1- Using Nodal Analysis, calculate the current through each resistor and the voltage across each resistor.

$$\frac{V_1-25}{\cancel{100}}+\frac{V_1-V_2}{\cancel{100}}+\frac{V_1-V_2}{\cancel{100}}=0$$

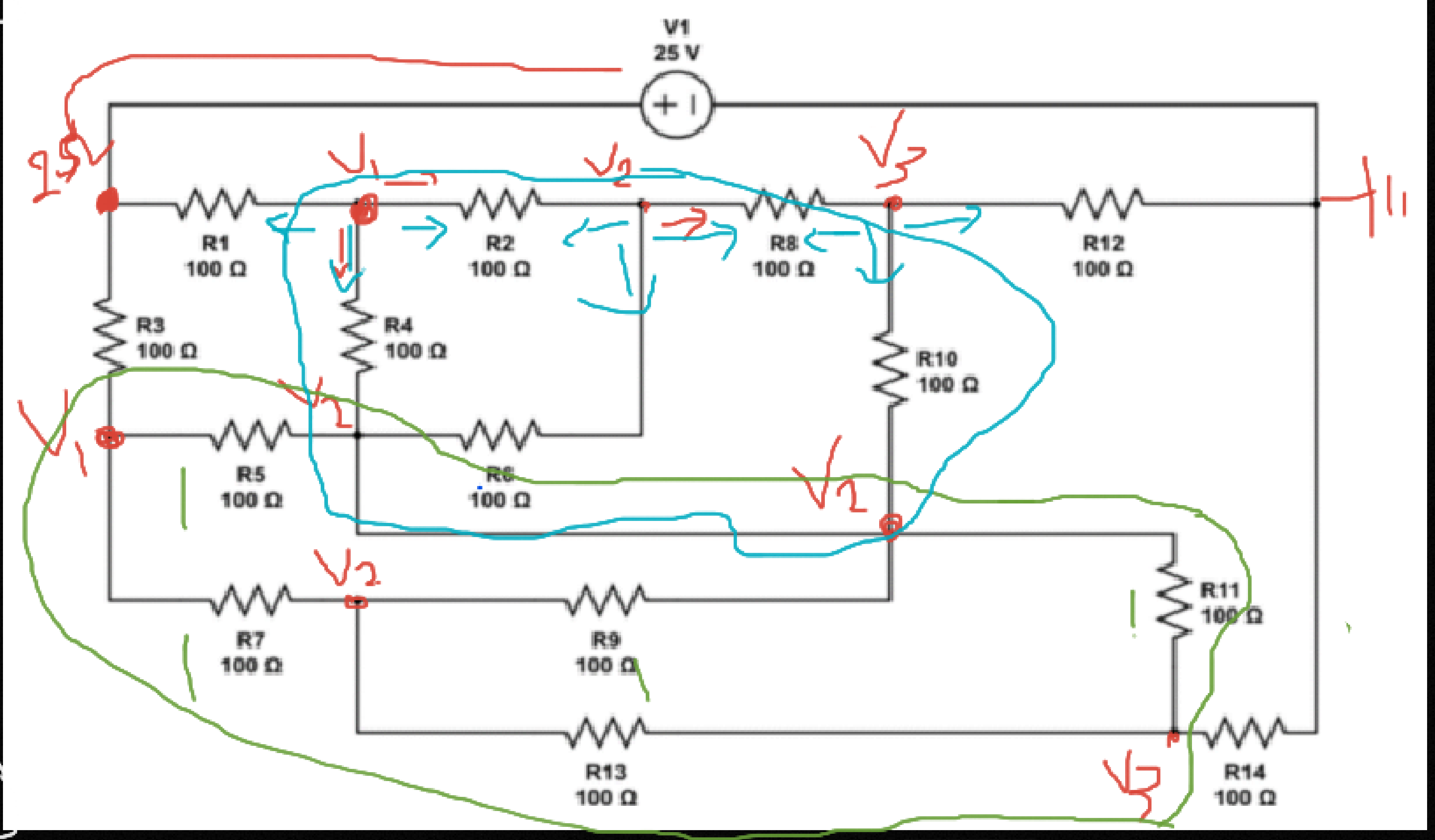
$$\boxed{3V_1-2V_2+0=25 \quad (1)}$$

$$\frac{V_2-V_1}{\cancel{100}}+\frac{V_2-V_3}{\cancel{100}}=0$$

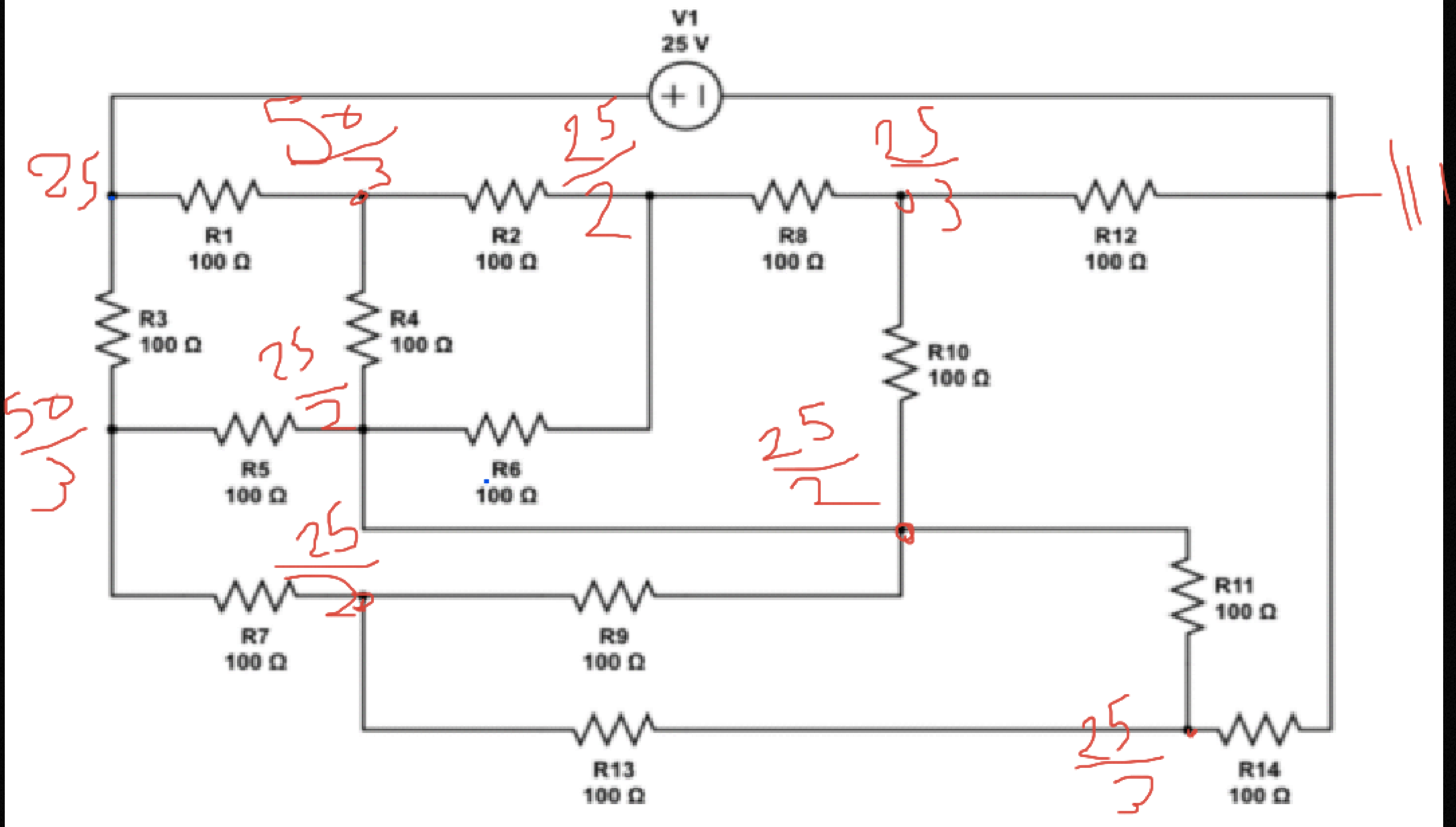
