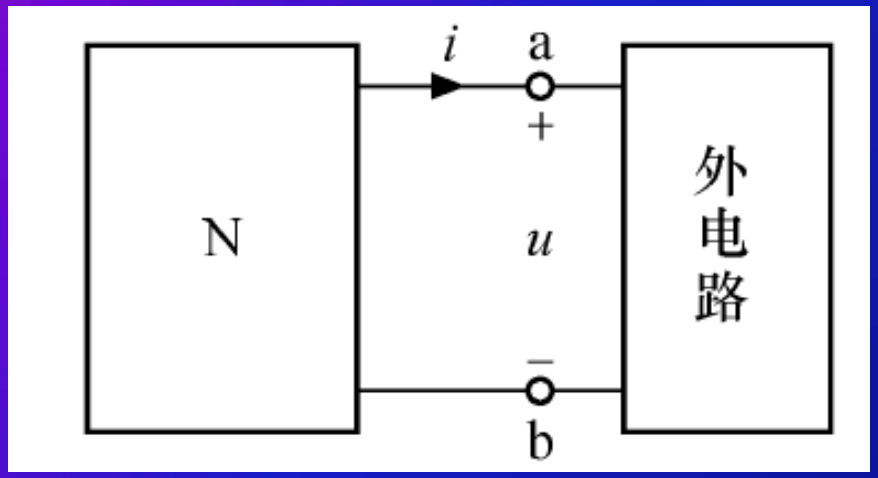
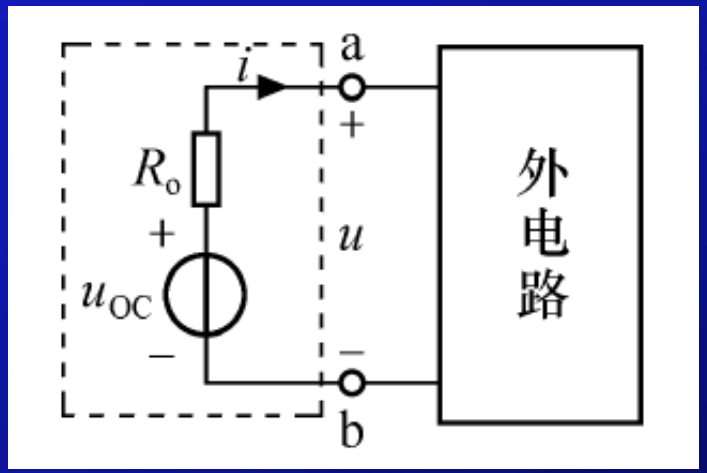
戴维南定理

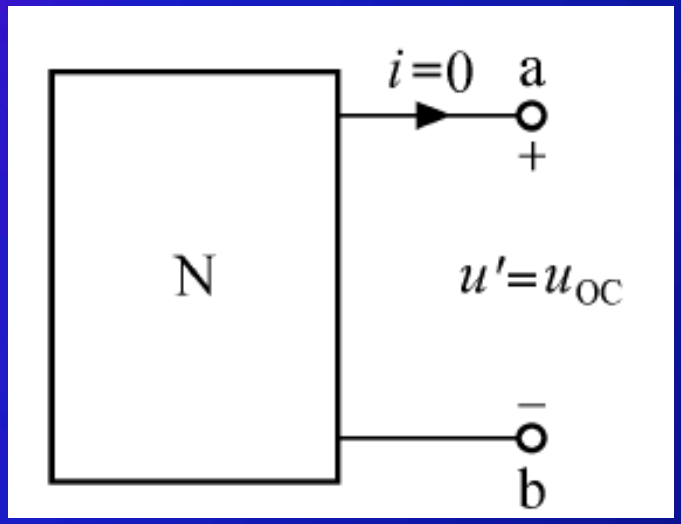
任一线性有源二端网络N，就其两个输出端而言总可等效为一个独立电压源和线性电阻的串联；

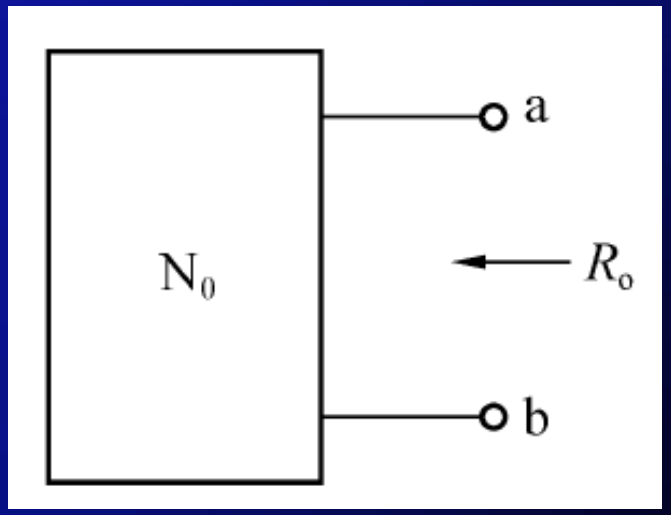
其中：独立电压源的电压等于该二端网络N输出端的开路电压 u_{OC}，电阻R_o等于N内所有独立源置零时从输出端看入的等效电阻。

戴维南定理示意图

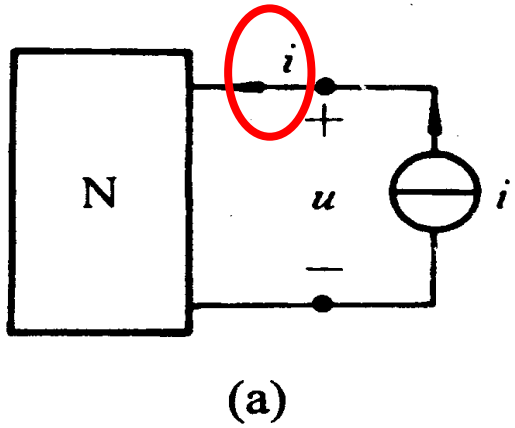




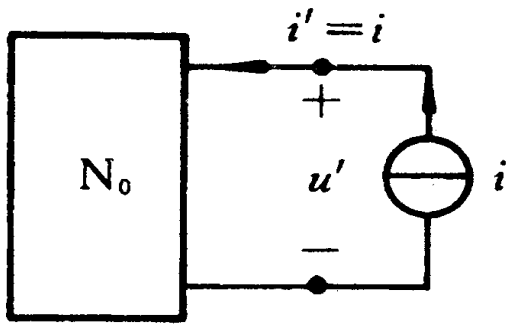




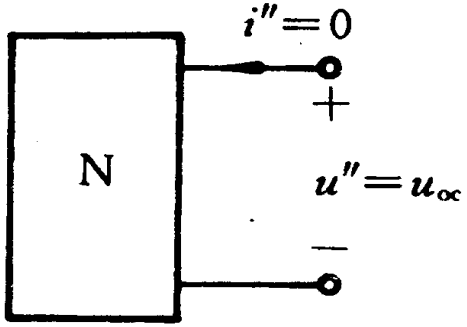
证明如下：



(a)



(b)



(c)

