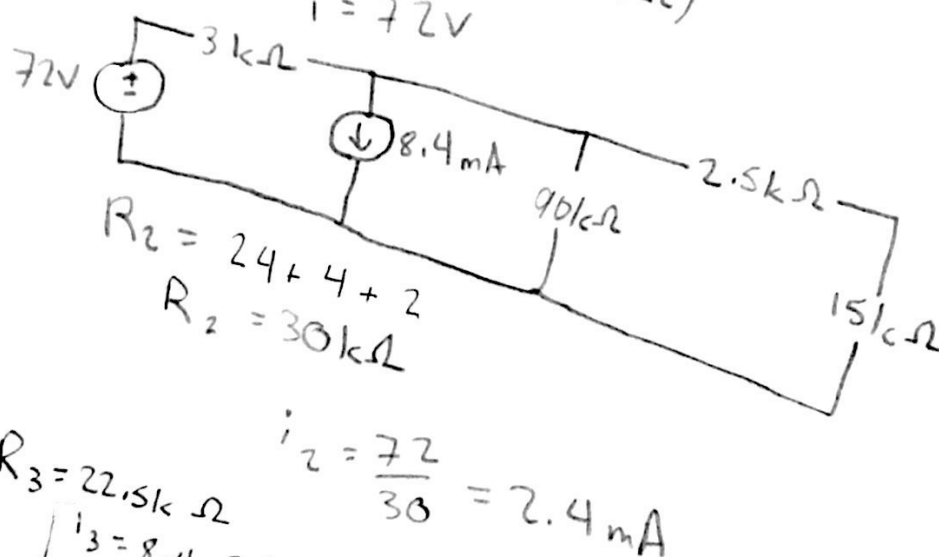
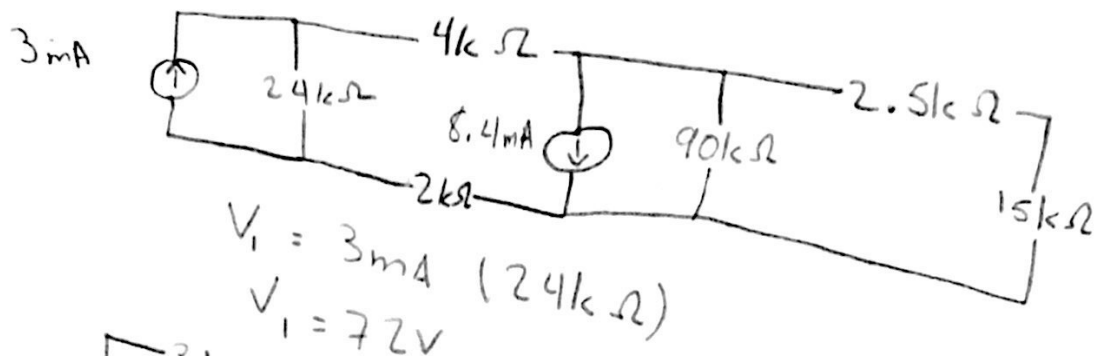
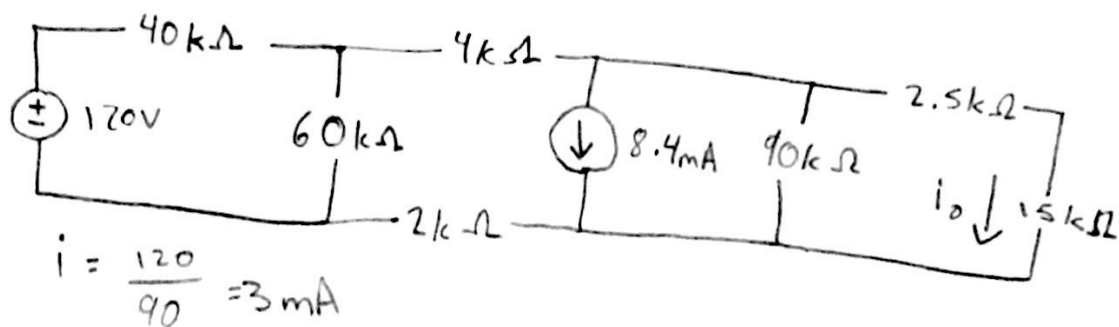


