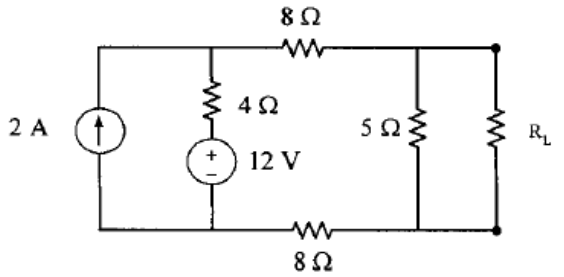
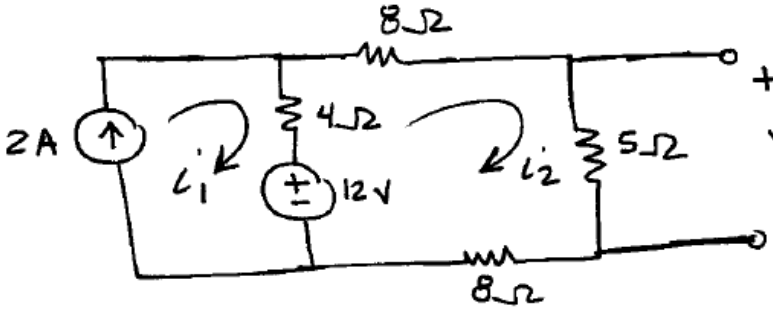
Problem 1:



For the circuit shown above find the maximum power absorb by the load resistor R_L ?

Since $P_{max} = \frac{V_{oc}^2}{4R_{th}}$ ⇒ we need Thevenin equivalent

step① Remove the Load R_L and find $V_{th} = V_{oc}$



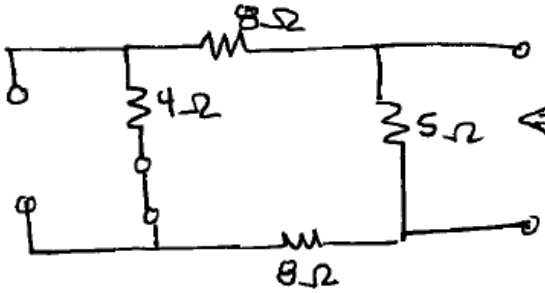
⇒ find i_2'

$i_1' = 2A$ by inspection

KVL on mesh ② $-12 + 4(i_2' - i_1') + 8i_2' + 5i_2' + 8i_2' = 0$

⇒ $i_2' = 0.8A$ ⇒ $\boxed{V_{oc} = V_{th} = 4V}$

step② Deactivate independent sources to find R_{th}



$R_{th} = (8+4+8) \,//\, 5$
$= 20 \,//\, 5 = \boxed{4\Omega}$

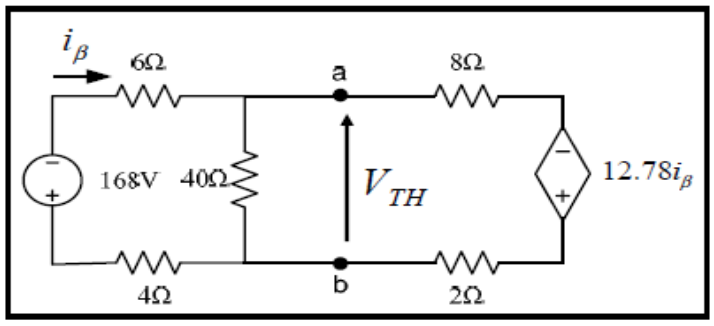
$P_{max} = \frac{V_{oc}^2}{4R_{th}} = \frac{4^2}{4(4)} = \boxed{1W}$

Problem 2:

a) We need to calculate the Thevenin equivalent circuit.

First, we calculate V_{TH} using node-voltage:

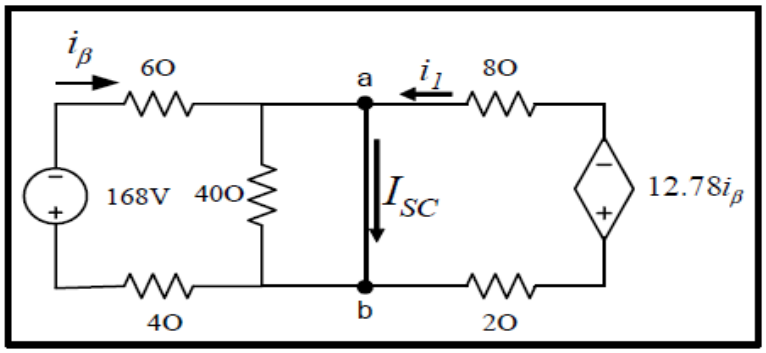
$$\begin{cases} \dfrac{V_{TH}+168}{4+6}+\dfrac{V_{TH}}{40}+\dfrac{V_{TH}+12.78i_\beta}{2+8}=0 \\ i_\beta=-\dfrac{V_{TH}+168}{4+6} \end{cases} \Rightarrow \quad V_{TH}=48.05\ V$$



