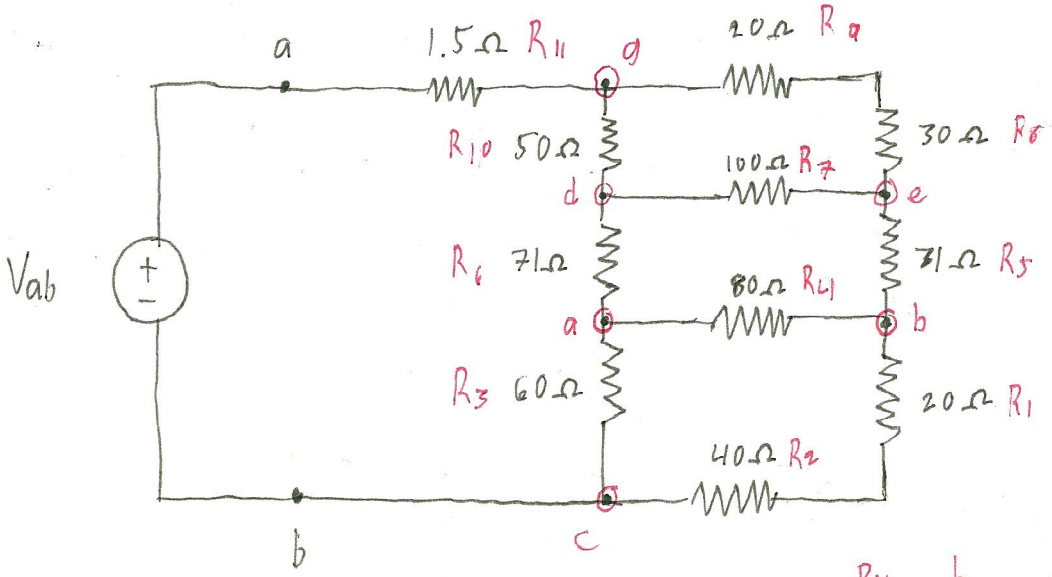
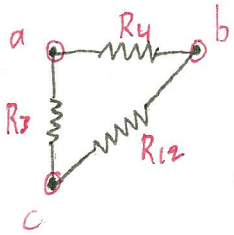
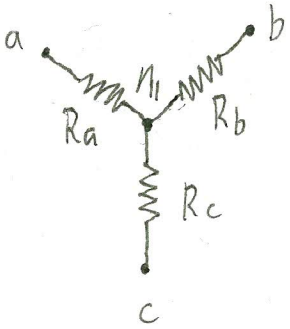
1)



$V_{ab} = 400\,V$



$\Rightarrow$



- R_1 and R_2 are in series

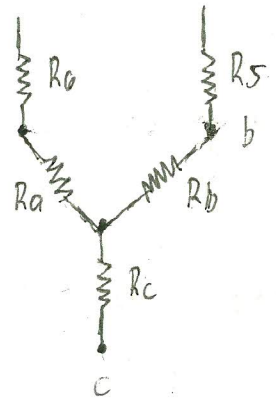
$R_{12} = R_1 + R_2 = 60\,\Omega$

- R_{12}, R_7, and R_4 from Δ-to-Y

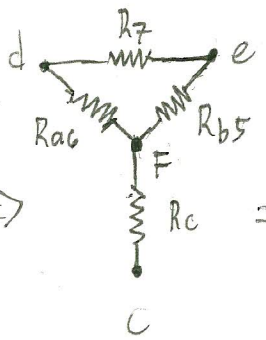
$$R_a = \frac{R_7 R_4}{R_{12} + R_7 + R_4} = 24\,\Omega$$

$$R_b = \frac{R_{12} R_4}{R_{12} + R_7 + R_4} = 24\,\Omega$$

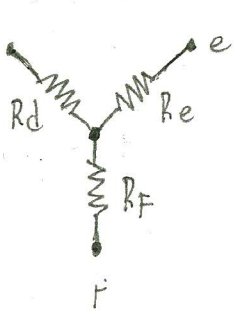
$$R_c = \frac{R_{12} R_7}{R_{12} + R_7 + R_4} = 18\,\Omega$$