端口支路用电流源i替代，如图(a)，

根据叠加定理：

外部电流源单独作用：$u^{'}=R_0 i$ 图(b)；

网络内部独立电源单独作用：$u^{''}=u_{OC}$（图c）

$$u=u^{'}+u^{''}=R_0 i+u_{OC}$$

戴维南定理分析方法

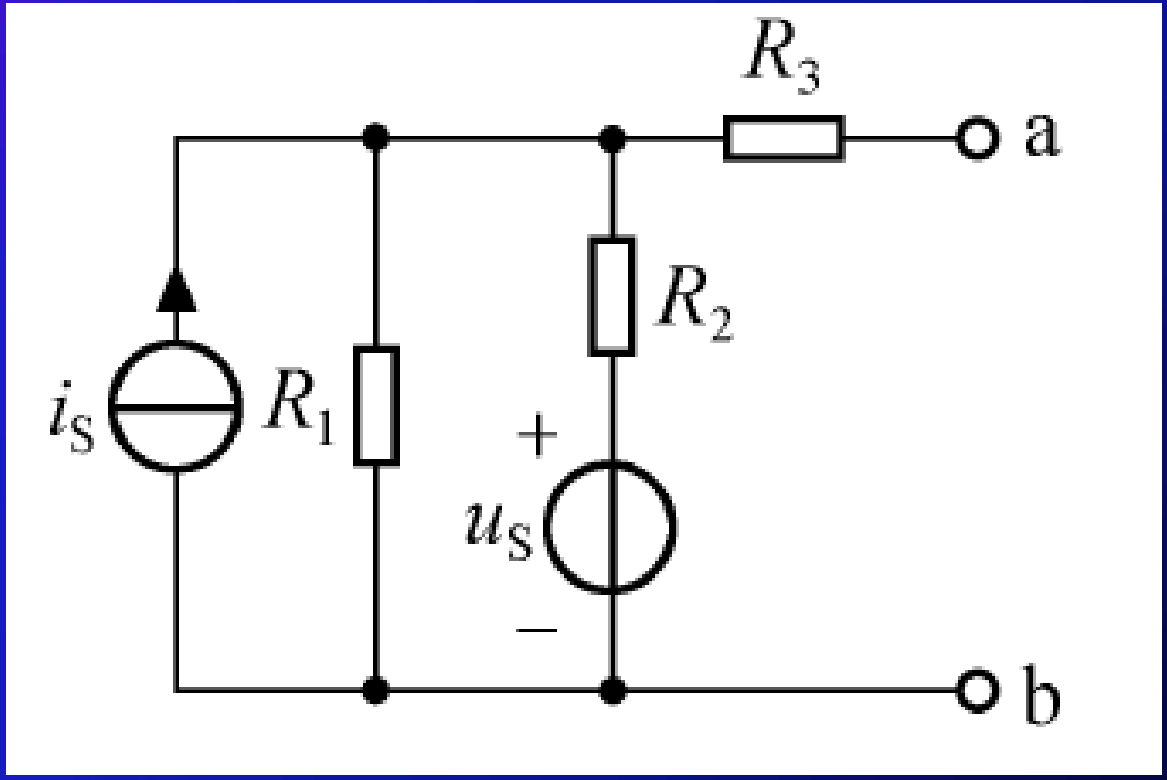
对于一线性有源二端网络

①确定戴维南**等效电压源**
即求端口开路电压 u_{OC} ；

②确定戴维南**等效内阻**
即求所有独立源置零时端口的输出电阻 R_o ；

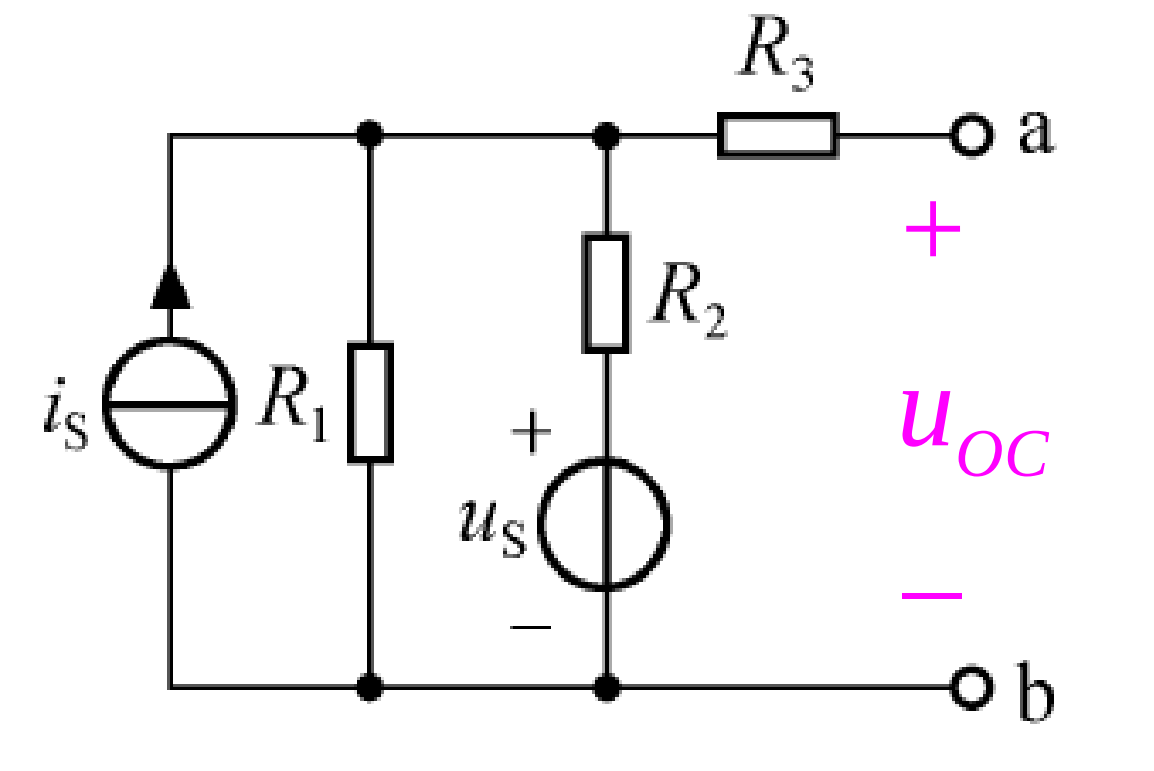
③画出戴维南等效电路；

例5（P89例4-5） 如图所示电路中，已知 $u_s = 12V, i_s = 4A, R_1 = 6\Omega, R_2 = 3\Omega, R_3 = 6\Omega;$ 试求电路a、b端的戴维南等效电路。



