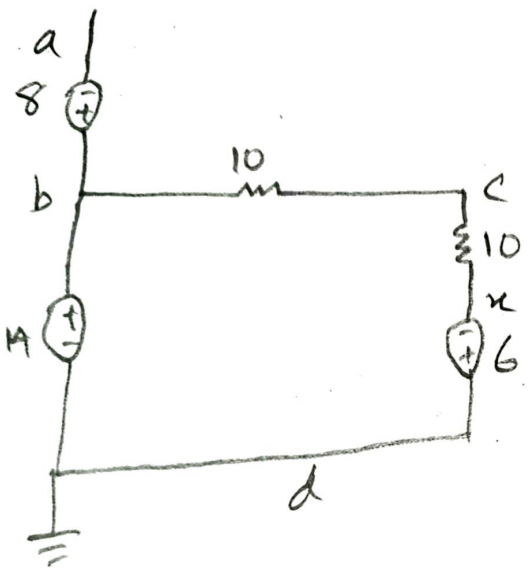
CSE250 practice set-2



$V_d = 0$

$V_b - V_d = 14$

$V_b = 14$

$V_b - V_a = 8$

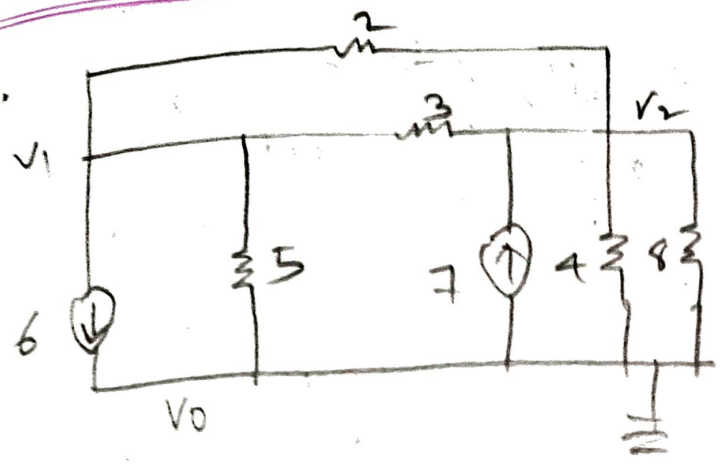
$\Rightarrow V_a = 6$

$V_x = -6$

$$V_c \frac{1}{5} + V_b \frac{1}{10} - V_x \frac{1}{10} = 0$$

$\Rightarrow V_c = 4$

2.



1.033 0.83

$$V_1\left(\frac{1}{2}+\frac{1}{3}+\frac{1}{5}\right) - V_2\left(\frac{1}{2}+\frac{1}{3}\right) = -6$$

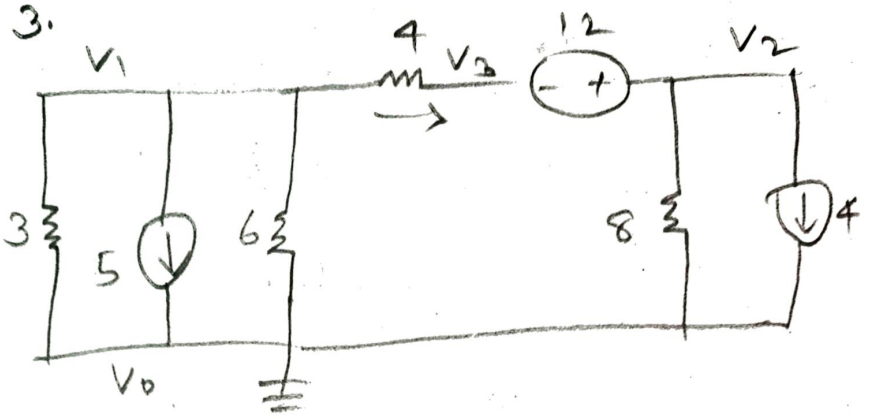
1.208 0.83

$$V_2\left(\frac{1}{2}+\frac{1}{3}+\frac{1}{4}+\frac{1}{8}\right) - V_1\left(\frac{1}{2}+\frac{1}{3}\right) = 7$$

$V_1 = -2.56 \quad V_2 = 4.03$

$V_0 = 0$

3.



