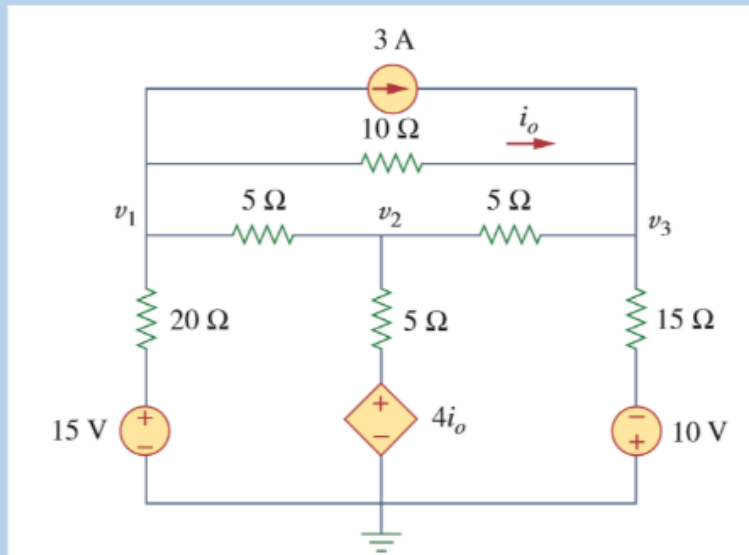
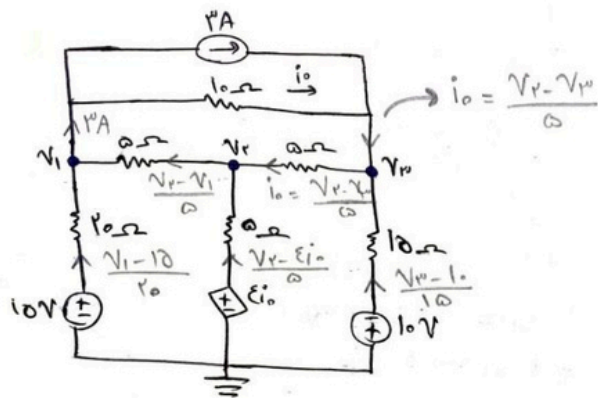


تمرین سری 1

آناهیتا الیاسی گرجی

۱- مدار زیر را با استفاده از تحلیل گره بررسی کرده و ولتاژهای v_1 ، v_2 و v_3 را بیابید؟





$$\text{KCL } \textcircled{1} : \frac{V_1 - 10}{2} + \frac{V_r - V_1}{2} = 2 \times 2 \rightarrow$$

$$V_1 - 10 + (V_r - V_1) = 4 \rightarrow \boxed{V_r - V_1 = 14}$$

$$\text{KCL } \textcircled{2} : \frac{V_r - V_w}{2} + \frac{V_r - 2i_0}{2} = \frac{V_r - V_1}{2} \times 2 \rightarrow$$

$$V_r - V_w + V_r - 2i_0 = V_r - V_1 \times 2 \rightarrow$$

$$2V_r - V_w - 2i_0 = 2V_r - 2V_1 \rightarrow$$

$$\boxed{V_r - V_w + 2V_1 = 0}$$

$$\text{KCL } \textcircled{3} : \frac{V_w - V_r}{2} + \frac{V_w - 10}{10} = 0 \times 2 \rightarrow 5V_w - 5V_r + V_w - 10 = 0 \rightarrow$$

$$\boxed{6V_w - 5V_r = 10}$$

$$\textcircled{1}, \textcircled{2} \rightarrow \begin{cases} 8V_2 - 3V_1 = 18 \\ 8V_3 - 3V_2 = 10 \end{cases} \xrightarrow{+} \begin{cases} -3V_1 + 8V_3 + V_2 = 28 \end{cases}$$

$$\begin{cases} 8V_1 - V_3 + V_2 = 0 \\ -3V_1 + 8V_3 + V_2 = 28 \end{cases} \xrightarrow{\times 8} \begin{cases} 8V_1 - V_3 + 8V_2 = 0 \\ -3V_1 + 8V_3 + V_2 = 28 \end{cases} \xrightarrow{+} \begin{cases} 11V_1 + 5V_2 = 28 \end{cases} \textcircled{3}$$