$$\boxed{-V_1+2V_2-V_3=0 \quad (2)}$$

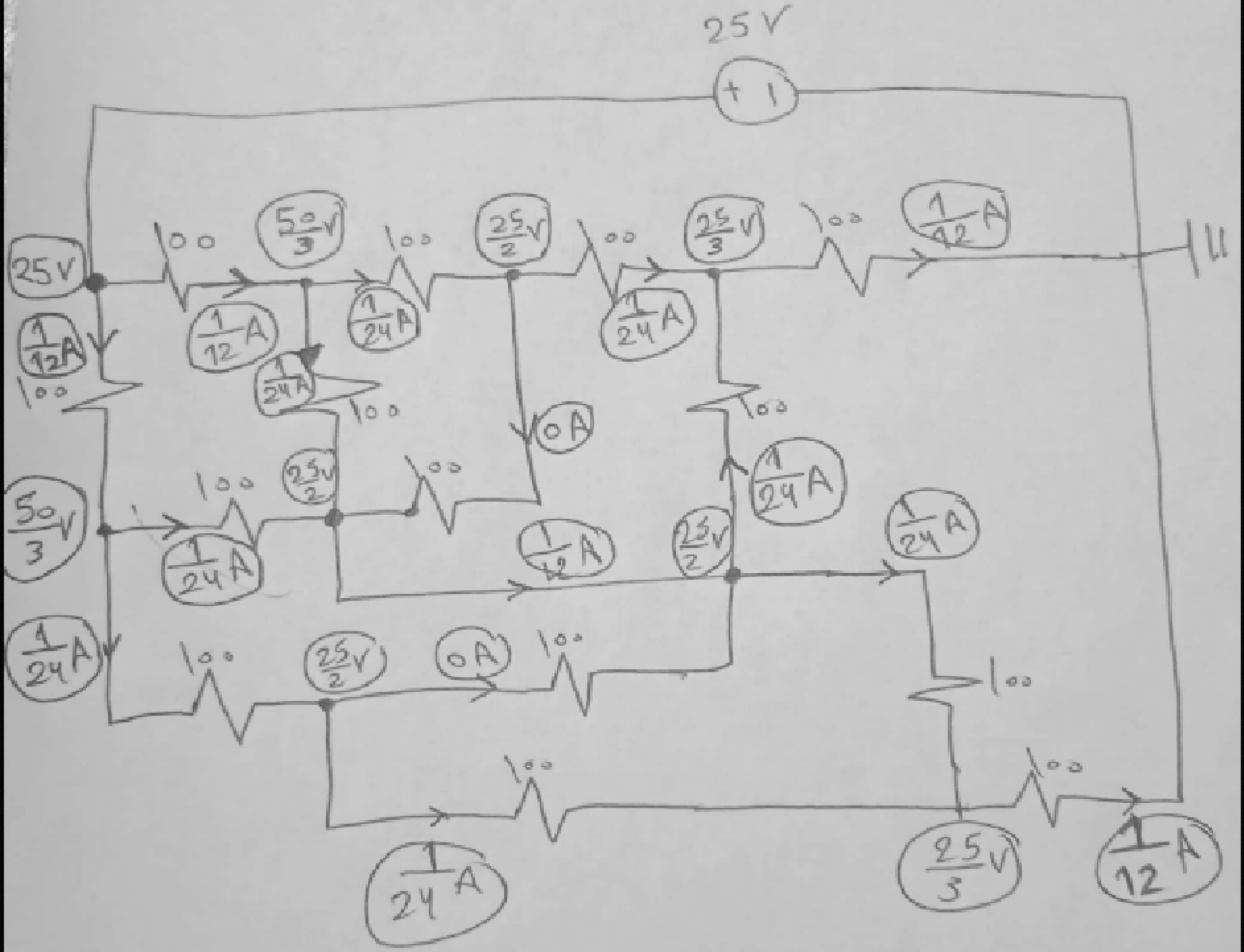
$$\frac{V_3-V_2}{\cancel{100}}+\frac{V_3-V_2}{\cancel{100}}+\frac{V_3-0}{\cancel{100}}=0$$

