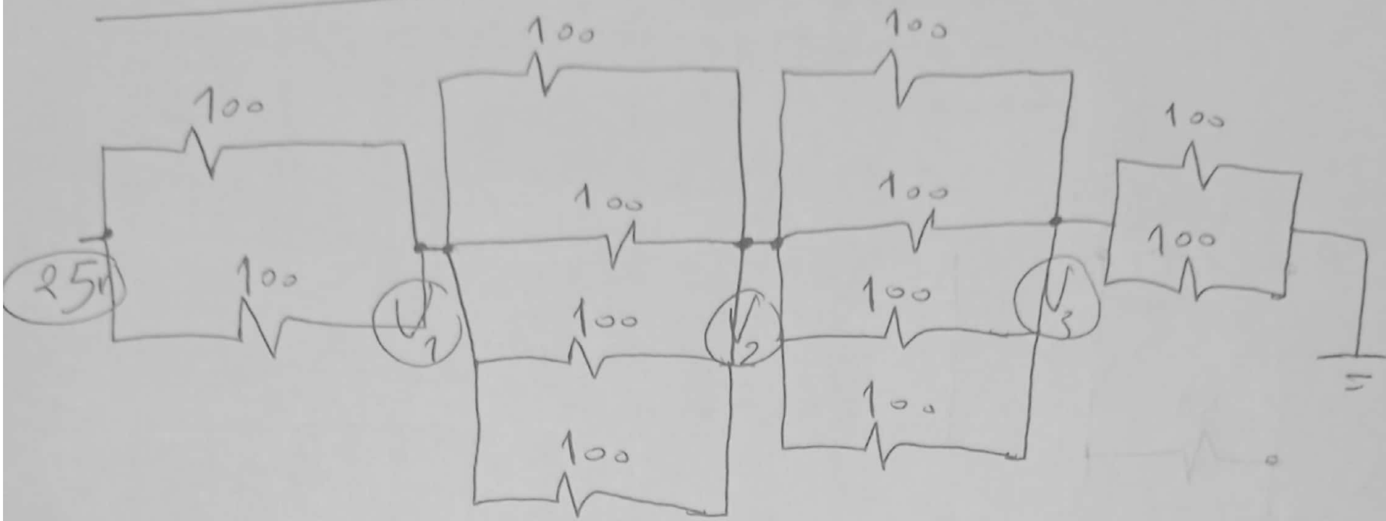
① Using Nodal Analysis:



$$\frac{V_1-25}{50}+\frac{V_1-V_2}{25}=0 \rightarrow V_1-25+2V_1-2V_2=0$$

$$\boxed{3V_1-2V_2+0=25}$$

$$\frac{V_2-V_1}{25}+\frac{V_2-V_3}{25}=0 \rightarrow V_2-V_1+V_2-V_3=0$$

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

$$\frac{V_3-V_2}{25}+\frac{V_3-0}{50}=0 \rightarrow 2V_3-2V_2+V_3=0$$

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

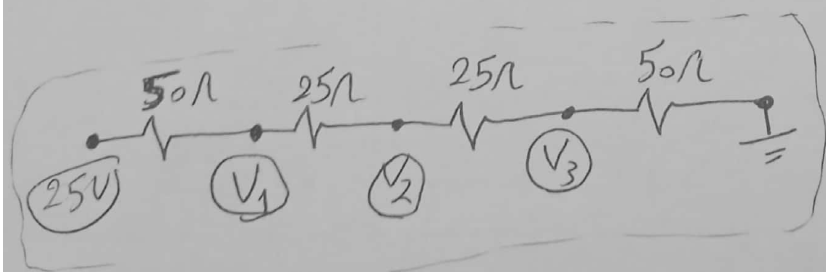
$$\boxed{\begin{aligned} V_1 &= \frac{50}{3}\,V \\ V_2 &= \frac{25}{2}\,V \\ V_3 &= \frac{25}{3}\,V \end{aligned}}$$