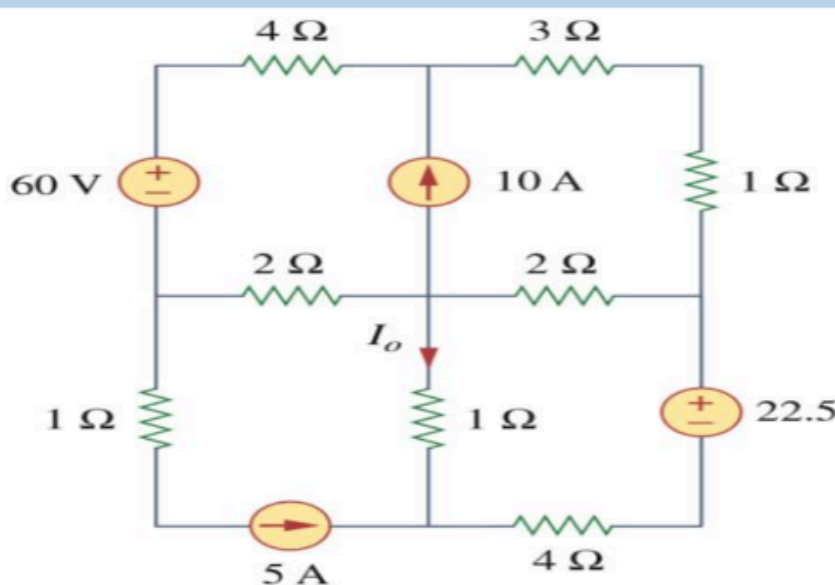
$$\textcircled{1}, \textcircled{3} \rightarrow \begin{cases} 8V_2 - 3V_1 = 18 \xrightarrow{\times (-5)} -40V_2 + 15V_1 = -90 \\ 11V_1 + 5V_2 = 28 \xrightarrow{\times 8} 88V_1 + 40V_2 = 224 \end{cases} \xrightarrow{+} \begin{cases} 48V_1 + 20V_2 = 112 \end{cases}$$

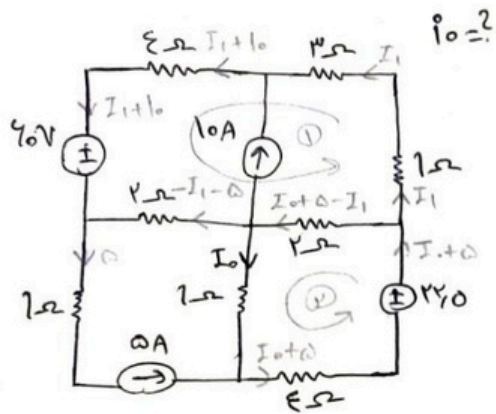
$$48V_1 = 224 \rightarrow V_1 = 4.67 \text{ V}$$

$$8V_2 - 3(4.67) = 18 \rightarrow 8V_2 = 32.01 \rightarrow V_2 = 4.00 \text{ V}$$

$$8V_3 - 3(4.67) = 10 \rightarrow V_3 = \frac{24.01}{8} = 3.00 \text{ V}$$

۲- در مدار زیر به کمک تحلیل مش جریان ها را بیابید؟





$$\text{KVL } \textcircled{1}: I_1 + 3I_1 + 8(I_1 + 10) + 10 + 2(I_1 + 5) - 2(I_0 + 5 - I_1) = 0$$

$$\rightarrow 14I_1 - 2I_0 = -100 \xrightarrow{\div 2} 7I_1 - I_0 = -50 \quad \textcircled{1}$$

$$\text{KVL } \textcircled{2}: 2(I_0 + 5 - I_1) + 10 + 8(I_0 + 5) = 20 \rightarrow$$