注：用戴维南定理求解

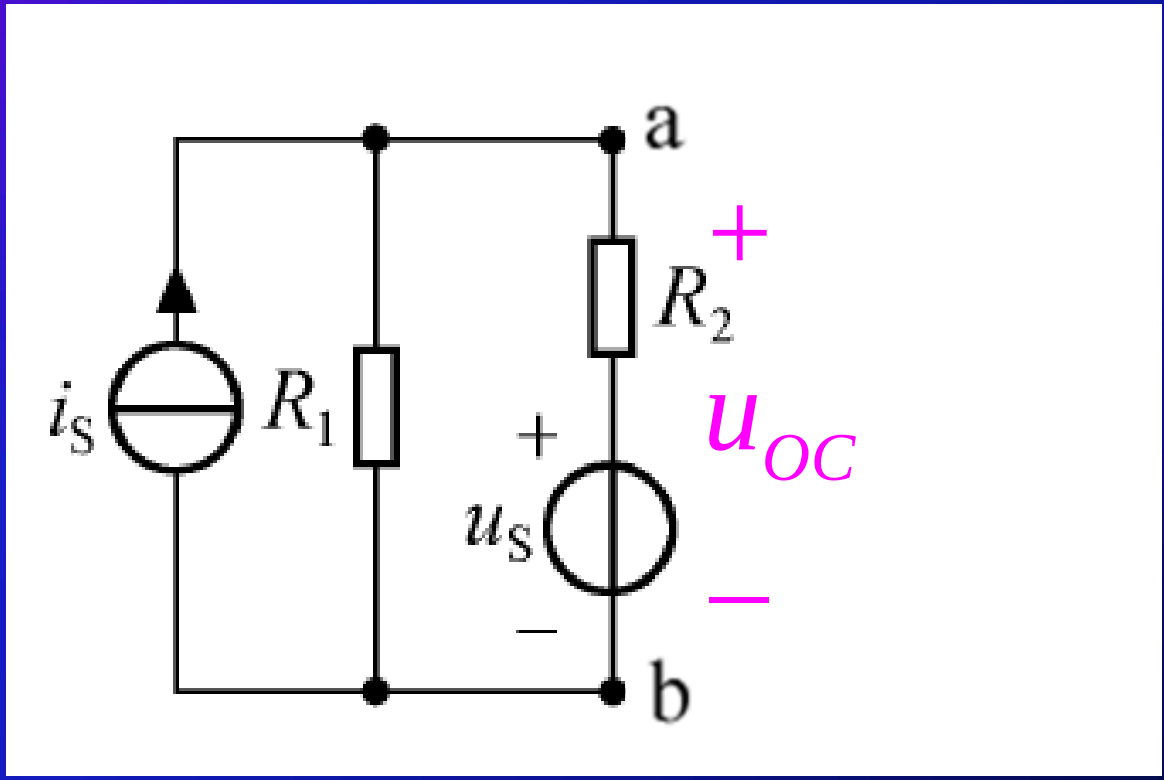
解：（1）求开路电压u_{oc}



✓开路电压是电路哪一段的电压？

✓如何求？

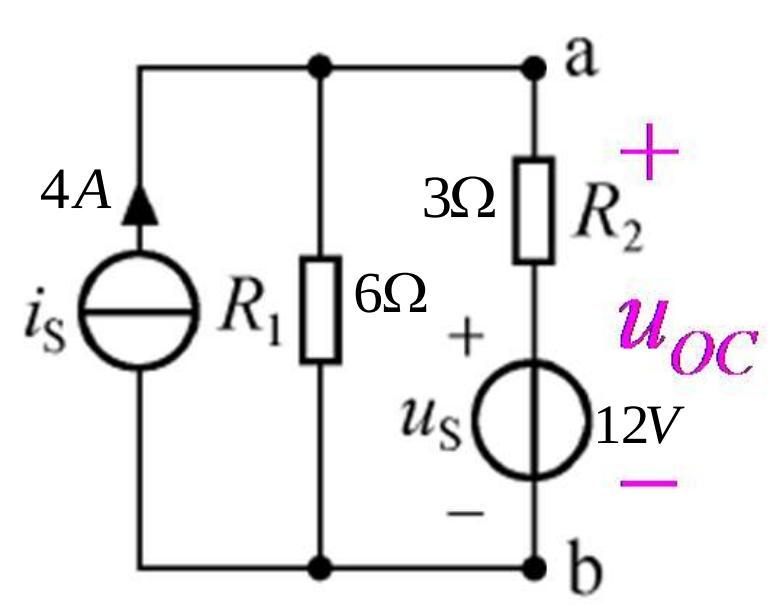
解：（1）求开路电压u_{oc}



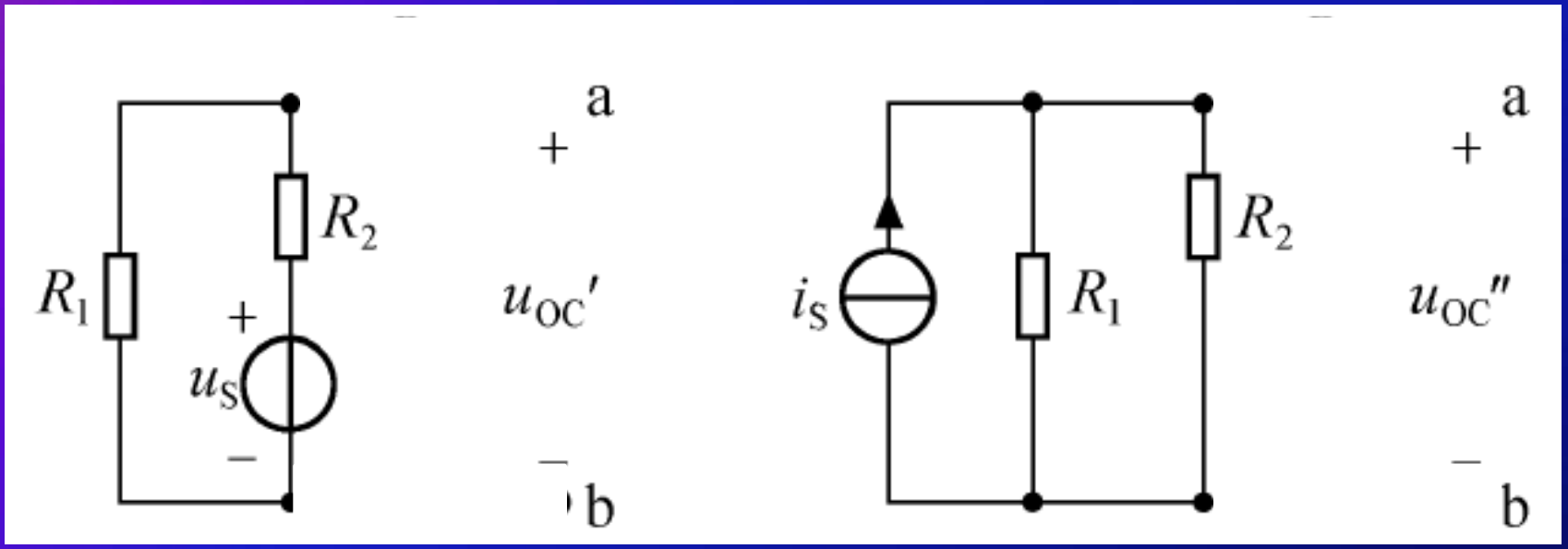
✓开路电压是电路哪一段的电压？

✓如何求？

解：（1）求开路电压u_{oc}



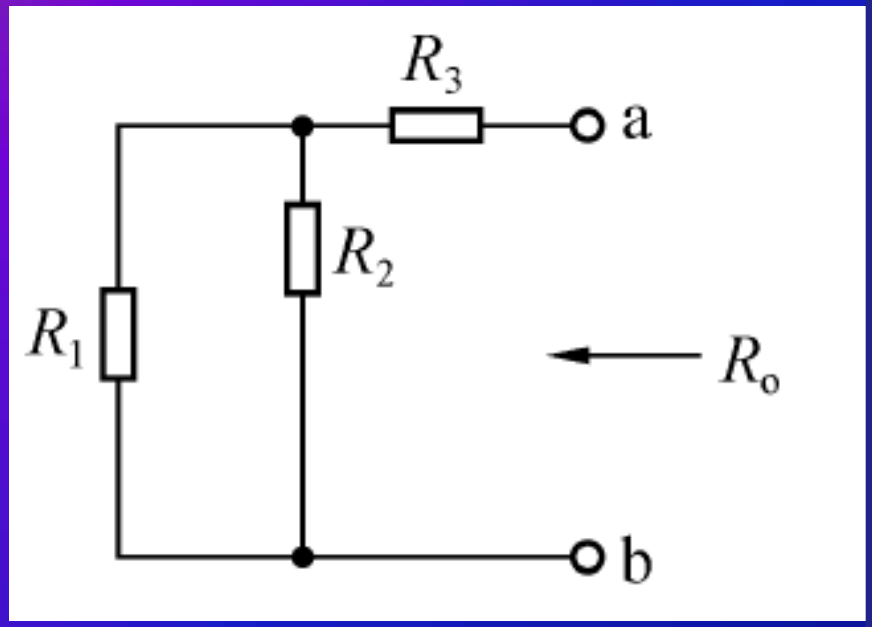
- ✓等效变换
- ✓网孔电流法
- ✓节点电位法
- ✓叠加定理



$$u_{oc}' = \frac{R_1}{R_1 + R_2} u_s = \frac{6}{6+3} \times 12 = 8V$$

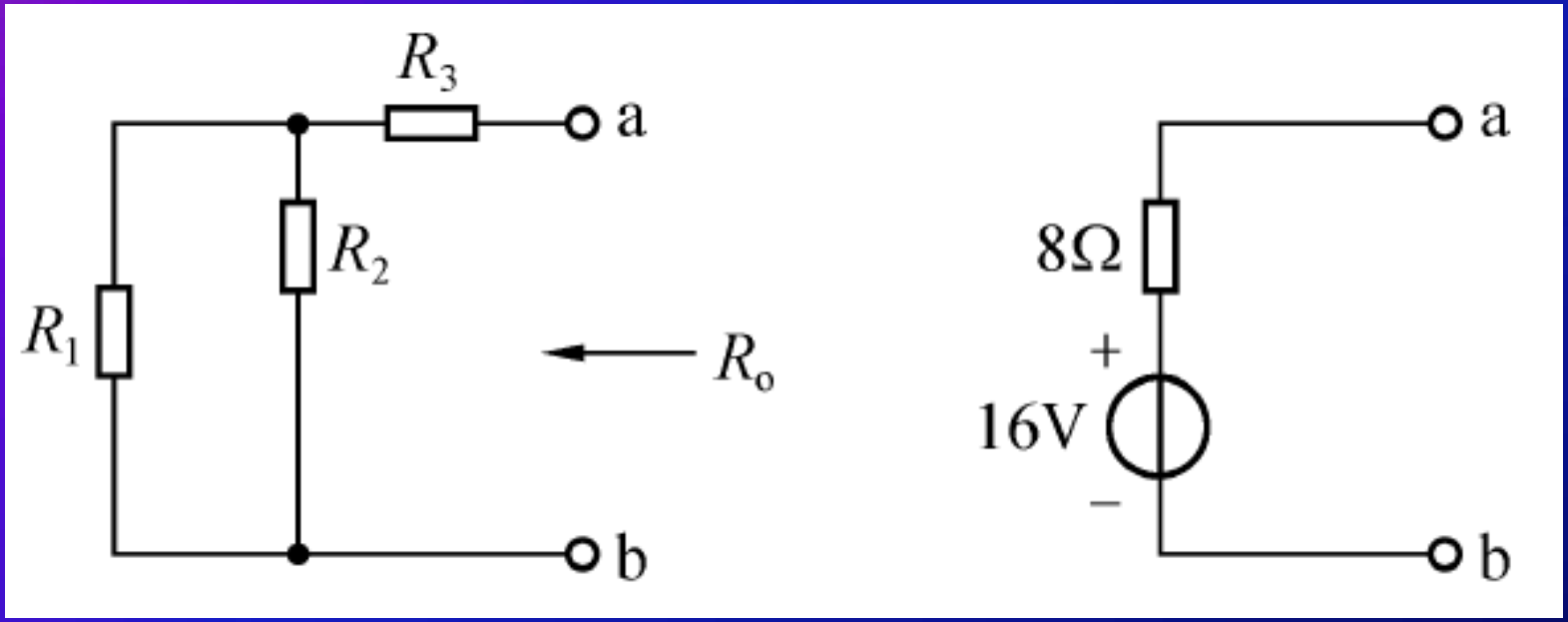
$$u_{oc}'' = \frac{R_1 R_2}{R_1 + R_2} i_s = \frac{6 \times 3}{6+3} \times 4 = 8V$$

