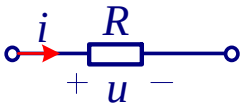
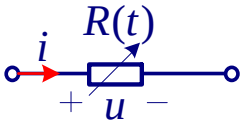
电阻电路元件

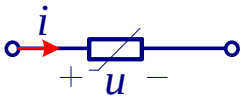
1、电阻元件



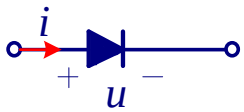
$u = Ri$ 或 $i = Gu$



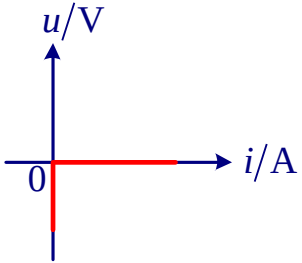
$u(t) = R(t)i(t)$ 或 $i(t) = G(t)u(t)$

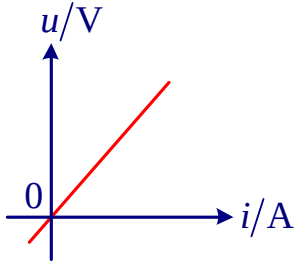


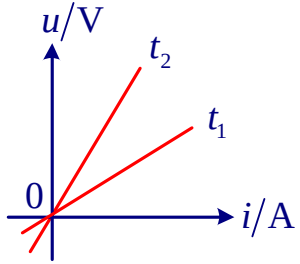
$f(u,i) = 0$ 或 $f(u,i,t) = 0$



$$\begin{cases} i = 0 & u < 0 \\ u = 0 & i > 0 \end{cases}$$





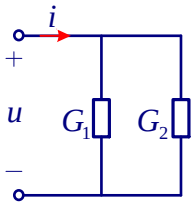


$$p(t) = u(t)i(t) = Ri^2(t)$$

$$w(t_0,t) = \int_{t_0}^{t} p(\tau)d\tau = R\int_{t_0}^{t} i^2(\tau)d\tau$$

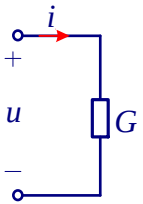
$w(-\infty,t) \geq 0$ 无源元件

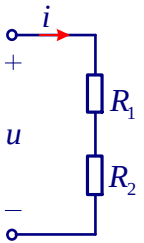
等效（端口特性相同）①特性方程、②特性曲线、③线性电阻：参数（*u*/*i*或*i*/*u*）