$$2I_0 + 10 - 2I_1 + I_0 + 8I_0 + 40 = 20 \rightarrow$$

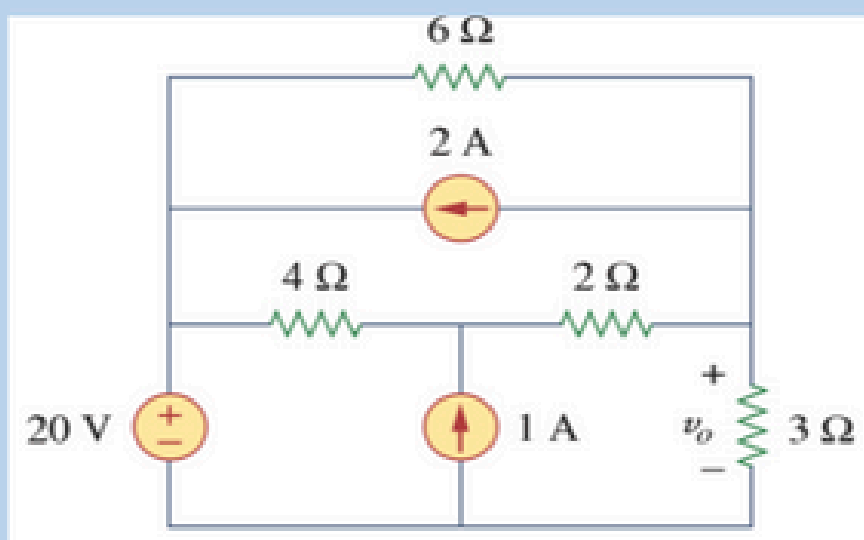
$$9I_0 - 2I_1 = 20 - 50 \rightarrow 9I_0 - 2I_1 = -30 \quad \textcircled{2}$$

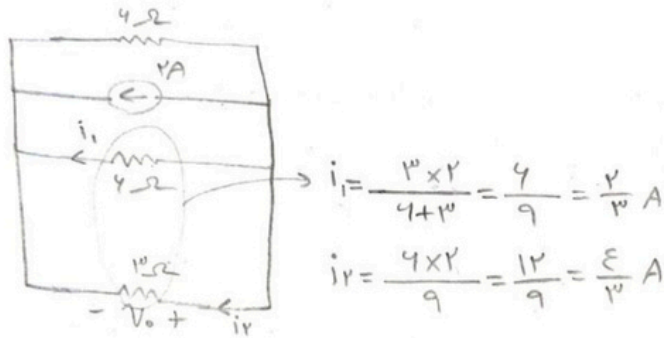
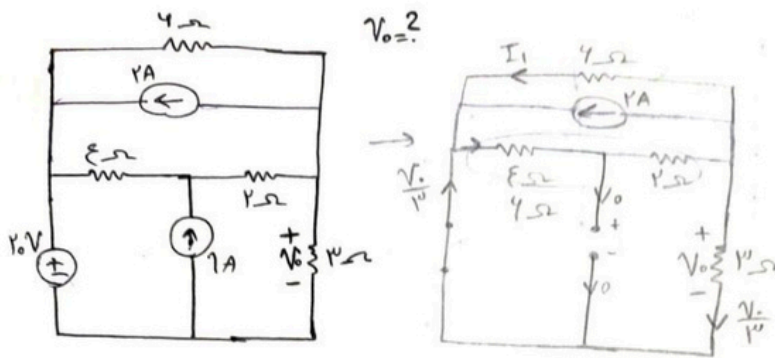
$$\textcircled{1} \rightarrow 4I_1 = I_0 - 50$$

$$\textcircled{2} \rightarrow 9I_0 - 2\left(\frac{I_0 - 50}{4}\right) = -30 \xrightarrow{\times 4} 36I_0 - 2I_0 + 100 = -120$$

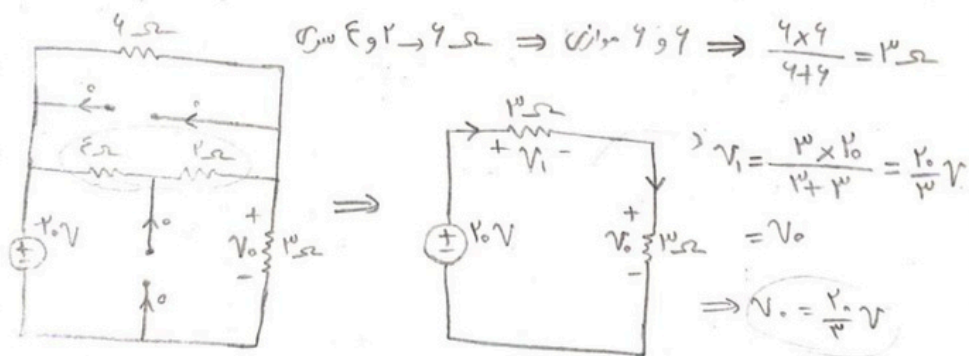
$$\rightarrow 34I_0 = -220 \rightarrow I_0 = -6.47 \text{ A}$$

