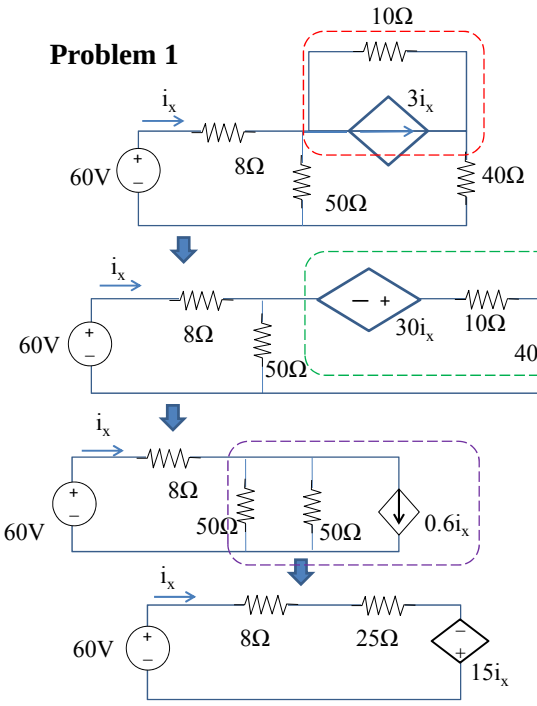
Problem 1

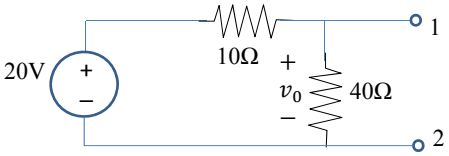


$$8i_x + 25i_x - 15i_x - 60 = 0$$

$$18i_x = 60$$

$$i_x = 3.33A$$

Problem 2



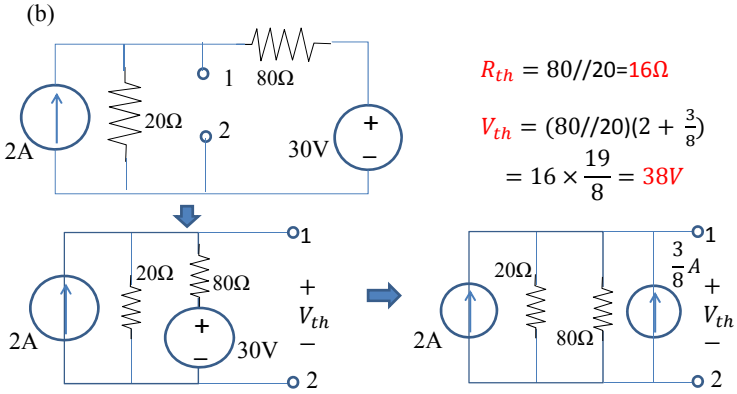
(a)

By voltage division:

$V_{TH} = v_0 = 20 \times \frac{40}{10+40} V = 16V$

$R_{TH} = 10//40\Omega = 8\Omega$

(b)

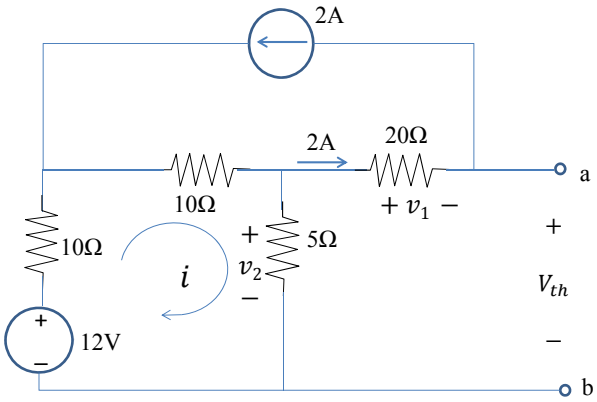


$R_{th} = 80//20 = 16\Omega$

$V_{th} = (80//20)(2 + \frac{3}{8})$

$= 16 \times \frac{19}{8} = 38V$

Problem 3



$V_{th} = v_2 - v_1$

$v_1 = 20 \times 2 = 40V$

To find v_2, apply KVL to the bottom loop,

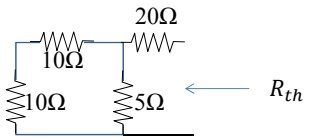
$-12 + 10i + 10(2 + i) + 5i = 0$

$\Rightarrow \quad i = -0.32A$

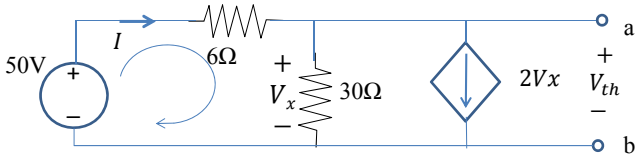
$v_2 = 5i = -0.32 \times 5 = -1.6V$

$V_{TH} = v_2 - v_1 = -1.6 - 40 = -41.6V$

$R_{TH} = 20 + 5//(10 + 10)\ \Omega = 24\Omega$



Problem 4



By KCL,

$$I = \frac{V_x}{30} + 2V_x$$

KVL around left loop:

$6\left(\frac{V_X}{30} + 2V_X\right) + V_X - 50 = 0$

$\Rightarrow \quad V_X = 3.788\text{V}$

$V_{TH} = VX = 3.788V$

To find R_{th}, turn off 50V with short circuit, supply 1A source,

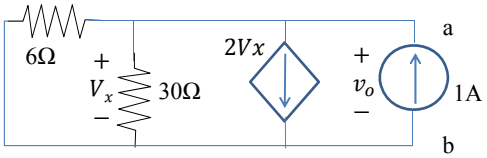
Need to find v_0. Note $v_0 = V_x$

KCL at top node:

$\frac{V_X}{30} + \frac{V_X}{6} + 2V_X = 1,\ V_x = 0.455V,$

$\Rightarrow \quad v_0 = 0.455V$

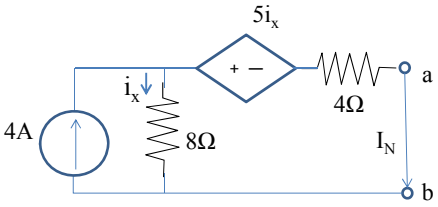
$\Rightarrow \quad R_{th} = \frac{v_0}{1} = 0.455\Omega$



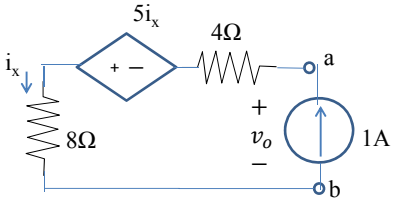
$I_N = V_{TH}/R_{TH} = 8.325A$

$V_{TH} = 3.788\text{V}$, $R_{TH} = R_N = 0.455\Omega$, $I_N = 8.325\text{A}$

Problem 5



$I_N = 4 - ix$
KVL along right mesh:
$5i_x + 4(4 - ix) - 8ix = 0$
$i_x = 2.286A$
$I_N = 4 - ix = 1.714A$

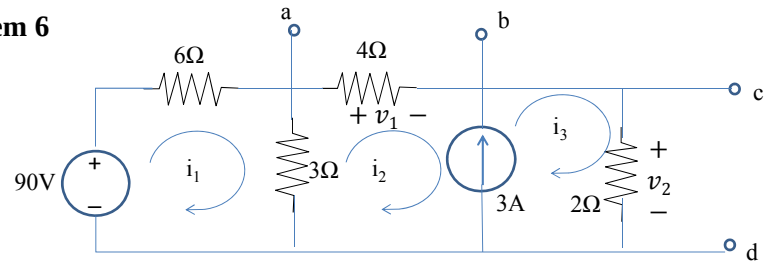


To find R_N, turn off 4A,
supply 1A source , need to find v_0

Since $i_x = 1A$, by KVL
$v_0 = 4i_x - 5i_x + 8i_x = 7i_x = 7V$
Then,
$R_N = v_o/1 = 7\Omega$

$I_N = 1.714A$, $R_N = 7\Omega$

Problem 6



$$\begin{cases} 6i_1+3(i_1-i_2)-90=0 \\ 4i_2+2i_3-3(i_1-i_2)=0 \\ i_3-i_2=3 \end{cases} \Rightarrow \begin{cases} i_1=11A \\ i_2=3A \\ i_3=6A \end{cases}$$

$V_{ab} = v_1 = 4i_2 = 12V$
$V_{cd} = v_2 = 2i_3 = 12V$

(a) a-b
$R_N=4//(6//3+2)\Omega=2\Omega$
$I_N=V_{ab}/2=6A$

(b) c-d
$R_N=2//(6//3+4)\Omega=1.5\Omega$
$I_N=V_{cd}/1.5=8A$

You may also use source transformation to obtain the same results

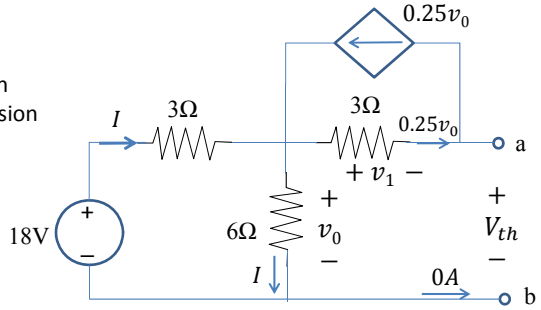
Problem 7

Since same current goes through the left 3Ω, and 6Ω, voltage division can be applied to find v_o