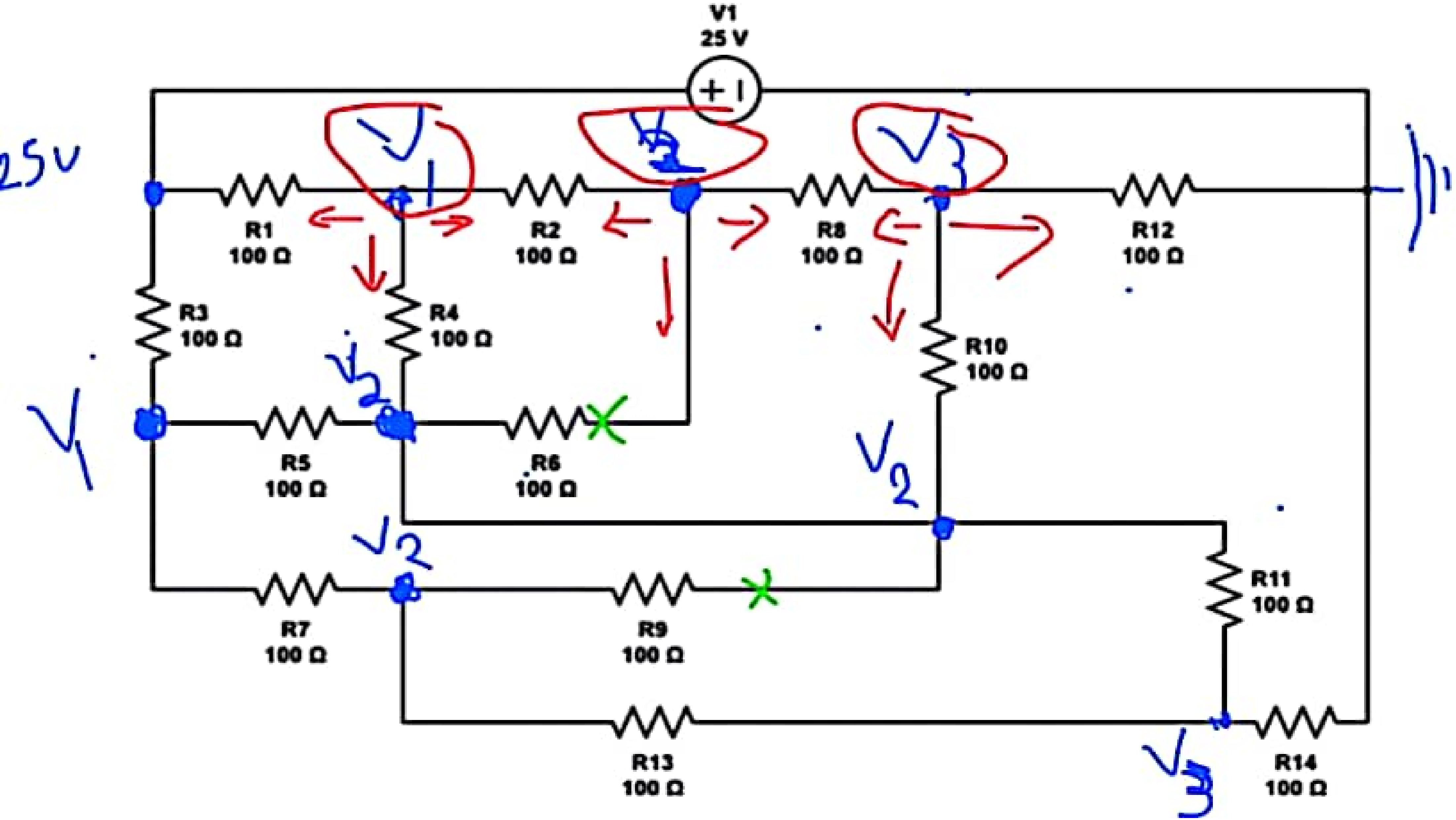
Notes:

→ we have equal resistors & 1 Voltage Src.

