CSE 250 MID ASSIGNMENT

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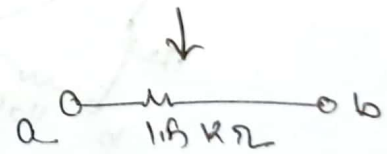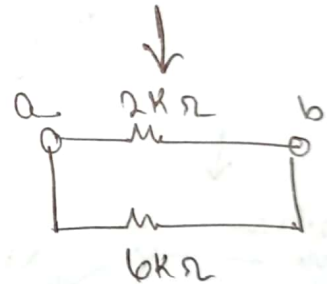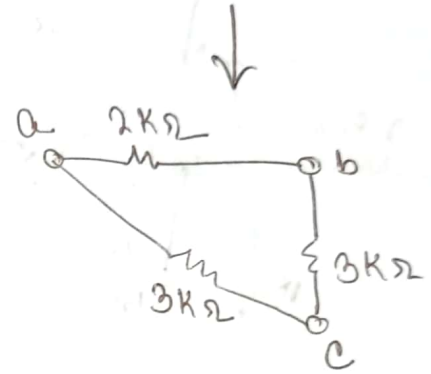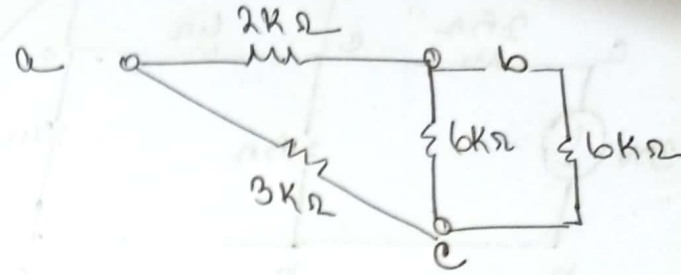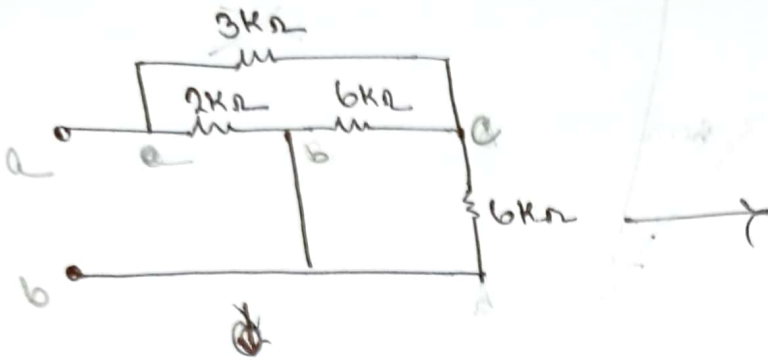
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SECTION: 6

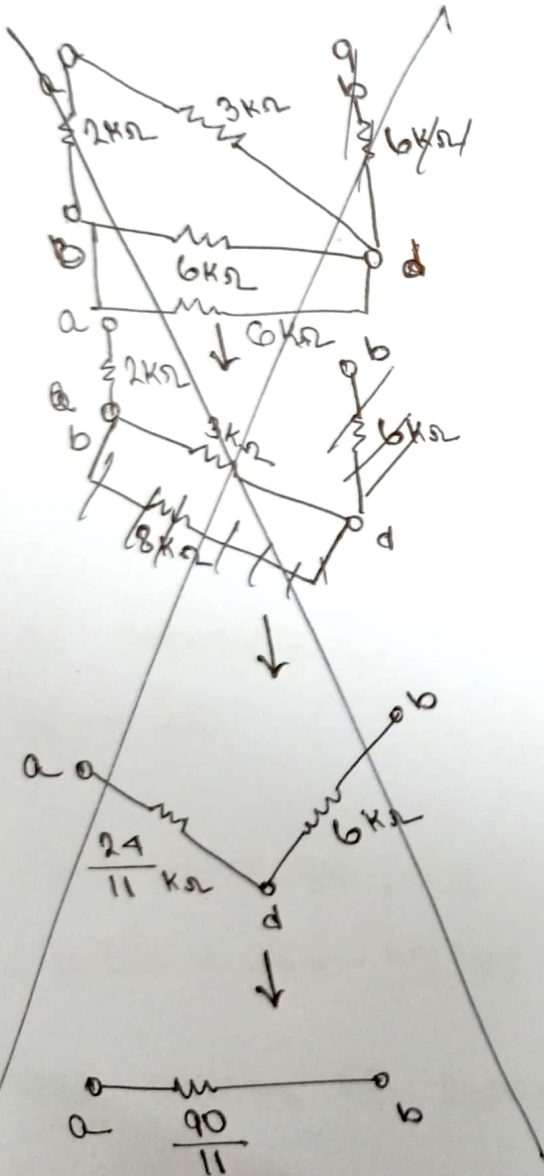SUBMISSION DATE: 11/11/2022

SERIES — PARALLEL CONFIGURATION

(1)