Then, we calculate the short-circuit current I_{SC} using the circuit below:

$$\begin{cases} i_\beta=\dfrac{-168}{4+6}=-16.8\ A \\ i_1=\dfrac{-12.78i_\beta}{2+8}=21.47\ A \end{cases} \Rightarrow \quad I_{SC}=i_\beta+i_1=4.67\ A \quad \Rightarrow \quad R_{TH}=\frac{V_{TH}}{I_{SC}}=10.29\ \Omega$$

$$R_L=R_{TH}=10.29\ \Omega$$

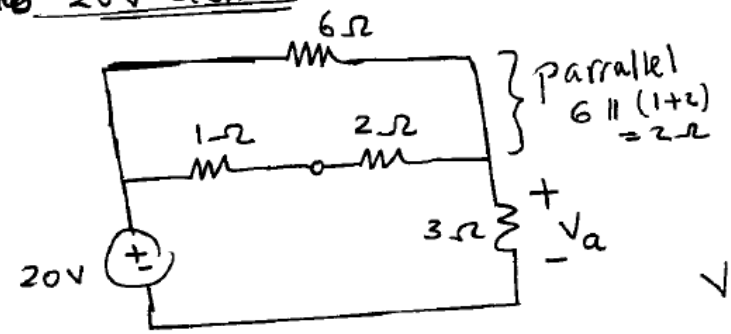


b) $P_{\max}=\dfrac{V_{TH}^2}{4R_L}=56.10\ W$

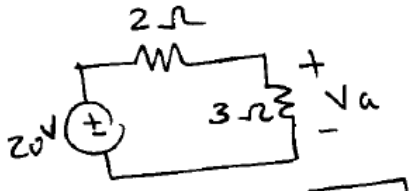
Problem 3:

superposition ⇒ Deactivate all independent sources except one source remain active.

