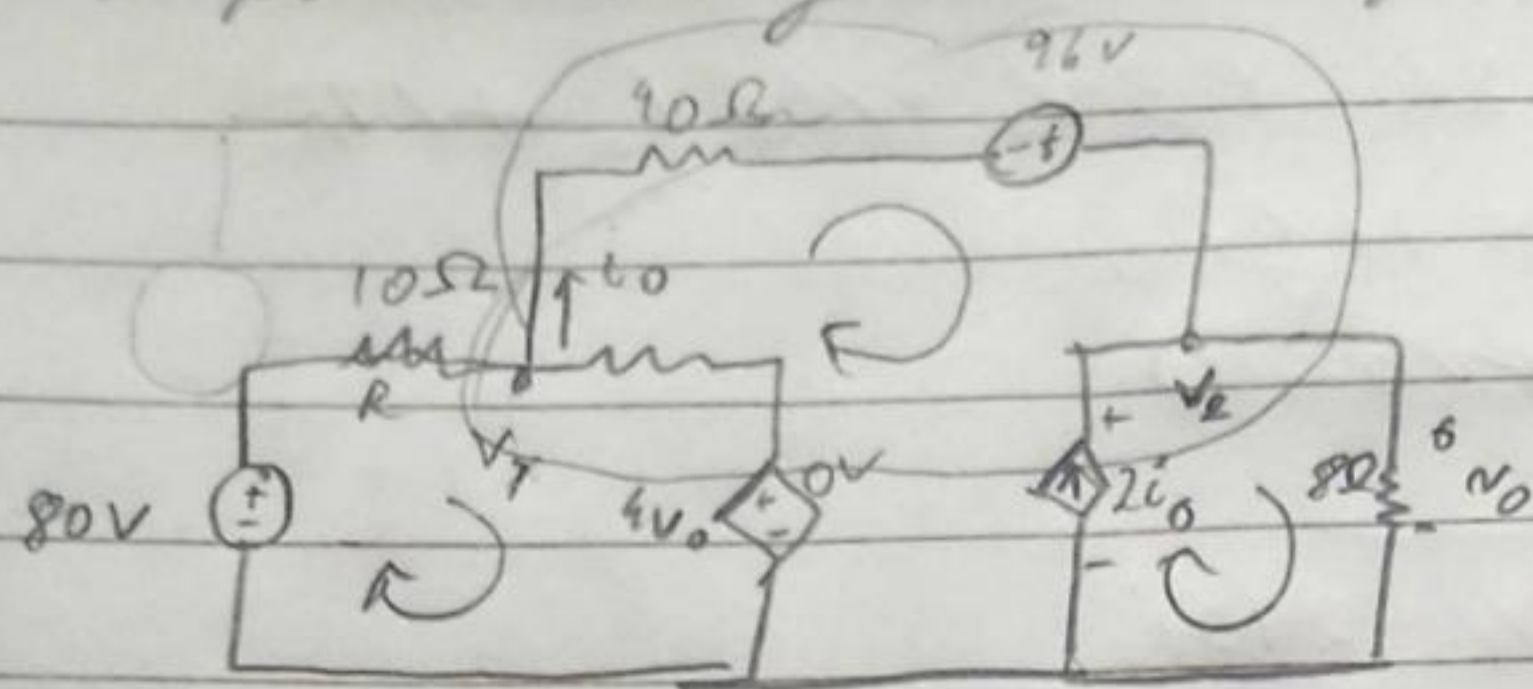


Problem 1

Compute V_o using node voltage method



a. \hookrightarrow Consider $\frac{-80V + V_1}{40} + \frac{V_1 - V_2 + 96}{40} + \frac{V_1 (V_1 - V_o)}{20} = 0$

ii. $\hookrightarrow \left(\frac{40 - 80V + V_1}{40} + \frac{(V_1 - V_2 + 96)}{40} + 2(V_1 - 4V_o) \right) = 0 \quad (1)$