$\Rightarrow$



$\Rightarrow$



- R_a and R_6 are series

$R_{ac} = R_a + R_6 = 95\,\Omega$

- R_b and R_5 are series

$R_{b5} = R_b + R_5 = 55\,\Omega$

- R_7, R_{ac}, and R_{b5} from Δ-to-Y

$$R_d = \frac{R_7 R_{ac}}{R_7 + R_{ac} + R_{b5}} = 38\,\Omega$$

$$R_e = \frac{R_7 R_{b5}}{R_7 + R_{ac} + R_{b5}} = 22\,\Omega$$

$$R_f = \frac{R_{ac} R_{b5}}{R_7 + R_{ac} + R_{b5}} = 20.9\,\Omega$$

- R_a and R_8 are series

$R_{8a} = R_8 + R_a = 50\,\Omega$

- Go to *

* $\rightarrow$ R_d and R_{10} in series

$R_{d10} = R_d + R_{10} = 88\,\Omega$

↳ R_e and R_{8a} in series

$R_{e8a} = R_e + R_{8a} = 72\,\Omega$

↳ R_{d10} and R_{e8a} in Parallel

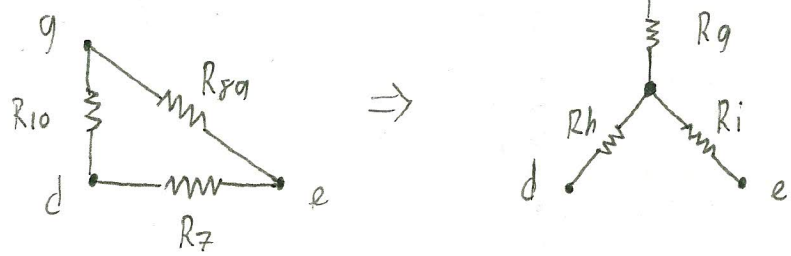
$$R_{de8a10} = \frac{R_{d10} R_{e8a}}{R_{d10} + R_{e8a}} = 39.6\,\Omega$$