3KΩ

2KΩ   6KΩ

a   c

6KΩ

b

↓

2KΩ   3KΩ   6KΩ

6KΩ

6KΩ

2KΩ   6KΩ   b

3KΩ   6KΩ

8KΩ   d

↓

a $\frac{24}{11}$ KΩ   b

6KΩ   d

↓

a $\frac{90}{11}$ b

Req = $\frac{90}{11}$

---

a   2KΩ   b

3KΩ   6KΩ   6KΩ

c

↓

a   2KΩ   b

3KΩ   3KΩ

c

↓

a   2KΩ   b

6KΩ

↓

a   1.8 KΩ   b

Req = 1.8 KΩ

(2)

Top circuit:
60Ω
12Ω
6Ω
2.5Ω
a
35V
b
15Ω
20Ω
80Ω
c
e
b

Second circuit:
a — 2.5Ω
c
12Ω
6Ω
60Ω
15Ω
80Ω
20Ω
e

Third circuit:
a — 2.5Ω — c
4Ω
12Ω
16Ω
e
b

Fourth circuit:
2.5Ω — c
12Ω   20Ω
b

Fifth circuit:
a — 2.5Ω — c
$\frac{15}{2}$ Ω
b

Sixth circuit:
a — Req — b
10Ω

∴ Req = 10Ω
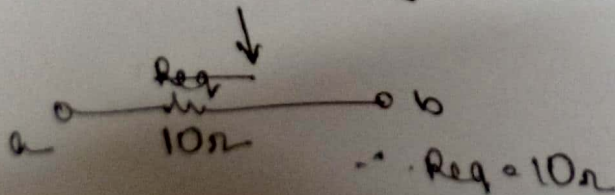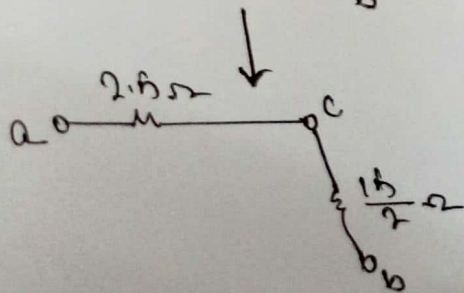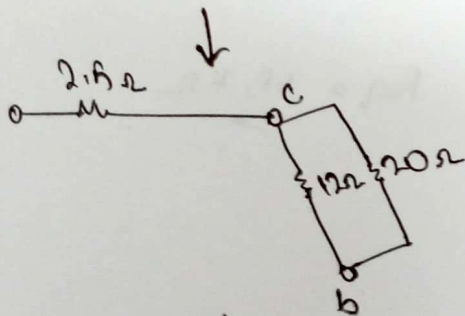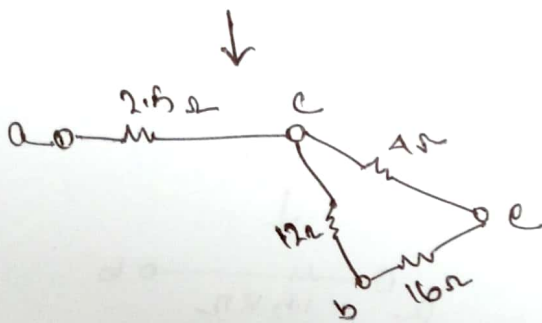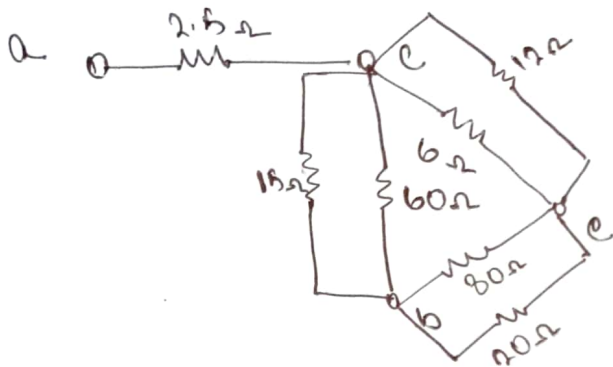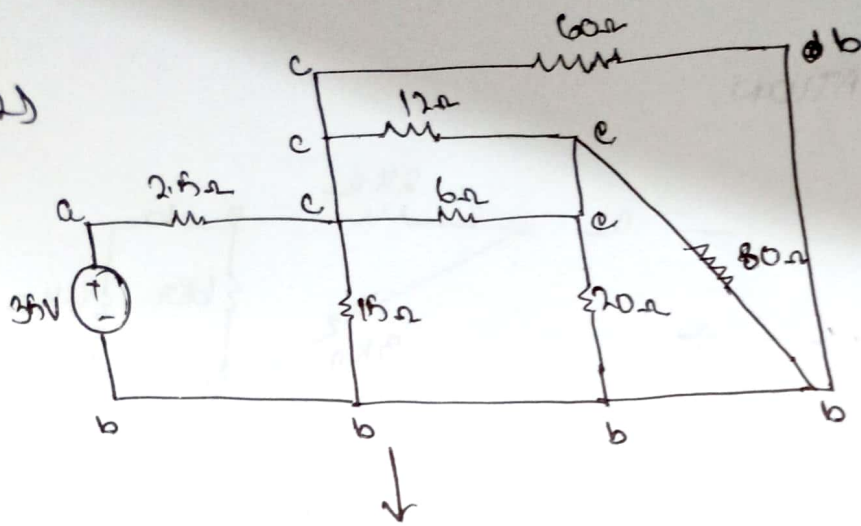
$I_0 = \dfrac{V}{Req} = \dfrac{35}{10} = 3A \ 3.5A$