20V active

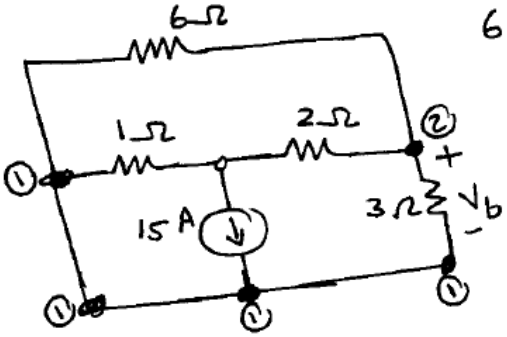


parallel $6 \parallel (1+2) = 2\Omega$

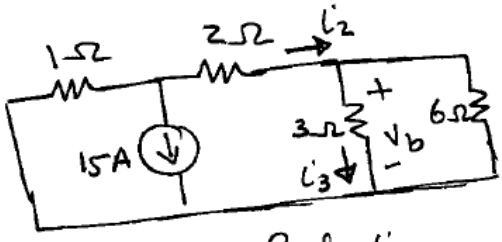


$$V_a = \frac{3}{2+3}\,20 = \boxed{12\ V}$$

15A active

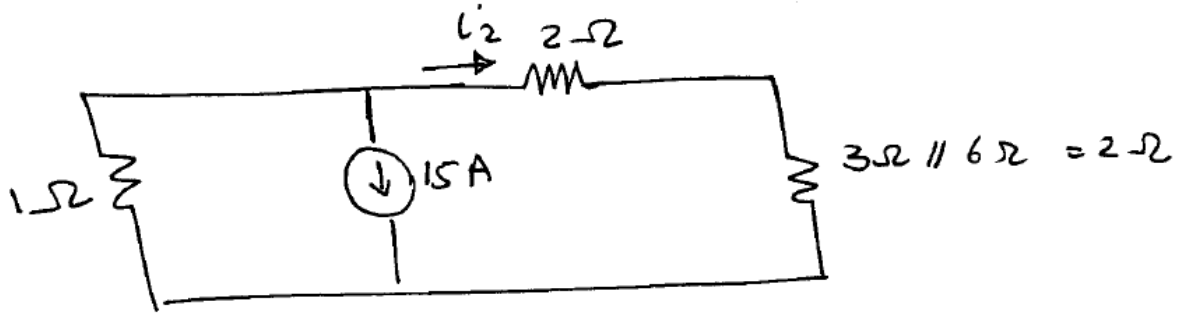


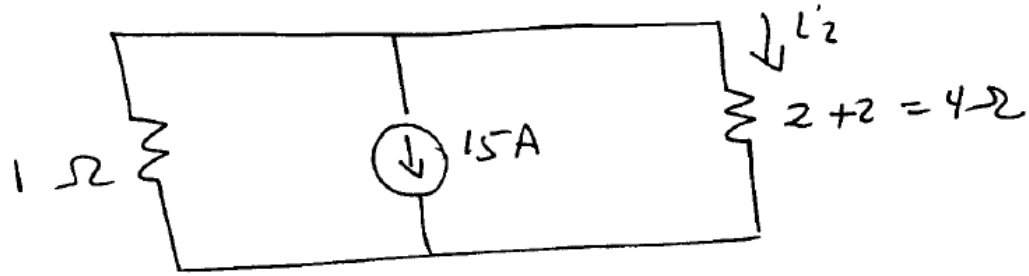
$6\Omega \parallel 3\Omega$



$V_b = 3\,i'_3$ ⇒ find i'_3

$i'_3 = \frac{6}{6+3}\,i'_2$ ⇒ find i'_2



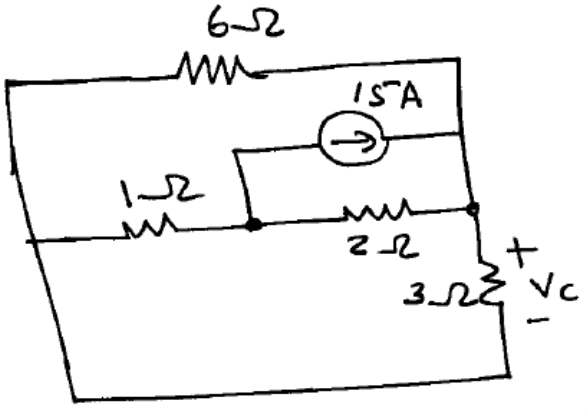


$$i_2' = \frac{1}{1+4}(-15) = -3\ A$$

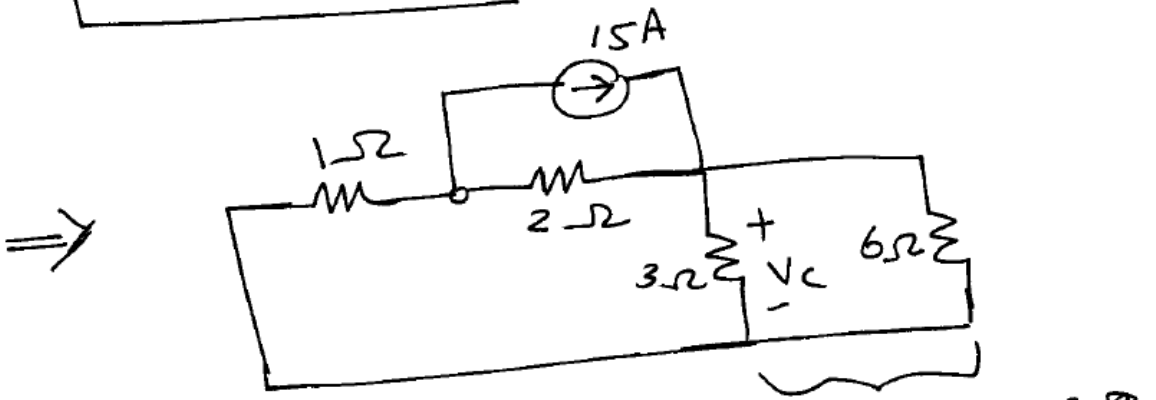
$$\Rightarrow i_3' = \frac{6}{6+3} i_2' = \frac{6}{9}(-3) = -2A$$