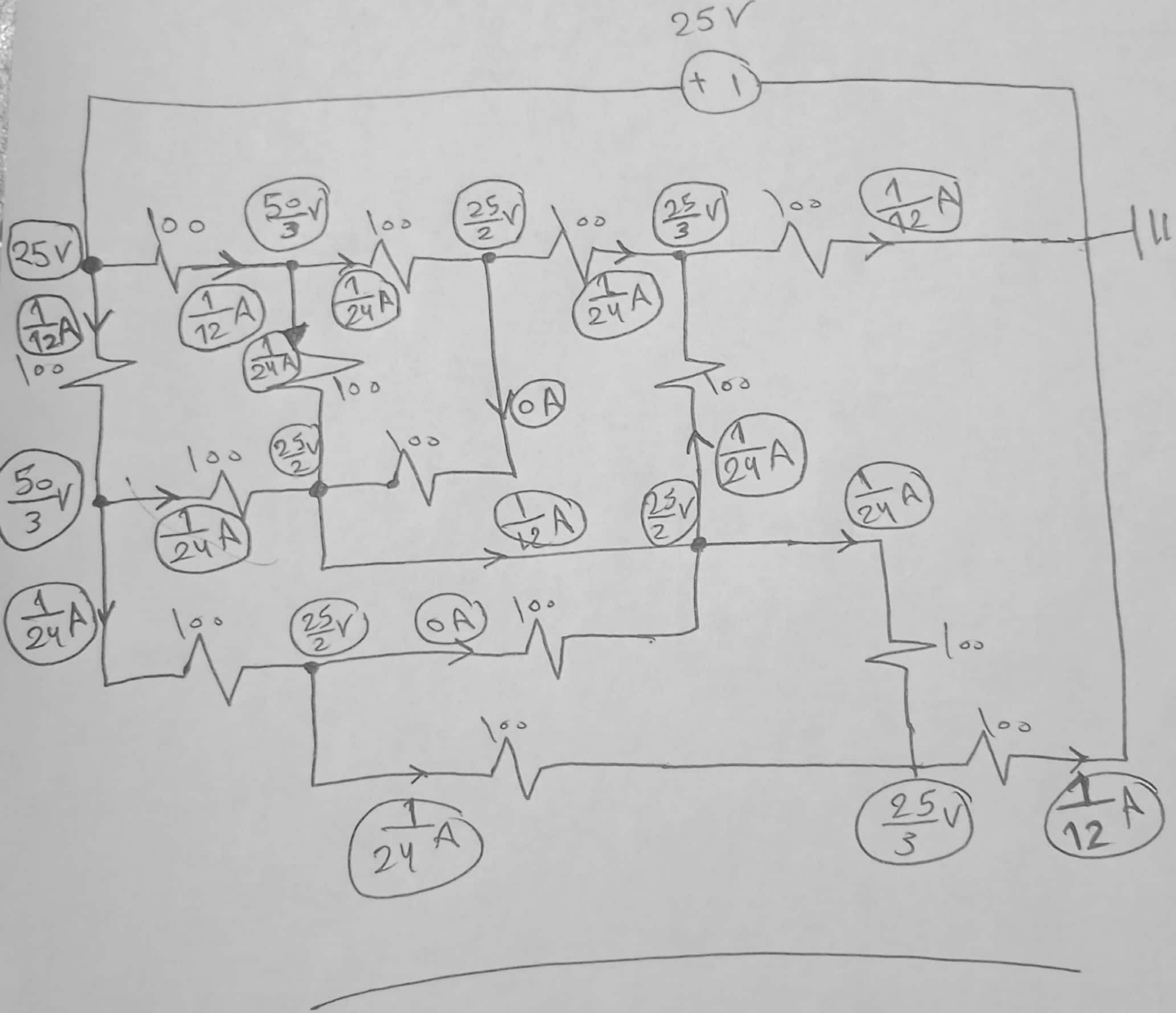
→ green resistors are eliminated (drop Voltage across each = 0 as I = 0)

→ In Nodal analysis, we get equivalent resistance between any two nodes.





