باسمه تعالی

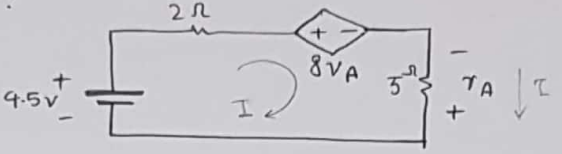
تمرین سری سوم

97/7/28

هست: فصل سوم (26، 33، 55، 56)

فصل چهارم (24، 47)، فصل پنجم (21، 42، 59)

26- power absorbed?



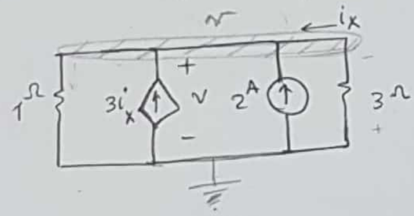
KVL: $-4.5 + 2I + 8v_A - v_A = 0$

$v_A = -5I \rightarrow I = -\frac{1}{5}v_A$

$7v_A - \frac{2}{5}v_A = 4.5 \Rightarrow \frac{33}{5}v_A = 4.5 \rightarrow \boxed{v_A = 0.68^V}$

$I = -\frac{1}{5}\times 0.68 = \boxed{-0.13A}$

33. $v = ?$ power suplied by each current source?



KCL@v: $\frac{v-0}{1} - 3i_x - 2 - i_x = 0$

$\frac{0-v}{3} = i_x \rightarrow \boxed{v = -3i_x}$

$-3i_x - 3i_x - 2 - i_x = 0$

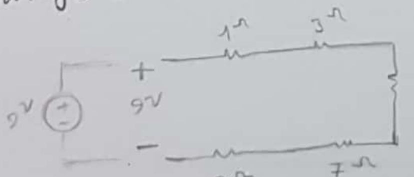
$7i_x = -2 \rightarrow \boxed{i_x = -\frac{2}{7}A}$

$v = -3\times -\frac{2}{7} = \boxed{\frac{6}{7}^V}$ ⇐

55- series connection of five resistors → 1Ω, 3Ω, 5Ω, 7Ω, 9Ω

9V → across the terminals of network.

voltage division ⇒ $v_{3\Omega} = ?$ $v_{7\Omega} = ?$ $v_{R_n} = \frac{R_n}{R_1 + \cdots + R_n}\times v$

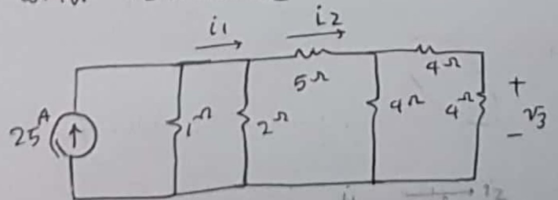


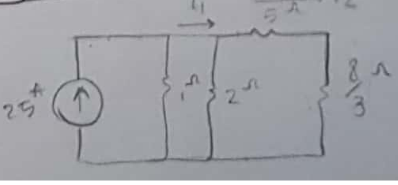
$v_{3\Omega} = \frac{3}{\underset{25}{1+3+5+7+9}}\times 9 = \boxed{1.08^V}$

$v_{7\Omega} = \frac{7}{\underset{25}{1+3+5+7+9}}\times 9 = \boxed{2.52^V}$

56- $i_1, i_2, v_3 = ?$

with resistance combination and current division as appropriate.





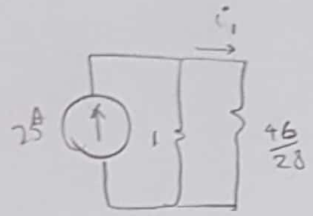
4Ω, 4Ω → سری ⇒ $\boxed{8\Omega}$

8Ω, 4Ω → موازی ⇒ $\frac{8\times 4}{\cancel{12}_3} = \boxed{\frac{8}{3}\Omega}$

$5, \frac{8}{3}$ → سری ⇒ $\boxed{\frac{23}{3}\Omega}$

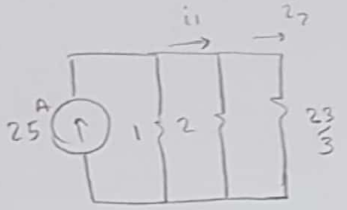
$2, \frac{23}{3}$ → موازی ⇒ $\frac{2\times\frac{23}{3}}{\underset{\frac{28}{3}}{2+\frac{23}{3}}} = \boxed{\frac{46}{28}\Omega}$

$$I_n = \frac{\frac{1}{R_n}}{\frac{1}{R_1}+\frac{1}{R_2}+\cdots+\frac{1}{R_n}} \times I \xrightarrow[\text{مقاومت}]{\text{2 تا}} I_1 = \frac{R_2}{R_1+R_2} \times I$$