$v_0=18\times\frac{6}{3+6}V=12V$

$v_1=3\times 0.25v_0=9V$

$V_{TH}=v_0-v_1=3V$



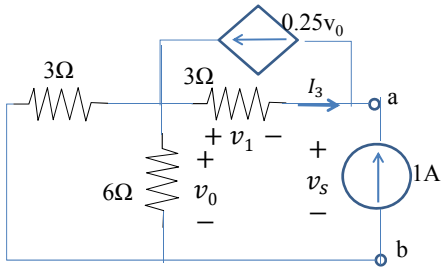
To find R_{th}, turn off 18V, supply 1A source , need to find v_s. In this case 3Ω *and* 6Ω are in parallel

$v_0=(3//6)\times 1=2V$

$v_1=3I_3=3\times(0.25v_0-1)=-1.5V$

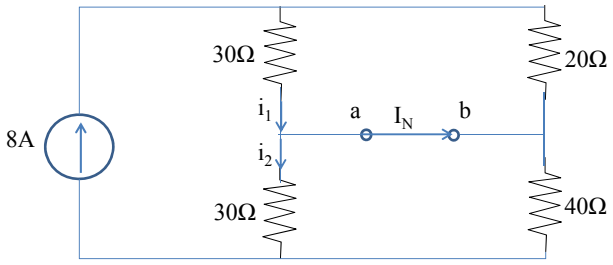
$v_s=v_0-v_1=3.5V$

$R_{TH}=v_s/1=3.5\Omega$



$V_{TH}=3V$, $R_{TH}=3.5\Omega$

Problem 8



By KCL, $I_N=i_1-i_2$

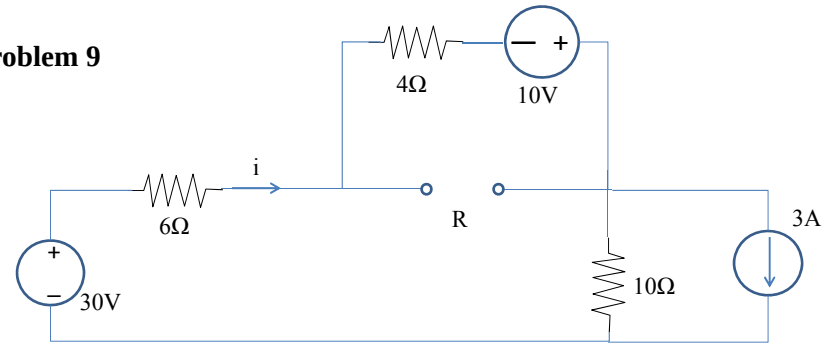
i_1, i_2 can be found by current division:

$I_N=i_1-i_2=8\times\frac{20}{30+20}-8\times\frac{40}{30+40}A=-1.371A$

$R_N=R_{TH}=(30+20)//(30+40)\Omega=29.167\Omega$

$V_{TH}=I_NR_{TH}=-40V$

Problem 9



Need to compute Thevenin's equivalent with respect to the two terminals:

-30+6i+4i-10+10(i-3)=0

i=3.5A

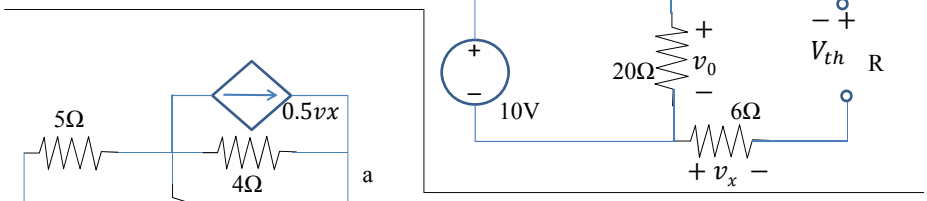
V_{TH} = 4i-10 = 4V

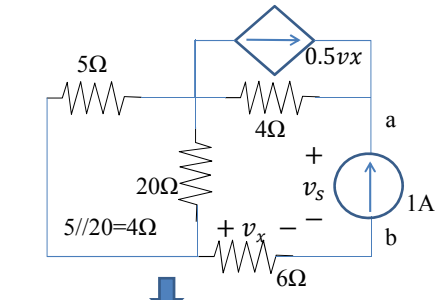
R_{TH}=4//(6+10) =3.2Ω

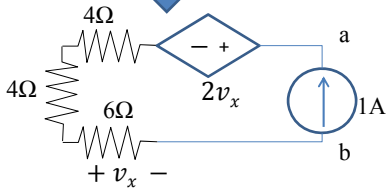
$P_{max}=(V_{TH})^2/(4R_{TH})$=1.25W

Problem 10

$V_{TH}=v_0=10\times\frac{20}{20+5}V=8V$







v_x=1 x 6 V=6V

v_s=6+4+4+2v_x=26V

$R_{TH}=v_s/1$=26Ω

$P_{max}=(V_{TH})^2/(4R_{TH})$=0.615W

Problem 11

$V_{TH}=V_{20\Omega}-V_{5\Omega}$

$=50\times\frac{20}{30}-50\times\frac{5}{30}$

$=25V$

$R_{TH}=10//20+25//5\ \Omega = 10.833\Omega$

$P_{max}=(V_{TH})^2/(4R_{TH})=14.424W$