iii. $\hookrightarrow -320 + 4V_1 + V_1 - V_2 + 96 + 2V_1 - 8V_o = 0$
 $7V_1 - V_2 = 8V_o + 224$

b. \hookrightarrow Apply node voltage @ V_2

i. $\hookrightarrow \left(\frac{-2i_o}{80} + \frac{V_2 - V_1 - 96}{80} \right) + \frac{V_2 - 0}{80} = 0$

ii. $\hookrightarrow \frac{-2i_o(80)}{80} + \frac{2V_2 - V_1 - 96}{80} + \frac{V_2}{80} = 0$

iii. $\hookrightarrow -160i_o + 2V_2 - 2V_1 - 112 + V_2 = 0$
 $\hookrightarrow -2V_1 + 3V_2 = 160i_o + 112$

C.E.1 $\rightarrow 7V_1 - V_2 = 8V_o + 224$ E.2. $-2V_1 + 3V_2 = 160i_o + 112$

c. Consider $i_o \uparrow$ & $2i_o \uparrow = 3i_o$

$V_o = 80V$

i. $\hookrightarrow 3i_o (80)$

ii. $\hookrightarrow V_o = 240i_o, V_2 = V_o$

d. Consider i_o for circuit

$\frac{V_1 - V_2 + 96V}{40} = i_o$

i. $\hookrightarrow V_1 - V_2 + 96 = 40i_o$

$V_1 = V_2 - 96 + 40i_o, V_2 = V_o$

ii. $\hookrightarrow V_1 = V_o - 96 + 40i_o$

e. Consider E.1 $\rightarrow V_1$

i. $\hookrightarrow 7(V_o - 96 + 40i_o) - V_o - V_o = 8V_o + 224$

ii. $\hookrightarrow 7V_o - 672 + 280i_o - V_o = 8V_o + 224$

iii. $\hookrightarrow 280i_o - 2V_o = 896$

J. Consider $V_1 = V_0 + 10i_0 - 96$

Eq 2 $\Rightarrow -2V_1 + 3V_0 = 160i_0 + 192$