$$\boxed{0-2V_2+3V_3=0 \quad (3)}$$



1- Using Nodal Analysis, calculate the current through each resistor and the voltage across each resistor.




25V
+ |
25V
100
50/3 V
100
25/2 V
100
25/3 V
100
1/12 A
1/12 A
1/24 A
1/24 A
1/12 A
1/24 A
100
100
0A
100
1/24 A
100
25/2 V
100
50/3 V
1/24 A
1/12 A
25/2 V
1/24 A
1/24 A
100
25/2 V
0A
100
100
100
100
1/24 A
25/3 V
1/12 A

Thevinin:

$$\frac{V_1 - 110}{15} + \frac{V_1 - V_2}{5} - 0.1 V_\Delta = 0 \quad (1)$$

$$\frac{V_2 - V_1}{5} + \frac{V_2 + 3i_\Delta}{8} = 0 \quad (2)$$

$$v_\Delta = 110 - V_1 \quad (3)$$

$$i_\Delta = \frac{V_2 - V_1}{5} \quad (4)$$

$$\boxed{V_{th} = 55V}$$

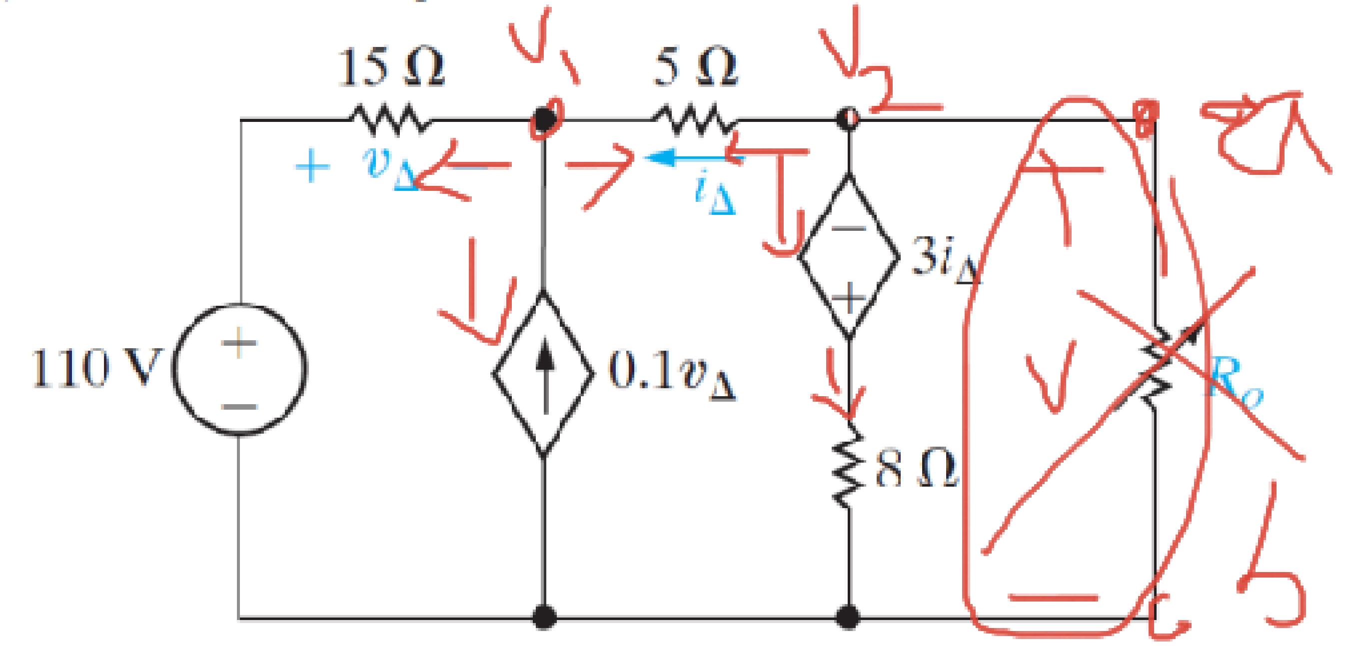
2- The variable resistor R_O in the following circuit is adjusted until it absorbs maximum power from the circuit.