$$i = G_1u + G_2u = (G_1 + G_2)u$$

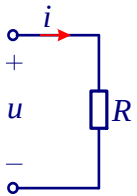
$$G = G_1 + G_2$$

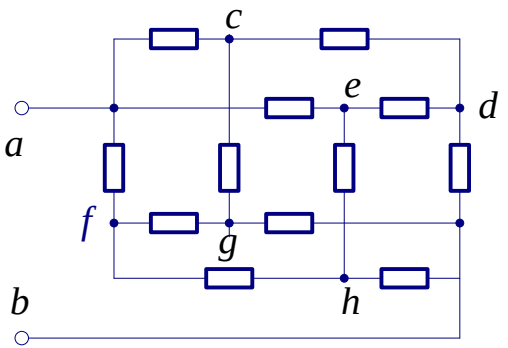


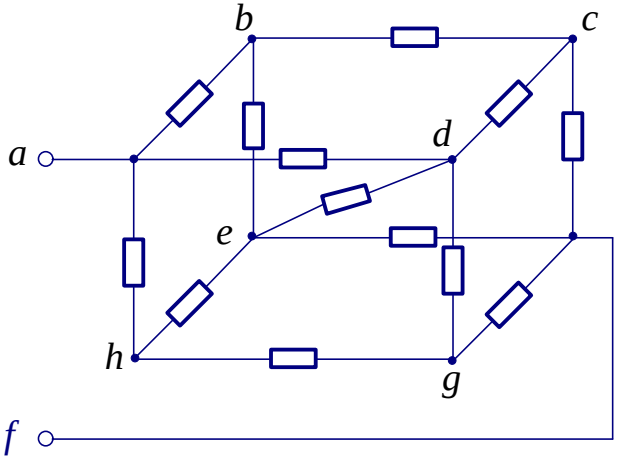


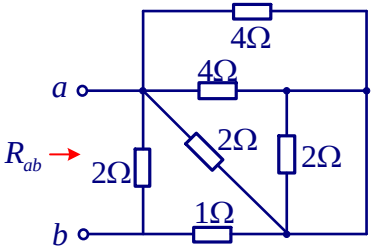
$$u = R_1i + R_2i = (R_1 + R_2)i$$

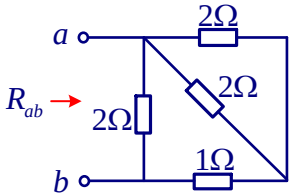