$V_0 = 0$, $V_2 - V_3 = 12$ — (I)

supernod 2, 3

$$V_3 \frac{1}{4} - V_1 \frac{1}{4} + V_2 \frac{1}{8} + 4 = 0$$

$$\Rightarrow -2V_1 + V_2 + 2V_3 = -32 \quad — (II)$$

node 1

$$V_1\left(\frac{1}{3} + \frac{1}{6} + \frac{1}{4}\right) - V_3 \frac{1}{4} + 5 = 0$$

$$\Rightarrow 3V_1 - V_3 = -20 \quad — (III)$$

$V_1 = -14.85$

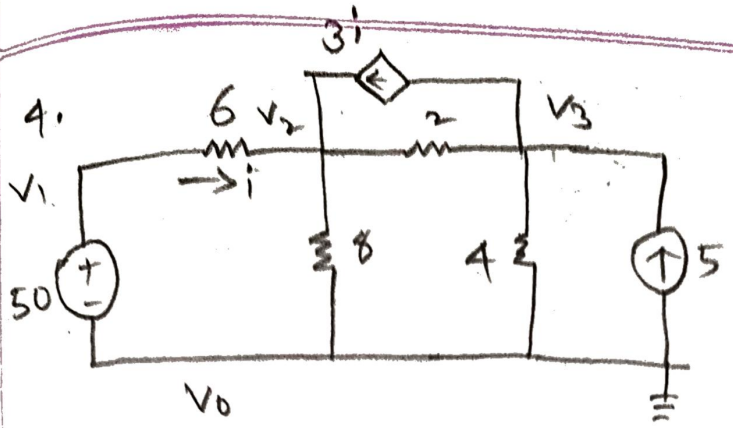
$V_2 = -12.57$

$V_3 = -24.573$

$I_{4\Omega} = 2.43\ A$

$P_{12V} = -29.16\ W$

4.



$V_0 = 0 \quad V_1 = 50$

$V_2 = 32 \quad V_3 = 16$

$i = 3\ A$

$\therefore P_{50V} = -Vi = -150\ W$

$\therefore P_{3i} = (V_3 - V_2)\,3i$

$= -144\ W$

$\therefore P_{5A} = (V_0 - V_3)\,5 = -80\ W$

$i = \dfrac{V_1 - V_2}{6}, \quad V_1 = 50$

node 2

$$V_2\left(\frac{1}{6} + \frac{1}{2} + \frac{1}{8}\right) - 3i - V_1\frac{1}{6} - V_3\frac{1}{2} = 0$$

$$\Rightarrow V_2\frac{19}{24} - 3\frac{-V_2 + V_1}{6} - V_1\frac{1}{6} - V_3\frac{1}{2} = 0$$

$$\Rightarrow V_2\frac{19}{24} - \frac{-V_2 + 50}{2} - \frac{50}{6} - V_3\frac{1}{2} = 0$$

$$\Rightarrow 19V_2 + 12V_2 + 600 - 200 - 12V_3 = 0$$

$$\Rightarrow 31V_2 - 12V_3 = 800$$

node 3

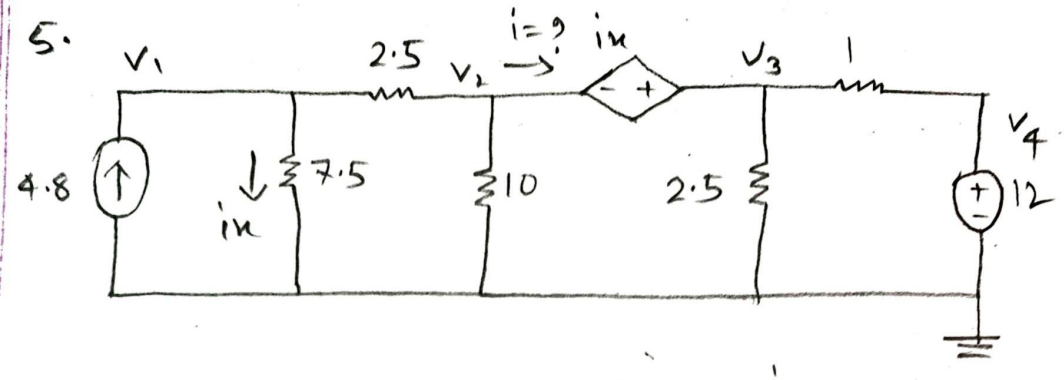
$$V_3\left(\frac{1}{2} + \frac{1}{4}\right) - V_2\frac{1}{2} - 5 + 3i = 0$$

$$\Rightarrow -V_2\frac{1}{2} + V_3\frac{3}{4} + \frac{-V_2 + 50}{2} - 5 = 0$$

$$\Rightarrow -2V_2 + 3V_3 + 2V_2 + 100 - 20 = 0$$

$$\Rightarrow 3V_3 - 2V_2 = 80$$

5.



