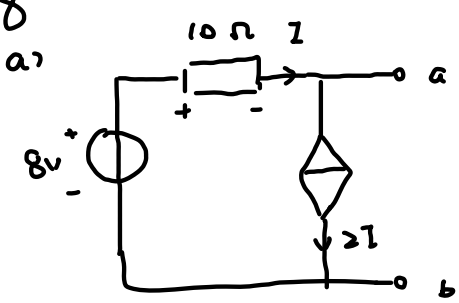
同理：$U_{S1} \Rightarrow 0.65 U_{ab}$

$\Rightarrow I_{S1} \Rightarrow 1 - 0.75 - 0.65 = -0.4\, U_{ab}$

I_{S1}反向（相当于减两个I_{S1}）$\Rightarrow U_{ab}'' = [1 - (-0.4) \times 2]\, U_{ab} = 1.8\, U_{ab}$

3.8

(a)

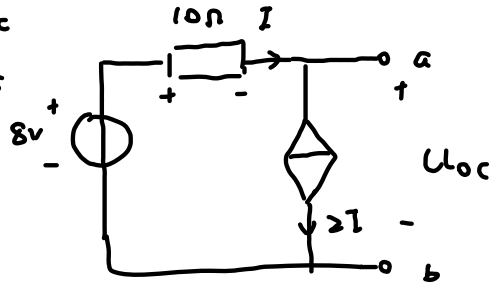


① 开路电压 U_{oc}

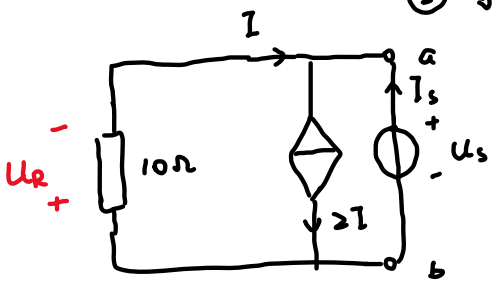
令 a、b 开路

$I = 2I \Rightarrow I = 0$

$U_{oc} = 8V$.



② 等效电阻 R_{eq}



$I_s + I = 2I \Rightarrow I_s = I$

$I_s = I = \frac{U_R}{R} = \frac{-U_s}{10\Omega}$

$R_{eq} = \frac{U_s}{I_s} = -10\Omega$.

(b)

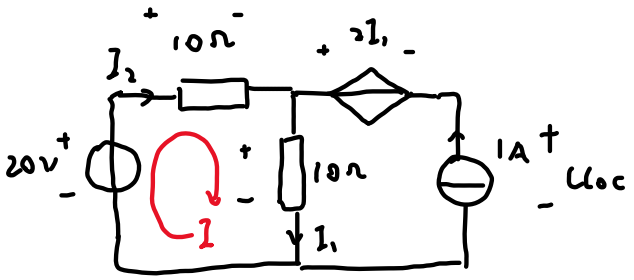
① U_{oc}：

$I_2 = I_1 - 1A$

$20 - 10I_2 = 10I_1$（回路 I KVL）

$\Rightarrow I_1 = 1.5A$

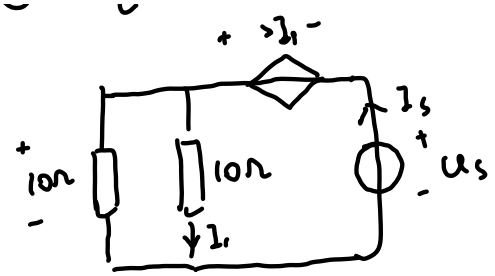
$U_{oc} = 10I_1 - 2I_1 = 12V$



② R_{eq}

对称性：$I_1 = \frac{1}{5} I_s$

$U_s + 2I_1 = 10I_1$



对称性： $I_1 = \frac{1}{5} I_S$

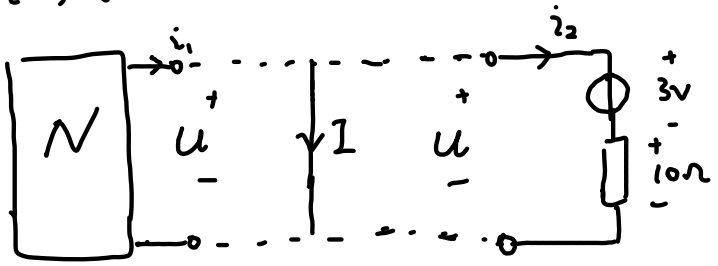
KVL： $U_S + 2I_1 = 10I_1$

$U_S + I_S = 5I_S$

$\Rightarrow R_{eq} = U_S / I_S = 4\Omega$

3.10

电路可等效为：



$i_1 = I + i_2$

找出两组 (U, i_1)