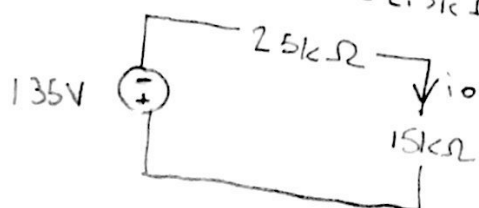
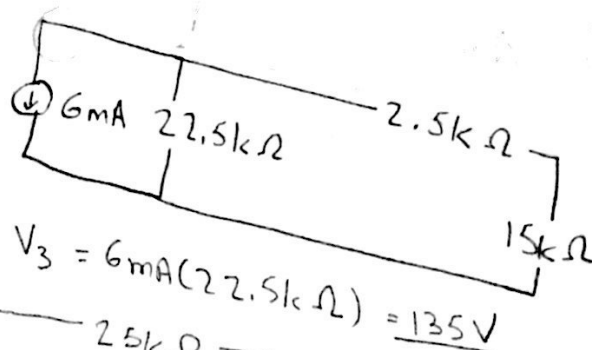
Q1) i)



$$R_3 = 22.5 \text{ k}\Omega$$

$$i_3 = 8.4 - 2.4 \text{ mA}$$

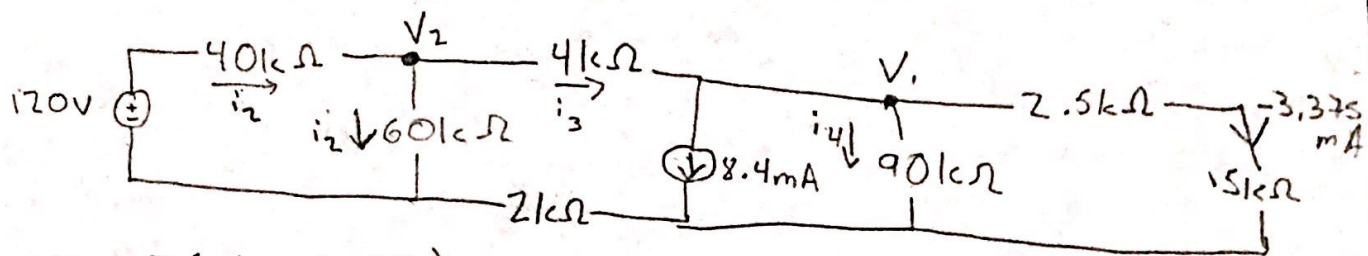
$$i_3 = 6 \text{ mA}$$



$$i = \frac{V}{R}$$

$$i_o = -\frac{135}{40} = -3.375 \text{ mA}$$

ii)