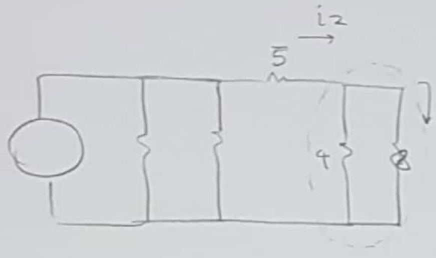


تقسیم جریان

$$\hookrightarrow i_1 = \frac{1}{1+\frac{46}{28}} \times 25 = \boxed{9.45^A}$$



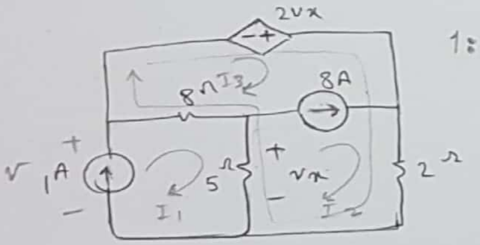
$$i_2 = \frac{2}{2+\frac{23}{3}} \times \overset{9.45}{i_1} = \boxed{1.95^A}$$



$$i_3 = \frac{4}{12} \times \overset{1.95}{i_2} = 0.65A$$

$$v_3 = RI = 4^{\Omega} \times 0.65^A = \boxed{2.6^V}$$

24. $v_x = ?$ power supplied by the 1A source = ?



1: $\boxed{I_1 = 1^A}$

2, 3: $-2v_x + 2I_2 - v_x + 8(I_3 - \overset{1}{I_1}) = 0$

$I_2 - I_3 = 8A$

$v_x = 5(\overset{1}{I_1} - I_2) = 5 - 5I_2$

$-15 + 15I_2 + 2I_2 + 8I_3 = 8$

$$\begin{cases} 17I_2 + 8I_3 = 23 \\ 8I_2 - 8I_3 = 64 \end{cases}$$

$25I_2 = 87$

$\Rightarrow I_2 = \boxed{3.48^A}$

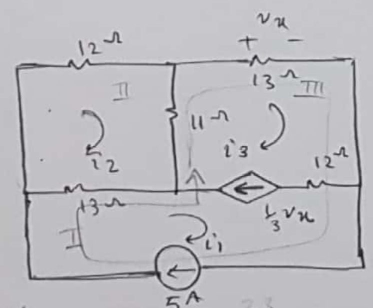
$\Rightarrow I_3 = \boxed{-4.52A}$

$v_x = 5 - 5 \times 3.48 = \boxed{-12.4V}$

KUL: $-v + 8(1-(-4.52)) + 5(1-3.48) = 0 \Rightarrow v = \boxed{31.76}$

47\. supermesh technique

$i_1, i_2, i_3 = ?$



KUL I: $\Rightarrow \boxed{i_1 = 5^A}$

KUL II: $13(i_2 - \overset{5}{i_1}) + 12(i_2) + 11(i_2 - \overset{4.57}{i_3}) = 0$

$i_3 - i_1 = \frac{1}{3}v_x \rightarrow i_3 = \boxed{\frac{1}{3}v_x + 5}$

$v_x = 13i_3 \rightarrow i_3 = \frac{1}{13}v_x$

$\Rightarrow \frac{1}{13}v_x = \frac{1}{3}v_x + 5$

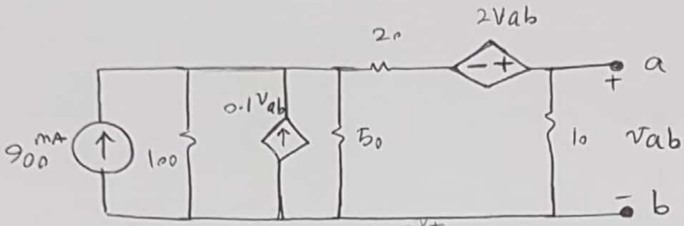
$\Rightarrow v_x = \boxed{-1.28^V}$

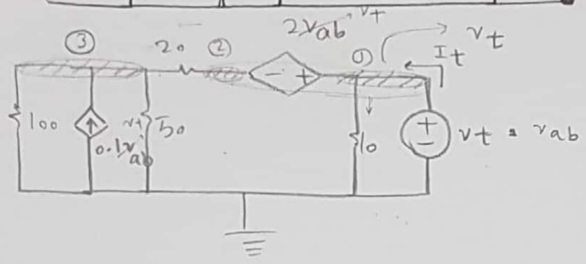
$\Rightarrow i_3 = \boxed{4.57A}$

$13i_2 - 65 + 12i_2 + 11i_2 - 50.27 = 0$

$36i_2 = 115.27 \rightarrow i_2 = \boxed{3.201\ A}$

54. Value of resistance would absorb max power from the circuit when connected across terminals a and b.





kcl ② ; ① : $-I_t + \frac{v_t - 0}{10} + \frac{v_2 - v_3}{20} = 0 \rightarrow v_3 = -20 I_t + 2v_t + v_2$