a) Find the Thevenin and Norton equivalents with respect to the terminals a,b

b) Find the value of R_O.

c) Find the maximum power.

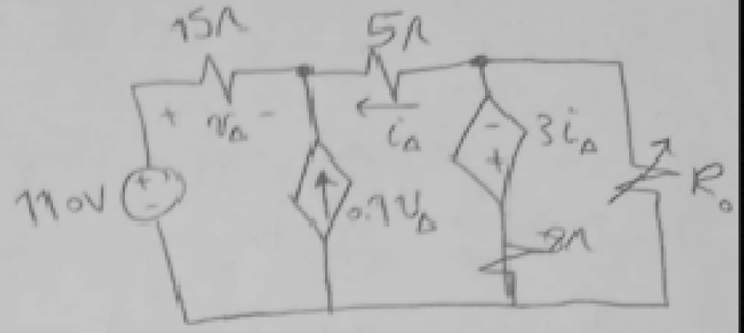
$R_L = R_{th}$



(2) (a) Thevenin, Norton

(b) $R_o = ?$

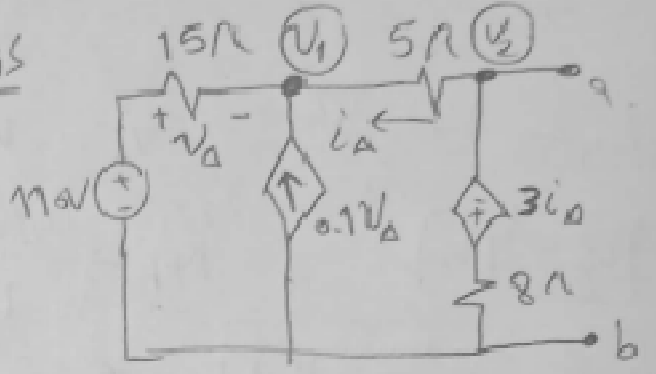
(c) Max power



Solution

To get V_{th} → open circuit

Nodal Analysis



$\frac{v_1-110}{15} + \frac{v_1-v_2}{5} - 0.1v_\Delta = 0$ → (1) *15

$\frac{v_2-v_1}{5} + \frac{v_2+3i_\Delta}{8} = 0$ → (2) *40

$i_\Delta = \frac{v_2-v_1}{5}$, $v_\Delta = 110 - v_1$ → Substituted in (1) & (2)

$v_1 - 110 + 3v_1 - 3v_2 - 15*0.1(110 - v_1) = 0$

$5.5v_1 - 3v_2 = 110 + 1.5*110$ (I)

$8v_2 - 8v_1 + v_2 + 3\left(\frac{v_2-v_1}{5}\right) = 0$ *5

$40v_2 - 40v_1 + 5v_2 + 3v_2 - 3v_1 = 0$

$\boxed{48v_2 = 43v_1}$ (II)