↳ R_{11}, R_{de8a10}, R_f, and R_c in series

a) $\boxed{R_{eq} = R_{11} + R_{de8a10} + R_c + R_f = 80\,\Omega}$

- R_8 and R_9 are series

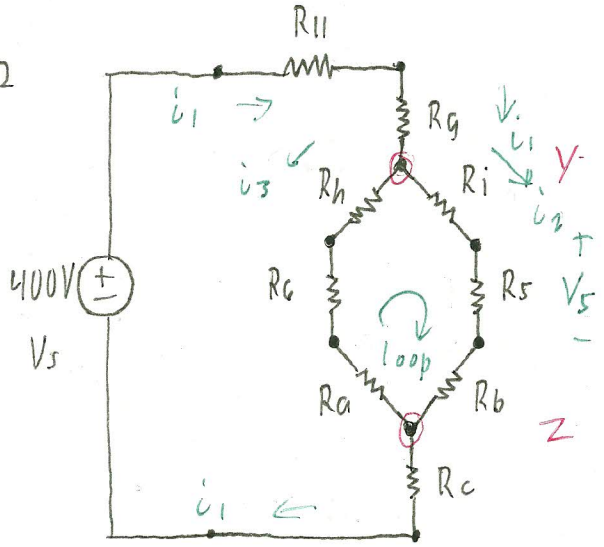
$R_{89} = 50\ \Omega$



$$R_g = \frac{R_{89} R_{10}}{R_7 + R_{89} + R_{10}} = 12.5\ \Omega$$

$$R_h = \frac{R_7 R_{10}}{R_7 + R_{89} + R_{10}} = 25\ \Omega$$

$$R_i = \frac{R_7 R_{89}}{R_7 + R_{89} + R_{10}} = 25\ \Omega$$



- Find i_1

$$i_1 = \frac{V_s}{R_{eq}} = 5\ A$$

- Use KCL @ node Y

$$i_1 - i_2 - i_3 = 0 \quad (1)$$

- Use KVL @ loop

$$-i_2 R_i - i_2 R_5 - i_2 R_b + i_3 R_a + i_3 R_c + i_3 R_h = 0 \quad (2)$$

- Solve (2) for i_3

$$-i_2 (R_i + R_5 + R_b) + i_3 (R_a + R_c + R_h) = 0$$

$$i_3 (120\ \Omega) = i_2 (80\ \Omega) \Rightarrow i_3 = i_2 \frac{2}{3} \quad (3)$$

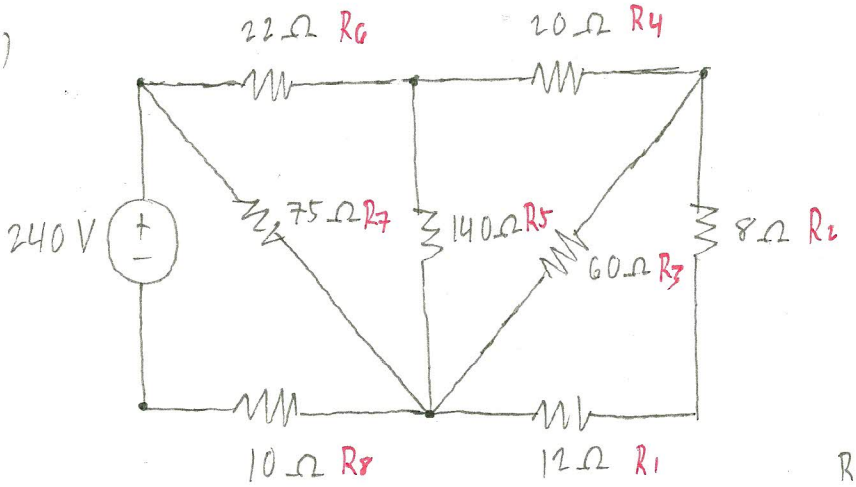
- use (3) in (1), solve for i_2

$$i_1 - i_2 - i_2 \frac{2}{3} = 0 \Rightarrow \frac{5}{3} i_2 = 5 \Rightarrow i_2 = 3A$$

- Find Power @ $R_{31\Omega}$

$$[P_{31\Omega} = -i_2^2 R_{31\Omega} = -279\ W] \ b)$$

2)



- R_1 and R_2 in series

$$R_{12} = R_1 + R_2 = 20\,\Omega$$

- R_{12} and R_3 in parallel

$$R_{123} = \frac{R_{12} R_3}{R_{12} + R_3} = 15\,\Omega$$

- R_{123} and R_4 in series

$$R_{1-4} = R_{123} + R_4 = 35\,\Omega$$

- R_{1-4} and R_5 in parallel

$$R_{1-5} = \frac{R_{1-4} R_5}{R_{1-4} + R_5} = 28\,\Omega$$

- R_{1-5} and R_6 in series

$$R_{1-6} = R_{1-5} + R_6 = 50\,\Omega$$

- R_{1-6} and R_7 in parallel

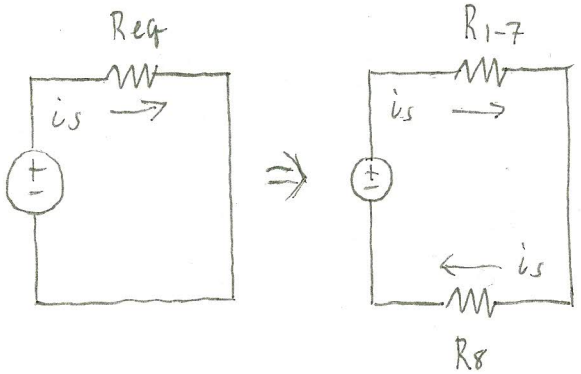
$$R_{1-7} = \frac{R_{1-6} R_7}{R_{1-6} + R_7} = 30\,\Omega$$

