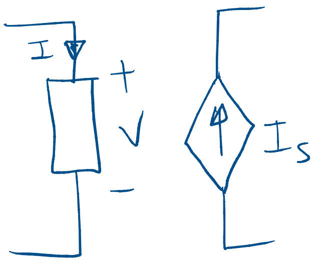
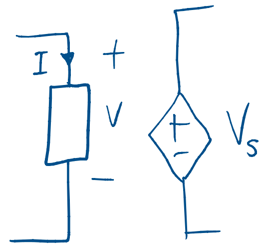
منابع وابسته



منبع جریان وابسته

$I_s = f(V)$

یا $I_s = f(I)$



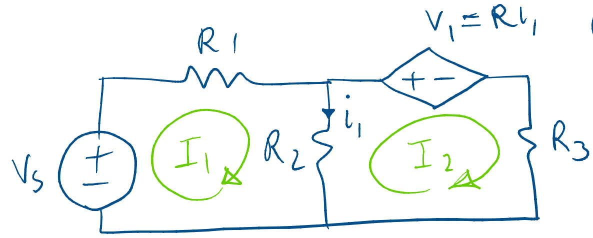
منبع ولتاژ وابسته

$V_s = f(V)$

یا $V_s = f(I)$

$I_s = GV$ (هدایت انتقالی) یا $I_s = KI$ (بهره جریان) (خطی) $V_s = KV$ (بهره ولتاژ) یا $V_s = RI$ (مقاومت انتقالی)

مثال ۱۱

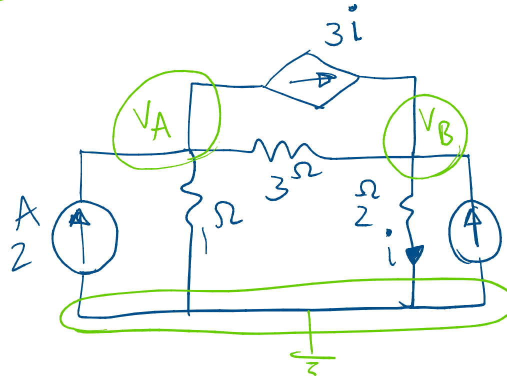


$$KVL1: -V_s + R_1 I_1 + R_2(I_1 - I_2) = 0$$
$$KVL2: R(I_1 - I_2) + R_3 I_2 + R_2(I_2 - I_1)$$

$$\begin{cases}(R_1 + R_2)I_1 - R_2 I_2 = V_s \Rightarrow I_2 = \dfrac{(R_1+R_2)I_1 - V_s}{R_2} \\ (R - R_2)I_1 + (-R + R_3 + R_2)I_2 = 0\end{cases}$$

$$\Rightarrow (R - R_2)I_1 + (-R + R_3 + R_2)\frac{(R_1+R_2)I_1 - V_s}{R_2} = 0 \Rightarrow I_1 = ? \qquad \Rightarrow I_2 = ?$$

مثال ۱۲

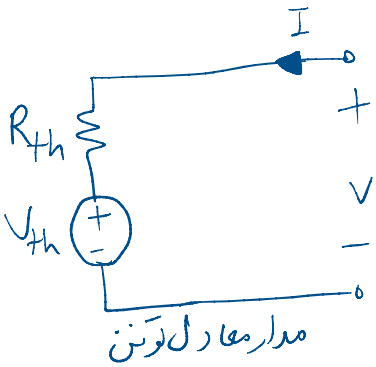


$$KCL\,A: 2 - \frac{V_A}{1} - 3\frac{V_B}{2} - \frac{V_A - V_B}{3} = 0$$
$$KCL\,B: \frac{3V_B}{2} + \frac{V_A - V_B}{3} - \frac{V_B}{2} + 3 = 0$$