$V_0 = 0$, $V_4 = 12$, $V_3 - V_2 = i_x$

$\Rightarrow V_3 - V_2 = \frac{V_1 - V_0}{7.5} \Rightarrow \frac{1}{7.5} V_1 + V_2 - V_3 = 0$ ——— (III)

node 1

$$V_1\left(\frac{1}{7.5} + \frac{1}{2.5}\right) - V_2 \frac{1}{2.5} - 4.8 = 0$$

$$\Rightarrow \frac{8}{15} V_1 - \frac{1}{2.5} V_2 = 4.8 \quad \text{——— (I)}$$

Supernode 2, 3

$$V_2\left(\frac{1}{2.5} + \frac{1}{10}\right) + V_3\left(\frac{1}{2.5} + 1\right) - V_1 \frac{1}{2.5} - V_4 = 0$$

$$\Rightarrow -\frac{1}{2.5} V_1 + \frac{1}{2} V_2 + \frac{7}{5} V_3 = 12 \quad \text{——— (II)}$$

(I), (II), (III) $\Rightarrow$

$V_1 = 15$, $V_2 = 8$, $V_3 = 10$

$$4.8 = i_x + i_{2.5}$$

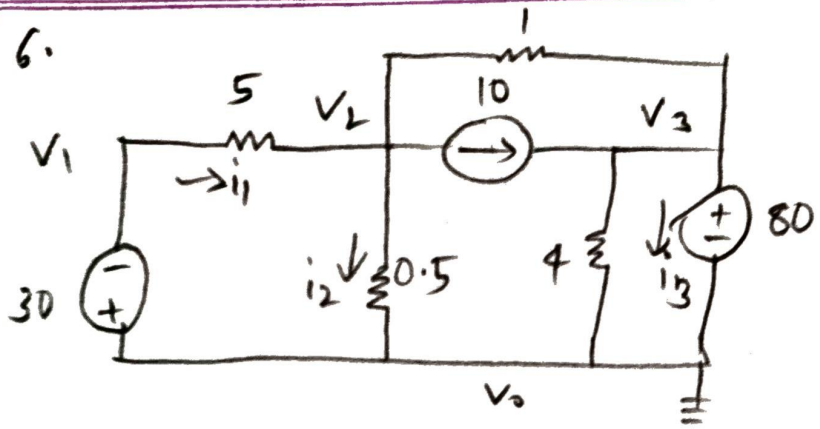
$$\Rightarrow i_{2.5} = 2.8$$

$$2.8 = i_{10} + i$$

$$\Rightarrow i = 2.8 - \frac{V_2}{10}$$

$$\Rightarrow i = 2\,A$$

6.



$V_0 = 0$, $V_1 = -30$, $V_3 = 80$

node 2

$$V_2\left(1+\frac{1}{5}+\frac{1}{0.5}\right) - V_1\frac{1}{5} - V_3 \cdot 1 + 10 = 0$$

$$\Rightarrow V_2\frac{16}{5} + 30\frac{1}{5} - 80 + 10 = 0$$

$$\Rightarrow V_2 = 20$$

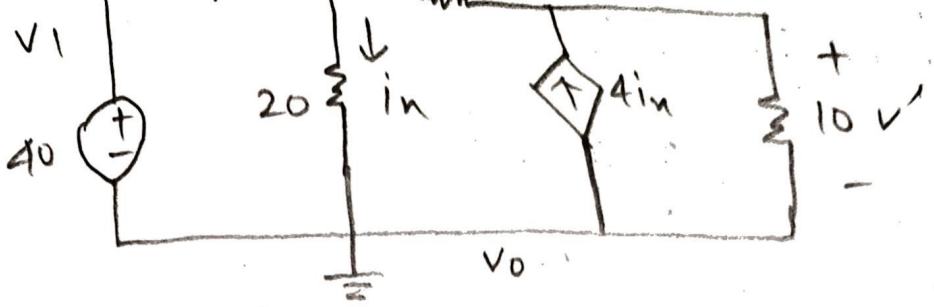
$$\therefore i_1 = \frac{-30-20}{5} = -10\ mA$$