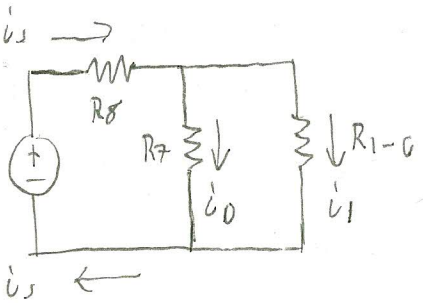
- R_{1-7} and R_8 in series

$$R_{eq} = R_{1-7} + R_8 = 40\,\Omega$$

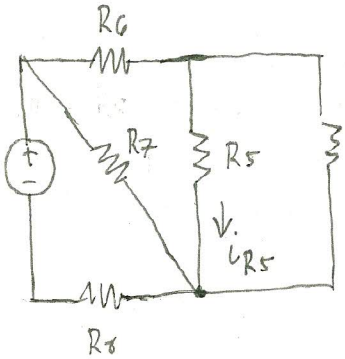
- Find i_s

$$V_s = i_s R_{eq} \Rightarrow i_s = \frac{240}{40} = 6\,A$$





a) $$\left[i_0 = i_s \left(\frac{R_{1-6}}{R_{1-6} + R_7} \right) = 2.4\,A \right]$$

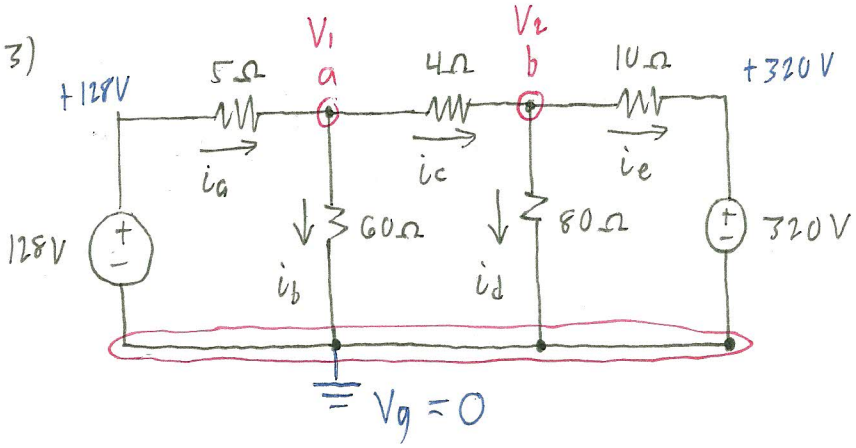


$$i_{R5} = i_s - i_0$$

$$i_{R5} = (i_s - i_0) \left(\frac{R_{1-4}}{R_{1-4} + R_5} \right) = 0.72\,A$$

b) $$\left[P_{140\Omega} = i_{R5}^2 R_5 = 72.576\,W \right]$$

3)



└ Use KCL @ node a

$$\left[\frac{V_1 - 128}{5} + \frac{V_1 - 0}{60} + \frac{V_1 - V_2}{4} = 0\right] 60$$

$$12V_1 - 1536 + V_1 + 15V_1 - 15V_2 = 0$$

$$28V_1 - 15V_2 = 1536 \quad (1)$$

└ Use KCL @ node b

$$\left[\frac{V_2 - V_1}{4} + \frac{V_2 - 0}{80} + \frac{V_2 - 320}{10} = 0\right] 80$$

$$20V_2 - 20V_1 + V_2 + 8V_2 - 2560 = 0$$

$$-20V_1 + 29V_2 = 2560 \quad (2)$$

└ Find V_2 in (2)