Nodal Analysis

(3)
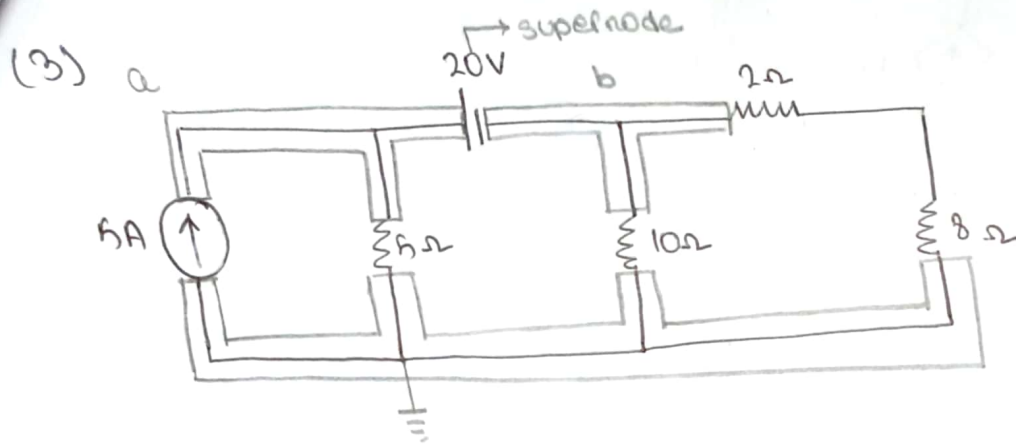
KCL at node a and b,

$$5 + \frac{0 - V_a}{5} + \frac{0 - V_b}{10} + \frac{0 - V_b}{2 + 8} = 0$$

$$\frac{V_a}{5} + \frac{8 V_b}{5} = 5 \quad\text{——} \quad ①$$

KVL at supernode,

$$V_b - V_a = 20$$
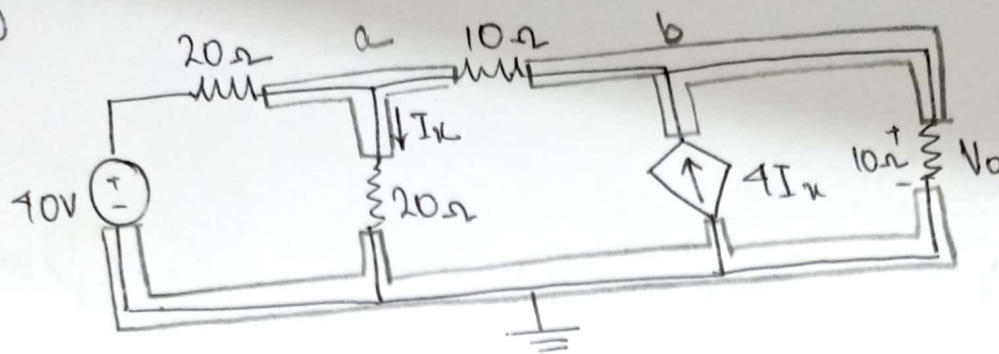
$$V_a = \cancel{-8.75 V} \cancel{2V} 2.5 V$$