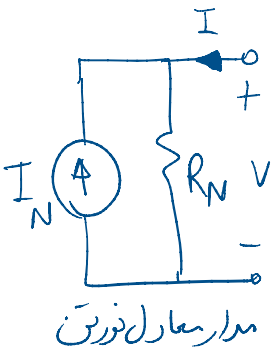
$$\begin{cases}\frac{4}{3}V_A + \frac{7}{6}V_B = 2 \\ \frac{1}{3}V_A + \frac{4}{3}V_B = -3\end{cases} \Rightarrow \begin{cases}8V_A + 7V_B = 12 \\ V_A + 4V_B = -9\end{cases}$$

$$\Rightarrow V_B = \frac{84}{-25} \Rightarrow V_A = ?$$

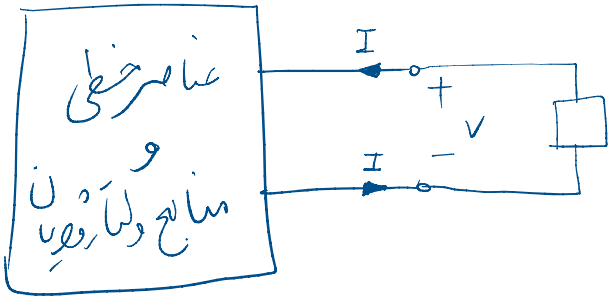
قضیه تونن-نورتن

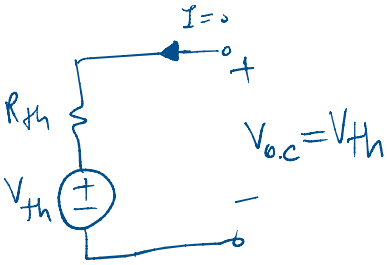


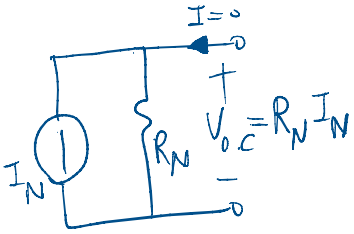
مدار معادل تونن

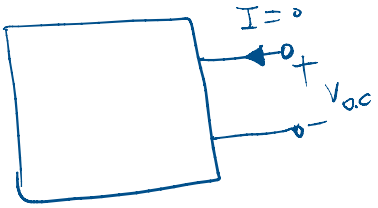


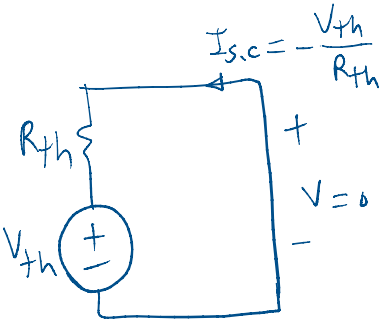
مدار معادل نورتن

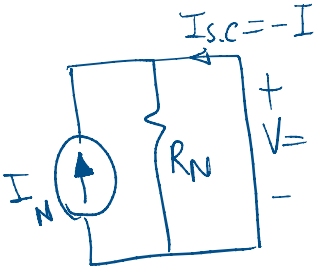


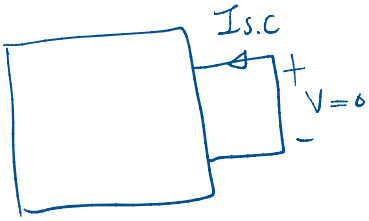












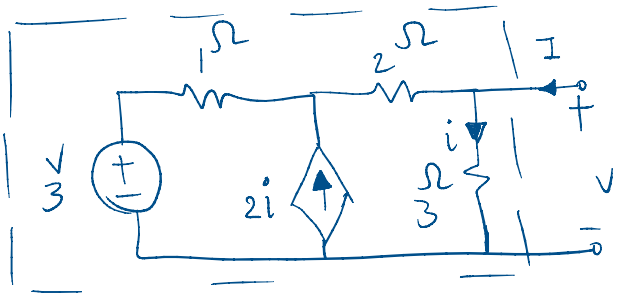
$$V_{th} = R_N I_N = R_{th} I_N$$

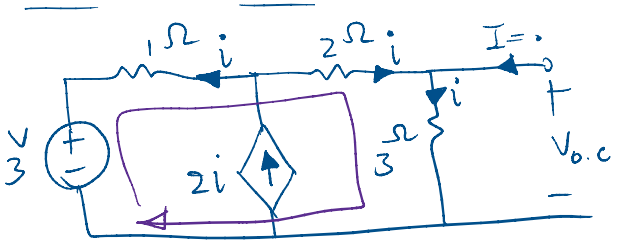
$$R_N = R_{th} = -\frac{V_{o.c}}{I_{s.c}}$$