$$V_2 = \frac{2560}{29} + \frac{20}{29}V_1 \quad (3)$$

└ use (3) in (1), Find V_1

$$28V_1 - 15\left(\frac{2560}{29} + \frac{20}{29}V_1\right) = +1536$$

$$28V_1 - \frac{300}{29}V_1 = \frac{38400}{29} + 1536$$

$$\frac{512}{29}V_1 = \frac{82944}{29} \Rightarrow V_1 = 162\ V$$

└ Find V_2 in (1) with V_1

$$28(162) - 1536 = 15V_2 \rightarrow V_2 = 200\ V$$

a)

$$i_a = \frac{V_1 - 128}{5} = -6.8\ A$$

$$i_b = \frac{V_1}{60} = 2.7A$$

$$i_c = \frac{V_1 - V_2}{4} = -9.5\ A$$

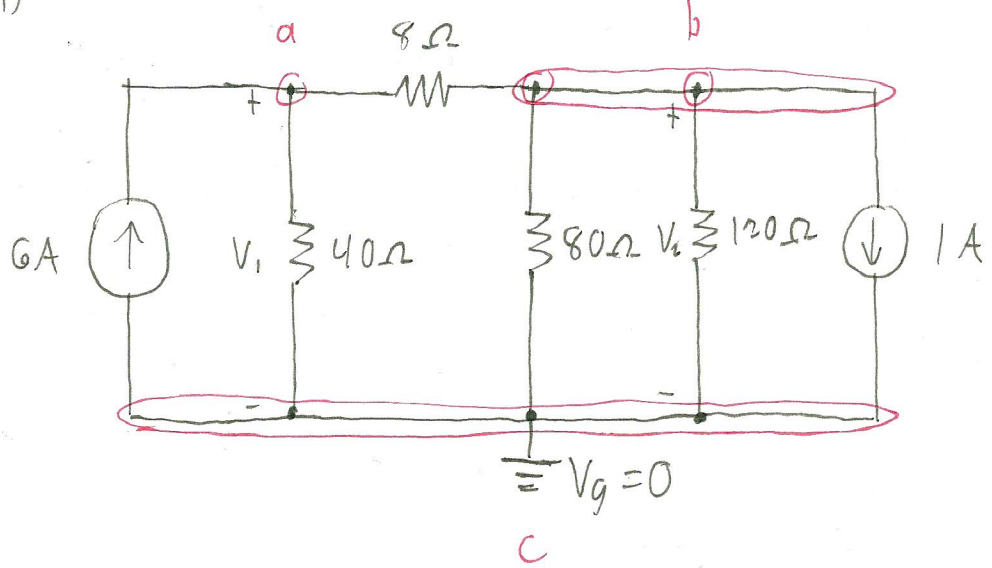
$$i_d = \frac{V_2}{80} = 2.5A$$

$$i_e = \frac{V_2 - 320}{10} = -12\ A$$

$$P_{128V} = -i_a V_{128} = 870.4\ W$$

b) $\left[P_{320V} = i_e V_{320} = -3840\ W\right]$

4)



L Use KCL @ a

$$\left[-6 + \frac{V_1 - 0}{40} + \frac{V_1 - V_2}{8} = 0\right] 40$$

$$-240 + V_1 + 5V_1 - 5V_2 = 0$$

$$6V_1 - 5V_2 = 240 \quad (1)$$

L Use KCL @ b

$$\left[\frac{V_2 - V_1}{8} + \frac{V_2 - 0}{80} + \frac{V_2 - 0}{120} + 1 = 0\right] 120$$

$$15V_2 - 15V_1 + 1.5V_2 + V_2 + 120 = 0$$

$$-15V_1 + 17.5V_2 = -120 \quad (2)$$

L Find V_2 in (2)

$$17.5V_2 = -120 + 15V_1 \Rightarrow V_2 = \frac{-120}{17.5} + \frac{15V_1}{17.5} \quad (3)$$