i. \hookrightarrow Thus, $-2(V_0 + 10i_0 - 96) + 3V_0 = 160i_0 + 192$

ii. $\hookrightarrow -80i_0 + V_0 = 160i_0$

$\hookrightarrow 240i_0 + V_0 = 0$

Consider Eq 1 & Eq 2 $V_0 = 240i_0$

i. $\hookrightarrow 280i_0 - 2V_0 = 896$ $\hookrightarrow 240i_0 - V_0 = 0$

$280i_0 - 2(240i_0 - V_0) = 896$

$\hookrightarrow 280 - 480i_0 = 896$

$\hookrightarrow 200i_0 = 896$

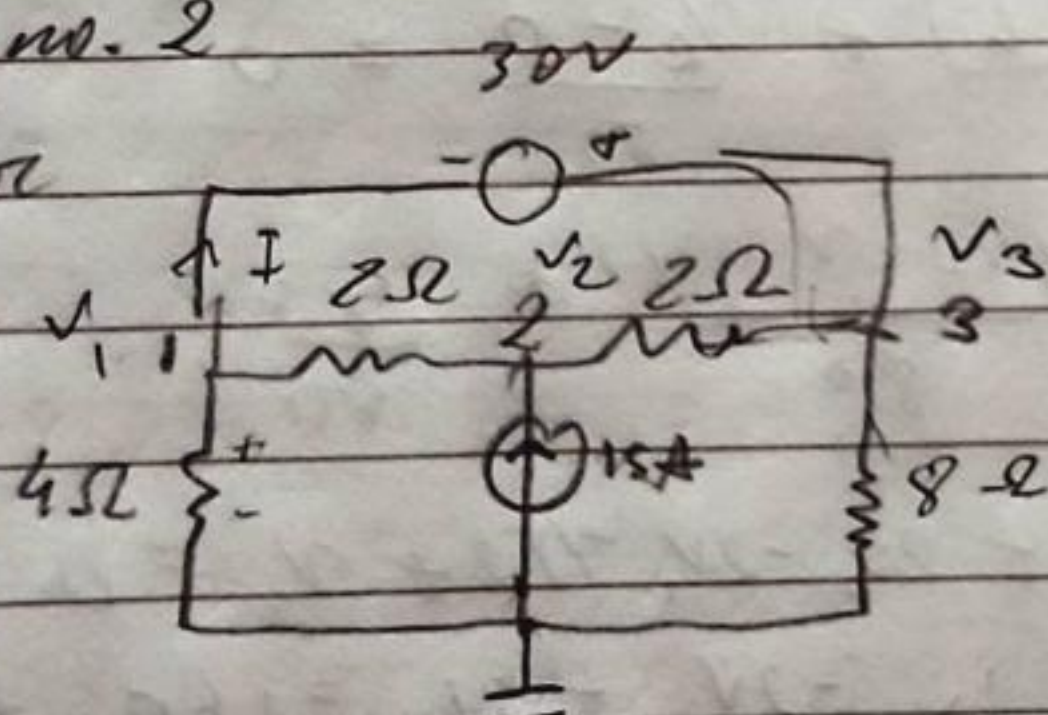
$i_0 = -4.48 \checkmark$

ii. $240(-4.48) - V_0 = 0$

$\hookrightarrow V_0 = -1072.2 \checkmark \checkmark$

Problem no. 2

Consider



i. \hookrightarrow KCL at Node 2 - Determine Node Voltage

$\hookrightarrow \left(\frac{V_2 - V_1}{2} + \frac{V_2 - V_3}{2} \right) = (15)^2$

$V_2, V_3 - V_1 = 30$

$\hookrightarrow 2V_2 - V_1 - V_3 = 30 \checkmark$

$V_2, V_3 - V_1 = 30$

ii. KCL at node 3

$\frac{V_3 - V_2}{2} + \frac{V_3}{8} = 0$

$\hookrightarrow \left(\frac{4V_3 - 4V_2}{8} + \frac{V_3}{8} \right) = 0$

$\hookrightarrow 5V_3 - 4V_2 = 0 \checkmark$

iii. KCL at node 1

$\frac{V_1 - V_2}{2} + \frac{V_1}{4} = 0$

$\hookrightarrow \frac{2V_1 - 2V_2 + V_1}{2} = 0$

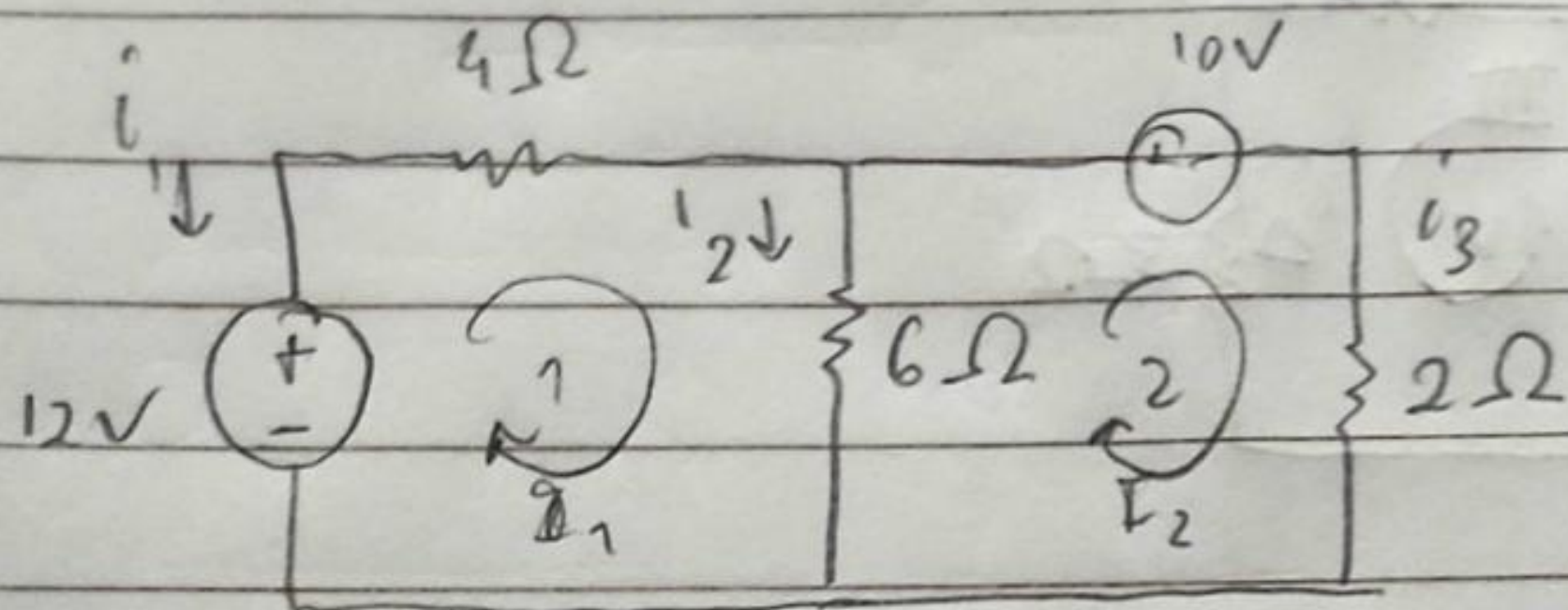
$5V_3 - 4V_2 = 8 \left(\frac{2V_2 - 3V_1}{2} \right)$