Solving (I) & (II) → $\boxed{\therefore v_2 = 55V}$

$\boxed{\therefore V_{th} = 55V}$ #

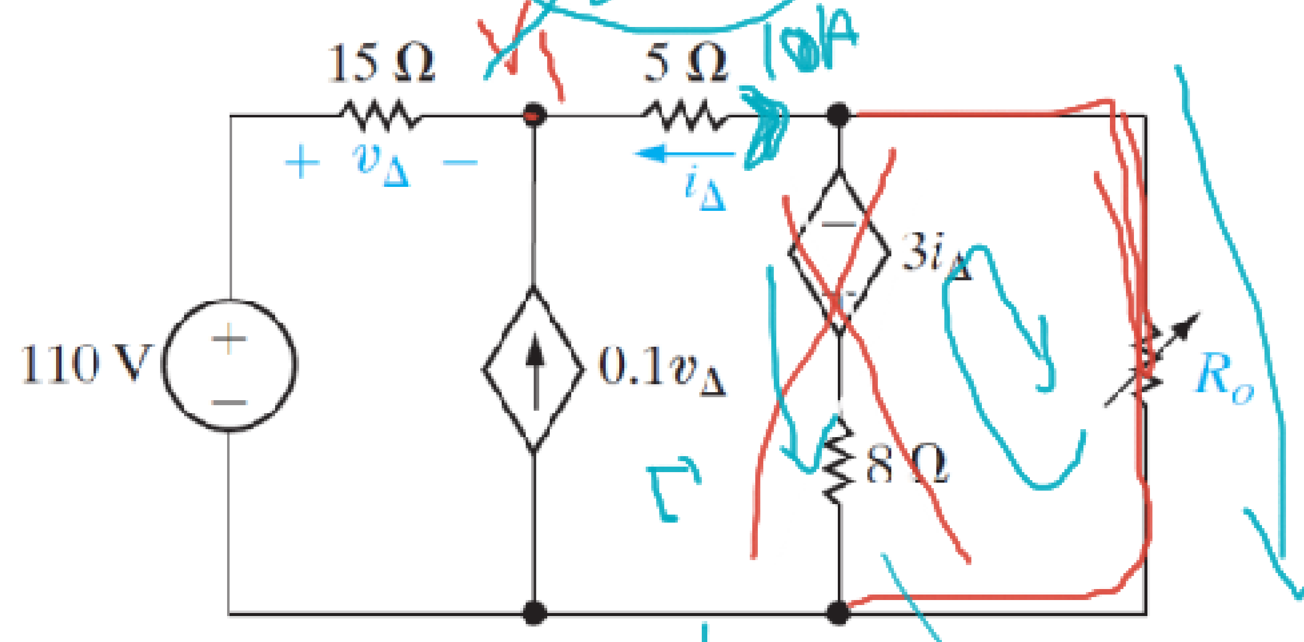
Norton I_N

2- The variable resistor R_O in the following circuit is adjusted until it absorbs maximum power from the circuit.

a) Find the Thevenin and Norton equivalents with respect to the terminals a,b

b) Find the value of R_O.

c) Find the maximum power.