$$u = u_{oc}' + u_{oc}'' = 8 + 8 = 16V$$



（2）求等效电阻

$$R_0 = R_3 + \frac{R_1 R_2}{R_1 + R_2} = 6 + 2 = 8\Omega$$



（2）求等效电阻

$$R_0 = R_3 + \frac{R_1 R_2}{R_1 + R_2} = 6 + 2 = 8\Omega$$

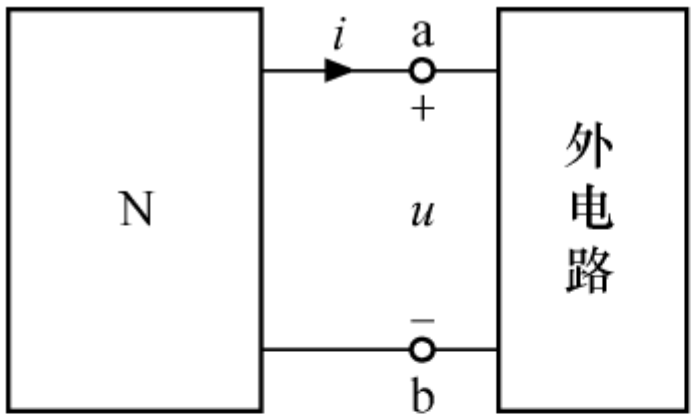
（3）画戴维南等效电路

诺顿定理

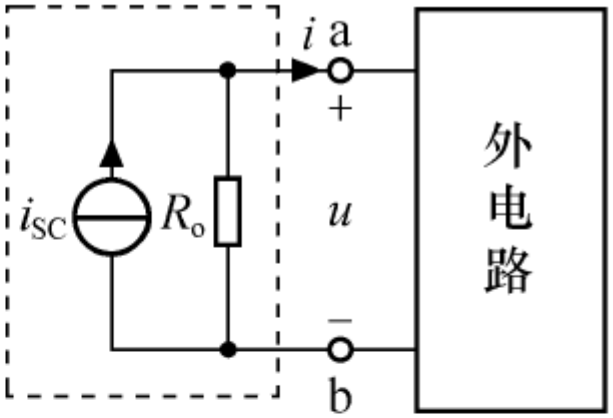
任一线性有源二端网络N，就端口而言，总可以等效为一个电流源和电阻的并联。

其中：电流源的电流等于网络外部端口短路时的短路电流i_{sc}；电阻R_o是网络内全部独立源为零时从输出端看入的等效电阻。

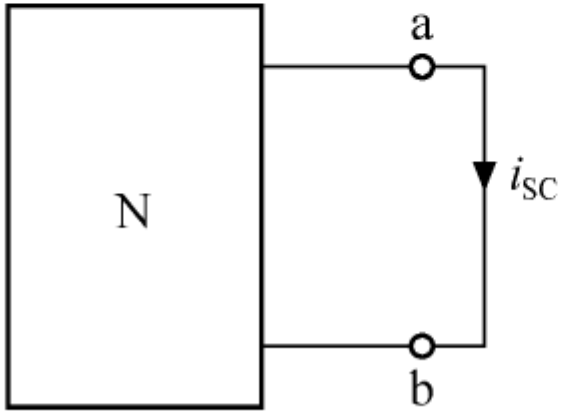
诺顿定理示意图



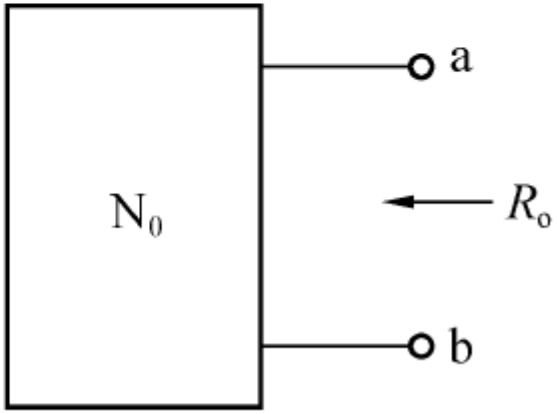
(a)



(b)

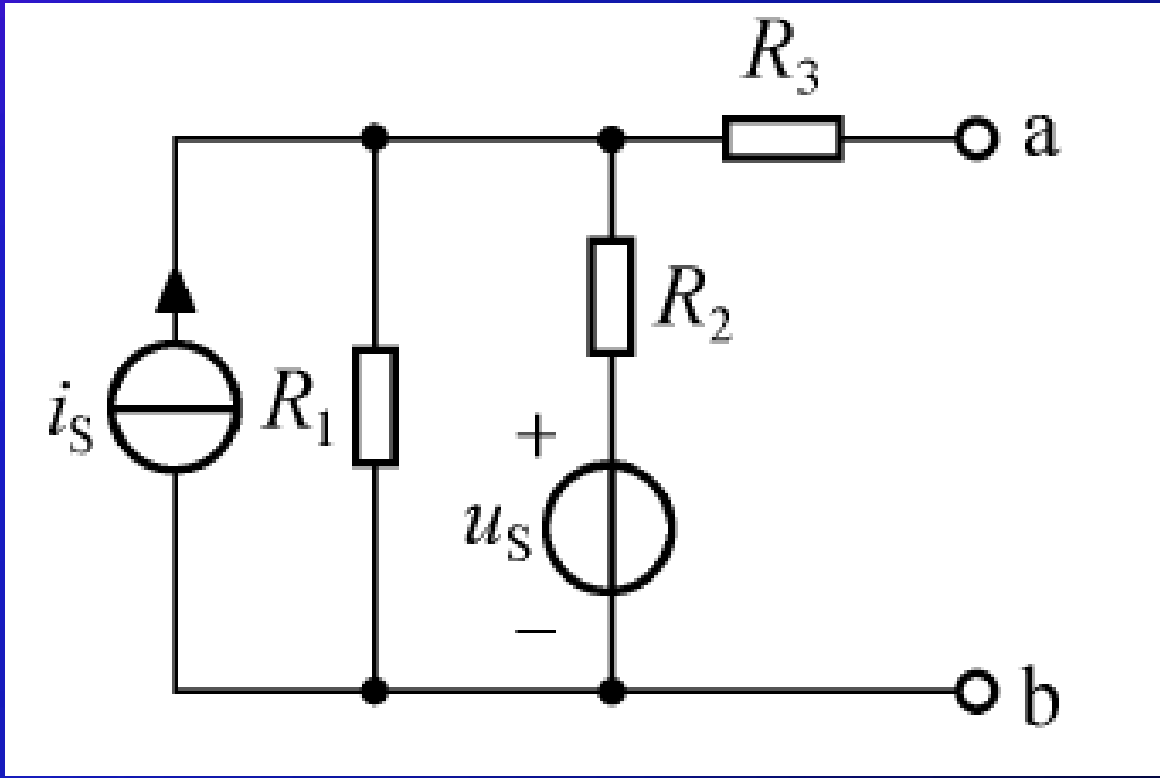


(c)



