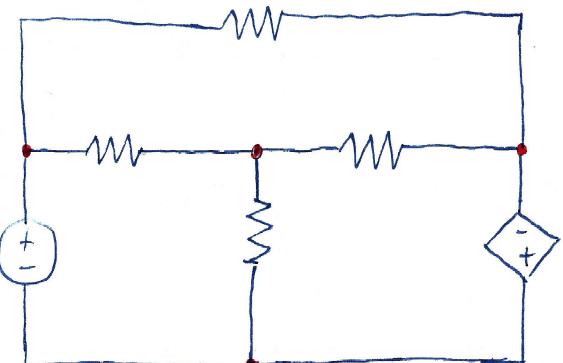
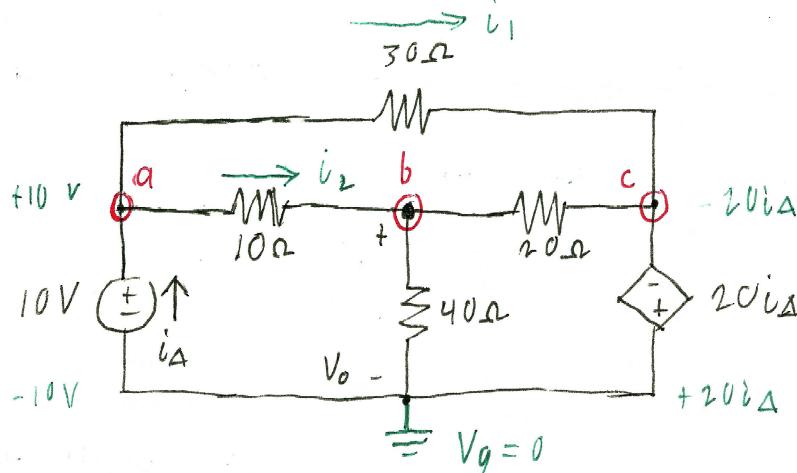


1)



$$\# \text{be} = 6, \# \text{ne} = 4 - 1$$

* Needed 2 node-voltage equations

L Use KCL @ node b

$$\left[\frac{V_o - 10}{10} + \frac{V_o - 0}{40} + \frac{V_o - (-20i_\Delta)}{20} = 0 \right] 40$$

$$4V_o - 40 + V_o + 2V_o + 40i_\Delta = 0$$

$$7V_o + 40i_\Delta = 40 \quad (1)$$

L @ node a find i_1, i_2 using KCL \leftarrow OR \rightarrow

$$i_1 = \frac{10 - (-20i_\Delta)}{30}, i_2 = \frac{10 - V_o}{10}$$

L know that

$$i_A = i_1 + i_2$$

L So

$$\left[i_\Delta = \frac{10 + 20i_\Delta}{30} + \frac{10 - V_o}{10} \right] 30$$

$$30i_\Delta = 10 + 20i_\Delta + 30 - 3V_o$$

$$3V_o + 10i_\Delta = 40 \quad (2)$$

L Multiply (-4) on (2) then add to (1)