V1
25 V
25v
R1
100 Ω
R2
100 Ω
R8
100 Ω
R12
100 Ω
R3
100 Ω
R4
100 Ω
R10
100 Ω
R5
100 Ω
R6
100 Ω
R7
100 Ω
R9
100 Ω
R11
100 Ω
R13
100 Ω
R14
100 Ω
V1
V2
V3



25V
+ |
25V
$\frac{50}{3}$V
$\frac{25}{2}$V
$\frac{25}{3}$V
$\frac{1}{12}$A
$\frac{1}{24}$A
0A
100

Another Solution: From the image

$$\frac{V_1-25}{100}+\frac{V_1-V_2}{100}+\frac{V_1-V_2}{100}=0 \rightarrow \boxed{3V_1-2V_2+0=25}$$

$$\frac{V_2-V_1}{100}+\frac{V_2-V_3}{100}=0 \rightarrow \boxed{-V_1+2V_2-V_3=0}$$

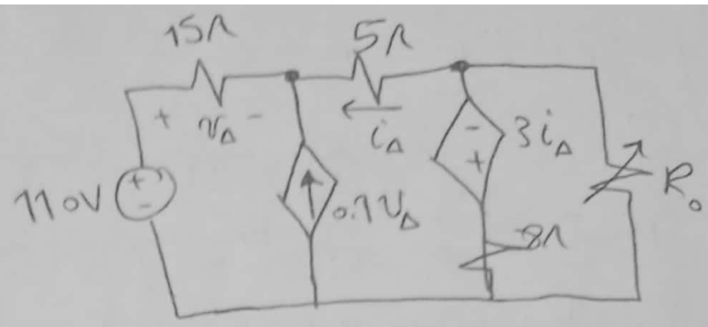
$$\frac{V_3-V_2}{100}+\frac{V_3-0}{100}+\frac{V_3-V_2}{100}=0 \rightarrow \boxed{0-2V_2+3V_3=0}$$

$$\boxed{V_1=\frac{50}{3}V} \quad \boxed{V_2=\frac{25}{2}V} \quad \boxed{V_3=\frac{25}{3}V}$$

(2) (a) Thevenin, Norton

(b) $R_o = ?$

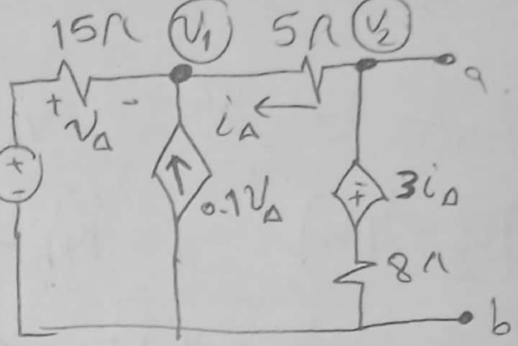
(c) Max power



Solution

To get $V_{th} \rightarrow$ open circuit

Nodal Analysis



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

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

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

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

$$\boxed{5.5v_1 - 3v_2 = 110 + 1.5 * 110} \quad (I)$$

$*5$

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

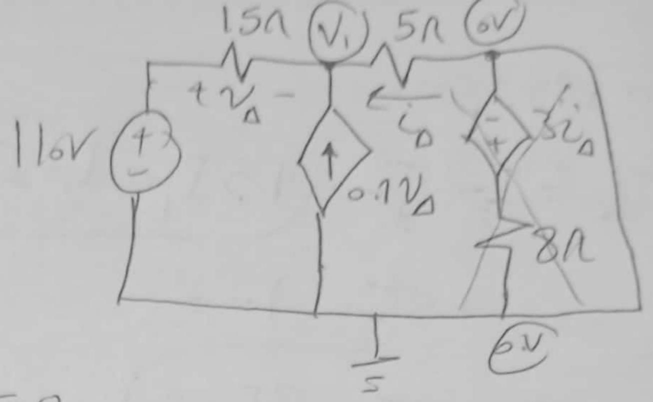
$$40v_2 - 40v_1 + 5v_2 + 3v_2 - 3v_1 = 0$$