$$\therefore i_2 = \frac{20}{0.5} = 40\ mA$$

$$10 = i_{4\Omega} + i$$

$$\Rightarrow i = 10 - 20 = -10$$

$$-10 + \frac{V_2 - V_3}{1} = i_3 \Rightarrow i_3 = -70\ mA$$



$v_o = 0$, $v_1 = 40$, $i_x = \frac{v_2}{20}$

node 2

$$v_2\left(\frac{1}{20} + \frac{1}{20} + \frac{1}{10}\right) - v_1\frac{1}{20} - v_3\frac{1}{10} = 0$$

$$\Rightarrow \frac{1}{5}v_2 - \frac{1}{10}v_3 = 2 \quad \text{---} (1)$$

node 3

$$v_3\left(\frac{1}{10} + \frac{1}{10}\right) - v_2\frac{1}{10} - 4i_x = 0$$

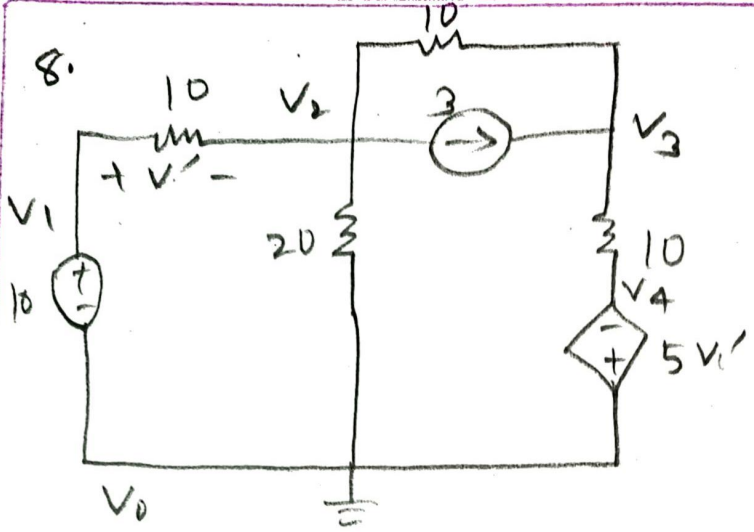
$$\Rightarrow v_3\frac{1}{5} - v_2\frac{1}{10} - 4\frac{v_2}{20} = 0$$

$$\Rightarrow \frac{3}{10}v_2 - \frac{1}{5}v_3 = 0 \quad \text{---} (2)$$

(1), (2) $\Rightarrow v_2 = 40$, $v_3 = 60$

$V' = V_3 - V_o$
$= 60V$

8.



$v' = ?$

$V_0 = 0$, $V_1 = 10$, $v' = 10 - V_2$, $V_4 = -5v'$

node 2

$$V_2\left(\frac{1}{10} + \frac{1}{20} + \frac{1}{10}\right) + 3 - V_1\frac{1}{10} - V_3\frac{1}{10} = 0$$

$$\Rightarrow \frac{1}{4}V_2 + 3 - 1 - \frac{1}{10}V_3 = 0$$

$$\Rightarrow \frac{1}{4}V_2 - \frac{1}{10}V_3 = -2$$

$V_2 = 60$

$V_3 = 170$

$\therefore v' = 10 - 60$

$= -50$

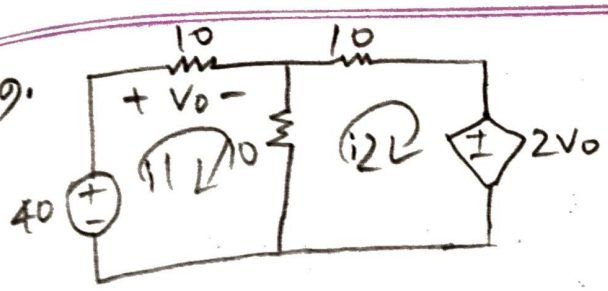
node 3

$$V_3\left(\frac{1}{10} + \frac{1}{10}\right) - 3 - V_2\frac{1}{10} - V_4\frac{1}{10} = 0$$

$$\Rightarrow \frac{1}{5}V_3 - \frac{1}{10}V_2 + 5\frac{1}{10}v' = 3$$

$$\Rightarrow -\frac{3}{5}V_2 + \frac{1}{5}V_3 = -2 \quad \ldots$$

9.



