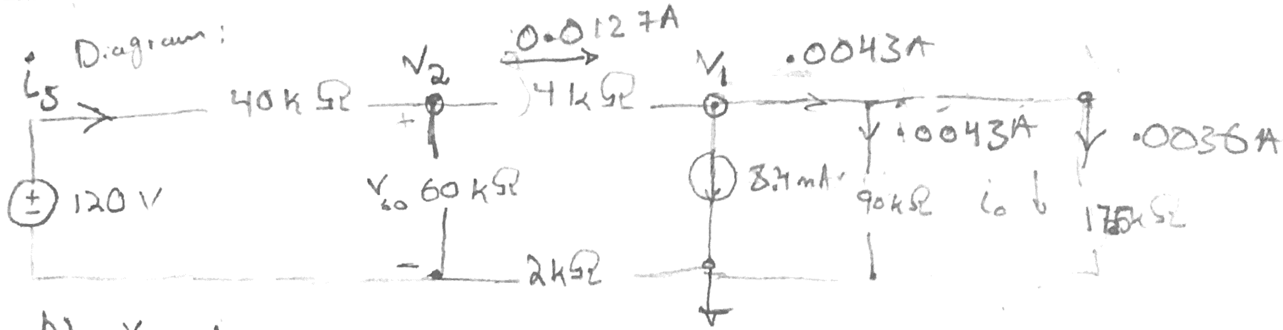
Problem # 1

Abdul Popal

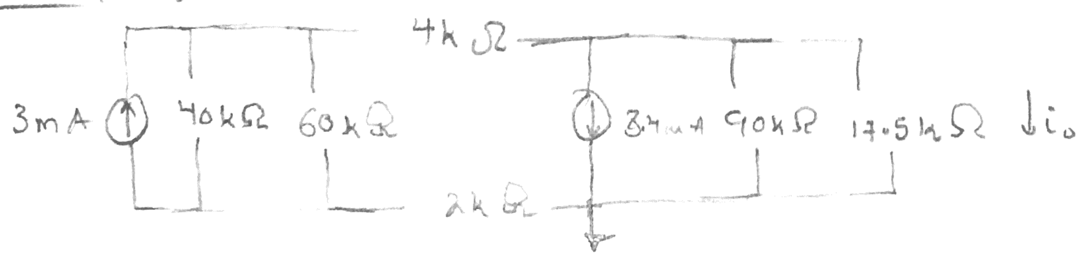
H'work 9

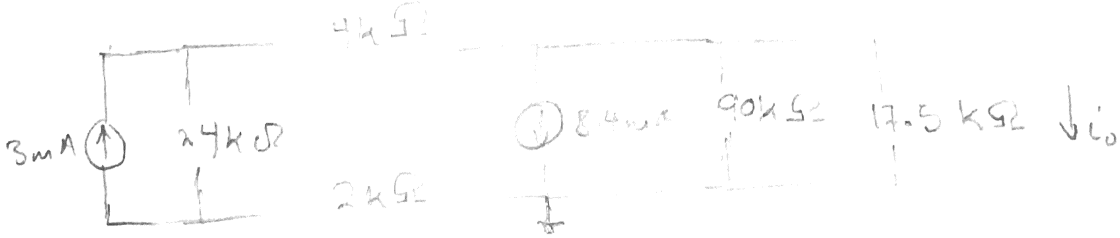
Given:

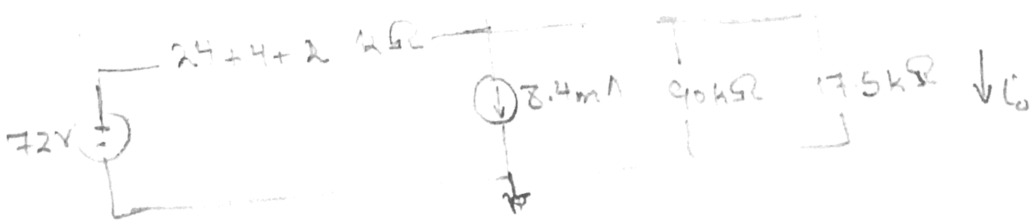


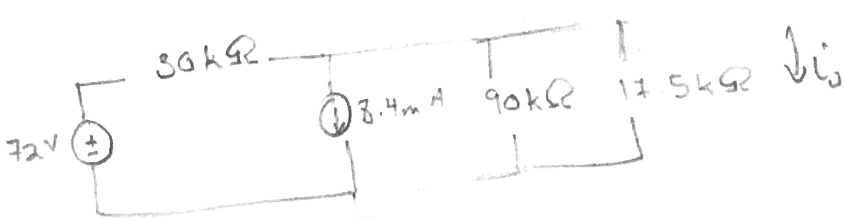
Find: a) i_o b) V_1, i_{90}, i_4, V_2, i_s

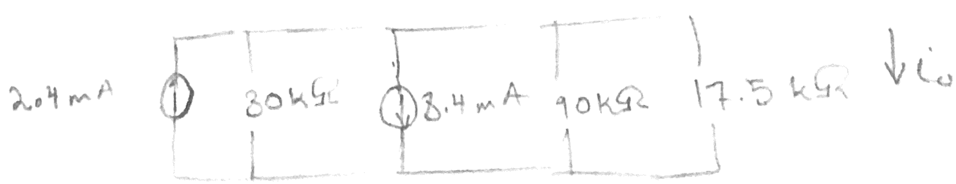
Solution: a)



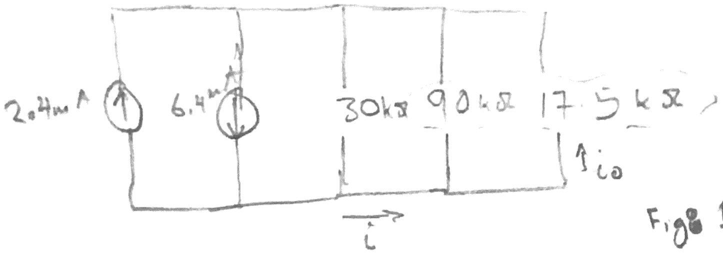








* Voltages are the same across branches



→ add together

Fig 1

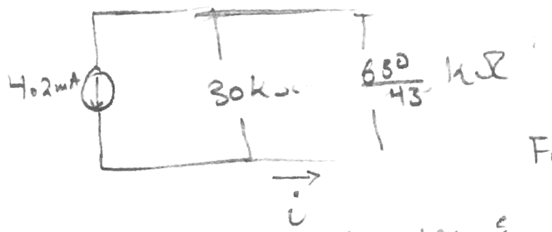


Fig: 2

* using current division :

$$i = \frac{9.84375}{\frac{630}{43}}(4.2\times10^{-3}A) = 0.0043\ A$$ using Fig 2.

$$i_o = \frac{630/43}{17.5}(0.0043A) = \underline{0.0036\ A}$$ using Fig 1.

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b) $v_1 = v_{90} = v_{17.5} = 17.5k\Omega(0.0036A) = \underline{63V}$

$$i_{90} = i - i_o = (0.0043 - 0.0036)A$$

$$i_{90} = \underline{0.7\ mA}$$

Using Intial Diagram:

$$-i_4 + .0043A + 0.0084A = 0$$

$$i_4 = \underline{0.0127\ A}$$

Node 2: $-\dfrac{(120-V_2)}{40k\Omega} + 0.0127A + \dfrac{V_2}{60k\Omega} = 0$

$$\frac{V_2-120}{40k\Omega} + \frac{V_2}{60k\Omega} = -0.0127$$

$$60,000(V_2-120) + 40,000V_2 = -0.0127$$

$$60,000V_2 - 60,000(120) + 40,000V_2 = -0.0127$$

$$V_2(100,000) = 60,000(120) - 0.0127$$

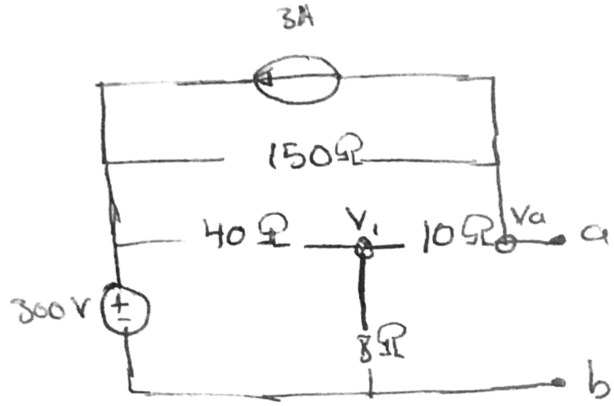
$$V_2 = \underline{\underline{72V}} = V_{60}.$$

KCL(2): $-i_8 + 0.0127A + 0.0012A = 0$

$$i_8 = 0.0139A \text{ or } \underline{\underline{13.9\ mA}}$$

Problem # 2

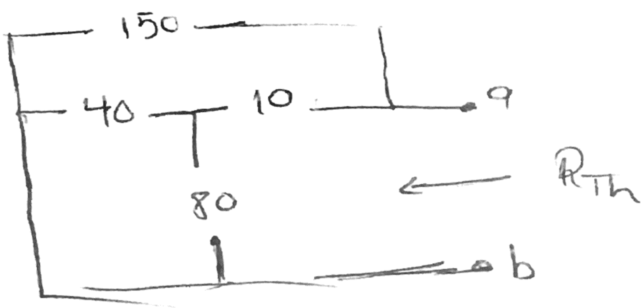
Given:



Find: R_{TH}, V_{TH}

Solution:

- open circuit for current.
- short circuit for voltage.



$\rightarrow R_{Th} = 150 \,//\, \{10 + (40 // 8)\}$

$= 150 \,//\, \{\frac{50}{3}\}$

$= \underline{15\,\Omega}$

Node(1): $\dfrac{V_1 - 300}{40} + \dfrac{V_1 - V_a}{10} + \dfrac{V_1}{8} = 0$ --- (1)

$50V_1 - 20V_a = 1500$

$3A + \dfrac{V_a - 300}{150} + \dfrac{V_a - V_1}{10} = 0$ --- (2)

$-15V_1 + 16V_a = -150$

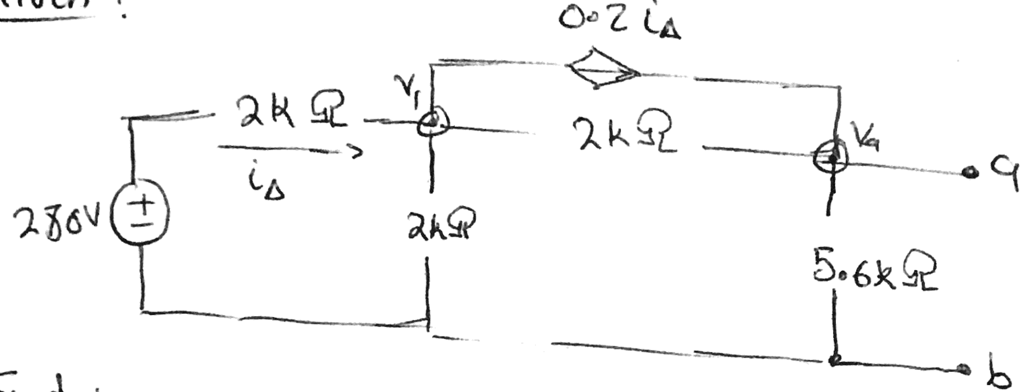
Using Matrices: $V_1 = 42\,V$

$V_a = 30\,V$

$V_{Th} = V_a - V_b$

$= 30 - 0 = \underline{30V}$

Problem # 3
Given !



Find ! Norton equivalent for the following circuit.