$v_3 = -20 I_t + 2v_t - v_t$

$\hookrightarrow \boxed{v_3 = -20 I_t + v_t}$

kcl ③ : $\frac{v_3 - 0}{100} - 0.1 v_t + \frac{v_3 - 0}{50} + \frac{v_3 - v_2}{20} = 0$

$v_t - v_2 = 2v_t \rightarrow \boxed{v_2 = -v_t}$

$\underline{v_3} - 10 v_t + \underline{2v_3} + \underline{5v_3} - 5v_2 = 0$

$8v_3 - 5v_2 - 10v_t = 0 \rightarrow -160 I_t + \underline{8v_t} + \underline{5v_t} - \underline{10 v_t} = 0$

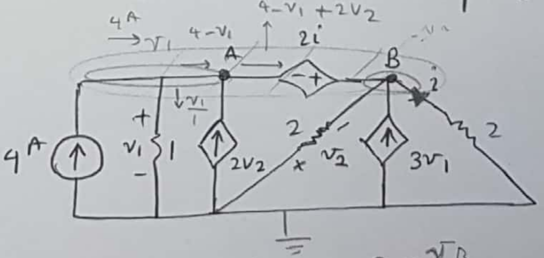
$3v_t = 160 I_t \Rightarrow R_{th} = \frac{v_t}{I_t} = \frac{160}{3} \Omega$

$\left(R = \frac{160}{3} \Omega\right) \Leftarrow$ مزدوج

مه دار ← فصل سوم : 2، 23، 25، 36، 59 - 63 - 99

23- توان هر منبع که تحویل می دهد = ?

اصل بقای انرژی



Kcl @ A , B : $-4 + \frac{v_1 - 0}{1} - 2v_2 - \frac{0 - v_B}{2} - 3v_1 + \frac{v_B - 0}{2} = 0$

$v_B = -v_2$

$v_B - v_A = 2i \Rightarrow -v_2 - v_1 = 2\left(\frac{0 - (-v_2)}{2}\right)$

$\Rightarrow -v_2 - v_1 = +v_2 \Rightarrow 2v_2 = -v_1 \rightarrow \boxed{v_1 = -2v_2}$

$\Rightarrow -4 + v_1 - 2v_2 - \underbrace{\frac{v_2}{2} - 3v_1 - \frac{v_2}{2}}_{-v_2} = 0 \Rightarrow -3v_2 - 2v_1 = 4$

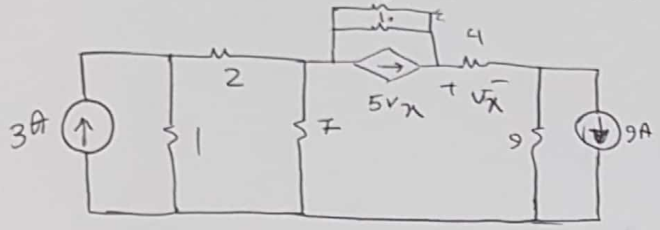
$-3v_2 + 4v_2 = 4$

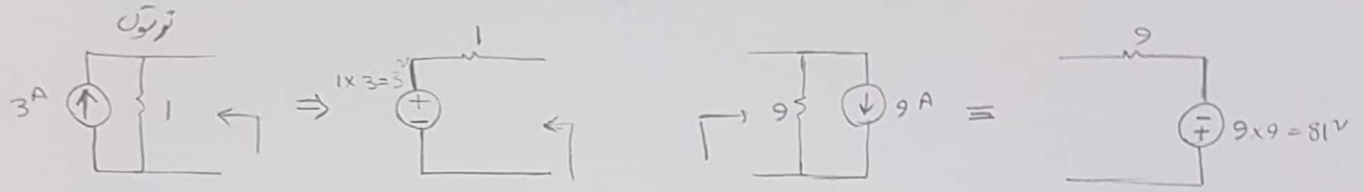
$\Rightarrow \boxed{v_2 = 4V}$

$\hookrightarrow \boxed{v_1 = -8V}$

? تقسیم $I = \frac{R_2}{} \times I$

21- source transformations to first convert all three sources to voltage sources. then simplify. $v_x = ?$