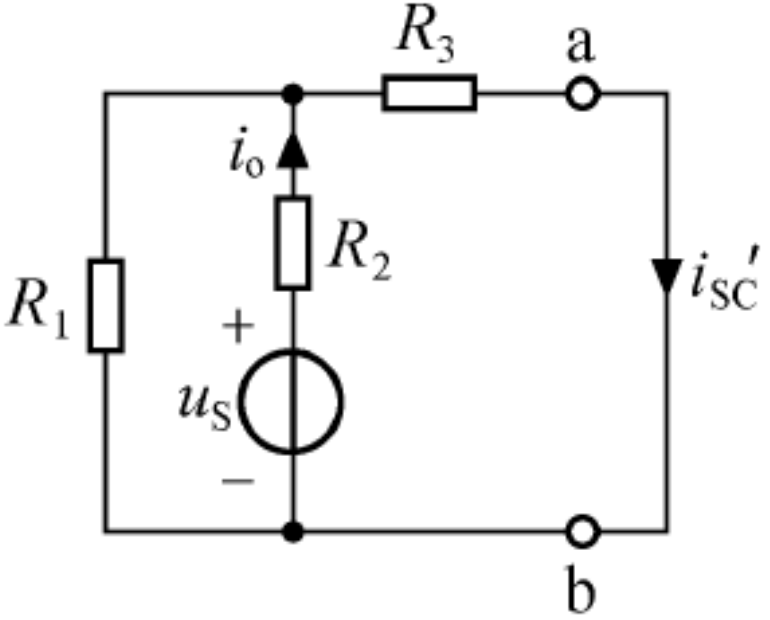
(d)

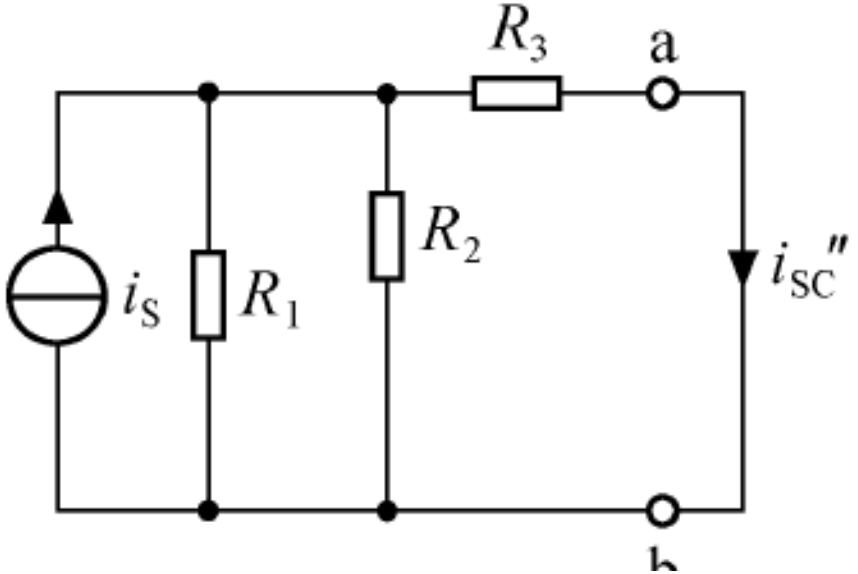
例6（P91例4-6） 如图所示电路中，已知 $u_s = 12V, i_s = 4A, R_1 = 6\Omega, R_2 = 3\Omega, R_3 = 6\Omega;$ 试求电路a、b端的诺顿等效电路。



注：用诺顿定理求解

解：（1）求短路电流i_{sc}



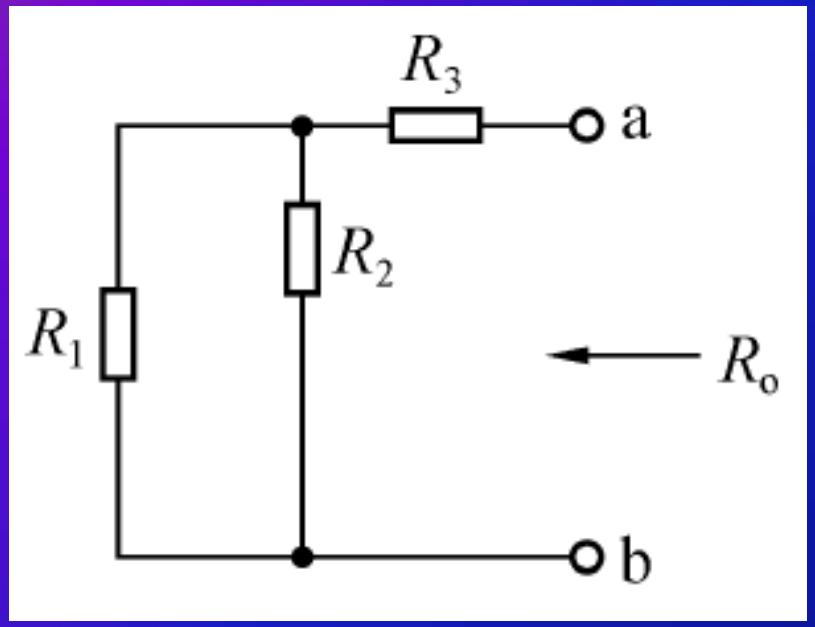


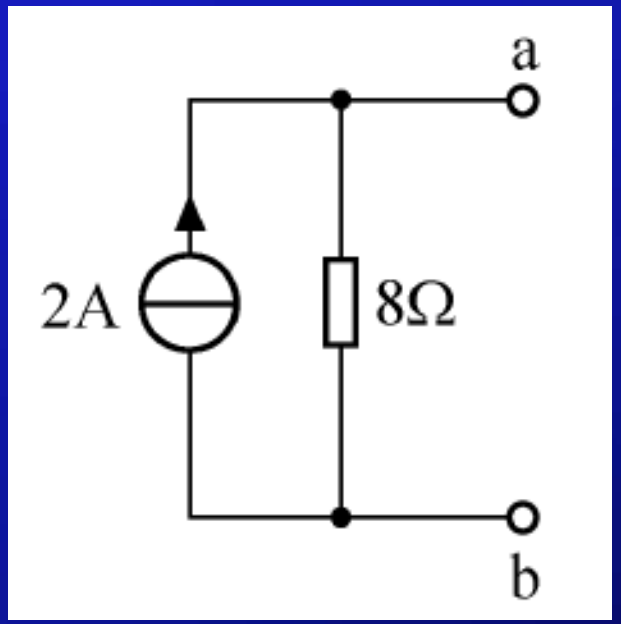
$$i_o = \frac{u_S}{R_2 + \dfrac{R_1 R_3}{R_1 + R_3}} = \frac{12}{3 + 3} = 2\,\text{A}$$

$$i_{SC}' = \frac{R_1}{R_1 + R_3} i_o = 1\,\text{A}$$

$$i_{SC}'' = \frac{\dfrac{1}{R_3}}{\dfrac{1}{R_1} + \dfrac{1}{R_2} + \dfrac{1}{R_3}} i_S = 1\,\text{A}$$