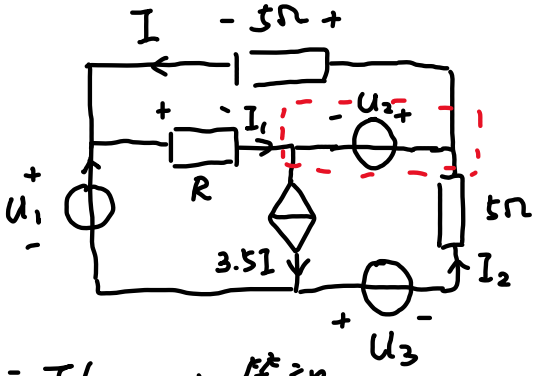
① 开关断开时 $U = 13V$, $i_1 = 1A$

② 开关闭合时 $U = 0$, $i_2 = -0.3A$, $i_1 = 3.6A$

$$\begin{cases} U_{oc} - R_{eq} = 13 \\ U_{oc} - 3.6R_{eq} = 0 \end{cases} \Rightarrow U_{oc} = 18V,\ R_{eq} = 5\Omega$$

3.15

初步分析：



KCL： $I_1 + I_2 = I + 3.5I$

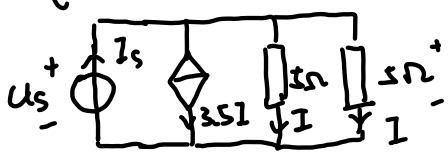
$\Rightarrow I = 2A$

$U_2 = 5I + RI_1$

$= 20V$

对电路除R部分Thevenin等效.

① R_{eq}：

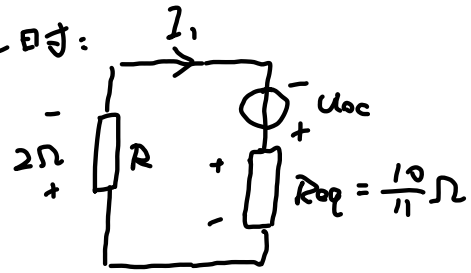


$I = \frac{U_S}{5}$ $I_S = 5.5I$

$R_{eq} = \frac{U_S}{I_S} = \frac{10}{11}\Omega$

② U_{oc}：

$R=2\Omega$ 时：



$U_{oc}=I_1(R_{eq}+R)$

$=5\times\frac{32}{11}=\frac{160}{11}V$

立即有：$R=4\Omega$ 时 $I_1'=\frac{U_{oc}}{R'+R_{eq}}=\frac{160}{54}=\frac{80}{27}A$

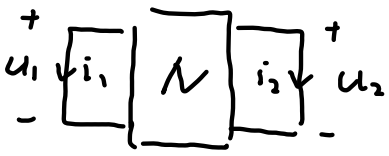
$U_2=I_1'R'+5I \Rightarrow I=\frac{44}{27}A$

$I_2=I+3.5I-I_1=4.5\times\frac{44}{27}-\frac{80}{27}=\frac{118}{27}A.$

3.18

和课上例题一样

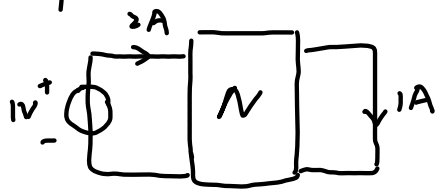
$U_1\tilde{i}_1+U_2\tilde{i}_2=\tilde{U}_1i_1+\tilde{U}_2\tilde{i}_2$



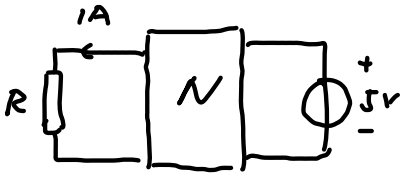
$10I+2\times(-4)=0+\frac{2}{5}\times20$

$I=1.6A$

3.19

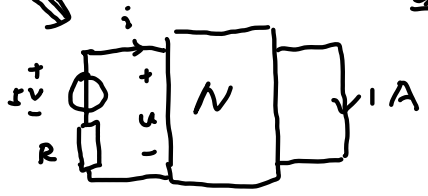


(a)



(b)

等价 ⇔ 互易



(c)

所以(c)中 $i=2A$，$u=1V$

$5-2R=1$

$R=2\Omega.$