$$R = R_1 + R_2$$

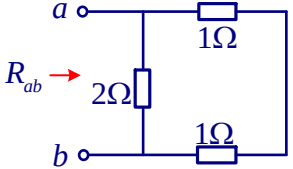




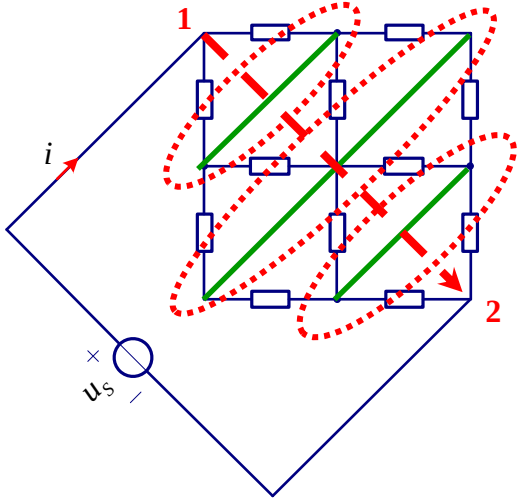








等电位与零电流



$$R_{12}=\frac{R}{2}+\frac{2R}{4}+\frac{R}{2}=1.5R$$

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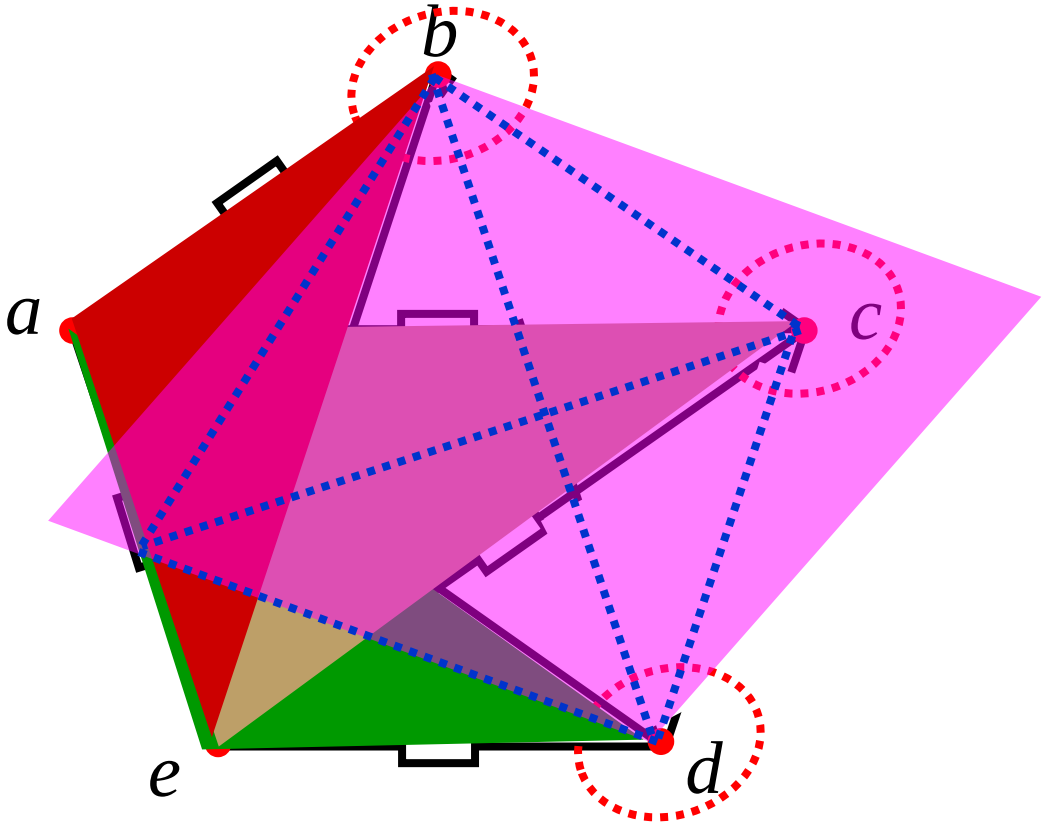
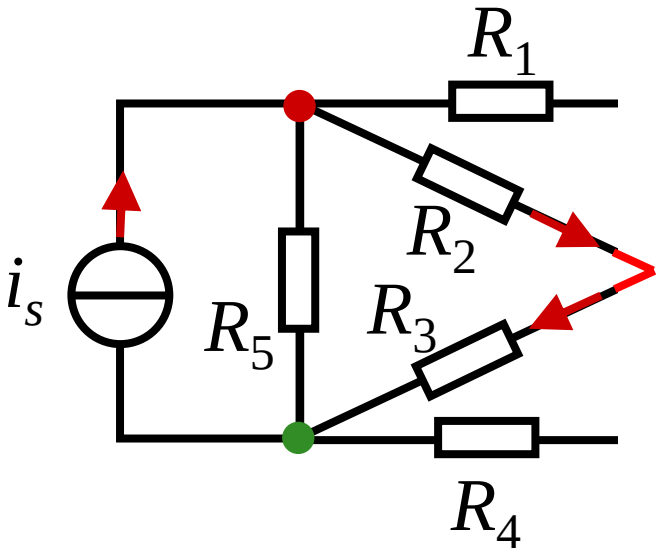