$$V_1 = -3.375(2.5 + 15)$$

$$V_1 = -59.0625V$$

$$i_4 = \frac{V}{R} = \frac{-59.0625}{96}$$

$$i_4 = -0.6563mA$$

$$i_3 = 8.4 + i_4 - 3.375$$

$$i_3 = 8.4 - 0.6563 - 3.375$$

$$i_3 = 4.3687mA$$

$$V_2 = 4.3687(6) + (-59.0625V)$$

$$V_2 = -32.8503V$$

$$i_2 = \frac{-32.8503}{60k\Omega}$$

$$i_2 = -0.5475mA$$

$$i_1 = i_2 + i_3$$

$$= -0.5475 + 4.3687$$

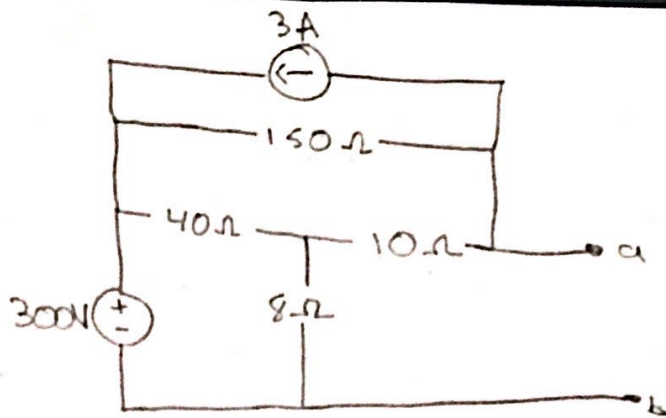
$$i_1 = 3.8212mA$$

$$P = iV$$

$$P_{120V} = 3.8212(120V)$$

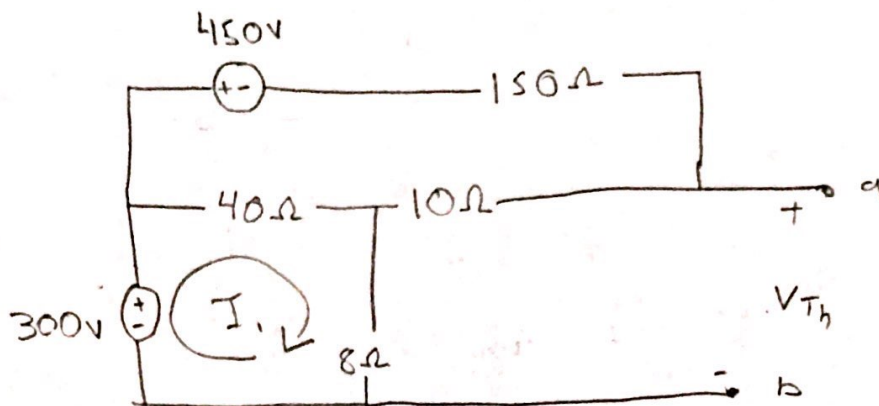
$$P_{120V} = 458.5W$$

Q2)



$$V = 3(150)$$

$$V = 450V$$



mesh current

$$-300 + 40(i_1 - i_2) + 8i_1 = 0$$

$$48i_1 - 40i_2 = 300$$

$$450 + 150i_2 + 10i_2 + 40(i_2 - i_1) = 0$$

$$-40i_1 + 200i_2 = -450$$

$$\begin{bmatrix} 48 & -40 \\ -40 & 200 \end{bmatrix} \begin{bmatrix} i_1 \\ i_2 \end{bmatrix} = \begin{bmatrix} 300 \\ -450 \end{bmatrix}$$

$$i_1 = 5.25A$$

$$i_2 = -1.2A$$

$$V_{Th} = 10i_2 + 8i_1$$

$$V_{Th} = 30V$$

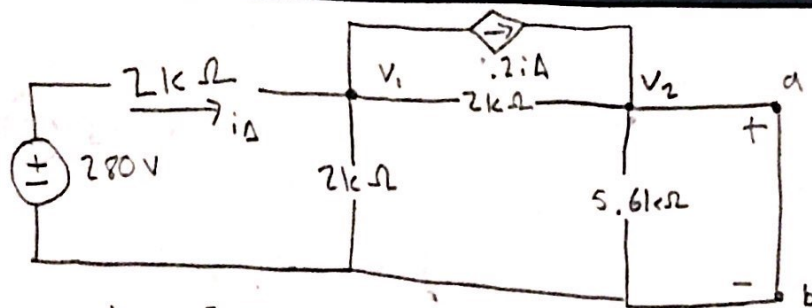
$$R_{Th} = [(40 \parallel 8) + 10] \parallel 150$$

$$= \frac{40(8)}{48} + 10 = 16.67$$

$$= \frac{16.67(150)}{16.67 + 150}$$

$$R_{Th} = 15\Omega$$

Q3)



$$i_{\Delta} = \frac{280 - V_1}{2000} \quad V_2 = 0V$$

KVL1

$$\frac{V_1 - 280}{2000} + \frac{V_1}{2000} + \frac{V_1 - V_2}{2000} = -0.2i_{\Delta}$$