$$V_{th} = V_{o.c.}$$

$$I_N = -I_{s.c}$$

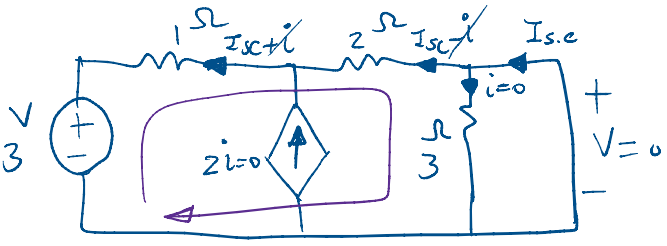
مثال ۱۴





$$KVL: -3 - i + 2i + 3i = 0 \Rightarrow i = \frac{3}{4}\ A$$

$$V_{th} = V_{o.c} = 3i = \frac{9}{4}\ V$$

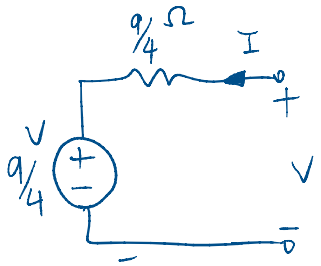


$$KVL: -3 - I_{s.c} - 2I_{s.c} = 0$$

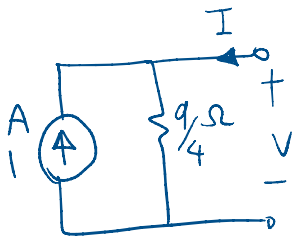
$$\Rightarrow I_{s.c} = -1\ A$$

$$I_N = -I_{s.c} = 1\ A$$

$$R_{th} = -\frac{V_{o.c}}{I_{s.c}} = \frac{9}{4}\ \Omega$$

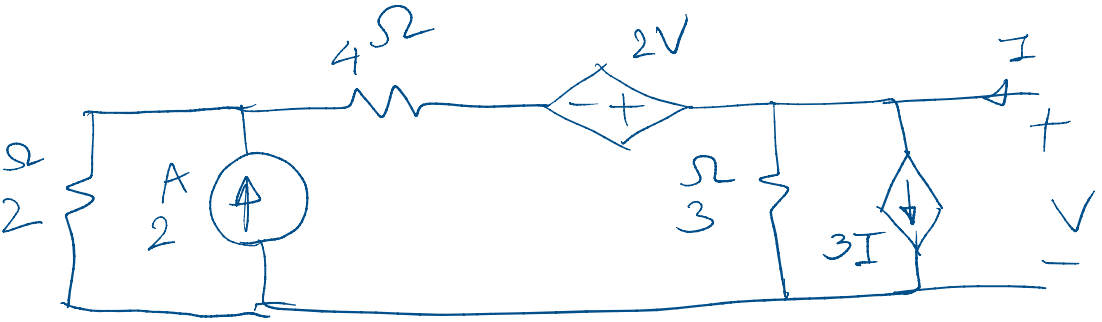