$$-12V_o - 40i_\Delta = -160$$

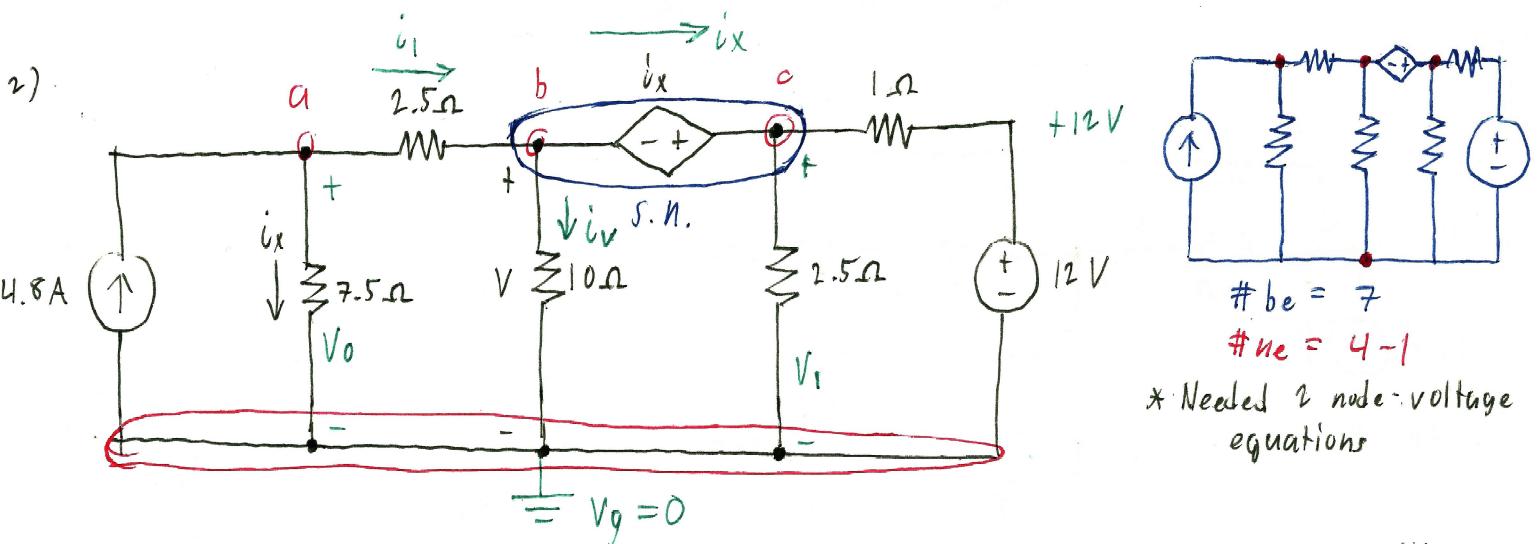
$$7V_o + 40i_\Delta = 40$$

$$\underline{-5V_o = -120} \quad (3)$$

$$\boxed{V_o = 24 V}$$

@ node a use KCL

$$\frac{10 - (-20i_\Delta)}{30} + \frac{10 - V_o}{10} - i_A = 0$$



L Use KCL @ node s.n.

$$\left[\frac{V - V_0}{2.5} + \frac{V - 0}{10} + \frac{V_1 - 0}{2.5} + \frac{V_1 - 12}{1} = 0 \right] 10$$

$$4V - 4V_0 + V + 4V_1 + 10V_1 - 120 = 0$$

$$5V - 4V_0 + 14V_1 = 120 \quad (1)$$

L Use KCL @ node a

$$\left[i_x - 4.8 + \frac{V_0 - V}{2.5} = 0 \right] 5$$

$$5i_x - 24 + 2V_0 - 2V = 0 \quad (2)$$

L Constraint equation @ s.n.

$$V + i_x = V_1 \quad (3)$$

+ sub i_x from (3) in (2)

$$5V_1 - 5V - 24 + 2V_0 - 2V = 0$$

$$-7V + 2V_0 + 5V_1 = 24 \quad (4)$$

L Know that

$$i_x = i_1 - i_V = \frac{V_0 - V}{2.5} - \frac{V}{10} \quad (5)$$

L Use (5) in (3)

$$\left[V - \frac{V}{2.5} - \frac{V}{10} + \frac{V_0}{2.5} - V_1 = 0 \right] 10$$

$$10V - 4V - V + 4V_0 - 10V_1 = 0$$

$$5V + 4V_0 - 10V_1 = 0 \quad (6)$$

L Add (1) and (6)

$$10V + 4V_1 = 120 \quad (7)$$

+ Go to *

* Multiply 2 in (4) then add (1)

$$-9V + 24V_1 = 168$$

$$L V_1 = 7 + \frac{3}{8}V \text{ Use this in (7)}$$

L Find V in (7)