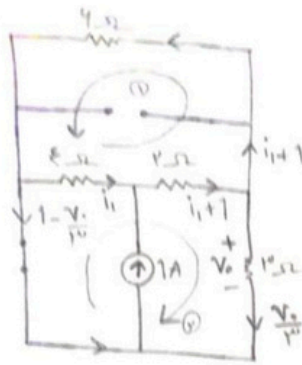
۳- به کمک جمع آثار ولتاژ v_o را در مدارهای زیر بیابید؟





$$V_0 = i_2 \times 10 = \frac{4}{3} \times 10 = 13.33 \text{ V}$$





$$\text{KVL } \textcircled{1}: 4(i_1+1) + 4(i_1+1 - \frac{V_o}{10}) + 8i_1 = 0$$

$$\rightarrow 4i_1 + 4 + 4i_1 + 4 - 2V_o + 8i_1 = 0$$

$$\rightarrow 16i_1 + 8 = 2V_o \xrightarrow{\div 2} 8i_1 + 4 - V_o = 0$$

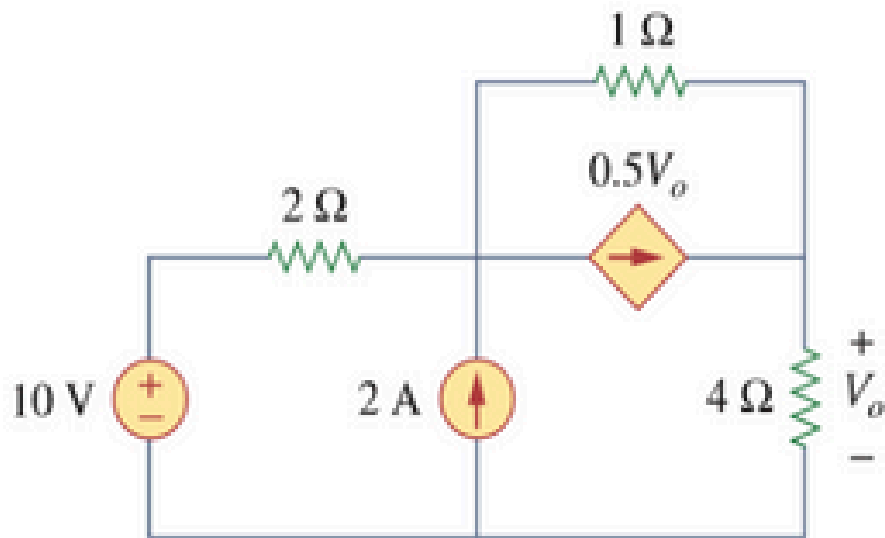
$$\text{KVL } \textcircled{2}: 8i_1 + 2i_1 + 2 + V_o = 0 \rightarrow$$

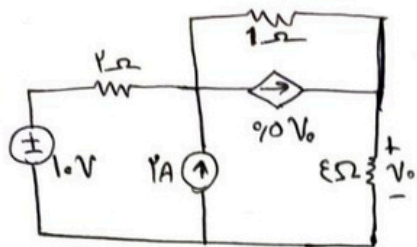
$$10i_1 + 2 + V_o = 0$$

$$\textcircled{1}, \textcircled{2} \rightarrow \begin{cases} 8i_1 + 4 - V_o = 0 \\ 10i_1 + 2 + V_o = 0 \end{cases} \rightarrow 18i_1 + 6 = 0 \rightarrow i_1 = -\frac{1}{3} \text{ A}$$

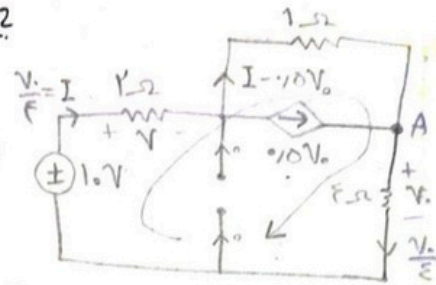
$$8(-\frac{1}{3}) + 2 + V_o = 0 \rightarrow V_o = -\frac{2}{3} \text{ A}$$

Finally $\rightarrow V_o = 8 + \frac{V_o}{10} - 1 = 7 + \frac{V_o}{10} = \frac{79}{10} \text{ V} = 7.9 \text{ V}$