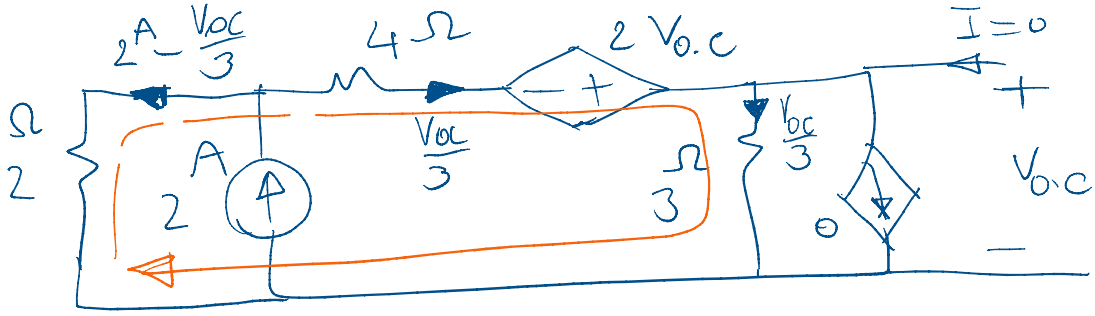
مدار معادل تونن



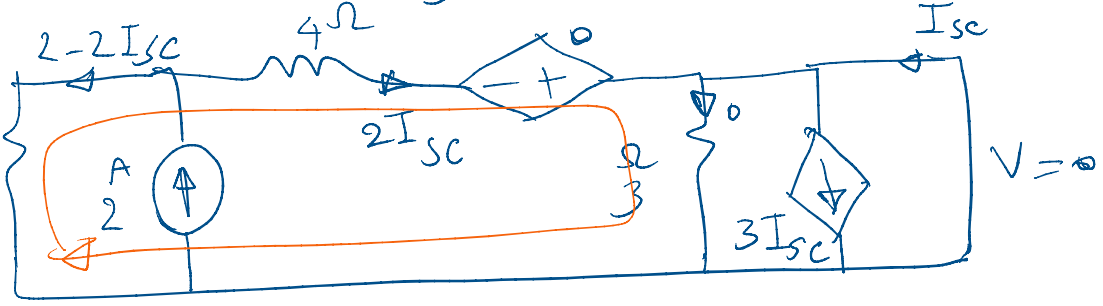
مدار معادل نورتن

مثال ۱۴

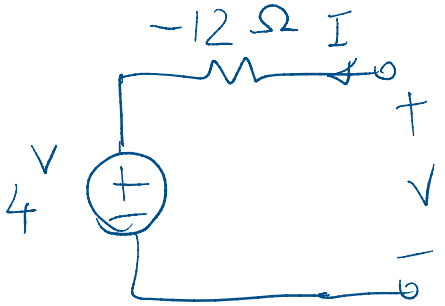




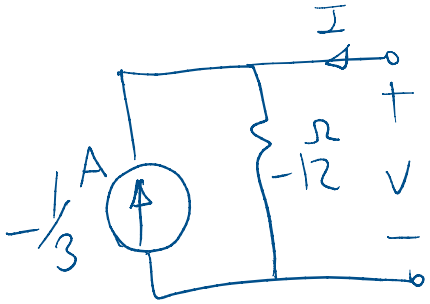
KVL: $-2\left(2-\frac{V_{oc}}{3}\right)+4\frac{V_{oc}}{3}-2V_{oc}+V_{oc}=0 \Rightarrow V_{oc}=4\ V$

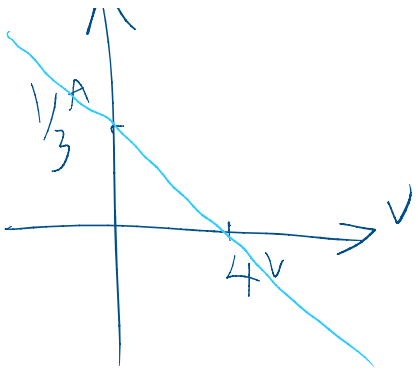


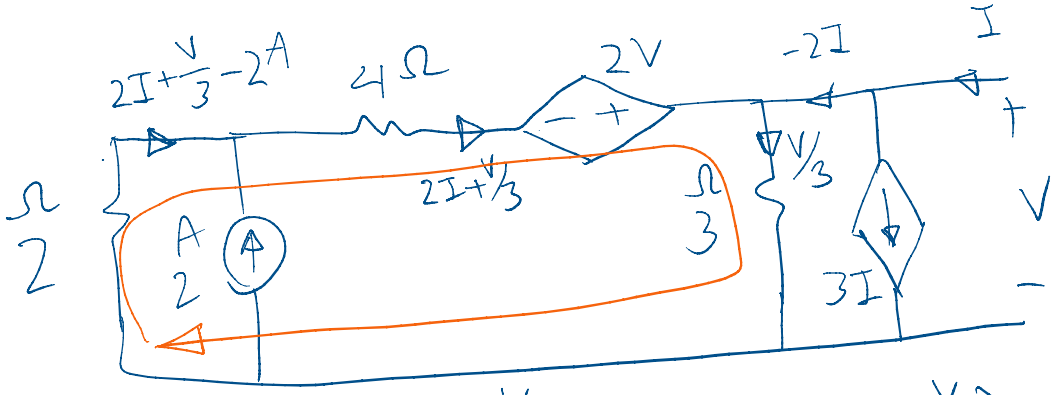
KVL: $-2(2-2I_{sc})+4(2I_{sc})=0 \Rightarrow I_{sc}=\frac{1}{3}\ A$