Solution;

$$\frac{V_1 - 280}{2000} + \frac{V_1}{2000} + \frac{V_1 - V_a}{2000} + 0.2\, i_\Delta = 0 \quad ----(1)$$

$$3V_1 - V_a + 400\, i_\Delta = 280 \quad ---(1)$$

$$-0.2\, i_\Delta + \frac{V_a - V_1}{2000} + \frac{V_a}{5600} = 0 \quad ---(2)$$

$$-14V_1 + 19V_a - 5600\, i_\Delta = 0 \quad ---(2)$$

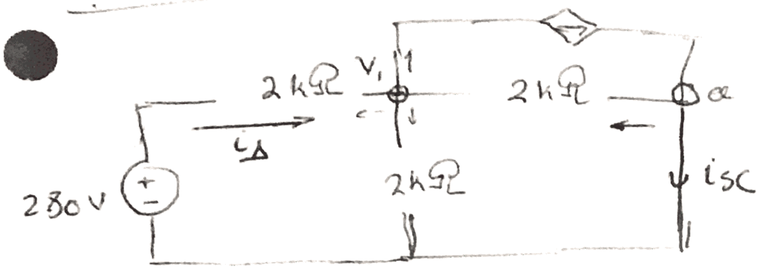
$$2000\, i_\Delta = 280 - V_1 \quad ---(3)$$

$$V_1 + 0V_a + 2000\, i_\Delta = 280 \quad ---(3)$$

using calculator ! $V_1 = 120V$, $V_a = 112V$, $i_\Delta = 0.08A$

$$V_{Th} = V_a - V_b = 112 - 0 = \underline{112\ V}$$

Problem #3 cont.



Node (V_1):

$$\frac{V_1 - 280}{2000} + \frac{V_1}{2000} + 0.2 i_\Delta + \frac{V_1}{2000} = 0$$

$$\frac{3V_1}{2000} = \frac{28}{200} - 0.2 i_\Delta \quad \text{--- (4)}$$

$$i_\Delta = \frac{V_1 - 280}{2000} \quad \text{--- (5) using constraint}$$

~~KCL @ a~~

$V_1 = 80V$, $i_\Delta = 0.1A$

$$-0.2 i_\Delta - \frac{V_1}{2000} + i_{sc} = 0$$

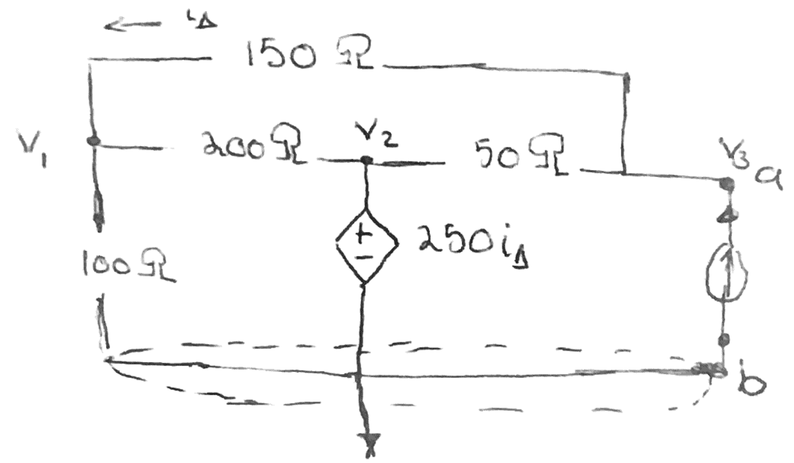
$$i_{sc} = \frac{V_1}{2000} + 0.2 i_\Delta \quad \text{--- (6)}$$

$$i_{sc} = i_N = \underline{60mA}$$

$$R_N = \frac{V_{TH}}{I_N} = \frac{112}{0.06} = \underline{1.867 k\Omega}$$

Problem # 4

Given:



Find: $R_{TH} = ?$

Solution: since no independent Source is contained with in the circuit there fore $V_{TH} = 0$

→ To find R_{TH} we put a 1A independent source –

$$V_2 = 250\, i_\Delta \quad \text{---(1)}$$

$$\frac{V_1}{100} + \frac{V_1 - 250 i_\Delta}{200} + \frac{V_1 - V_3}{150} = 0 \quad \text{----(2)}$$

$$13V_1 - 4V_3 - 750\, i_\Delta = 0 \quad \text{---(2)}$$

$$\frac{V_3 - V_1}{150} + \frac{V_3 - \overset{= 250 i_\Delta}{V_2}}{50} - 1 = 0 \quad \text{---(3)}$$

$$-V_1 + 4V_3 - 750\, i_\Delta = 150 \quad \text{---(3)}$$

$$i_\Delta = \frac{V_3 - V_1}{150} \quad \text{---(4)}$$ ∴ Sub(4) in (2),(3).