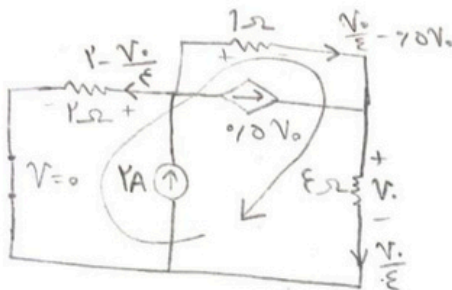




$$V_o = 2$$



$$\text{KCL A: } I - 0.5V_o + 0.5V_o = \frac{V_o}{2} \rightarrow I = \frac{V_o}{2} \Rightarrow V = \frac{V_o}{2} \times 2 = \frac{V_o}{2}$$



$$\text{KVL: } -10 + \frac{V_o}{2} + \frac{V_o}{2} - 0.5V_o + V_o = 0$$

$$\rightarrow \frac{10}{2} V_o = 10 \rightarrow V_o = \frac{10}{2} V$$

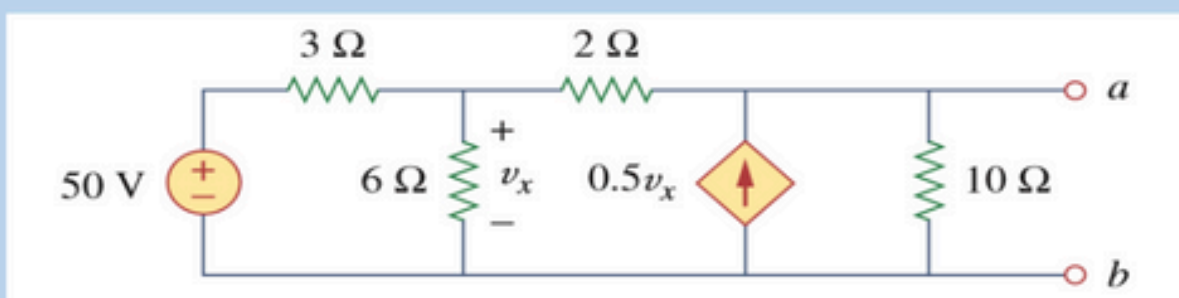
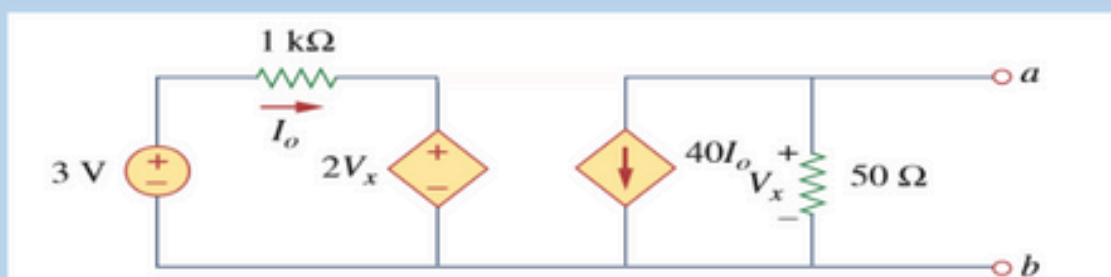
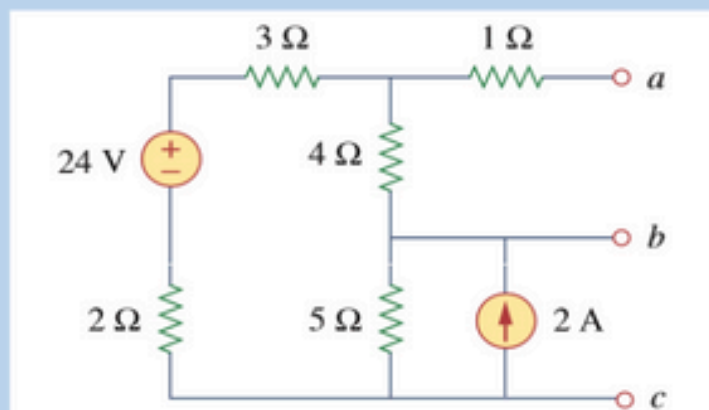
$$\text{KVL: } 2(2 - \frac{V_o}{2}) = \frac{V_o}{2} - 0.5V_o + V_o \rightarrow$$