$\hookrightarrow 5V_3 - 4V_2 = 8V_2 - 12V_1$

$\hookrightarrow 12V_1 - 12V_2 + 5V_3 = 0$

Problem No. 3

Use the mesh-current method to find i_1 , i_2 , i_3



Mesh for \mathcal{R}_1 , $\hookrightarrow 12V - 4i_1 - 6(i_1 - i_2) = 0$

$$\hookrightarrow 12 - 10i_1 + 6i_2 = 0$$

$$\hookrightarrow 10i_1 - 6i_2 = 12$$

Mesh for \mathcal{R}_2 , $\hookrightarrow 10 + 2(i_2) + 6(i_2 - i_1) = 0$

$$\hookrightarrow -6i_1 + 8i_2 = -10$$

$$\hookrightarrow 6i_1 - 8i_2 = 10$$

$$\text{ii} \hookrightarrow i_2 = \frac{(10 - 6i_1)}{8}$$

$$\hookrightarrow 10i_1 - 6\left(\frac{10 - 6i_1}{8}\right) = 12$$

$$\hookrightarrow 10i_1 + \frac{60 - 36i_1}{8} = 12$$

$$\left(\frac{80i_1 + 60 - 36i_1}{8} = 12\right)^8$$

$$80i_1 + 60 - 36i_1 = 96$$

$$44i_1 = 36$$

$$i_1 = 36/44 = 0.81 \checkmark$$

$$\hookrightarrow \text{Thus, } i_1 = 0.81$$

ii. Since $6i_1 - 8i_2 = 10$

$$6(0.81) - 8i_2 = 10 = 10 -$$

$$i_2 = \frac{10 - 6(0.81)}{8}$$

$$i_2 = -0.6425 \checkmark$$

iii. find i_1, i_2, i_3

$$\hookrightarrow i_1 = 0.8181$$

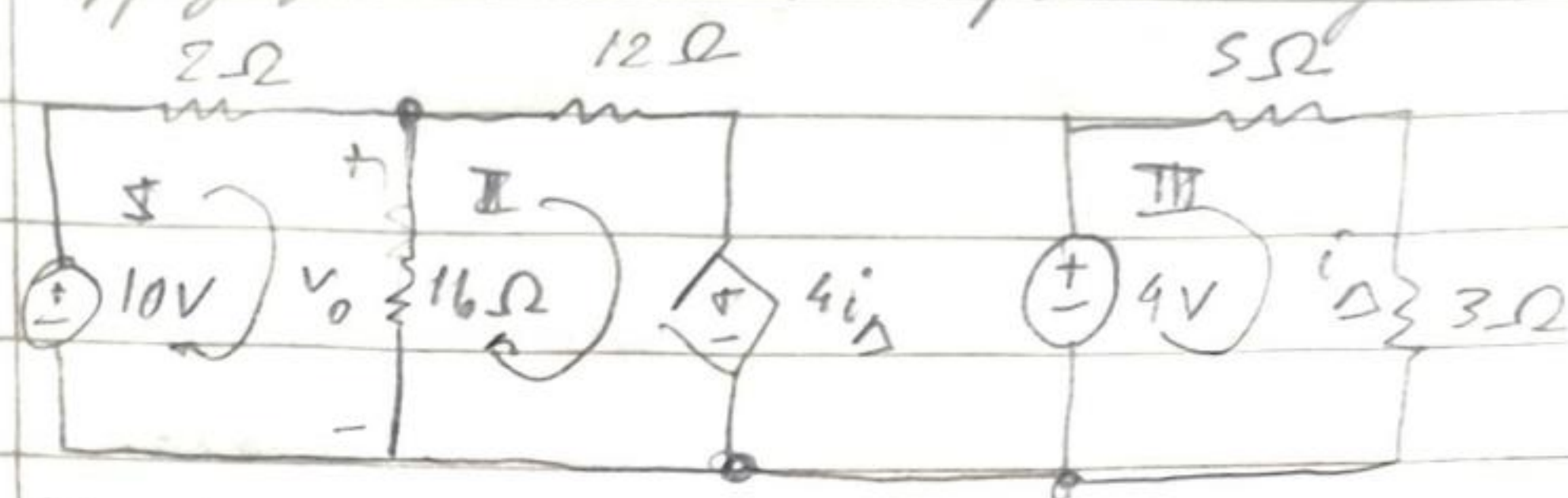
$$i_2 = i_1 - i_2 = 0.81 + 0.631 \checkmark$$