$$\Rightarrow V_b = 3 i_3' = 3(-2) = \boxed{-6\ V}$$

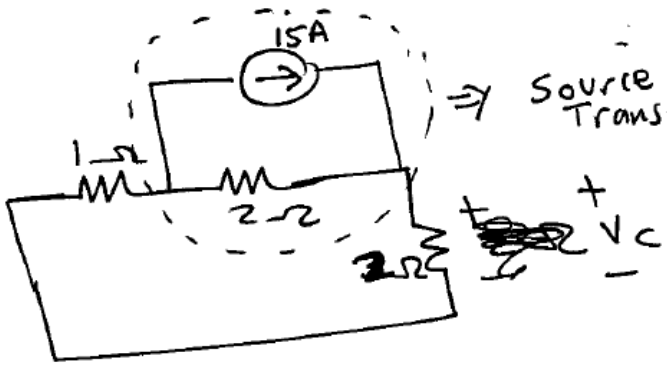
15A active



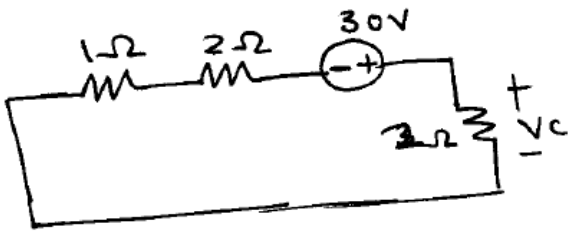
$6\Omega \,//\, 3\Omega$



$6\Omega \,//\, 3\Omega = 2\Omega$



⇒ Source Transformation

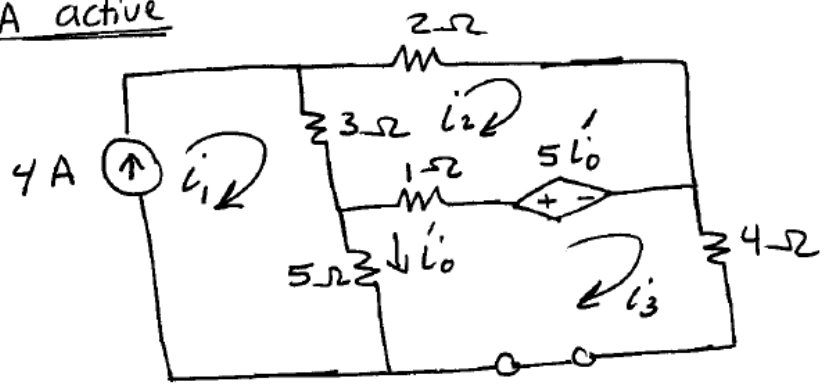


$$V_c = \frac{2}{1+2+2}(30) = \boxed{12\,V}$$

$$\Rightarrow V = V_a + V_b + V_c = 12 - 6 + 12 = \boxed{18\,V}$$

Problem4:

4A active



$i_1' = 4A$ by inspection

KVL mesh ②

$$3(i_2' - i_1') + 2i_2' - 5i_0' + 1(i_2' - i_3') = 0$$

$$-3i_1' + 6i_2' - 1i_3' - 5i_0' = 0$$

$i_1' = 4A \quad i_0' = i_1' - i_3' = 4 - i_3'$

$$\Rightarrow 6i_2' + 4i_3' = 32 \quad - ①$$

KVL on mesh ③

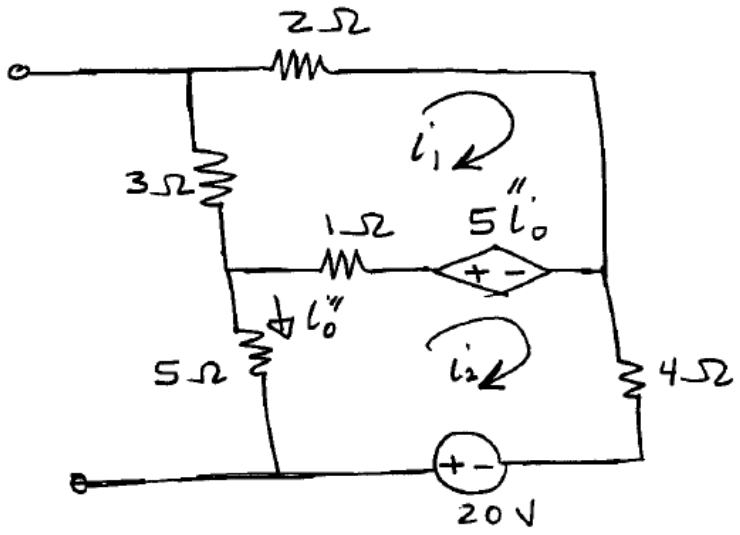
$$1(i_3' - i_2') + 5i_0' + 4i_3' - 5i_0'' = 0$$

$$-i_2' + 5i_3' = 0 \quad - ②$$

solving ①, ② for i_3' $\Rightarrow i_3' = 0.941$ A

$\Rightarrow i_0'' = 4 - i_3' =$ **3.05 A**

20V active



KVL on mesh ①

$$2i_1' - 5i_o'' + 1(i_1' - i_2') + 3i_1' = 0$$

$$6i_1' - i_2' - 5i_o'' = 0$$

$$i_o'' = -i_2'$$

$$\Rightarrow 6i_1' + 4i_2' = 0 \quad \text{— ①}$$

KVL on mesh ②

$$5i_o'' + 4i_2' - 20 - 5i_o'' + 1(i_2' - i_1') = 0$$

$$-i_1' + 5i_2' = 20 \quad \text{— ②}$$

solving ① and ② for $i_2' \Rightarrow i_2' = 3.53$ A

$$\Rightarrow i_o'' = -i_2' = -3.53 \text{ A}$$

$$\Rightarrow i_o = i_o' + i_o'' = -0.48 \text{ A}$$

Problem 5: $L_{eq}=L$

Problem 6: $C_{eq}= 4F$