L Use (3) in (1), find V_1

$$6V_1 - 5\left(\frac{-120}{17.5} + \frac{15V_1}{17.5}\right) = 240$$

$$6V_1 + \frac{240}{7} - \frac{30}{7}V_1 = 240$$

$$\frac{12}{7}V_1 = \frac{1440}{7}$$

$$[V_1 = 120\,V] \; a)$$

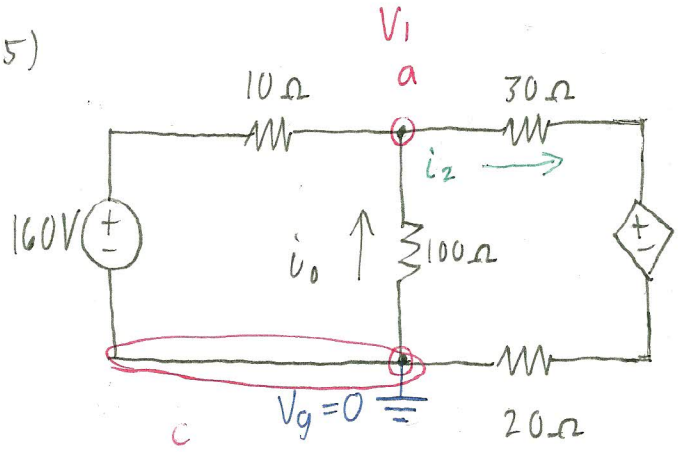
L Find V_2 in (1) with V_1

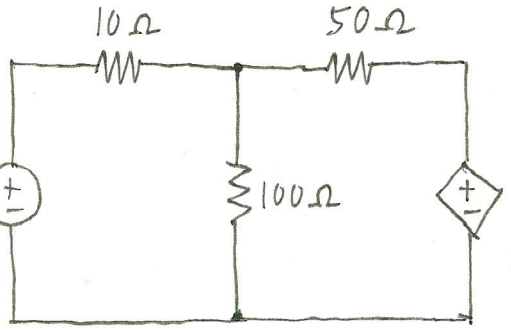
$$6(120) - 5V_2 = 240$$

$$5V_2 = 480$$

$$[V_2 = 96V] \; b$$

5)





- Use KCL @ a

$$\left[\frac{V_1 - 160}{10} + \frac{V_1 - 0}{100} + \frac{V_1 - 150i_0}{50} = 0\right]300$$