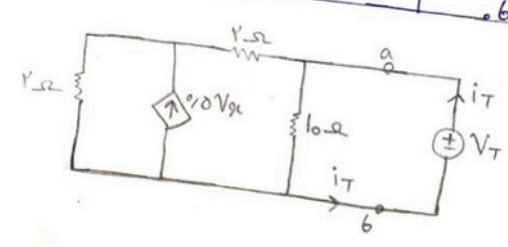
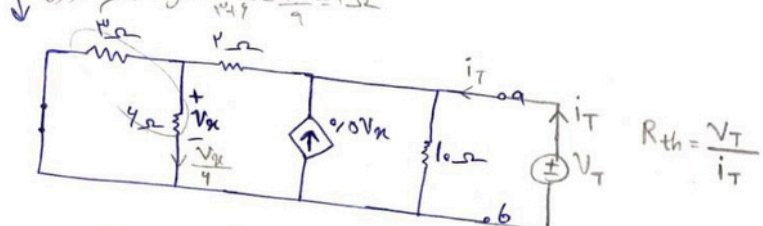
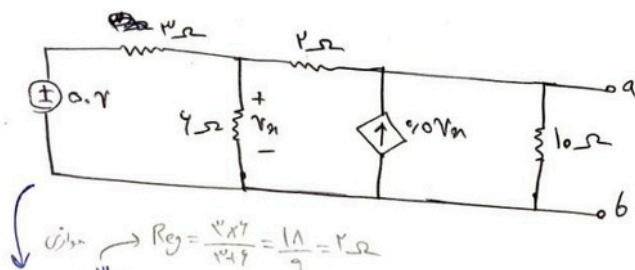
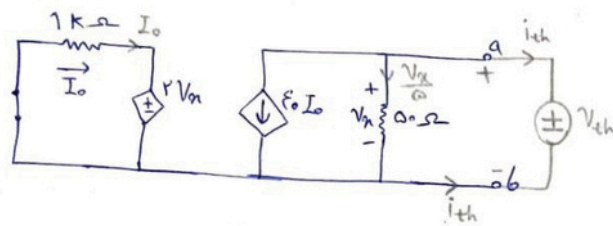
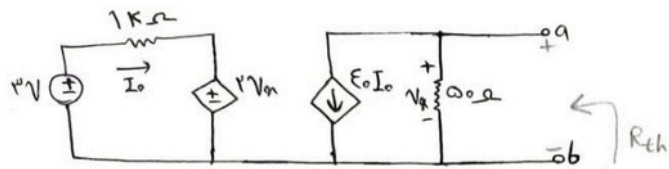
$$2 - \frac{V_o}{2} = \frac{V_o}{2} + 0.5V_o \rightarrow 2 = \frac{V_o}{2} + \frac{V_o}{2} + \frac{1}{2}V_o \rightarrow$$

$$2 = \frac{2}{2} V_o \rightarrow V_o = \frac{14}{2} V$$

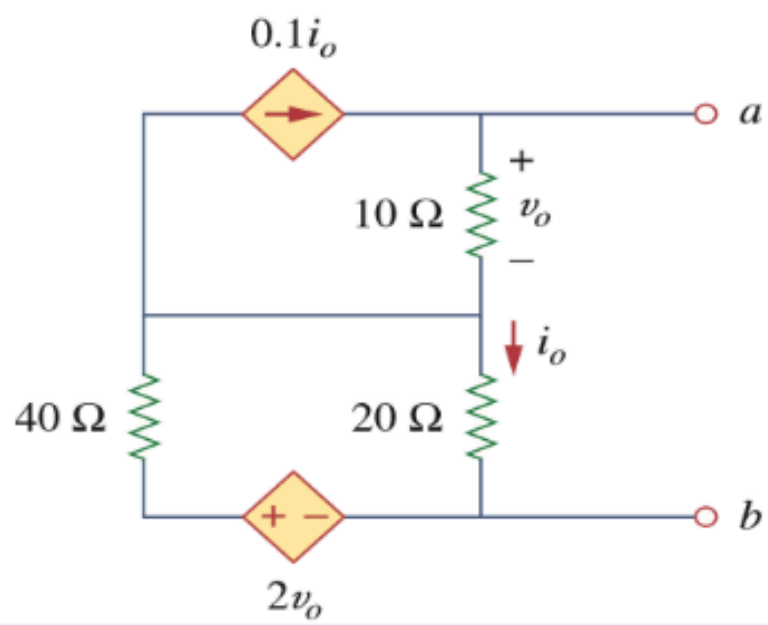
$$\Rightarrow V_o = \frac{1}{2} + \frac{14}{2}$$