$$i_{sc} = i_{sc}' + i_{sc}'' = 1 + 1 = 2A$$



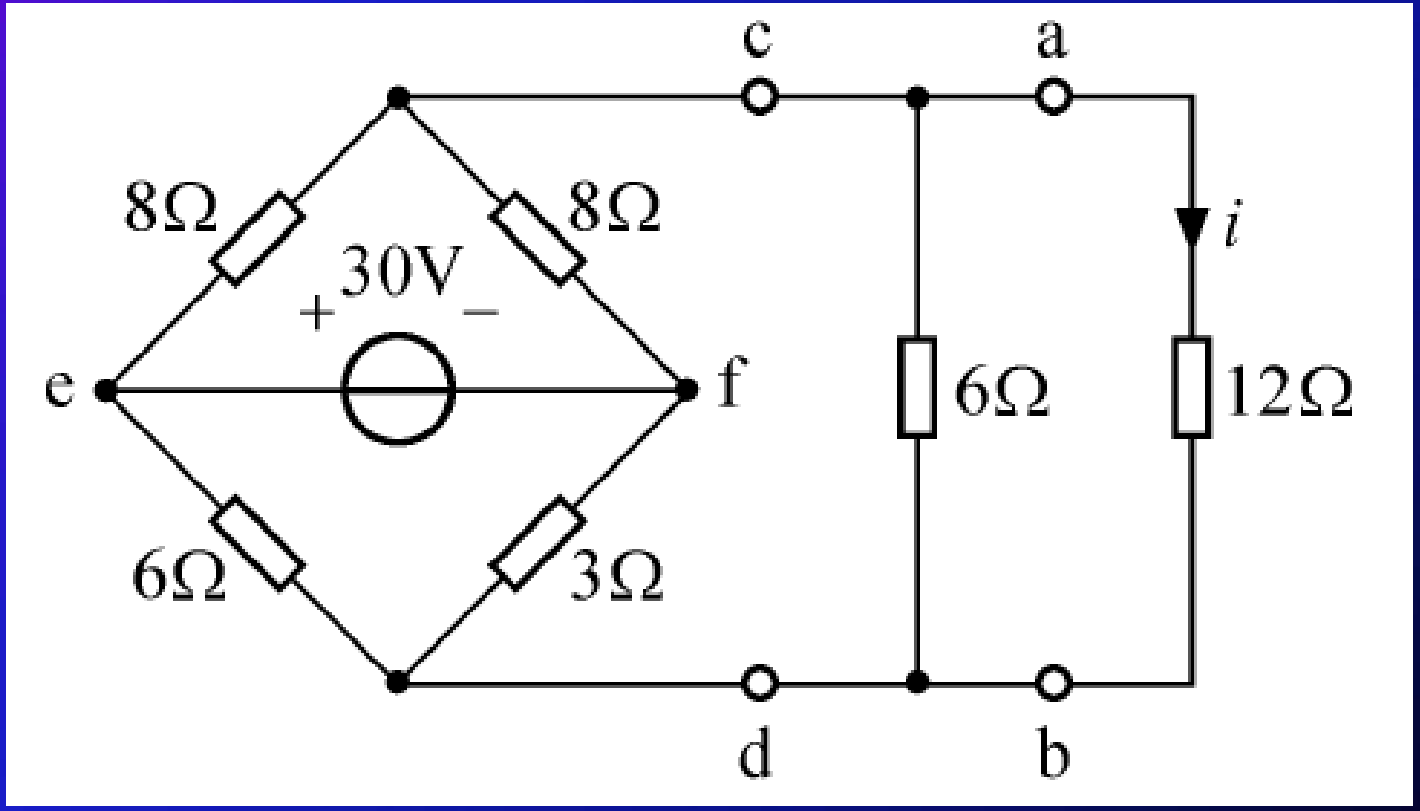


（2）求等效电阻

$$R_0 = R_3 + \frac{R_1 R_2}{R_1 + R_2} = 6 + 2 = 8\Omega$$

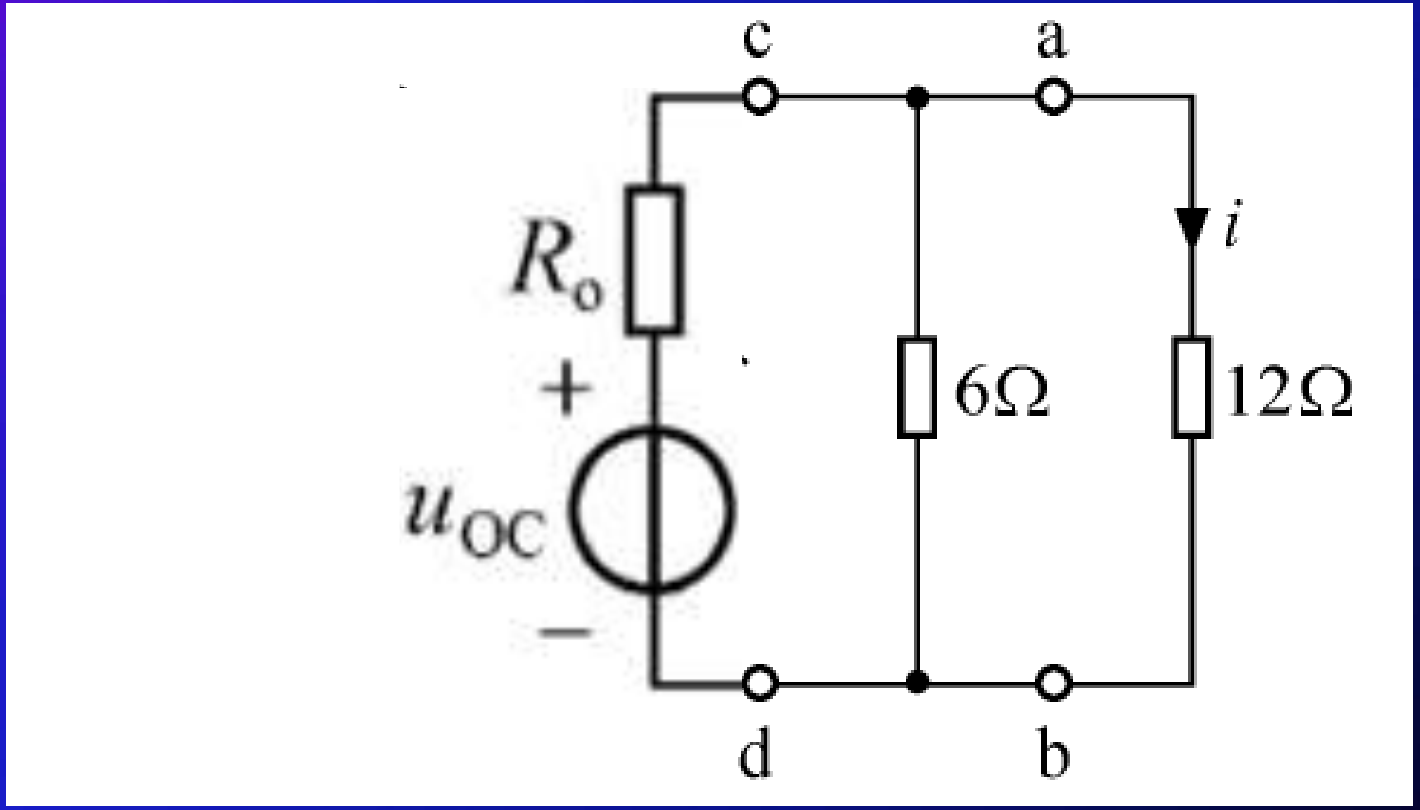
（3）画诺顿等效电路

例7（P92例4-7）如图所示电路中，试求12Ω电阻支路的电流i。



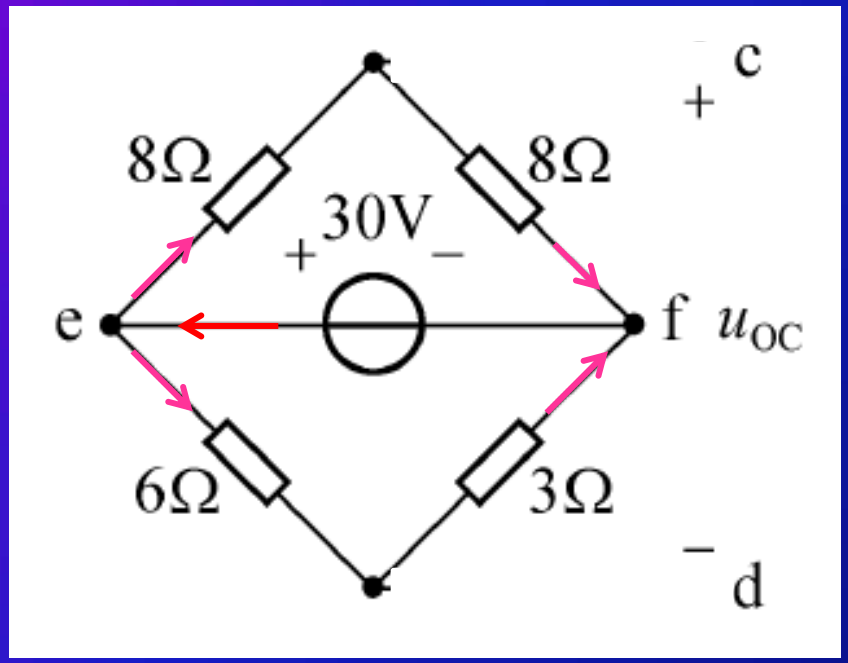
✓如何合理选择有源二端网络？