$$\hookrightarrow 1.454 \text{ Amp. } \checkmark$$

$$i_3 = i_2 = -0.6245 \checkmark$$

Problem No. 5

• Apply Mesh Method to compute V_o of the following circuit



i₁ - kvl in loop 1

$$-10 + 2I_1 + 16(I_1 - I_2) = 0$$

$$\Rightarrow 18I_1 - 16I_2 = 10 \quad \checkmark \text{ Eq 1}$$

i₂ - kvl in loop 2

$$16(I_2 - I_1) + 12I_2 + 4i_\Delta = 0$$

$$\Rightarrow 16I_2 - 16I_1 + 12I_2 + 4(0.5) = 0$$

$$\Rightarrow -16I_1 + 28I_2 + 2 = 0$$

$$\Rightarrow 16I_1 + 28I_2 = -2 \quad \checkmark \text{ Eq 2}$$

$$\Rightarrow 18I_1 - 16I_2 = 10$$

$$18I_1 - 16I_2 = 10$$

$$\Rightarrow 16I_1 + 28I_2 = -2$$

$$\Rightarrow -16I_1 + 28I_2 = -2$$

i₃ - kvl loop 3

$$-4 + 5i_\Delta + 3i_\Delta = 0$$

$$\Rightarrow 8i_\Delta = 4$$

$$i_\Delta = \frac{1}{2} \text{ A}$$

iv. Compute $V_o = 16(I_1 - I_2)$

$$\Rightarrow 16(1 - 0.5)$$

$$\Rightarrow 8 \text{ V} \quad \checkmark$$

• Independent Src

$$\Rightarrow 4i_\Delta(I_2)$$

$$\Rightarrow 4(0.5)^2$$

$$\Rightarrow 1.00 \text{ W} \quad \checkmark$$

dependent Src

Independent = dependent

$$\Rightarrow -1.00 \text{ W} \quad \checkmark$$