$$V_b = \cancel{11.25 V} \cancel{18V} 22.5 V$$

voltage across 5A current source = $V_a - 0$

$$= 22.5 - 0$$

$$= 22.5 V$$

(4)

KCL at node a

$$\frac{V_a - 40 - 0}{20} + \frac{V_a - 0}{20} + \frac{V_a - V_b}{10} = 0$$

$$\frac{1}{5}V_a - \frac{V_b}{10} = 2$$

KCL at node b,

$$\frac{V_a - V_b}{10} + 4I_x + V_0 = 0 \qquad I_x = \frac{V_a - 0}{20}, \quad V_0 = \frac{0 - V_b}{10}$$
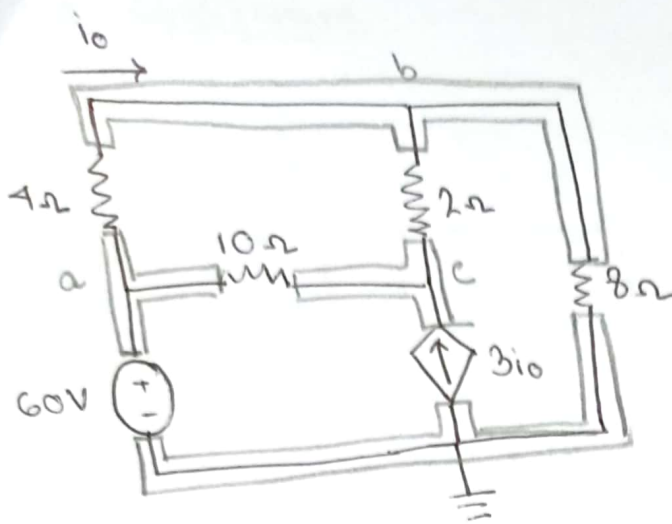
$$\frac{V_a - V_b}{10} + 4\left(\frac{V_a - 0}{20}\right) + \frac{0 - V_b}{10} = 0$$

$$\frac{-1}{10}V_a - \frac{1}{5}V_b = \frac{4}{5} = 0 \qquad \frac{3}{10}V_a - \frac{1}{5}V_b = 0$$

$V_a = 10 V, \quad V_b = -4V \; 60V$

$V_0 = 0 - V_b = 0 - -4 = 4V$

$V_0 = V_b - 0 = 60V$

$V_a = 60V$

KCL at node b,

$$\frac{V_a - V_b}{4} + \frac{V_c - V_b}{2} + \frac{0 - V_b}{8} = 0$$

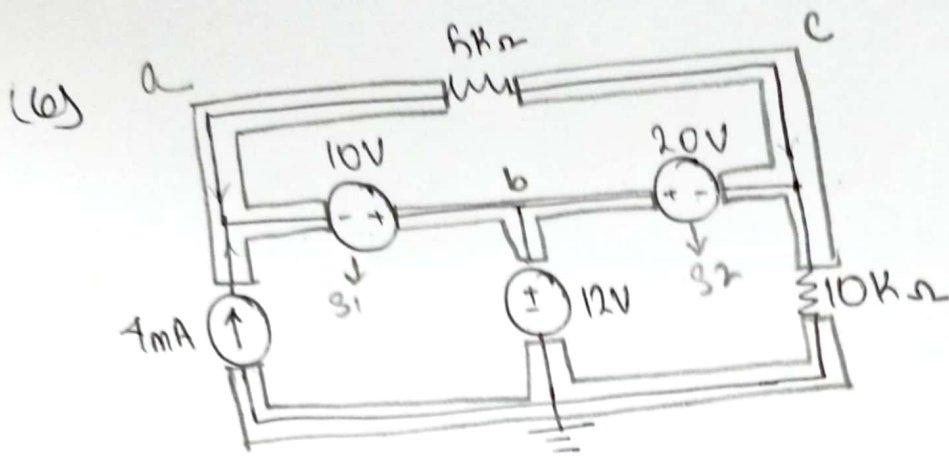$$-\frac{7}{8} V_b + \frac{V_c}{2} = -15$$