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

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

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

Norton:

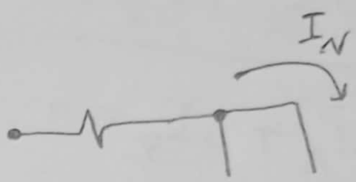


$$\frac{V_1 - 110}{15} + \frac{V_1 - 0}{5} - 0.1\,v_\Delta = 0$$

$v_\Delta = 110 - V_1$

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

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

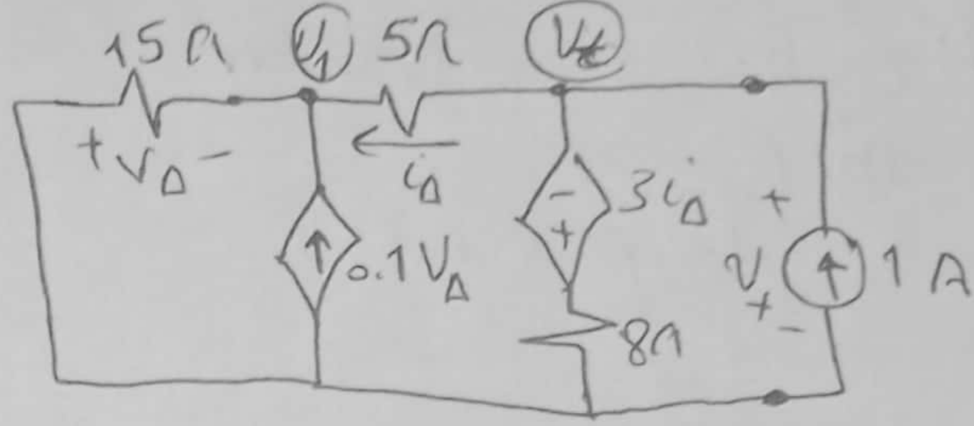


$i_\Delta = -10A$

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

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

To get R_{th} :



$$\frac{v_1}{15} - 0.1 V_\Delta + \frac{v_1 - v_t}{5} = 0$$

$$\frac{v_t - v_1}{5} + \frac{v_t - 3 i_\Delta}{8} - 1 = 0$$

$$i_\Delta = \frac{v_t - v_1}{5} \quad , \quad V_\Delta = -v_1$$

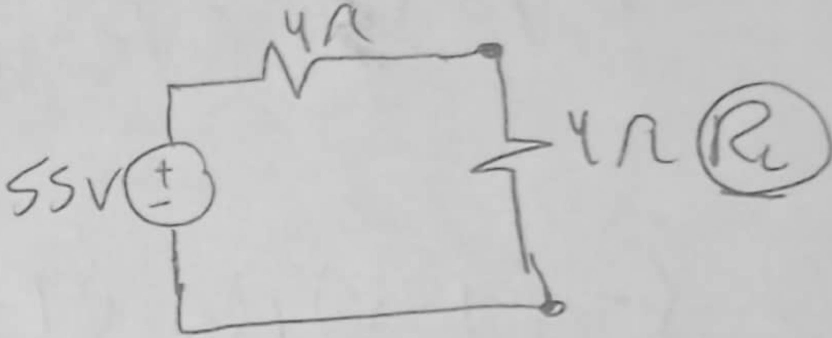
solving equations we get :

$\boxed{v_t = 4V}$ $\quad \therefore R_{th} = \frac{v_t}{1} = \boxed{4 \Omega}$

$\boxed{\therefore R_o = R_{th} = 4 \Omega}$ #

2 (c)

$$P_{max} = \frac{V^2}{R} = \frac{(27.5)^2}{4} = \boxed{189.0625\,W}$$



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

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

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

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

The touch occurred in the upper right corner of the screen