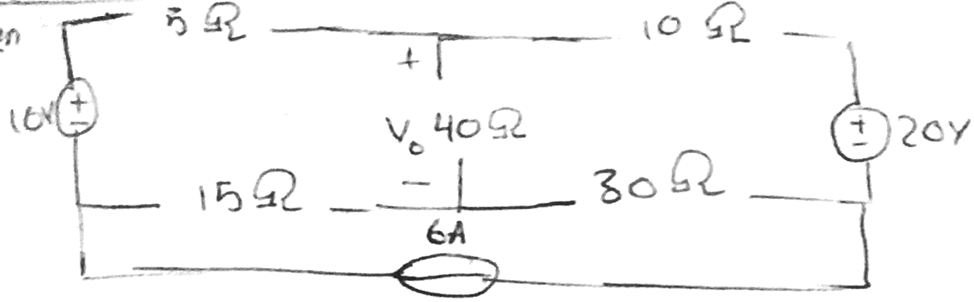
$$18V_1 - 9V_3 = 0 \rightarrow V_1 = \frac{V_3}{2}$$

$$4V_1 - V_3 = 150$$

$$V_3 = 150\,V \quad ∴ \quad R_{TH} = \frac{150\,V}{1\,A} = 150\,Ω$$

Problem # 5

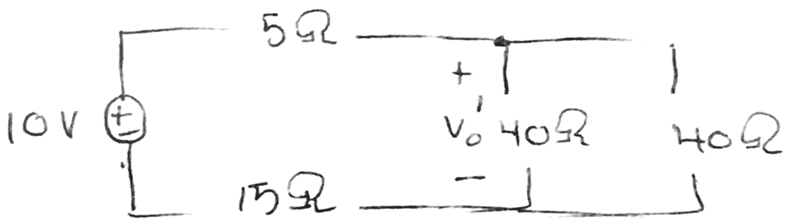
Given



Find: V_o using principle of super position -

Solution :-

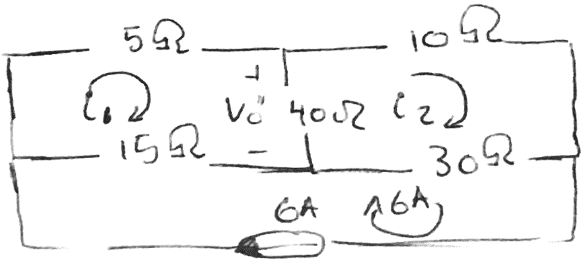
a) * Deactivate 20V by short circuit and 6A source by open circuit



* using voltage divider

$$V_o' = \frac{20\,\Omega}{(20+5+15)\,\Omega} \times 10\,V = \underline{5\,V}$$

b) * Deactivate 20V Source, 10V Voltage source



mesh(1):

$60i_1 - 40i_2 = 90 \quad \text{--- (1)}$

mesh(2)

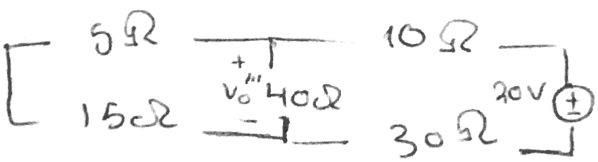
$-40i_1 + 80i_2 = 180 \quad \text{--- (2)}$

Eq (1) and (2) : $i_1 = 4.5\,A$

$i_2 = 4.5\,A$

therefore: $V_o'' = \underline{0}$

c)



$$V_o''' = \frac{20 // 40}{(20//40) + 40}(20\,V) = \underline{5\,V}$$

$V_o = V_o' + V_o'' + V_o''' = \underline{10\,V}$