$$G_{ae}=\frac{1}{2R}+\frac{1}{2R}+\frac{1}{2R}+\frac{1}{R}=\frac{5}{2R}$$

$$R_{ae}=0.4R$$

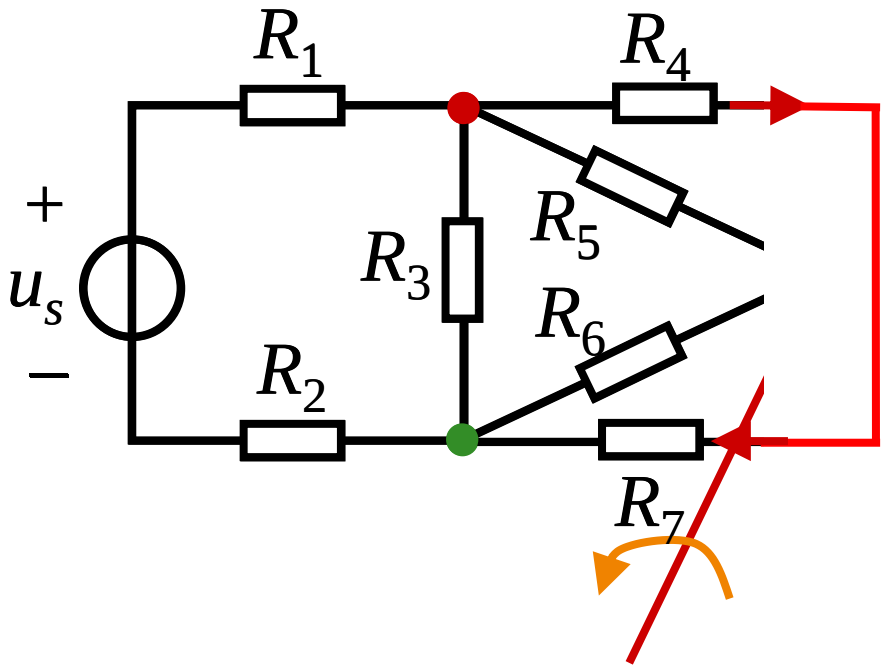
翻转对称网络

互为镜像

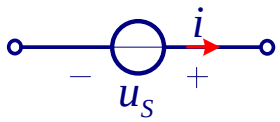


旋转对称网络

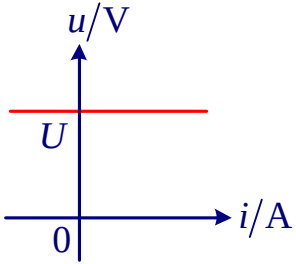
互为倒像

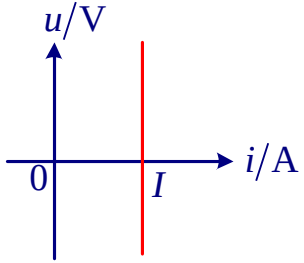


2、独立电源



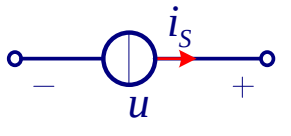
$u_S = U$



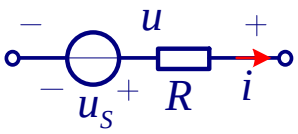


或 $u_S = \varepsilon(t)$ $u_S = \delta(t)$

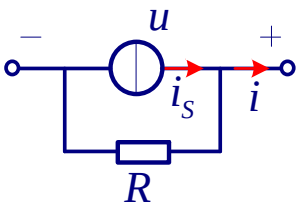
或 $u_S = U_m \sin(\omega t + \varphi)$



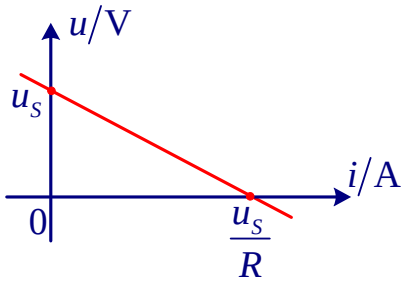
$i_S = I$

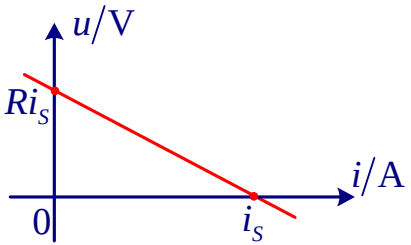


$u = u_S - Ri$



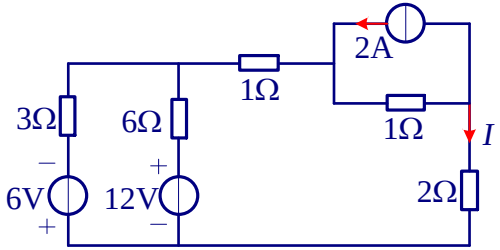
$i = i_S - \dfrac{u}{R}$



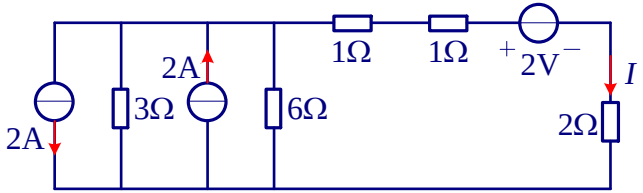


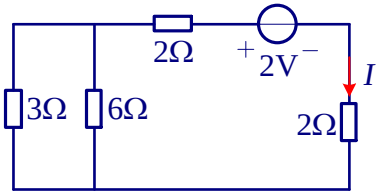
若 $u_S = Ri_S$ 则二者端口特性相同

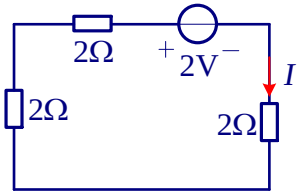
例：试用电源等效变换计算电流*I*



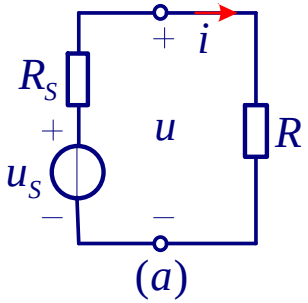
$$I = -\frac{2}{6} = -\frac{1}{3}\text{A}$$







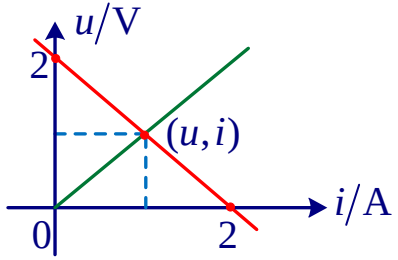
若 $u_S = 2\text{V}$　$R_S = R = 1\Omega$，求 u 和 i