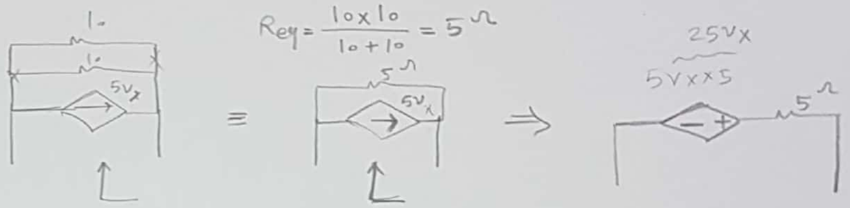


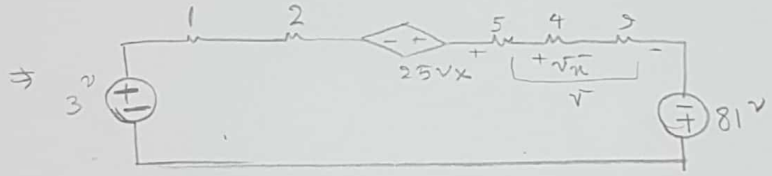


$v_{th} = I_N \times R_N$

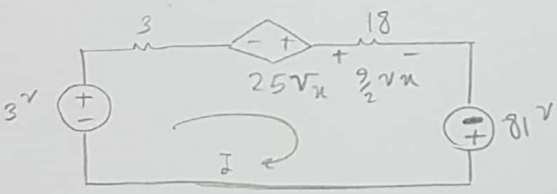
$R_N = R_{th}$

$R_{eq} = \frac{10 \times 10}{10+10} = 5\Omega$





$v_x = \frac{\overset{2}{4}}{\underset{\overset{\cancel{18}}{9}}{4+5+9}} \times v \Rightarrow \boxed{v = \frac{9}{2} v_x}$



KVL: $-3 + 3I - 25v_x + \frac{9}{2}v_x - 81 = 0$

$18I = \frac{9}{2}v_x \Rightarrow \boxed{I = \frac{1}{4}v_x}$

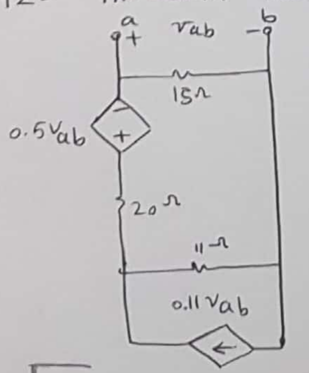
$\frac{3}{4}v_x + \frac{\overset{18}{\cancel{9}}}{\cancel{2}}v_x - \underset{\frac{100}{4}}{25}v_x = 84$

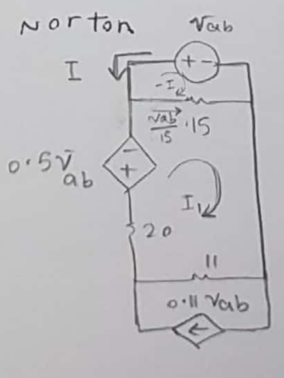
$\begin{array}{r} 100 \\ 21 \\ \hline 79 \end{array}$

$\Rightarrow -\frac{79}{4}v_x = 84$

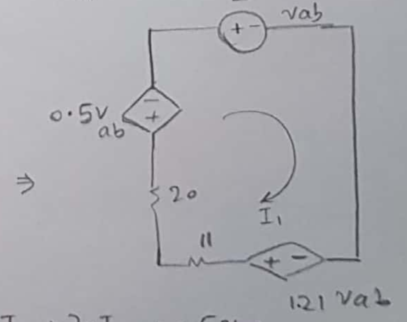
$\Rightarrow \boxed{v_x = 4.25V}$

42- Thevenin and Norton

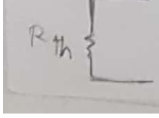




$R_{th} = R_N = \frac{v_{ab}}{I}$



$I_1 = I - \frac{v_{ab}}{15}$



KVL: $-1.21v_{ab} + 11I_1 + 20I_1 + 0.5v_{ab} + v_{ab} = 0$

$0.29v_{ab} = -31I_1 \Rightarrow$

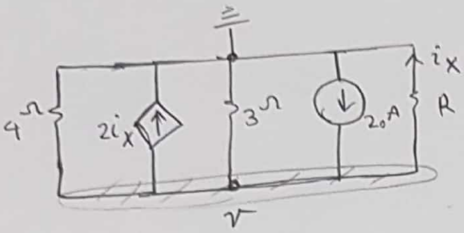
$0.29v_{ab} = -31I + \frac{31}{15}v_{ab}$