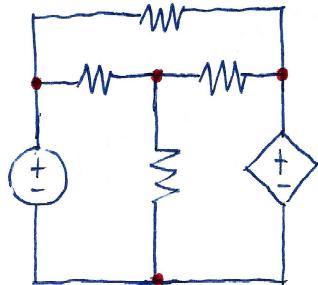
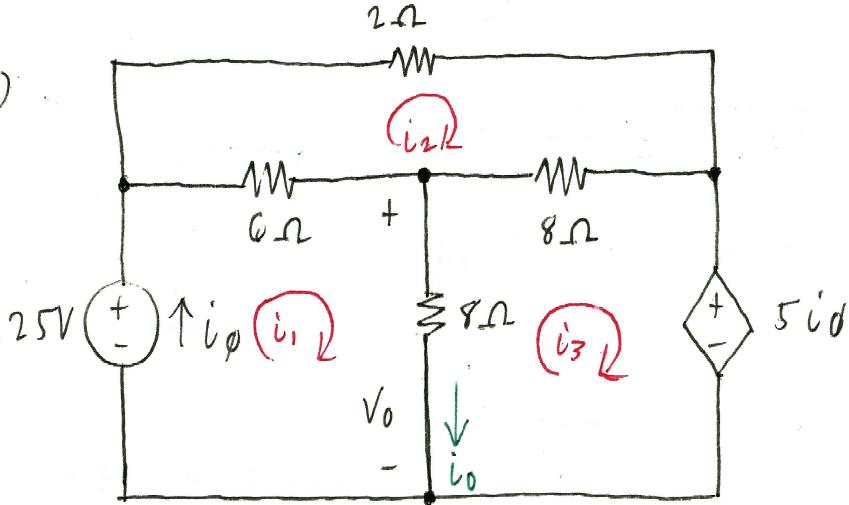
$$10V + 4\left(7 + \frac{3}{8}V\right) = 120$$

$$10V + \frac{3}{2}V = 120 - 28$$

$$\frac{23}{2}V = 92$$

$$V = 8 \text{ Volt.}$$

3)



$$\#be = 6$$

$$\#ne = 4 - 1$$

* Need 3 mesh equations

L Use KVL @ i_1

$$-25 + 6(i_1 - i_2) + 8(i_1 - i_3) = 0$$

$$-25 + 14i_1 - 6i_2 - 8i_3 = 0 \quad (1)$$

L Use KVL @ i_2

$$6(i_2 - i_1) + 2i_2 + 8(i_2 - i_3) = 0$$

$$-6i_1 + 16i_2 - 8i_3 = 0 \quad (2)$$

L Use KVL @ i_3

$$8(i_3 - i_1) + 8(i_3 - i_2) + 5i_d = 0$$

$$-8i_1 - 8i_2 + 16i_3 + 5i_d = 0$$

L Know that

$$i_d = i_1$$

$$-8i_1 - 8i_2 + 16i_3 + 5i_1 = 0$$

$$-3i_1 - 8i_2 + 16i_3 = 0 \quad (3)$$

L By calculator

$$i_1 = 4, i_2 = 5, i_3 = 2$$

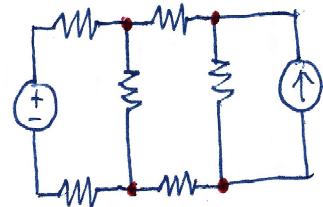
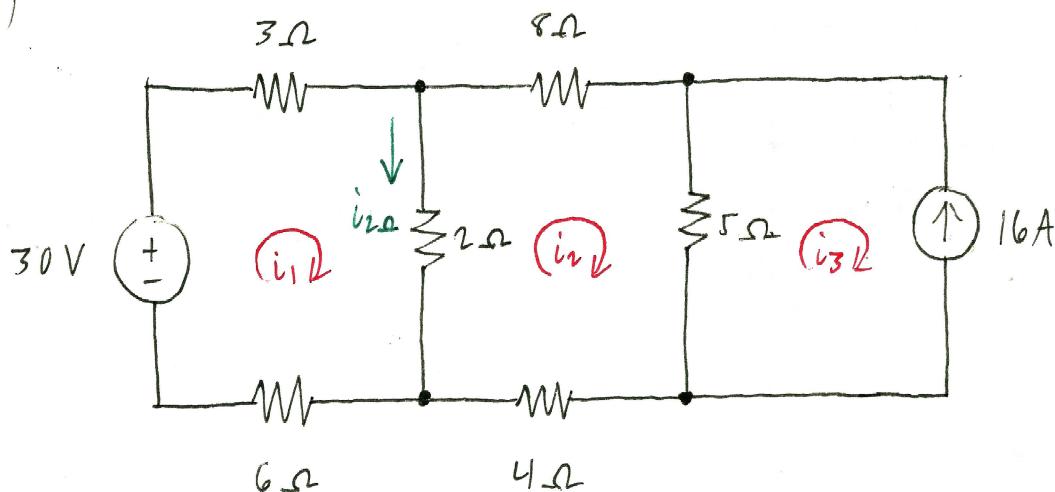
L Know that

$$i_0 = i_1 - i_2 = 2A$$

L Find V_o with i_0

$$[V_o = i_0(8\Omega) = 16V]$$

4)