KCL at node c,

$$\frac{V_a - V_c}{10} + 3i_0 + \frac{V_b - V_c}{2} = 0 \qquad \left[i_0 = \frac{V_a - V_{ab}}{4} \right]$$

$$\frac{V_a - V_c}{10} + 3 \left[\frac{V_a - V_b}{4} \right] + \frac{V_b - V_c}{2} = 0$$

$$-\frac{61}{4} V_b - \frac{3V_c}{105} = 34 - 51$$

$V_{ab} = 53.08V$, $V_{bc} = 62.89$

$$i_0 = \frac{V_a - V_b}{4} = \frac{60 - 53.08}{4} = 1.73A$$

(6)

$V_b = 12\ V$

KCL at node a, b, c

$$4 + \frac{V_c - V_a}{5} + \frac{V_a - V_c}{5} + \frac{0 - V_c}{10} = 0$$

$V_c = 40\ V$

KVL at supernode 1,

$V_b - V_a = 10$

~~$V_a - 12 = 10$~~ $12 - V_a = 10$

~~$V_a = 22\ V$~~ $V_a = 2V$

KVL at super node 2,

$V_b - V_{bc} = 20$

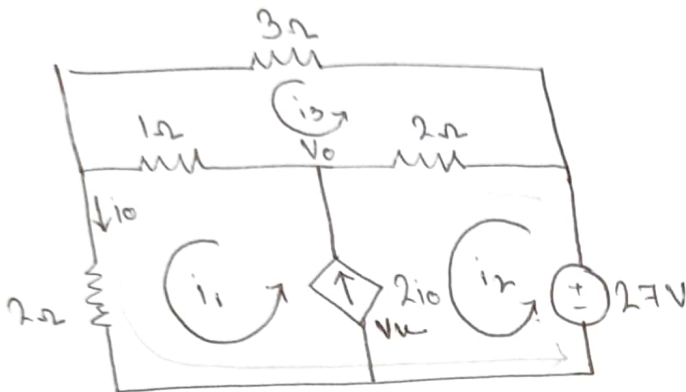~~$10 - V_b = 20$~~

$12 - V_c = 20$

$V_c = -8V$

MESH ANALYSIS

(7)

KVL at loop 1 and 2,

$$-27 + 2(i_2 - i_3) + 1(i_1 - i_3) + 2i_1 = 0$$

$$3i_1 + 2i_2 - 3i_3 = 27$$

KVL at loop 3,

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

$$-i_1 - 2i_2 + 6i_3 = 0$$

KCL at supermesh,

$$i_1 - i_2 = 2i_0 \qquad [i_0 = \infty\, i_1]$$

$$i_1 - i_2 = 2(i_1)$$

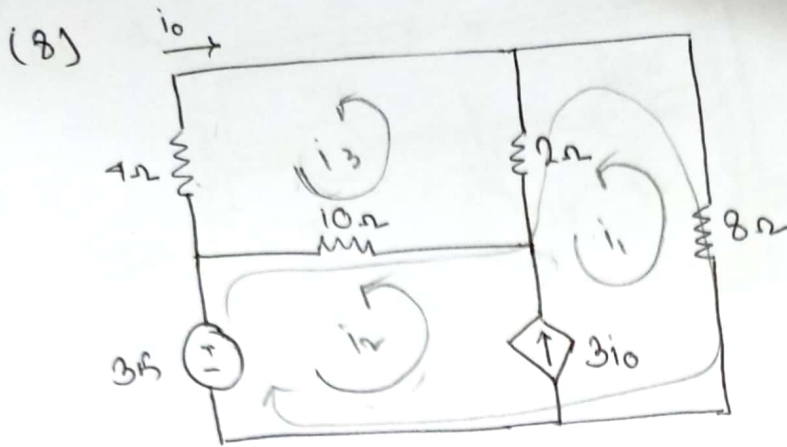$$-i_1 - i_2 = 0$$

$i_1 = 18A$

$i_2 = -18A$

$i_3 = -3A$

$i_0 = i_1 = 18A$

KVL at loop 1,

$$1(i_1 - i_3) + 2i_1 + V_u = 0$$

$$1(18 - -3) + 2(18) + V_u = 0$$

$$V_u = -57V$$

(8)