$\Rightarrow 31I = 1.77v_{ab}$

$\Rightarrow \frac{v_{ab}}{} = 17.51\Omega$

25-

$R = ? \rightarrow v = 24^{v}$



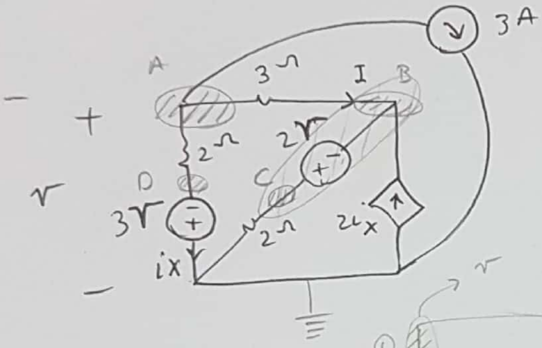
$$\text{KCl @ } v: \quad \frac{\overset{24}{v}-0}{4} + 2i_x + \frac{\overset{24}{v}-0}{3} - 20 + i_x = 0$$

$$6 + 2i_x + 8 - 20 - i_x = 0$$

$$\boxed{3i_x = 6} \Rightarrow \boxed{i_x = 2^{A}}$$

$$Ri_x = v \Rightarrow R \times (2^{A}) = 24^{v} \Rightarrow \boxed{R = 12^{\Omega}}$$

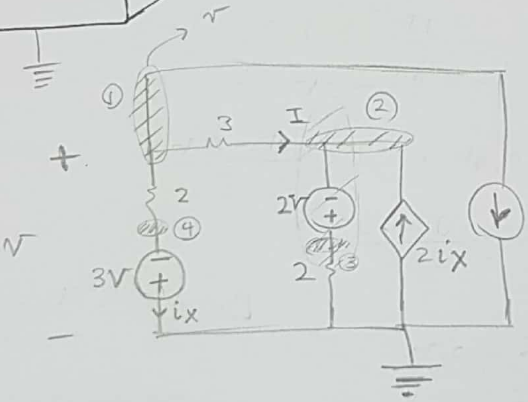
36-



$I = ?$ $\quad v = ?$

$$\text{KCL①}: \frac{v+3v}{2} + I + 3^{A} = 0$$

$$\text{KCL②,③}: -2i_x - I + \frac{v_3 - 0}{2} = 0$$



$v_1 = v$

$v_4 = -3v$

$$v_3 - v_2 = 2v$$

$$\hookrightarrow v_3 = v_2 + 2v$$

$$v - v_2 = 3I \rightarrow v_2 = v - 3I$$

$$\Rightarrow v_3 = v - 3I + 2v$$
$$= \boxed{3v - 3I}$$

$$4v + 2I + 6 = 0$$

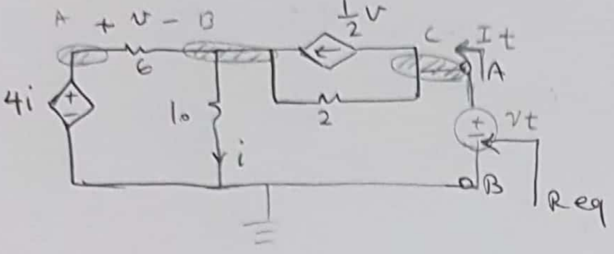
$$\underbrace{v + 3v}_{4v} = 2i_x \longrightarrow i_x = 2v$$

$$-4v - I + \frac{3}{2}v - \frac{3}{2}I = 0 \Rightarrow -\frac{5}{2}v - \frac{5}{2}I = 0 \longrightarrow +5v + 5I = 0$$

$$\begin{cases} 20v + 10I = -30 \\ -10v - 10I = 0 \end{cases}$$
$$10v = -30 \Rightarrow \boxed{v = -3}$$

$$5I = 15 \rightarrow \boxed{I = 3^{A}}$$

59- مقاومت دیده شده از سرهای B, A =?



$A \Rightarrow v_A = 4i$

$C \Rightarrow v_C = v_t$

$KCL @ B: \; -\frac{v}{6} - \frac{1}{2}v + \frac{v_B - v_C}{2} + \frac{v_B - 0}{10} = 0$

$v_A - v_B = v \Rightarrow \boxed{v_B = 4i - v}$

$\frac{v_B - 0}{10} = i \rightarrow \boxed{v_B = 10i}$ }

$4i - v = 10i \Rightarrow 6i = -v$

$\Rightarrow \boxed{v = -6i}$

$I_t = \frac{1}{2}v + \frac{v_C - v_B}{2}$

$\hookrightarrow I_t = -3i + \frac{v_t - 10i}{2} \Rightarrow 2I_t = \underbrace{-6i + v_t - 10i}_{-16i}$