$$\frac{V_1-110}{15}+\frac{V_1-5}{0}-0.1V_\Delta=0$$

$$V_\Delta=110-V_1$$

$$\boxed{V_1=56V}$$

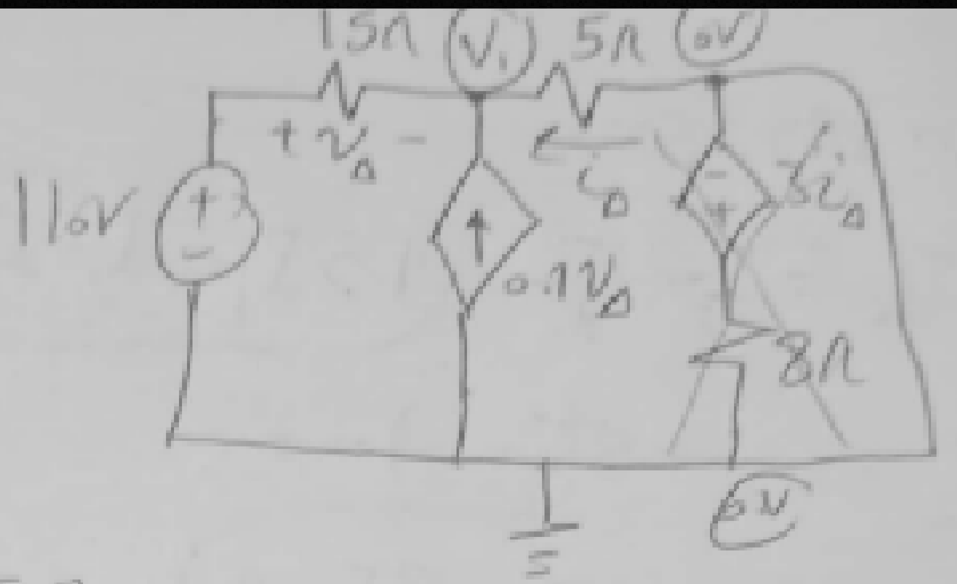
$$i_\Delta=-10A$$

$$\boxed{I=\frac{30}{8}}$$

$$8I+3\overset{-10}{i_\Delta}=0$$

$$I_N=10-\frac{30}{8}=\boxed{13.75A}$$

Norton:



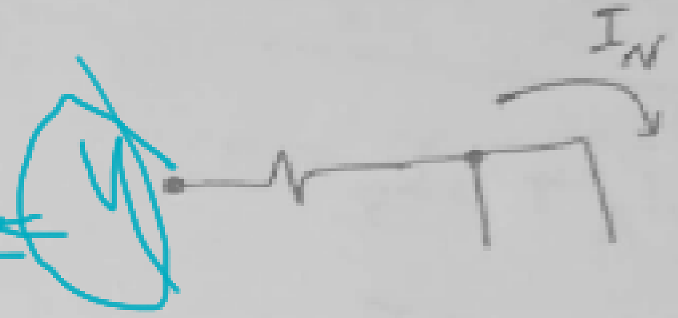
$$\frac{V_1-110}{15}+\frac{V_1-0}{5}-0.1v_\Delta=0$$

$$v_\Delta = 110 - V_1$$

$$\therefore \frac{V_1-110}{15}+\frac{V_1}{5}-0.1(110-V_1)=0$$

$$\boxed{\therefore V_1 = 50V}$$

$$R_{th} = \frac{V_{th}}{I_N}$$



$$\frac{V^2}{R}$$

$$i_\Delta = -10A$$

$$-3i_\Delta + 8I_3 = 0 \longrightarrow I_3 = \frac{-30}{8}$$

$$10 = I_N - \frac{30}{8} \longrightarrow \boxed{I_N = 13.75A} \ \#$$

$R_{th} = y$

$$\frac{(55/2)^2}{4} = y$$

3- A resistive touch screen has 5 V applied to the grid in the x-direction and in the y-direction. The screen has 480 pixels in the x-direction and 800 pixels in the y-direction. When the screen is touched, the voltage in the x-grid is 1 V and the voltage in the y-grid is 3.75 V.)

a) Calculate the values of α and β.