$$30V_1 - 4800 + 3V_1 + 6V_1 - 900i_0$$

$$39V_1 - 900i_0 = 4800$$

$$\left[P_0 = i_2V_2 = 5(-150) = -750\ W\right]$$

- The current i_0 depends on

$$-\frac{V_1}{100} = i_0 \quad (2)$$

- Use (2) in (1), find V_1

$$39V_1 - 900\left(\frac{-V_1}{100}\right) = 4800$$

$$V_1 = \frac{4800}{48} = 100\ V$$

- Find i_0 in (2) with V_1

$$i_0 = -\frac{100}{100} = -1\ A$$

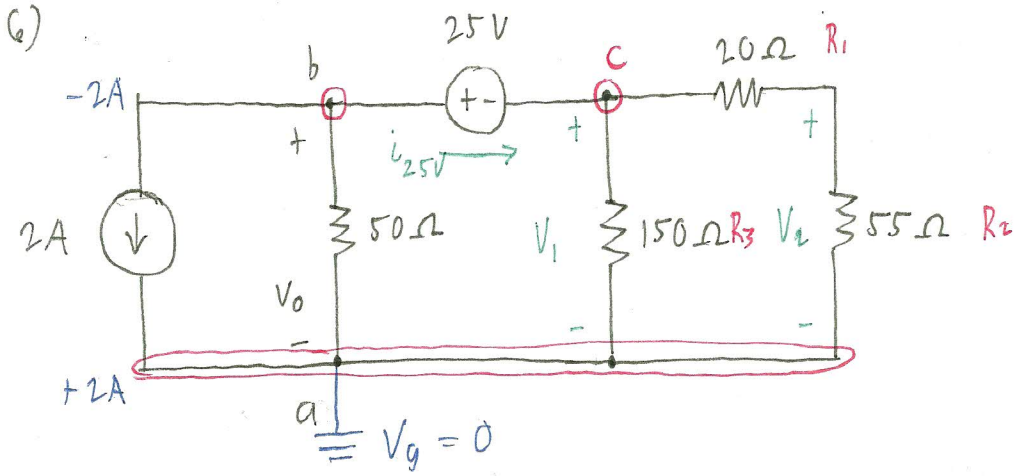
- Find V_2 with i_0

$$V_2 = 150(-1) = -150\ V$$

- Find i_2

$$i_2 = \frac{V_1 - V_2}{50} = \frac{100 - (-150)}{50} = 5\ A$$

6)

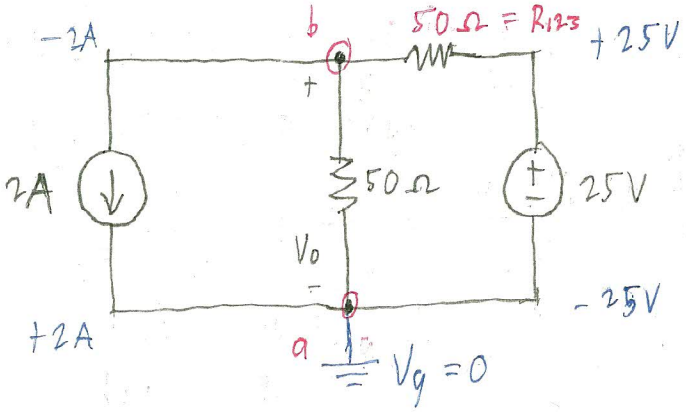


L R_1 and R_2 in series

$$R_{12} = R_1 + R_2 = 75\,\Omega$$

L R_{12} and R_3 in parallel

$$R_{123} = \frac{R_{12} R_3}{R_{12} + R_3} = 50\,\Omega$$



L Use KCL @ b, Find V_o

$$\left[-(-2) + \frac{V_o - 0}{50} + \frac{V_o - 25}{50} = 0 \right] 50$$

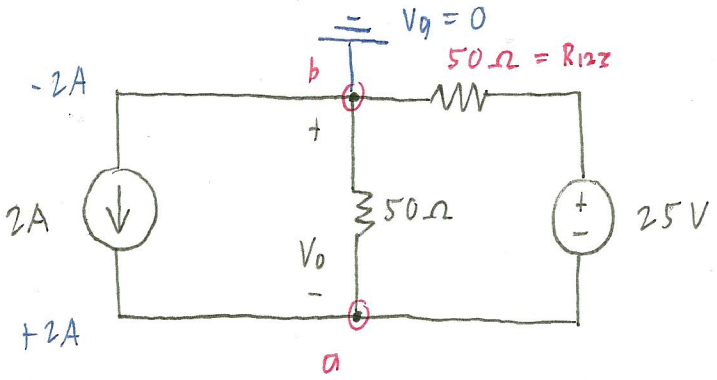
$$100 + V_o + V_o - 25 = 0$$

$$2V_o = -75$$

$$\left[V_o = \frac{-75}{2} = -37.5\ V \right] \quad 1\,a)$$

L Find P_{2A}

$$\left[P_{2A} = -i_{2A} V_o = -(2)(-37.5) = 75\ W \right] \quad 2\,a)$$



L Use KCL @ a

$$\left[-2 + \frac{(-V_o - 0)}{50} + \frac{(-V_o - (-25))}{50} = 0\right] 50$$

$$-100 - V_o - V_o + 25 = 0$$

$$2V_o = -75$$

$$\left[V_o = \frac{-75}{2} = -37.5\ V\right] \quad 1\,b)$$

L Find P_{2A}

$$\left[P_{2A} = -i_{2A} V_o = 75\ W\right] \quad 2\,b)$$