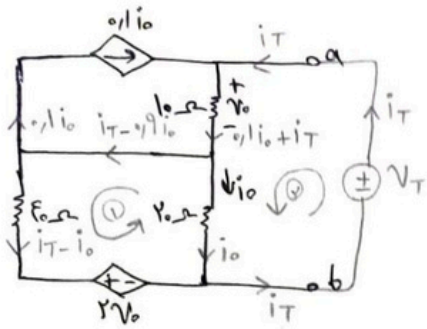
۴- مدار معادل تونن را برای مدارهای زیر بدست آورید؟ در شکل اول مدار معادل تونن را بین سرهای bc و ab بدست آورید؟





برای سه تایی بالا در همین قدر میتونستم حل کنم.





$$R_{th} = \frac{V_T}{i_T}$$

از معادله اول
 $V_T = \dots$
 \dots

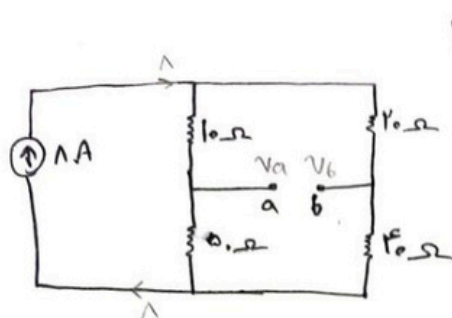
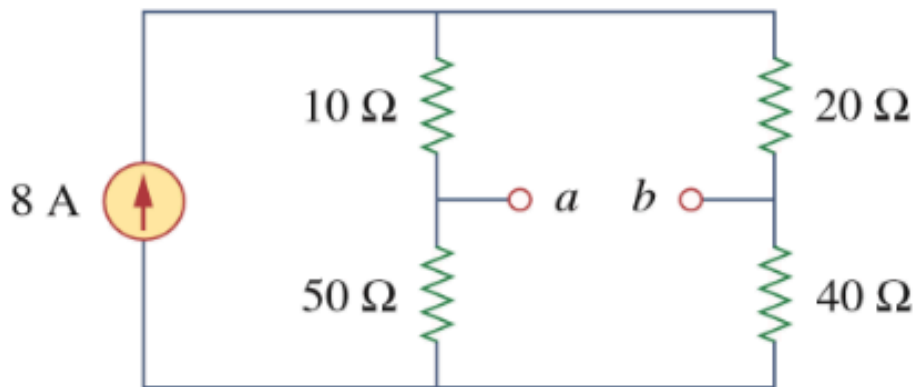
$$\text{KVL } \textcircled{1}: 2V_0 - 40i_0 + 60(i_T - i_0) = 0 \rightarrow 2V_0 - 40i_0 + 60i_T = 0$$

$$\text{KVL } \textcircled{2}: -V_T + V_0 + 40i_0 = 0$$

$$\begin{aligned} \textcircled{1}, \textcircled{2} \rightarrow 2V_0 - 40i_0 + 60i_T = 0 &\rightarrow 2V_0 - 40i_0 + 60i_T = 0 \\ V_0 + 40i_0 - V_T = 0 &\xrightarrow{\times (-2)} -2V_0 - 80i_0 + 2V_T = 0 \xrightarrow{\times (-\frac{1}{2})} \end{aligned}$$

$$\left. \begin{aligned} -40i_0 + 60i_T = 0 \\ 40i_0 - 2V_T = 0 \end{aligned} \right\} \Rightarrow 60i_T = 2V_T \rightarrow \frac{V_T}{i_T} = \frac{60}{2} = R_{th}$$

۵- مدار معادل تونن و نورتن را بین سرهای a و b بیابید؟

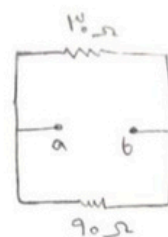
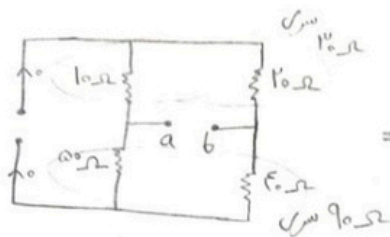


$$10 \times 50 \neq 20 \times 40$$

بنابراین:

$$V_a \neq V_b$$

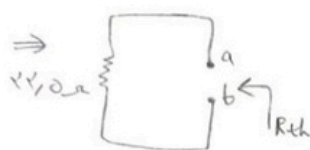
مدار معادل تونن:



$$90 \parallel 14.28 = \frac{90 \times 14.28}{110}$$

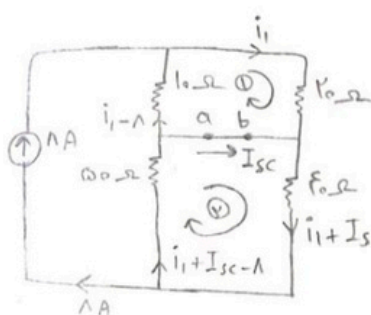
$$= \frac{9 \times 1.428 \times 100}{11 \times 10}$$

$$= \frac{9 \times 1.428}{11 \times 1} = \frac{12.85}{11} = 1.17 \Omega$$



$$R_{th} = 1.17 \Omega$$

مدار معادل نورتن:



$$KVL \text{ (left loop)}: V_{i1} + V_a - V_b + 10(i_1 - 8) = 0$$

$$\rightarrow (V_a - V_b) - 10 = -10i_1$$

$$KVL \text{ (right loop)}: 50i_1 + 50I_{sc} - 50(i_1 + I_{sc} - 8) + (V_a - V_b) + 50(i_1 + I_{sc}) + 50(i_1 + I_{sc} - 8) = 0$$

$$\rightarrow (V_a - V_b) + 90i_1 + 90I_{sc} = 400 \rightarrow$$

$$(V_a - V_b) + 90 \left(\frac{V_a - V_b - 10}{-10} \right) + 90I_{sc} = 400 \rightarrow$$

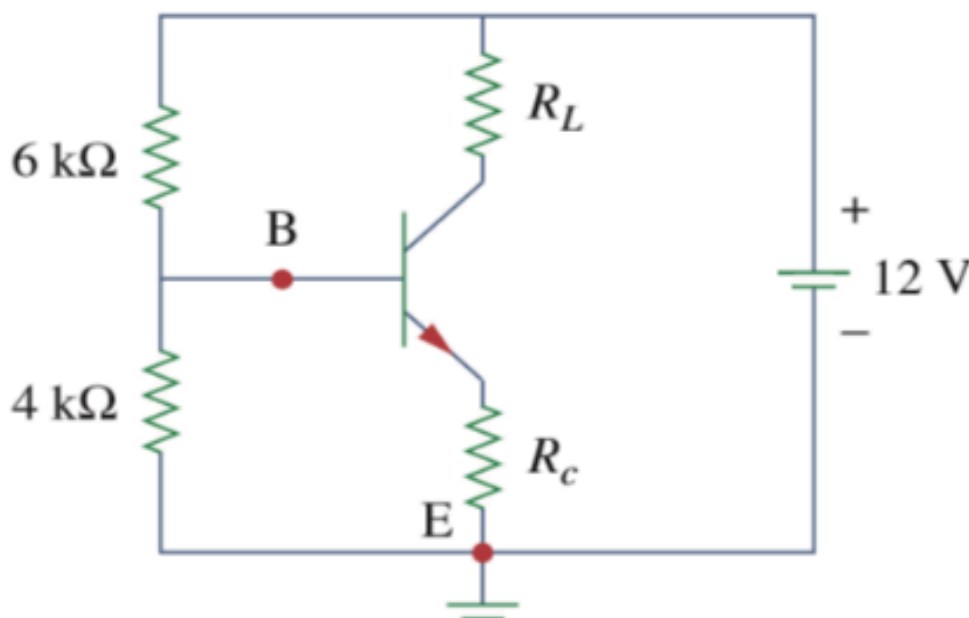
$$\overbrace{V}^{V_a - V_b} - \underbrace{V}_{V_b} (V_a - V_b - 10) + 90 I_{sc} = 100 \rightarrow$$

$$V - \underbrace{V}_{100} + \underbrace{90}_{100} I_{sc} = \cancel{100} \rightarrow$$

$$-V + 90 I_{sc} = -100 \rightarrow V = \frac{90 I_{sc} + 100}{1} \rightarrow$$

$$V = \frac{90}{1} I_{sc} + \frac{100}{1} \rightarrow V = \underbrace{13.8}_{R_N} I_{sc} + \underbrace{30.1}_{V_N} V$$

۶- مدار معادل تونن را بین بیس و امیتر ترانزیستور بیابید (BE)؟



این سوال رو استاد یاد ندادند.