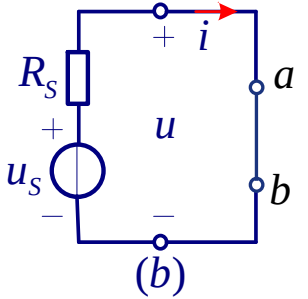


$$u = u_S - R_S i$$

$$u = Ri$$

$$\therefore i = \frac{u_S}{R_S + R} = \frac{2}{1+1} = 1\text{A},\ u = 1\text{V}$$

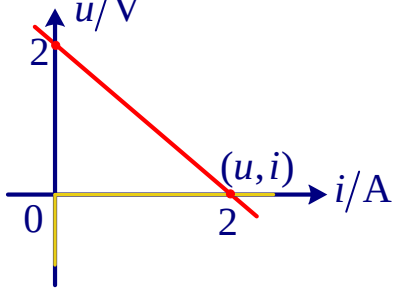




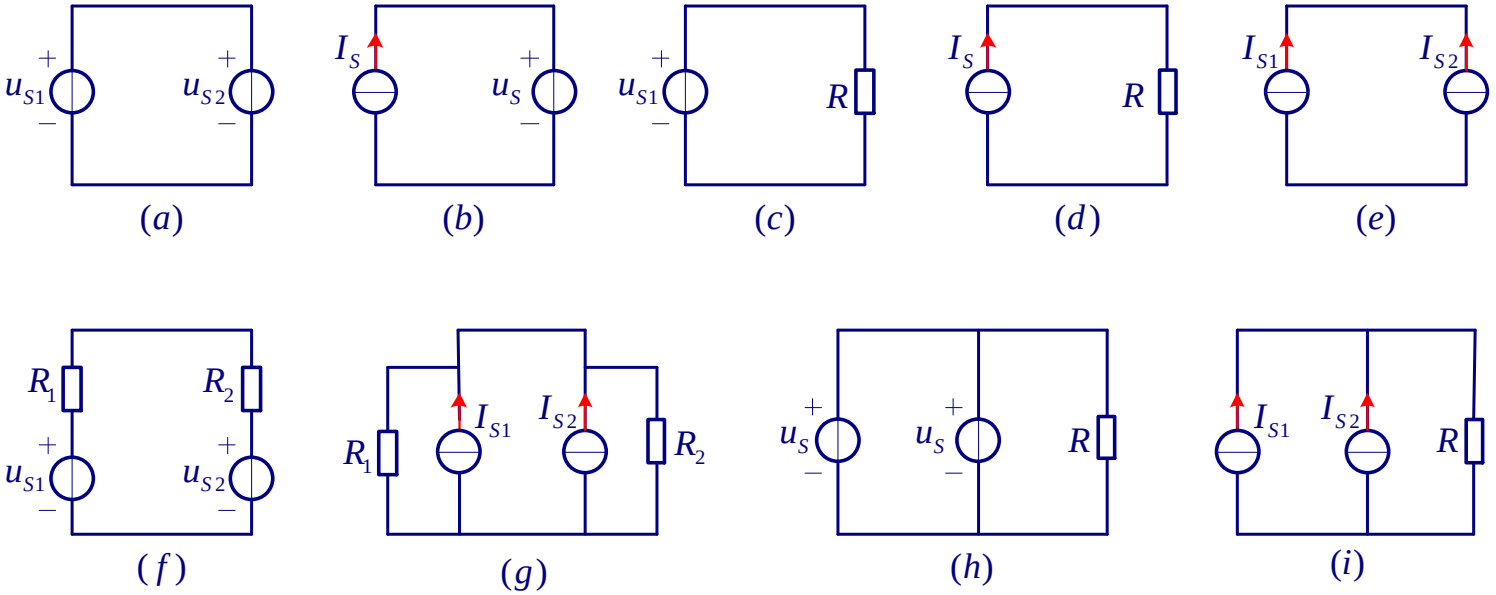
先断开二极管，此时 $V_a > V_b$

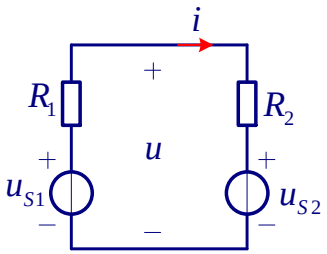
理想二极管导通（可视为短路）

$$\therefore i = \frac{u_S}{R_S} = \frac{2}{1} = 2\text{A},\ u = 0\text{V}$$



思考：（解的情况）　　**检验：KCL、KVL**（解的存在性与唯一性）