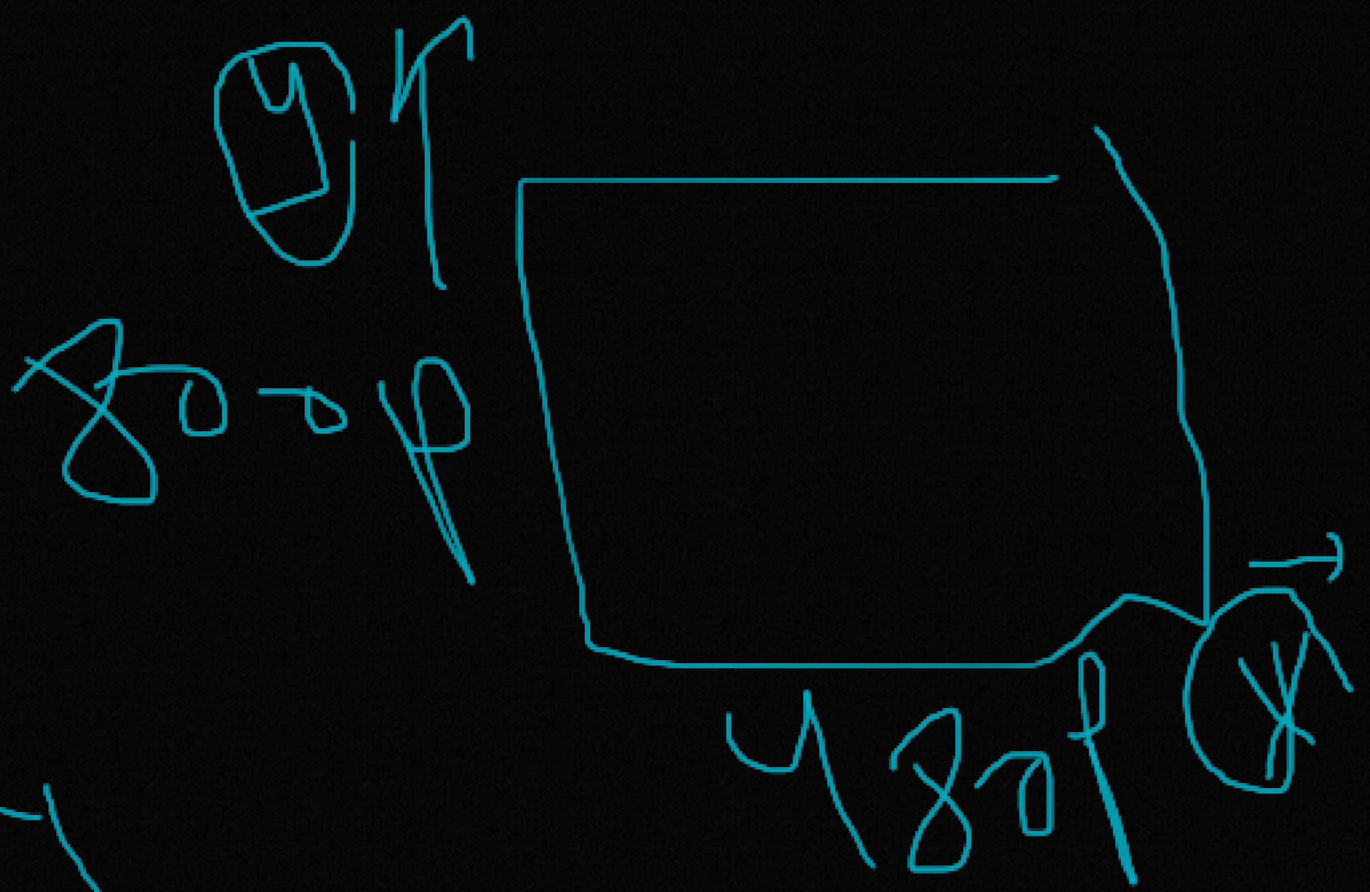
b) Calculate the x- and y-coordinates of the pixel at the point where the screen was touched.

$$\alpha = \frac{V_x}{V_s} = \frac{1}{5} = 0.2$$

$$\beta = \frac{V_y}{V_s} = \frac{3.75}{5} = 0.75$$

$$x = (1-\alpha) * 480 = 384$$

$$y = (1-\beta) * 800 = \boxed{200}$$



$\boxed{3}$ $V_x = \alpha V_s \Rightarrow \alpha = \frac{V_x}{V_s} = \frac{1}{5} = \boxed{0.2}$

ⓐ $V_y = \beta V_s \Rightarrow \beta = \frac{V_y}{V_s} = \frac{3.75}{5} = \boxed{0.75}$

ⓑ $X = (1-\alpha) P_x = (1-0.2) * 480 = \boxed{384}$

$y = (1-\beta) P_y = (1-0.75) * 800 = \boxed{200}$

The touch occurred in the upper right Corner of the Screen