$$3V_1 - 280 - V_2 = -400i_{\Delta}$$

$$3V_1 - 280 - V_2 = -400 \left(\frac{280 - V_1}{2000} \right)$$

$$3V_1 - 280 = -56 + 0.2V_1$$

$$V_1 = 80V$$

$$i_{\Delta} = \frac{280 - 80}{2000}$$

$$i_{\Delta} = .1A$$

KVL2

$$i_{sc} = (0.2)(.1) + \frac{80}{2000}$$

$$i_{sc} = .06A$$

KCL1

$$3V_1 - 280 - V_2 = -400 \left(\frac{280 - V_1}{2000} \right)$$

$$3V_1 - V_2 - 280 = -56 + 0.2V_1$$

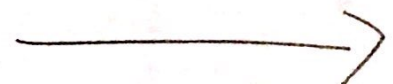
$$2.8V_1 = 224 + V_2$$

$$V_1 = \frac{224 + V_2}{2.8}$$

KCL2

$$\frac{V_2}{5600} + \frac{V_2 - V_1}{2000} = 0.2 - i_{\Delta}$$

$$-14V_1 + 19V_2 = 5600i_{\Delta}$$



$$-14V_1 + 19V_2 = 5600 \left(\frac{280 - V_1}{2000} \right)$$

$$-14V_1 + 19V_2 = 784 - 2.8V_1$$

$$-11.2V_1 + 19V_2 = 784$$

$$-11.2 \left(\frac{224 + V_2}{28} \right) + 19V_2 = 784$$

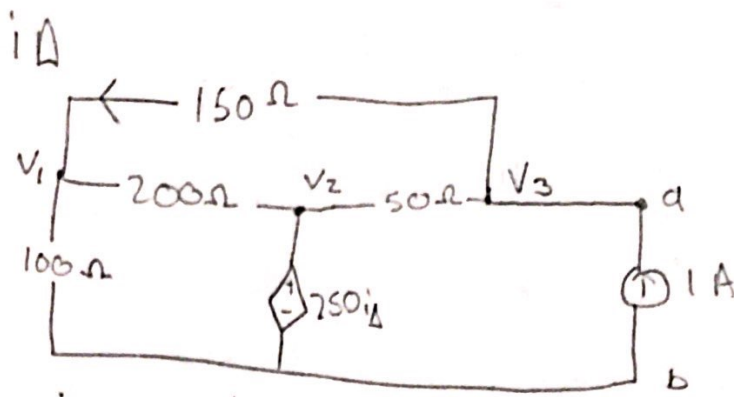
$$-896 - 4V_2 + 19V_2 = 784$$

$$V_{Th} = V_2 = 112V$$

$$R_N = \frac{112V}{.06}$$

$$R_N = 1866.7 \Omega$$

Q4)



$$i_D = \frac{V_3 - V_1}{150}, \quad V_2 - 250i_D$$

$$V_2 = 250 \left(\frac{V_3 - V_1}{150} \right) \rightarrow -\frac{5}{3}V_1 - V_2 + \frac{5}{3}V_3 = 0$$

KCL1

$$\frac{V_1}{100} + \frac{V_1 - V_3}{150} + \frac{V_1 - V_2}{150} = 0$$

$$6V_1 + 3V_1 - 3V_2 + 4V_1 - 4V_3 = 0$$

$$13V_1 - 3V_2 - 4V_3 = 0$$

KCL3

$$\frac{V_3 - V_2}{50} + \frac{V_3 - V_1}{150} = 1$$

$$3V_3 - 3V_2 + V_3 - V_1 = 150$$

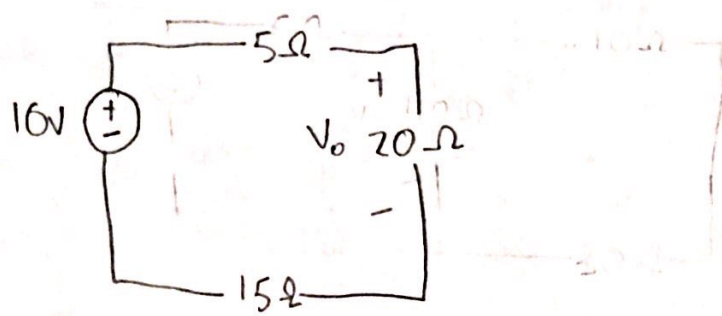
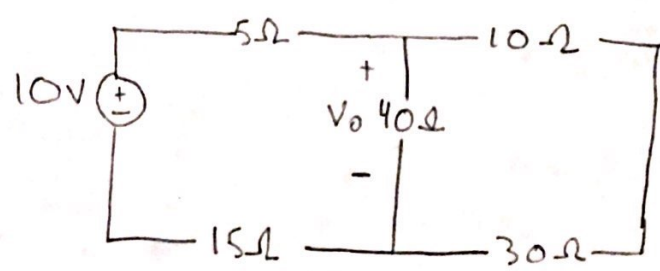
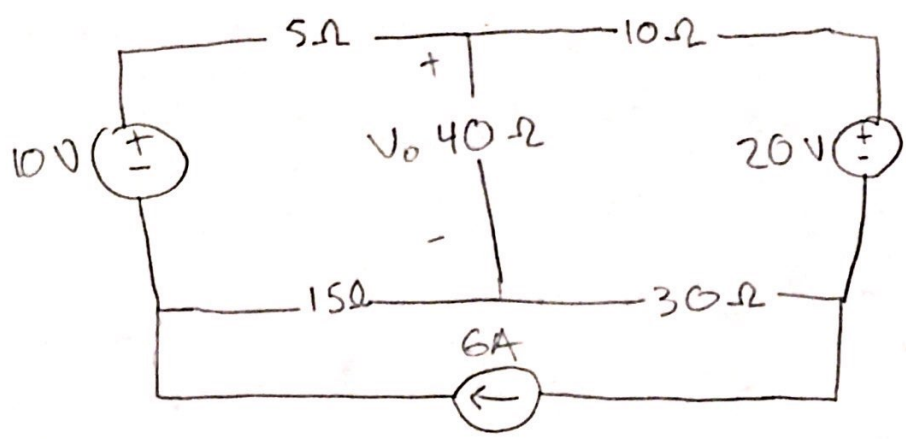
$$-V_1 - 3V_2 + 3V_3 = 150$$