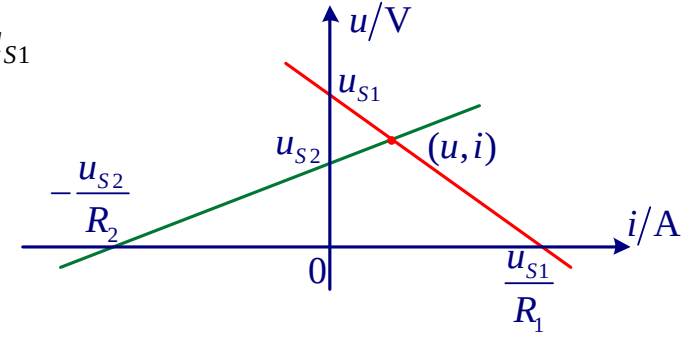


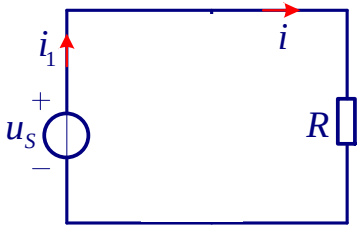


$$u = u_{S1} - R_1 i$$

$$u = u_{S2} + R_2 i$$

若 $u_{S2} < u_{S1}$

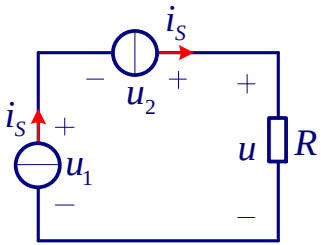




$$i = \frac{u_S}{R}$$

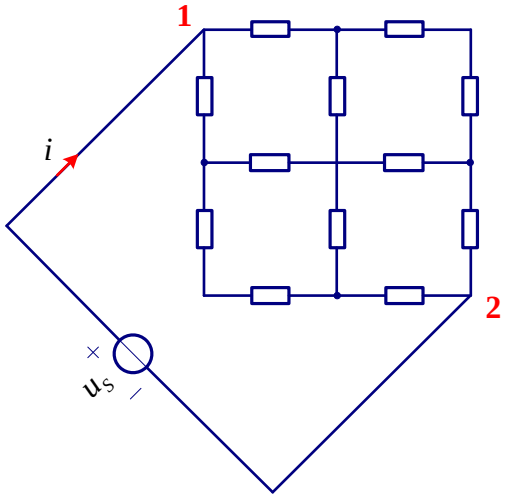
$$i_1 + i_2 = i$$

解不唯一！

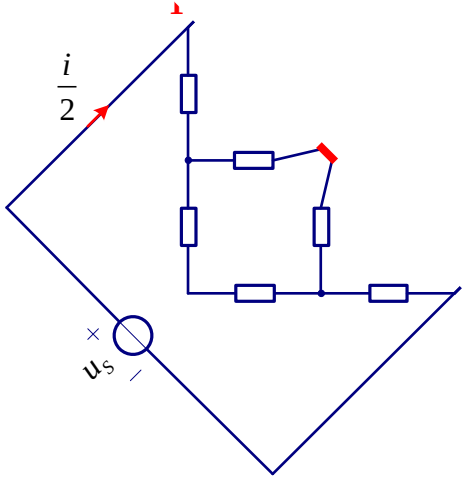


由正电阻及独立电源组成且不含纯电压源回路及纯电流源割集的电路，解答存在且唯一！

构造翻转对称（独立电压源的撕裂应用）



$$R_{12} = \frac{u_S}{i}$$



$$\frac{u_S}{\frac{i}{2}} = 3R$$