$$\#be = 6$$

$$\#ne = 4 - 1$$

* Need 3 mesh equations

Use KVL @ i_1

$$-30 + 3i_1 + 2(i_1 - i_2) + 6i_1 = 0$$

$$11i_1 - 2i_2 = 30 \quad (1)$$

Know that

$$i_{2\Omega} = i_1 - i_2 = 6A$$

Power delivered at 2Ω

$$[P_{2\Omega} = i_{2\Omega}^2 (2\Omega) = 72W]$$

Use KVL @ i_2

$$2(i_2 - i_1) + 8i_2 + 5(i_2 - i_3) + 4i_2 = 0$$

$$-2i_1 + 19i_2 - 5i_3 = 0 \quad (2)$$

Use KVL @ i_3

$$i_3 = -16A \quad (3)$$

Use (3) in (2)

$$-2i_1 + 19i_2 = -80 \quad (4)$$

Find i_1 in (4)

$$2i_1 = 19i_2 + 80$$

$$i_1 = \frac{19i_2 + 80}{2} \quad (5)$$

Find i_2 in (1) with (5)

$$\frac{209i_2 + 440}{2} - 2i_2 = 30$$

$$\frac{205i_2}{2} = -410$$

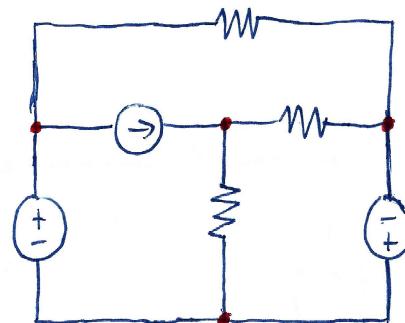
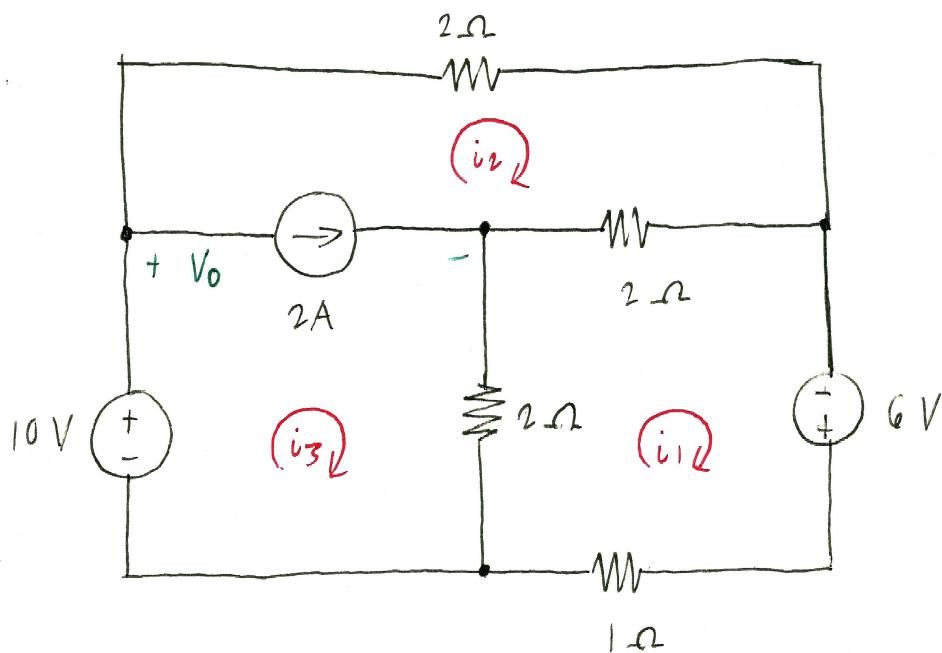
$$i_2 = -4A$$