$i = \frac{v_t - 2I_t}{16}$

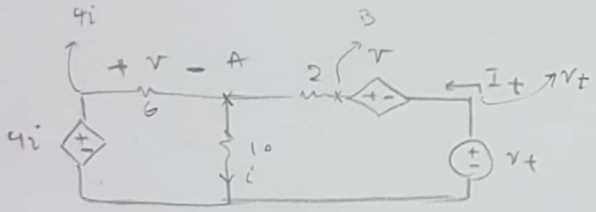
$-\underline{\underline{5v}} - \underline{\underline{15v}} + 15v_B - 15v_C + \underline{\underline{3v_B}} = 0$

$-20v + 18v_B - 15v_C = 0$

$\underbrace{120i + 180i}_{300i} - 15v_t = 0 \rightarrow 18.75v_t - 37.5I_t - 15v_t = 0$

$\Rightarrow 3.75v_t = 37.5I_t$

$\Rightarrow Req = \frac{v_t}{I_t} = \frac{37.5}{3.75} = 10\Omega$



$KCL\; A: \; -\frac{v}{6} - I_t + i = 0$

$V_A = 10i$

$V_B - v_t = v \Rightarrow v_B = v + v_t$

$I_t = \frac{v_B - v_A}{2} \Rightarrow I_t = \frac{v + v_t - 10i}{2} = \frac{-6i + v_t - 10i}{2} = \frac{v_t - 16i}{2}$

$\downarrow$

$2I_t - v_t = -16i$

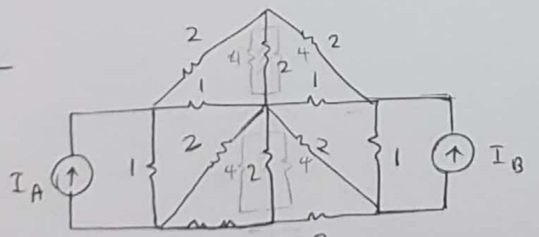
$i = \frac{v_t - 2I_t}{16}$

$4i - v_A = v \Rightarrow 4i - 10i = v \rightarrow \boxed{v = -6i}$

$\underbrace{i + i}_{2i} - I_t = 0 \rightarrow \frac{v_t - 2I_t}{8} - I_t = 0 \rightarrow v_t - 2I_t - 8I_t = 0$

$\Rightarrow v_t = 10I_t \Rightarrow Req = \frac{v_t}{I_t} = 10\Omega$

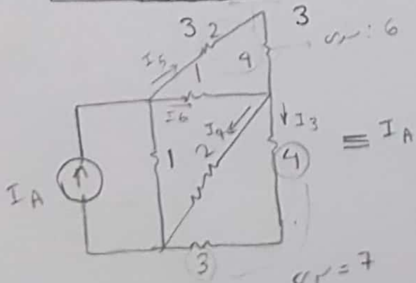
63- جریان تمام شاخه ها =?



الف) $I_A = I_B$

ب) $I_A = -I_B$

ج) $I_A \neq I_B$



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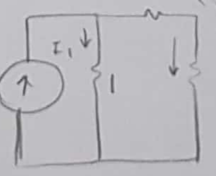
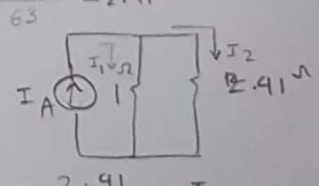


$\frac{6 \times 1}{7} = \frac{6}{7}\Omega$

$\frac{7 \times 2}{9} = \frac{14}{9}\Omega$

سری $\Rightarrow \frac{6}{7} + \frac{14}{9} = \frac{54 + 98}{63} = 2.41$

$\equiv$



$I_1 = \frac{2.41}{2.41 + 1} \times I_A$

$I_2 = \frac{1}{2.41 + 1} \times I_A$

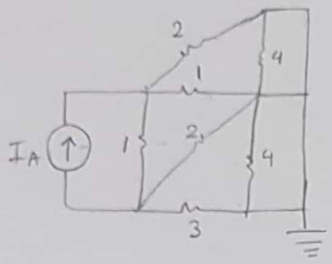
$I_3 = \frac{2}{2 + 7} \times I_2 = \frac{2}{9} \times \frac{1}{3.41} \times I_A$

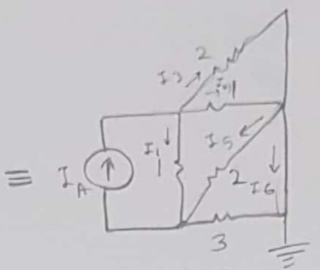
$I_4 = \frac{7}{2 + 7} \times I_2 = \frac{7}{9} \times \frac{1}{3.41} \times I_A$