KCL at loop 1 and 2

$-\cancel{\dfrac{3\beta}{3\theta}} + 10(i_2 - i_3) + 2(i_1 - i_3) + 8i_1 = 0$

$10i_1 + 10i_2 - 12i_3 = \cancel{10}\ 3\beta$

KCL at loop 3

$2(i_3 - i_1) + 10(i_3 - i_2) + 4i_3 = 0$

$-2i_1 - 10i_2 + 16i_3 = 0$

KVL at supermesh

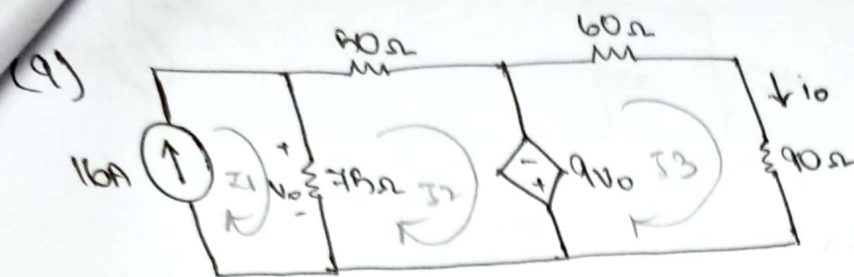$i_2 - i_1 = 3i_0 \qquad [i_0 = -i_3]$

$-i_1 + i_2 + 3i_3 = 0$

$\cancel{i_1 = 1.37A} \quad i_2 =$

$\cancel{i_1 = 4.47A \quad i_2 = -1.49A \quad i_3 = -0.43\beta}$

$i_1 = 3.87A, \ i_2 = 0.84A, \ i_3 = 1.01A$

$i_0 = -i_3$

$i_0 = -1.01A$

(9)