$$\begin{bmatrix} -5/3 & -1 & 5/3 \\ 13 & -3 & -4 \\ -1 & -3 & 4 \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \\ V_3 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 150 \end{bmatrix}$$

$$V_3 = 150$$

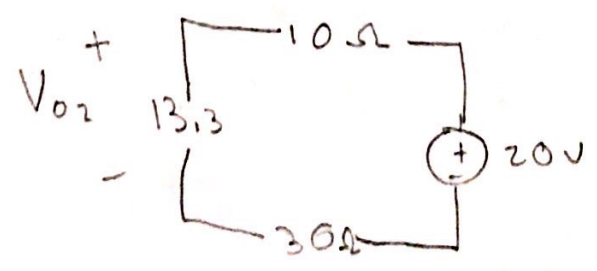
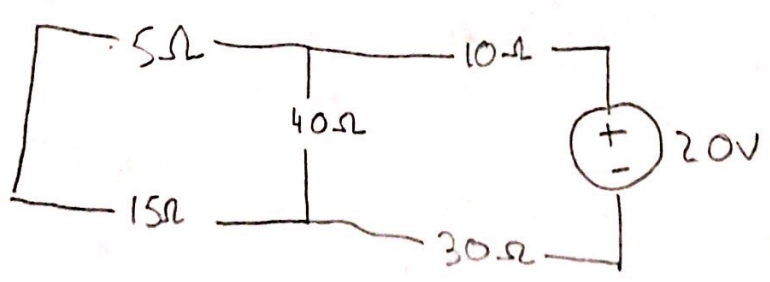
$$R_{Th} = \frac{150V}{1A} = 150\Omega$$

Q5)



$$V_0 = \frac{20}{20 + 15 + 5} (10)$$

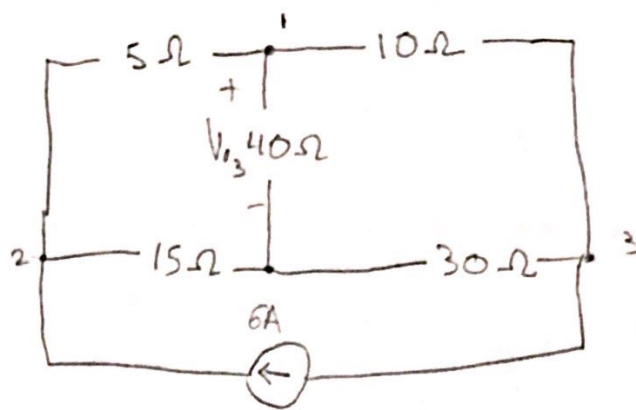
$$V_0 = 5V$$



$$V_{02} = 20 \left(\frac{13.3}{13.3 + 10 + 30} \right)$$

$$V_{02} = 5V$$

10V + 20V



KCl 1

$$\frac{V_{03}}{40} + \frac{V_{03} - V_3}{10} + \frac{V_{03} - V_2}{5} = 0$$

$$\frac{V_{03} + 4V_{03} - 4V_3 + 2V_{03} - 8V_2}{40} = 0$$

$$13V_{03} - 8V_2 - 4V_3 = 0$$

KCl 2

$$\frac{V_2 - V_{03}}{5} + \frac{V_2}{15} - 6 = 0$$

$$3V_2 - 3V_{03} + V_2 - 90 = 0$$

$$-3V_{03} + 4V_2 = 90$$

KCl 3

$$\frac{V_3}{30} + \frac{V_3 - V_{03}}{10} + 6 = 0$$

$$3V_3 - 3V_{03} + V_3 + 180 = 0$$

$$-3V_{03} + 4V_3 = -180$$

$$\begin{bmatrix} 13 & -8 & -4 \\ -3 & 4 & 0 \\ -3 & 0 & 4 \end{bmatrix} \begin{bmatrix} V_{03} \\ V_2 \\ V_3 \end{bmatrix} = \begin{bmatrix} 0 \\ 90 \\ -180 \end{bmatrix}$$

$$V_0 = V_{01} + V_{02} + V_{03}$$

$$V_0 = 5V + 5V + 0$$

$$V_0 = 10V$$