$R_{th}=R_N=\frac{4\ V}{-\frac{1}{3}A}=-12\Omega$

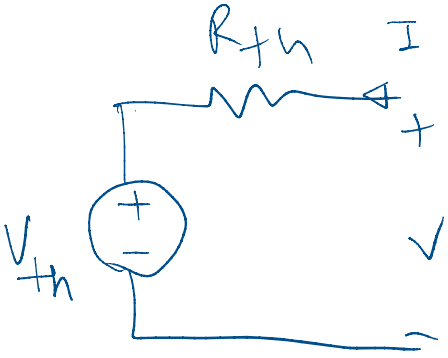






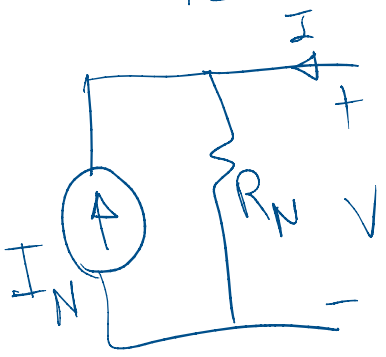
KVL: $2\left(2I+\frac{V}{3}-2\right)+4\left(2I+\frac{V}{3}\right)-2V+V=0$

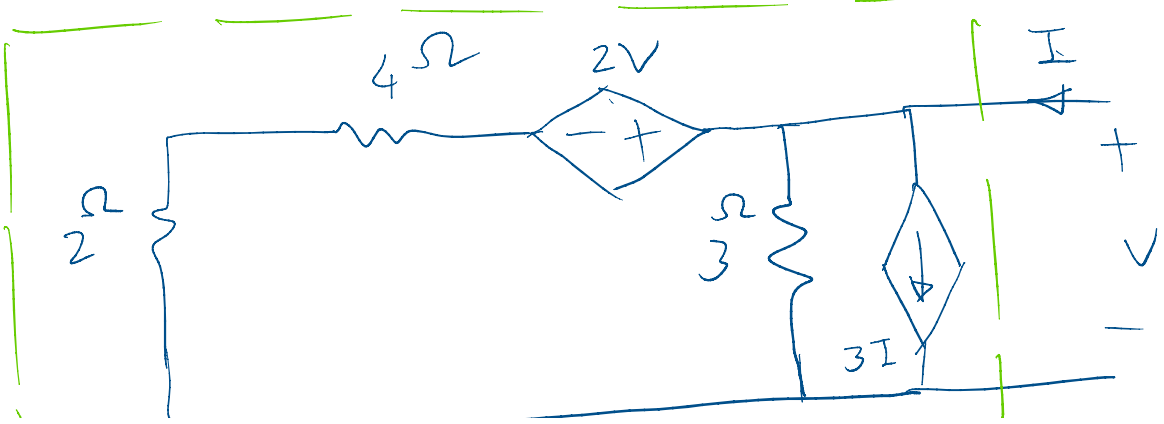
$$12I+V-4=0 \Rightarrow \begin{cases} V=4-12I \\ I=\dfrac{4-V}{12} \end{cases}$$