Find i_1 in (4)

$$2i_1 = 19(-4) + 80$$

$$i_1 = 2A$$

5)



$$\# \text{be} = 6$$

$$\# \text{ne} = 4 - 1$$

* Needed 3 mesh equations

L Use KVL @ i_1

$$-6 + 1i_1 + 2(i_1 - i_3) + 2(0_1 - i_2) = 0$$

$$5i_1 - 2i_2 - 2i_3 = 6 \quad (1)$$

L Use KVL @ i_2

$$-V_0 + 2i_2 + 2(i_2 - i_1) = 0$$

$$-2i_1 + 4i_2 - V_0 = 0 \quad (2)$$

L Use KVL @ i_3

$$-10 + V_0 + 2(i_3 - i_1) = 0$$

$$-2i_1 + 2i_3 + V_0 = 10 \quad (3)$$

L Add (2) and (3)

$$-4i_1 + 4i_2 + 2i_3 = 10$$

$$-2i_1 + 2i_2 + i_3 = 5 \quad (4)$$

L Know that

$$i_3 - i_2 = 2A \quad (5)$$

L Find i_1 in (4) then use in (1)

$$i_1 = i_2 + \frac{i_3}{2} - \frac{5}{2}$$

$$(5i_2 - 2i_2 + \frac{5i_3}{2} - 2i_3 = 6 + \frac{25}{2})^2$$

$$6i_2 + i_3 = 37 \quad (6)$$

L Use (5) in (6) find i_2

$$6i_3 + i_3 = 37 + 12$$

$$i_3 = 7A$$

L Find i_2 in (5) with i_3

$$i_2 = -2 + 7 = 5A$$

L Find i_1 in (1)

$$5i_1 - 2(5) - 2(7) = 6$$

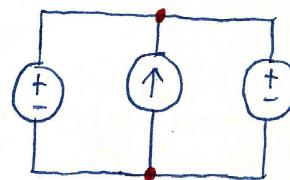
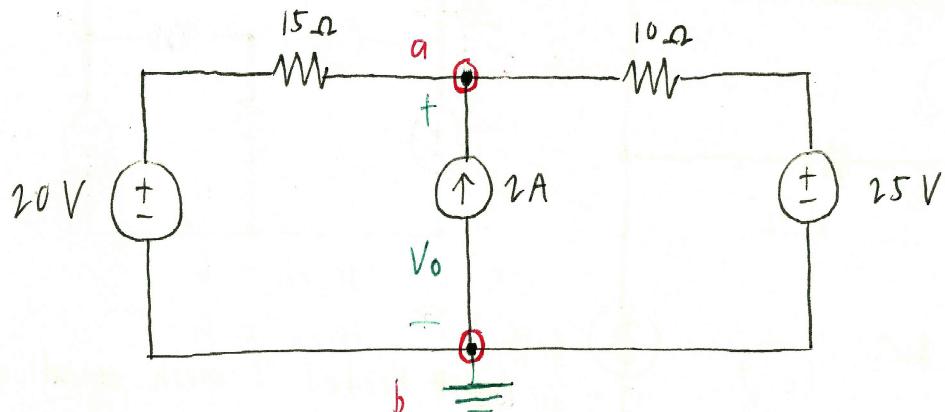
$$5i_1 = 30$$

$$i_1 = 6A$$

L Power at 1Ω

$$[P_{1\Omega} = i_{1,2}^2 (1\Omega) = 36W]$$

6)



$$\#be = 3$$

$$\#ne = 2 - 1$$

* Needed 1 node-voltage equation

L Use KCL @ node a

$$\left[\frac{V_o - 20}{15} + \frac{V_o - 25}{10} - 2 = 0 \right] 30$$

$$2V_o - 40 + 3V_o - 75 - 60 = 0$$

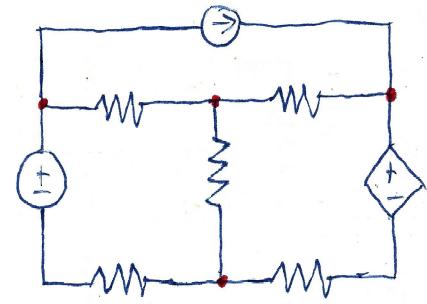
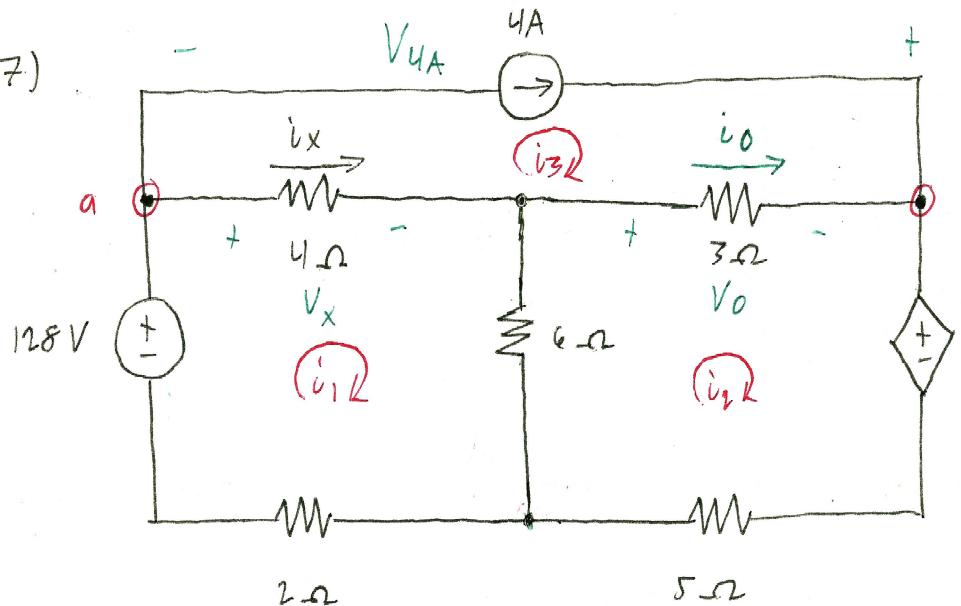
$$5V_o = 175$$