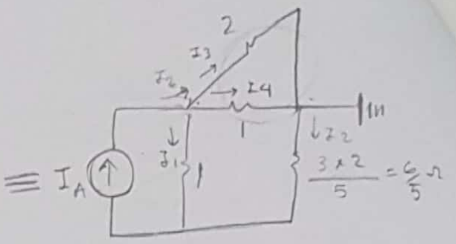
$I_5 = \frac{1}{1 + 6} \times I_2 = \frac{1}{7} \times \frac{1}{3.41} I_A$

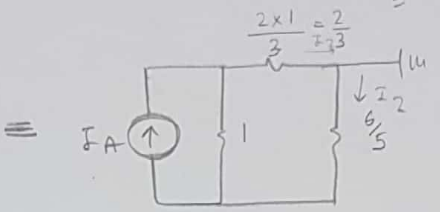
$I_6 = \frac{6}{1 + 6} \times I_2 = \frac{6}{7} \times \frac{1}{3.41} I_A$

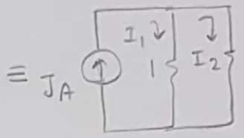
ب)











$\frac{6}{5}+\frac{2}{3}=\frac{18+10}{15}=1.86$

$I_1=\frac{1.86}{1+1.86}\times I_A$, $I_2=\frac{1}{1+1.86}\times I_A$, $I_3=\frac{1}{1+2}\times I_2=\frac{1}{3}\times\frac{1}{2.86}\times I_A$

$I_4=\frac{2}{2+1}\times I_2=\frac{2}{3}\times\frac{1}{2.86}I_A$, $I_5=\frac{3}{2+3}\times I_2=\frac{3}{5}\times\frac{1}{2.86}I_A$

$I_6=\frac{2}{2+3}\times I_2=\frac{2}{5}\times\frac{1}{2.86}I_A$

ج) $I_A \neq I_B$

$I_A=\frac{I_A-I_B}{2}+\frac{I_A+I_B}{2}$

$I_B=\frac{I_A+I_B}{2}-\frac{I_A-I_B}{2}$

$I_3=\frac{27}{8}I_2+\frac{3}{8}I_t-I_2$

$\Rightarrow I_3=\frac{15}{8}I_2+\frac{3}{8}I_t$

در قسمت الف که هم جهت بودند و برابر جریان در خط تقارن صفر بود و جریان‌های آینه‌ای هم حال در این جریان‌های برابر

$\frac{I_A+I_B}{2}$ را بجای I_A در الف قرار میدیم و در قسمت ب در خلاف جهت بودند و در این حالت روی خط تقارن برابر

صفر است که جریانها قرینه هستند

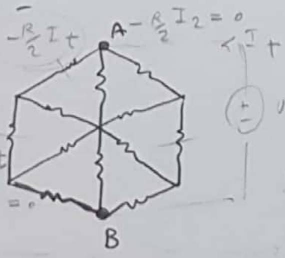
99 - تمام مقاومت‌ها R = ?

مقاومت دیده شده از دو سر A و B

$+v_t-\frac{R}{2}I_t-\frac{R}{2}I_3-\frac{R}{2}I_t-\frac{R}{2}I_2=0$

v_t-RI_t

$-\frac{R}{2}\left(-\frac{27}{71}I_t-\frac{15}{8}\times\frac{27}{71}I_t+\frac{3}{8}I_t\right)=0$

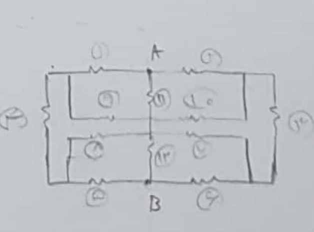


$3I_1-I_2-I_3=0\rightarrow I_3=3I_1-I_2$

$\frac{7}{2}I_2+\frac{1}{2}I_t-3I_1+I_2-I_1=0$

$\hookrightarrow I_1=\frac{9}{2}I_2-3I_1+\frac{1}{2}I_t$

$\Rightarrow I_1=\frac{9}{8}I_2+\frac{1}{8}I_t$



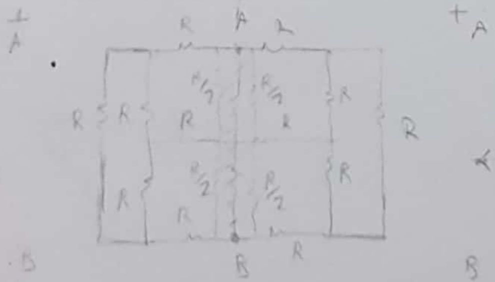
$\frac{105}{16}I_2+\frac{21}{16}I_t-\frac{9}{8}I_2-\frac{1}{8}I_t$