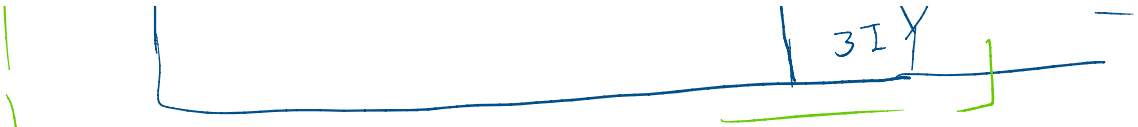
$$V = V_{th} + R_{th} I$$

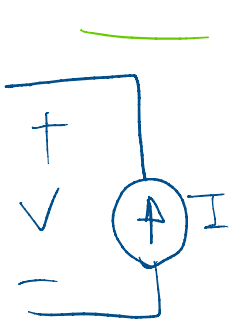
$$I = -I_N + \frac{V}{R_N}$$





$$R_{th} = \frac{V}{I}$$



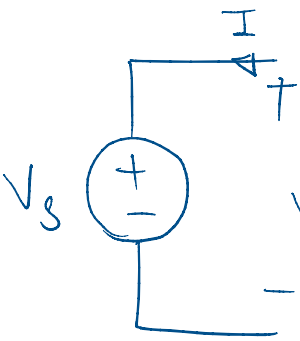


تعیین R_{th}

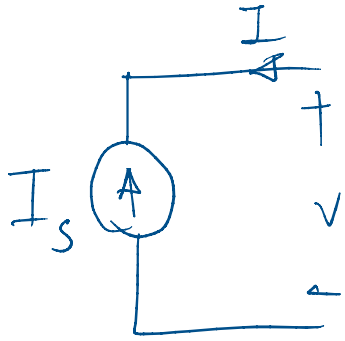
قرار دادن منبع ولتاژ و اندازه گیری I

یا " " " جریان " " V

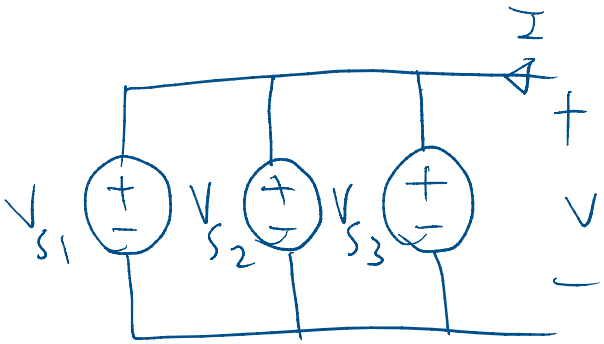
مثال ۱۵



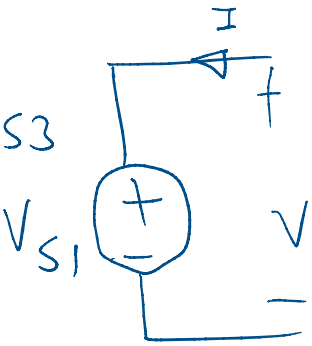
معادل نورتن ندارد



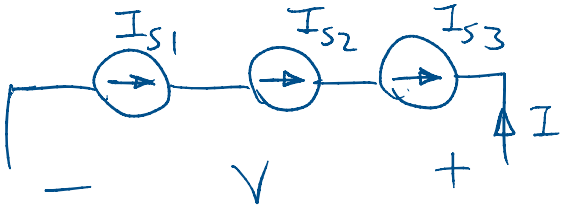
معادل تونن ندارد



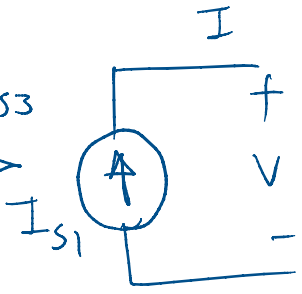
$V_{S1}=V_{S2}=V_{S3}$



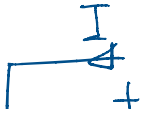
اتصال موازی منابع ولتاژ نامساوی به دلیل نقض قانون ولتاژ مجاز نیست.

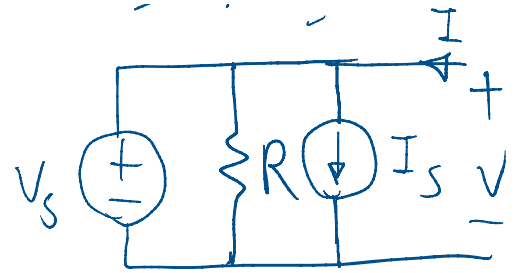


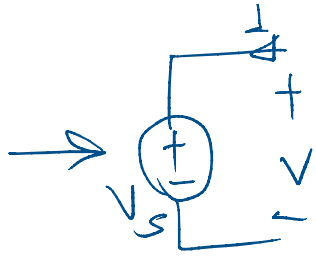
$I_{S1}=I_{S2}=I_{S3}$



اتصال سری منابع جریان نامساوی به دلیل نقض قانون جریان مجاز نیست.

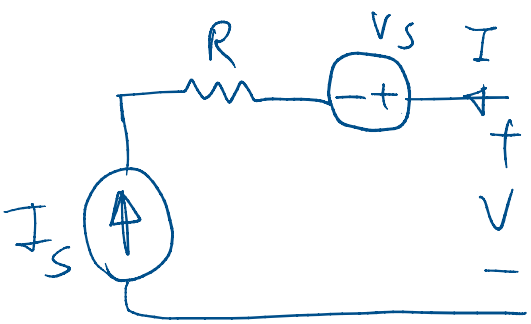


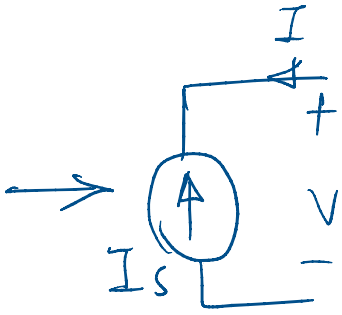




عناصر موازی با منبع ولتاژ

و





عناصر سری با منبع جریان بی‌اثرند.