$$V_o = 35V$$

L Power at $2A$

$$[P_{2A} = i_{2A} V_o = 70W]$$

7)



* Needed 3 mesh equations

L Use KVL @ i_1

$$2i_1 - 128 + 4(i_1 - i_3) + 6(i_1 - i_2) = 0$$

$$12i_1 - 6i_2 - 4i_3 = 128 \quad (1)$$

L Use KVL @ i_2

$$6(i_2 - i_1) + 3(i_2 - i_3) + 30i_x + 5i_2 = 0$$

$$-6i_1 + 14i_2 - 3i_3 + 30i_x = 0 \quad (2)$$

L Know that

$$i_3 = 4A \quad (3)$$

L Use (3) in (1)

$$12i_1 - 6i_2 = 144 \quad (4)$$

L Know that

$$i_x = i_1 - 4 \quad (5)$$

L Use (3), and (5) in (2)

$$-6i_1 + 14i_2 - 12 + 30i_1 - 120 = 0$$

$$24i_1 + 14i_2 = 132 \quad (6)$$

L Use (6) in (4), find i_1

$$14i_2 = 132 - 24i_1$$

$$i_2 = \frac{66}{7} - \frac{12}{7}i_1$$

$$12i_1 - 6\left(\frac{66}{7} - \frac{12}{7}i_1\right) = 144$$

$$\frac{156}{7}i_1 = \frac{1404}{7}$$

$$i_1 = 9A$$

L Find i_x in (5) with i_1

$$i_x = 9 - 4 = 5A$$

L Find i_2 in (4)