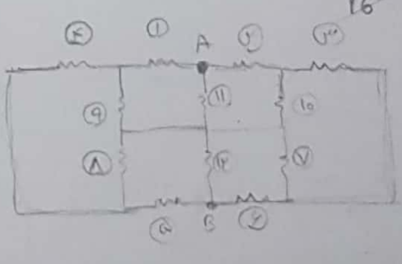
$-I_2+\frac{1}{2}I_t=0$

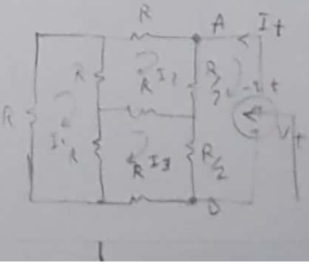
$\frac{105-18-16}{16}I_2=\frac{2-21-8}{16}I_t$

$71I_2=-27I_t$

$I_2=-\frac{27}{71}I_t$







1: $RI_1+RI_1-RI_2+RI_1-RI_3=0$

$R(3I_1-I_2-I_3)=0$

2: $RI_2+\frac{R}{2}I_2+\frac{R}{2}I_t+RI_2-RI_3$

$+RI_2-RI_1=0$

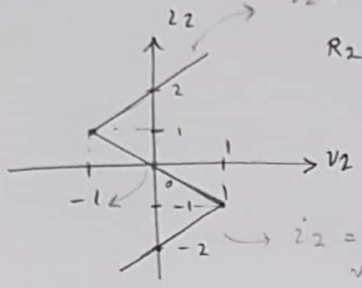
$R(\frac{7}{2}I_2+\frac{1}{2}I_t-I_3-I_1)=0$

3: $RI_3-RI_1+RI_3-RI_2+\frac{R}{2}I_3+\frac{R}{2}I_t$

$+RI_3=0$

$R(\frac{7}{2}I_3-I_1-I_2+\frac{1}{2}I_t)=0$

2- مشخصه‌های المان سری و موازی = ?



R_2

$i_2 = v_2 + 2$ $v_2 > -1$

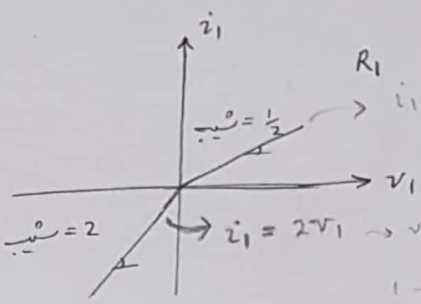
$-1 < v_2 < 1$

$\uparrow$

$i_2 = -v_2$

$i_2 = v_2 - 2$

$v_2 < 1$



R_1

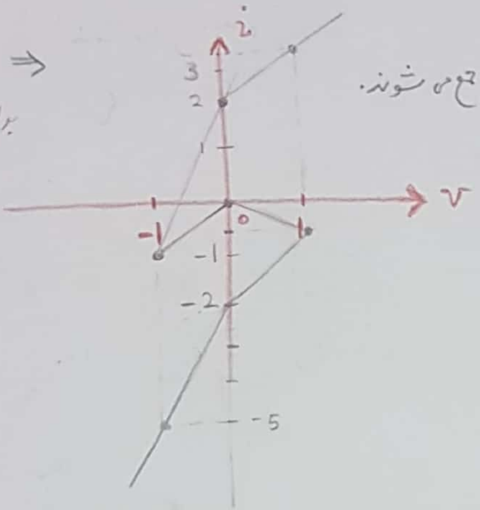
$i_1 = \frac{1}{2} v_1 \rightarrow v_1 = 2 i_1$

$i_1 = 2 v_1 \rightarrow v_1 = \frac{1}{2} i_1$

$1 - \frac{1}{2}$

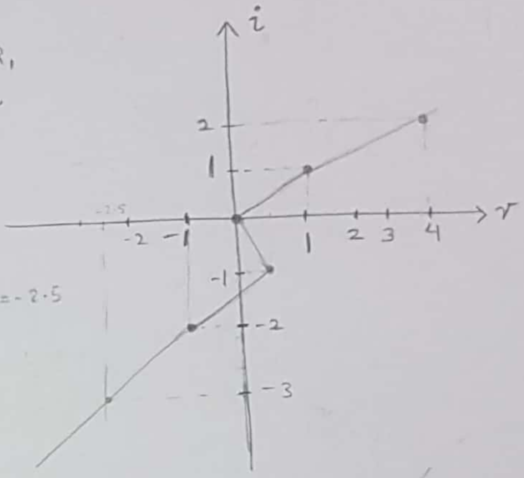
R_1 و R_2 موازی $\Rightarrow$

برای vهای مساوی iها جمع شدند.



R_1 و R_2 سری

برای iهای یکسان vها جمع می‌شوند.



$-1 - \frac{3}{2} = -\frac{5}{2} = -2.5$