$$I_1 = 16 A$$

KCL at loop 2,

$$50I_2 - 9V_0 + 75(I_2 - I_1) = 0 \qquad [V_0 = 75I_1 = 75(I_1 - I_2)]$$

$$50I_2 - 9[75(16 - I_2)] + 75(I_2 - 16) = 0$$

$$\cancel{75I_1 + 800I_2}$$

$$800I_2 = 12000$$

$$I_2 = 15 A$$

KCL at loop 3,

$$60I_3 + 90I_3 + 9V_0 = 0$$

$$150I_3 + 9[75(I_1 - I_2)] = 0$$

$$150I_3 + 9[75(16 - 15)] = 0$$

$$I_3 = -4.5 A$$

$$i_0 = I_3 = -4.5 A$$

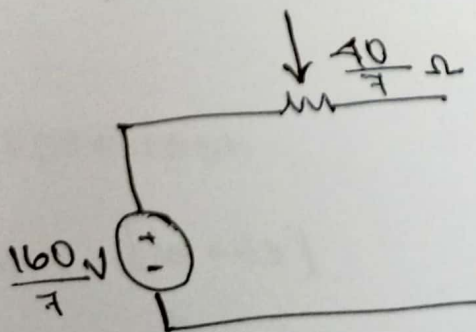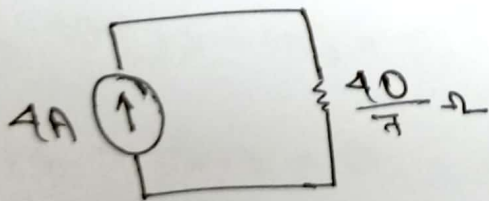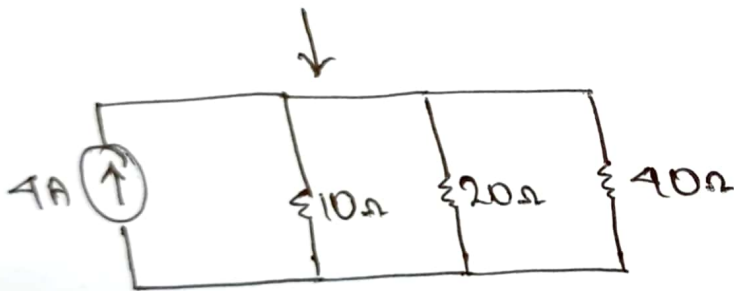$$V_0 = 75(I_1 - I_2)$$
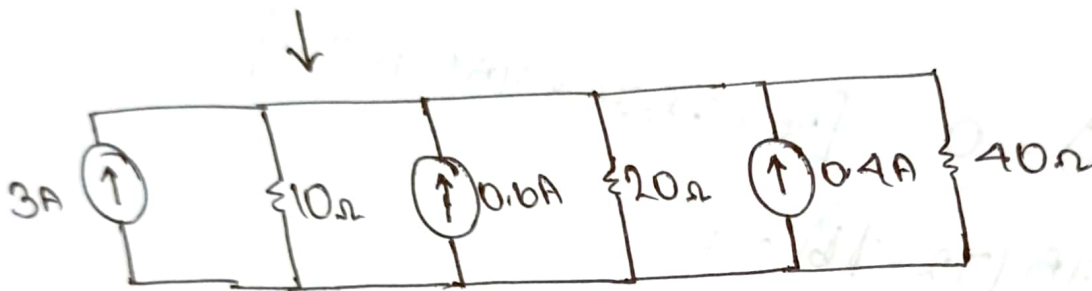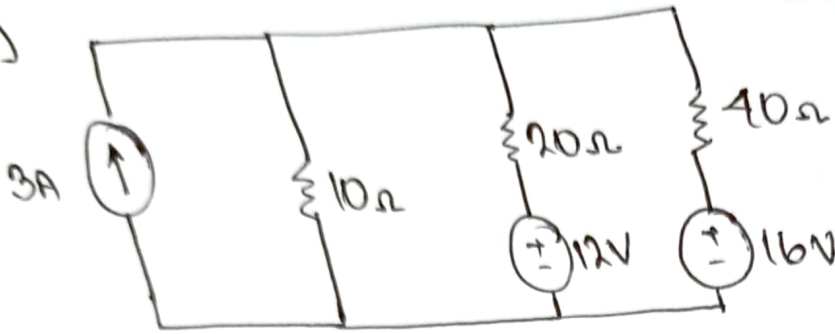
$$V_0 = 75(16 - 15)$$

$$V_0 = 75 V$$

SOURCE TRANSFORMATION

(10)

$3A$ ↑ 10Ω 20Ω 40Ω $12V$ $16V$

↓

$3A$ ↑ 10Ω ↑ $0.6A$ 20Ω ↑ $0.4A$ 40Ω

↓

$4A$ ↑ 10Ω 20Ω 40Ω

↓

$4A$ ↑ $\dfrac{40}{7}\Omega$
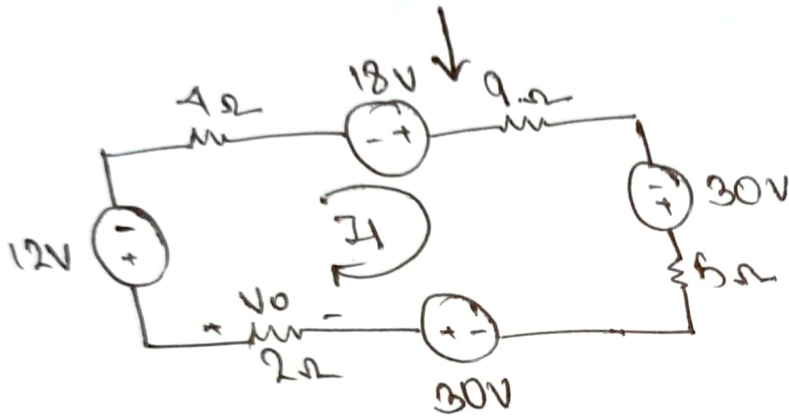
↓ $\dfrac{40}{7}\Omega$