$$6i_2 = 12(9) - 144$$

$$i_2 = -6A$$

L Find i_0

$$i_0 = (i_2 - i_3) = -10A$$

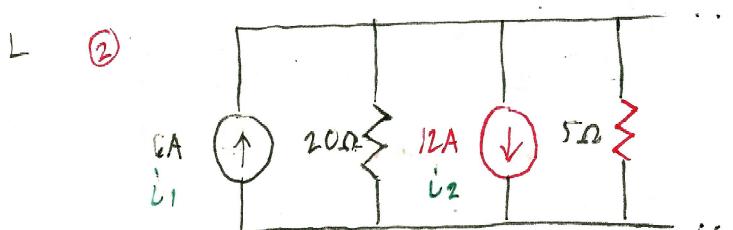
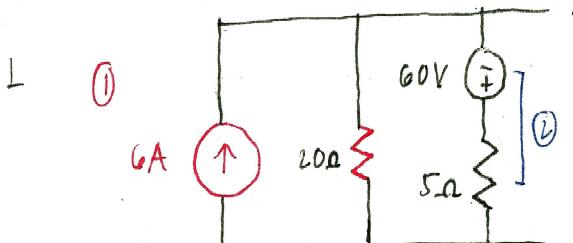
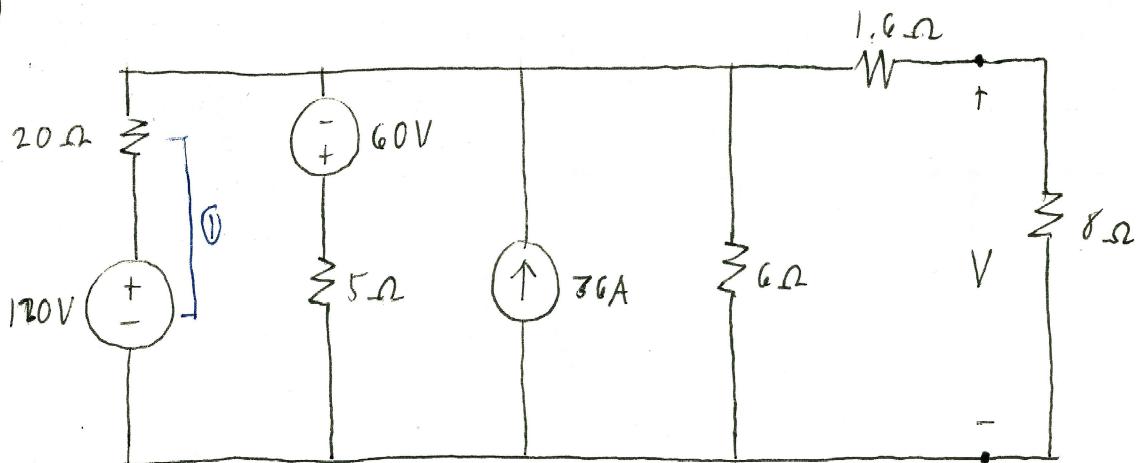
L $V_x = 20$, $V_0 = -30$, find V_{ab}

$$V_{ab} = V_x + V_0 = -10V$$

L Find P_{4A}

$$[P_{4A} = -i_{4A}V_{ab} = 40W]$$

r)

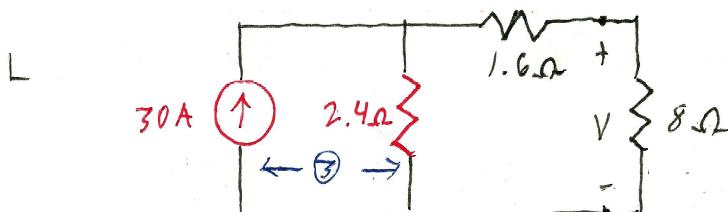
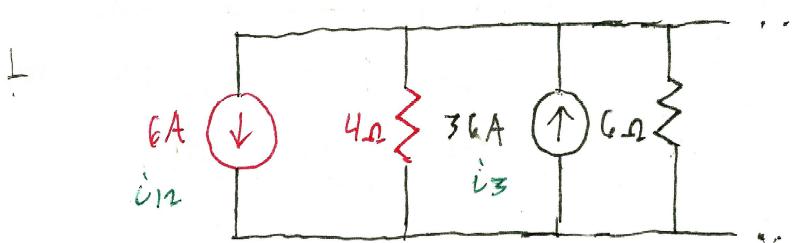