例7（P92例4-7）如图所示电路中，试求12Ω电阻支路的电流i。



✓如何合理选择有源二端网络？

解：（1）求开路电压u_{oc}



$$u_{oc} = u_{cd}$$

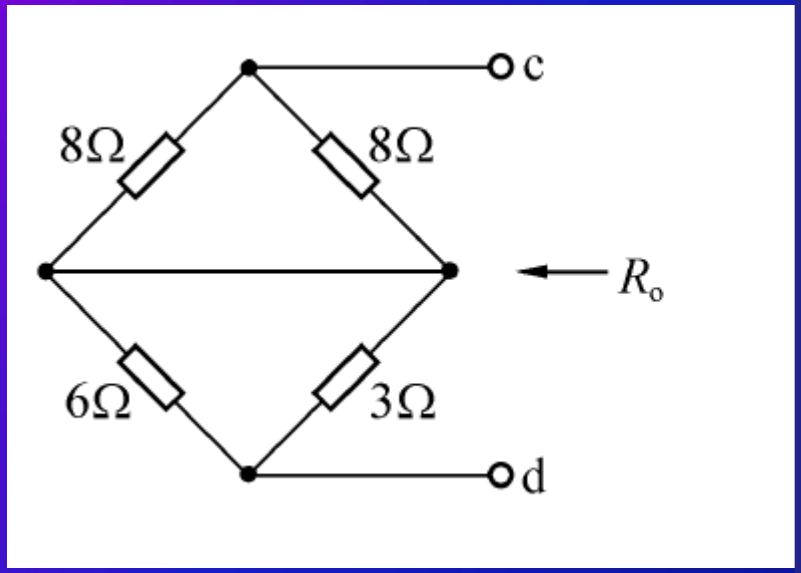
$$u_{cd} = u_{cf} + u_{fd}$$

$$= u_{cf} - u_{df}$$

$$= 30 \times \frac{8}{8+8} - 30 \times \frac{3}{6+3}$$

$$= 5V$$

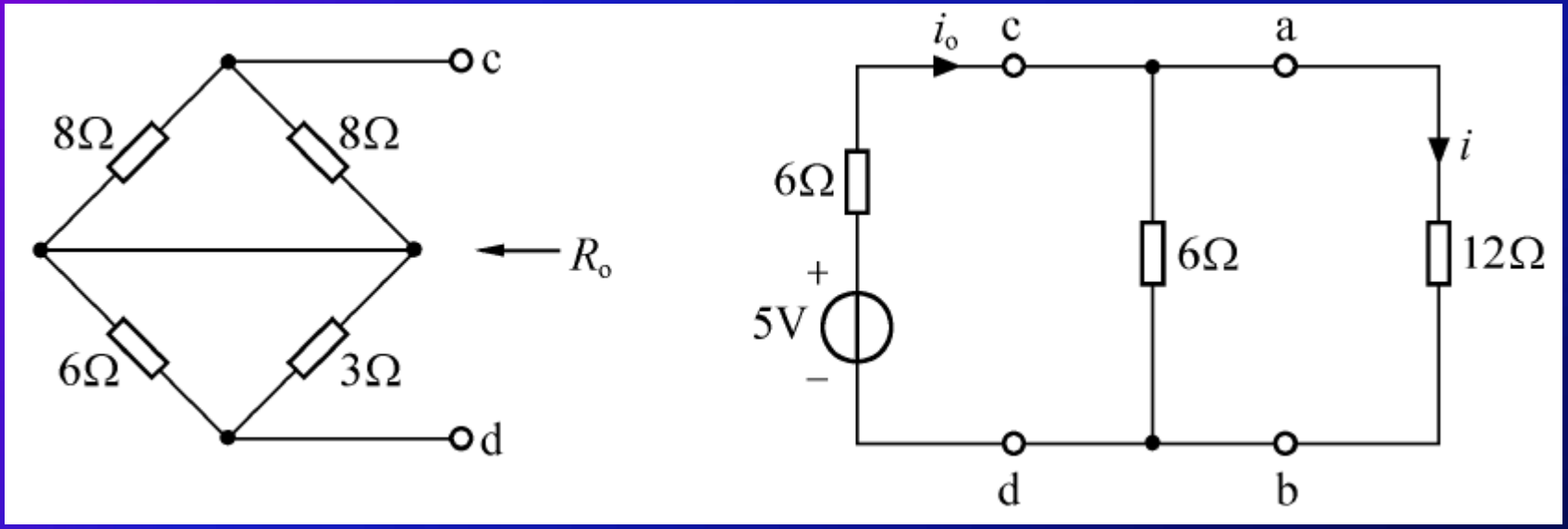
（2）求等效电阻 $R_0 = 8 \| 8 + 3 \| 6 = 6\Omega$