$\dfrac{160}{7}V$
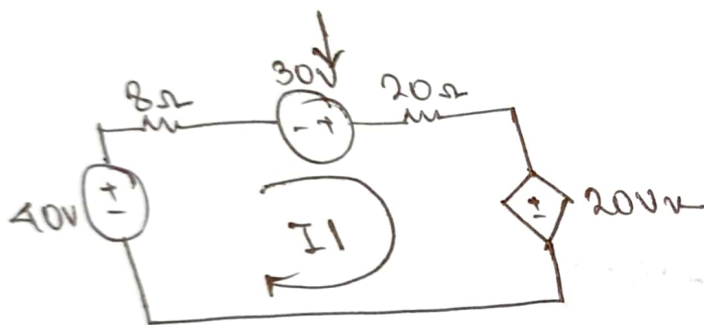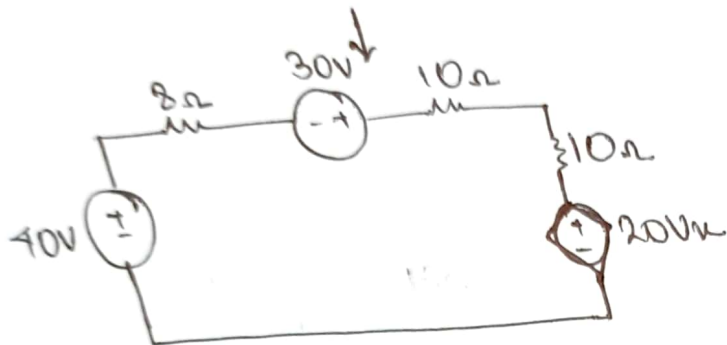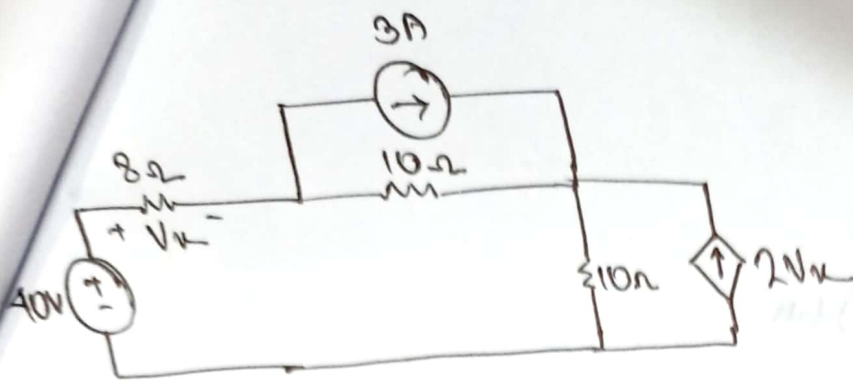
KVL at loop 1
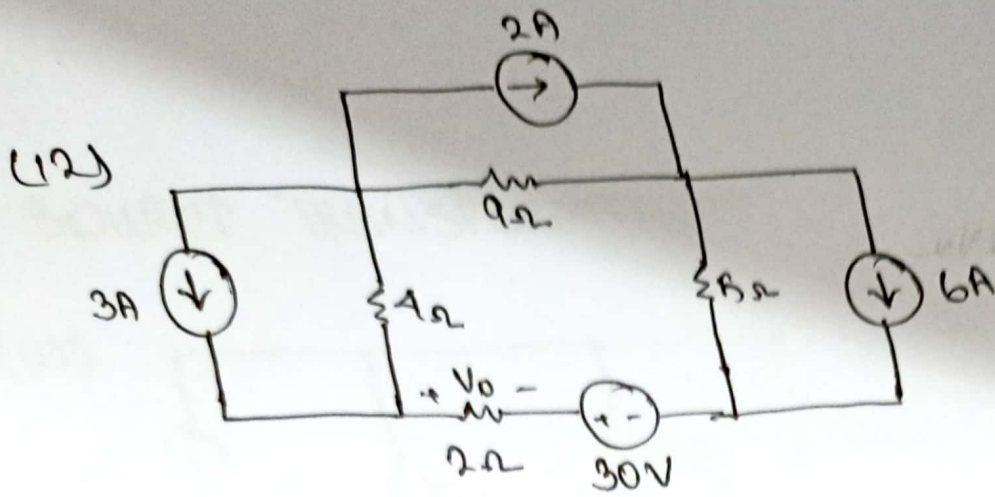
$-40 + 8I_1 - 30 + 20I_1 + 20V_x = 0 \quad [V_x = 8I_1]$

$-40 + 8I_1 - 30 + 20I_1 + 20(8I_1) = 0$

$188 I_1 = 70$

$I_1 = \dfrac{35}{94} \ A$

$V_x = \left(\dfrac{35}{94}\right)(8) = 2.98 \ V$

(12)

KVL at loop 1,

$$4I_1 - 18 + 9I_1 - 30 + 5I_1 - 30 + 2I_1 + 12 = 0$$

$$20I_1 = 66$$

$$I_1 = 3.3 \, A$$

$$V_0 = (3.3)(2) = 6.6 \, V$$