$$20\Omega \parallel 5\Omega = \frac{(20)(5)}{20+5} \Omega = 4\Omega$$

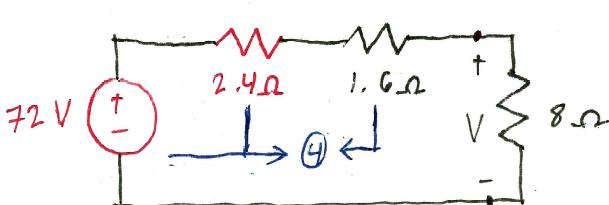
$$i_{12} = i_1 - i_2 = -6A$$

$$i_s = i_{12} - i_3 = 30A$$

$$4\Omega \parallel 6\Omega = \frac{(4)(6)}{4+6} \Omega = 2.4\Omega$$



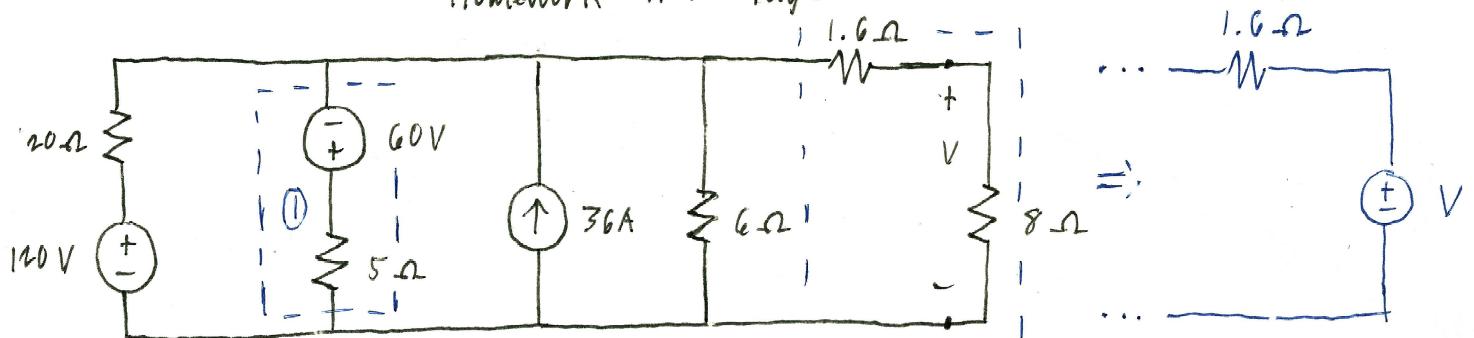
$$2.4\Omega + 1.6\Omega = 4\Omega$$



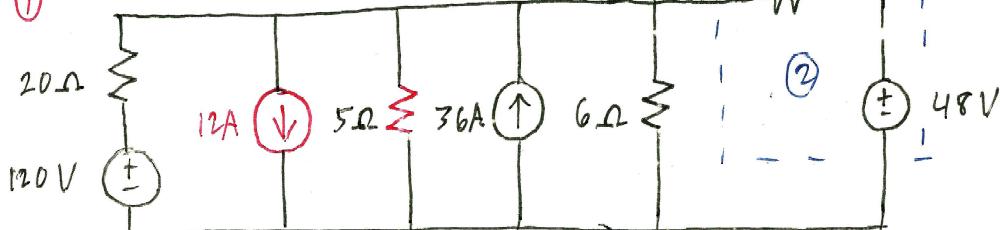
$$4\Omega \parallel 8\Omega \Rightarrow R_{eq} = \frac{(4)(8)}{4+8} \Omega = 2.67\Omega$$

a) $V = i_s R_{eq} = 48V$

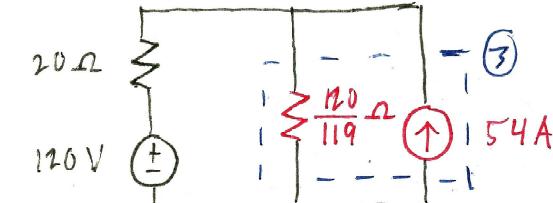
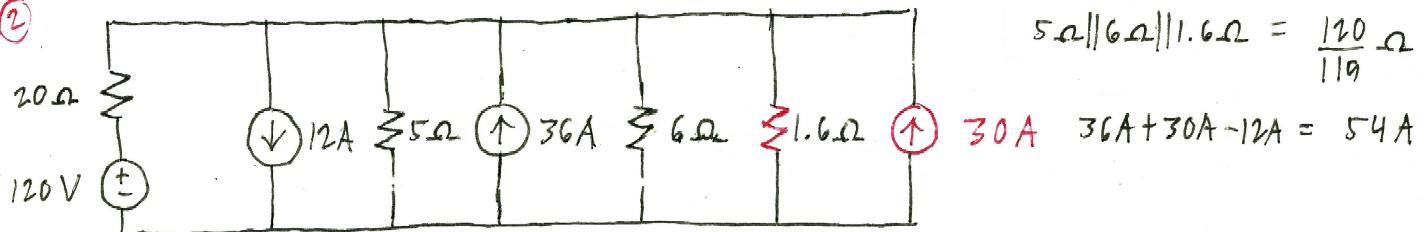
Homework #4 Page a



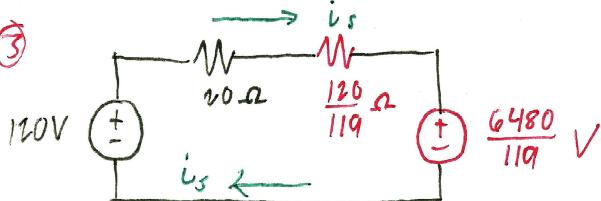
①



②



③



$$i_s = \frac{120 - \frac{6480}{119}}{20 + \frac{120}{119}} = 3.12A$$

$$b) [P_{120V} = -i_s V_{120V} = -374.4 W]$$