（3）画戴维南等效电路

$$i = \frac{5}{6+6\|12} \times \frac{6}{6+12} = \frac{1}{6} A$$

（2）求等效电阻 $R_0 = 8 \| 8 + 3 \| 6 = 6\Omega$



（3）画戴维南等效电路

$$i = \frac{5}{6+6\|12} \times \frac{6}{6+12} = \frac{1}{6} A$$

求等效电阻R_0方法

1、串、并联等效变换法；

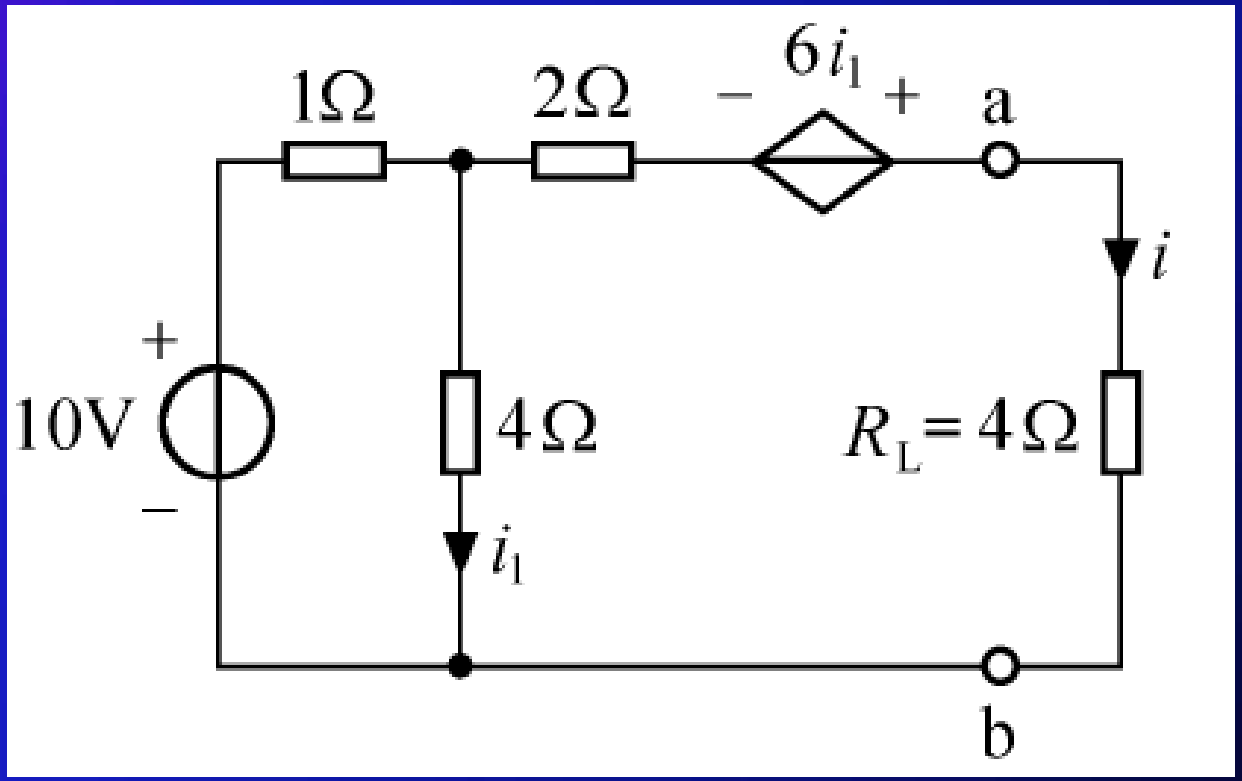
2、加压求流法（或加流求压法）

$$R_{eq} = R_0 = \frac{u}{i}$$

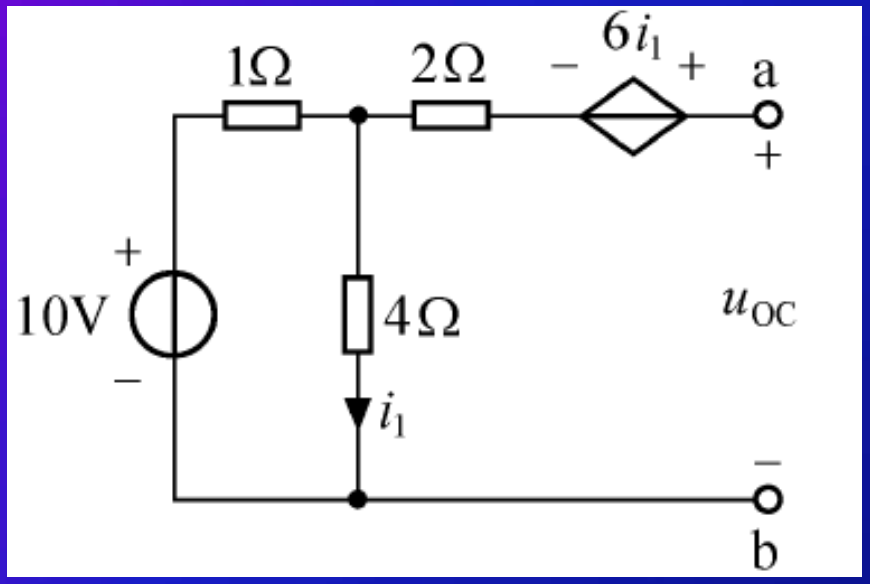
3、开短路法

$$R_o = \frac{u_{oc}}{i_{sc}}$$

例8（P93例4-8）试用戴维南定理求图示电路中的电流i。



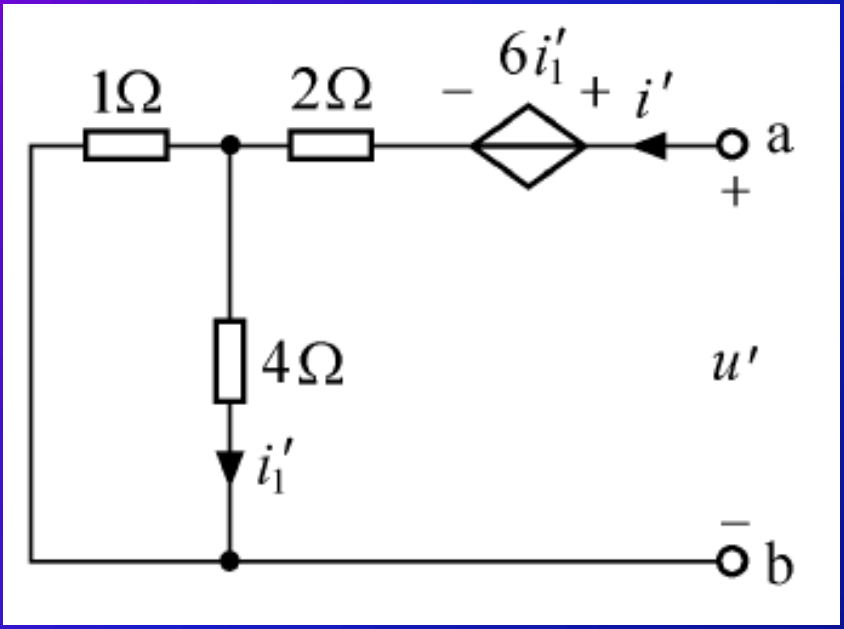
解：①求开路电压u_{oc}：



$i_1 = 2\text{A}$

$U_{oc} = 6i_1 + 4i_1 = 20\text{V}$

②求端口输出电阻R_o



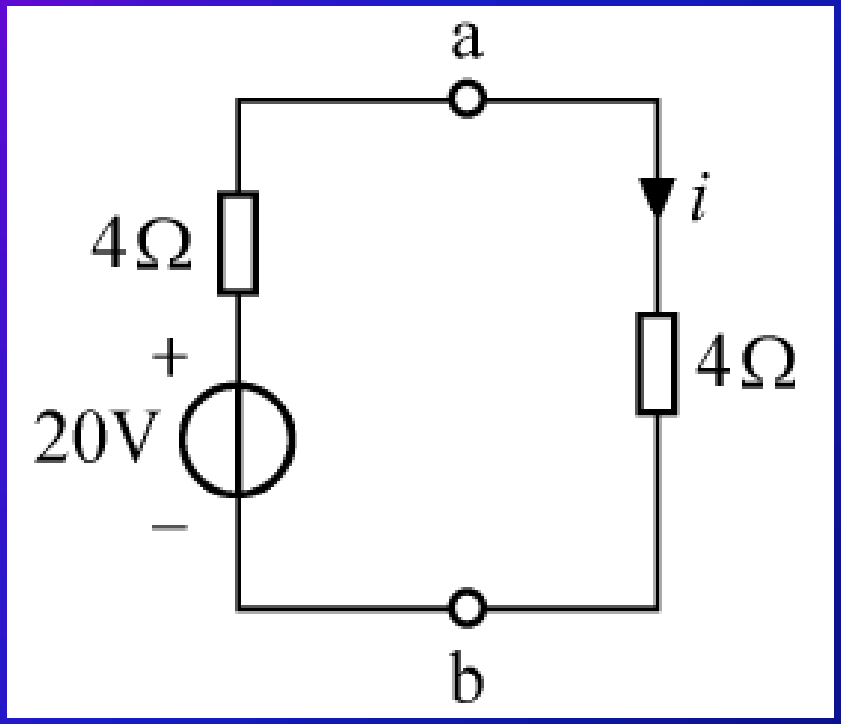
$u' = 6i_1' + 2i' + 4i_1'$

$i_1' = 0.2i'$

故 $u = 4i'$

即 $R_o = 4\Omega$

③画出戴维南等效电路图



$$i = \frac{20}{4+4} = 2.5A$$

注意：

①适用范围

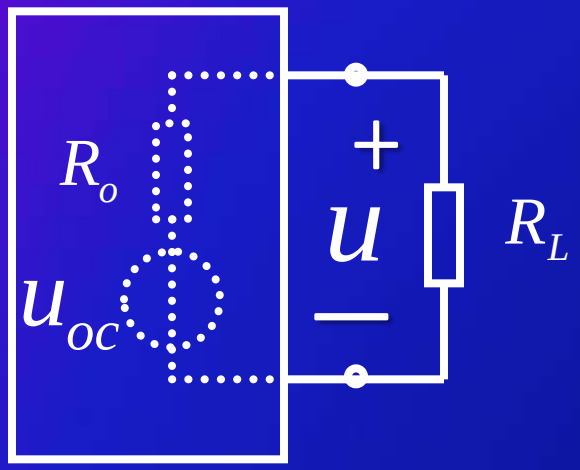
线性有源二端网络

与外电路非耦合

②当$R_0 \neq 0$和∞时，既有戴维南等效电路又有诺顿等效电路，且有

$$R_0 = \frac{u_{oc}}{i_{sc}} \text{、} u_{oc} = R_0 i_{sc} \text{、} i_{sc} = \frac{u_{oc}}{R_0}$$

③一般端口电压与端口的开路电压不相等。



$$u = \frac{R_L}{R_o + R_L} u_{oc}$$

④第二章等效变换介绍了由求端口的*VCR*关系得到戴维南（诺顿）模型的方法。

在没有规定必须用戴维南定理（诺顿）求解时，方法可以任选。