mesh1

$$-40 + I_1 \times 10 + 10(I_1 - I_2) = 0$$

$$\Rightarrow \quad 20I_1 - 10I_2 = 40$$

$$\Rightarrow \quad 2I_1 - I_2 = 4 \quad -(1)$$

mesh2

$$10(I_2 - I_1) + 10I_2 + 2 \times 10 \times I_1 = 0$$

$$\Rightarrow 10I_1 + 20I_2 = 0$$

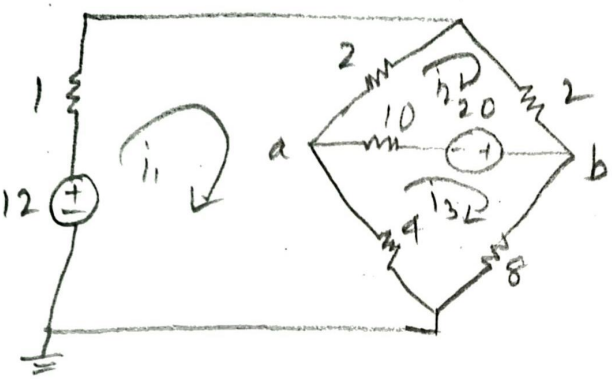
$$\Rightarrow I_1 + 2I_2 = 0 \quad -(11)$$

(1), (11) $\Rightarrow$

$$I_1 = 1.6\,A, \quad I_2 = -0.8\,A$$

$$\therefore V_o = 1.6 \times 10 = 16\,V$$

10.



$i_1 = 2.37\ i_2 = -0.19519$

$i_3 = 1.25203$

$\therefore V_{ab} = -20 + 10(i_3 - i_2)$

$= -5.3V$

mesh1

$$-12 + i_1 + 2(i_1 - i_2) + 4(i_1 - i_3) = 0$$

$$\Rightarrow 7i_1 - 2i_2 - 4i_3 = 12 \quad \text{---} \ (1)$$

mesh2

$$2(i_2 - i_1) + 2i_2 + 20 + 10(i_2 - i_3) = 0$$

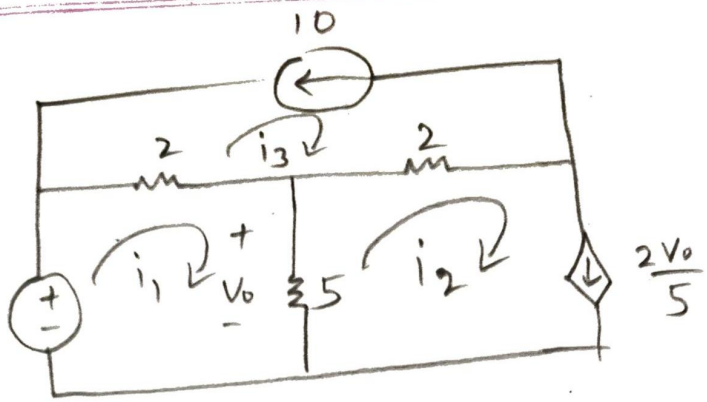
$$\Rightarrow -2i_1 + 14i_2 - 10i_3 = -20 \quad \text{---} \ (11)$$

mesh3

$$4(i_3 - i_1) + 10(i_3 - i_2) - 20 + 8i_3 = 0$$

$$\Rightarrow -4i_1 - 10i_2 + 22i_3 = 120 \quad \text{---} \ (111)$$

11.



$V_0 = (i_1 - i_2)5 \Rightarrow 5i_1 - 2V_0 = V_0 \Rightarrow 5i_1 - 3V_0 = 0$

$i_3 = -10$, $i_2 = \frac{2V_0}{5}$

mesh1

$-75 + 2(i_1 + 10) + 5(i_1 - i_2) = 0$

$\Rightarrow \quad 7i_1 - 5i_2 = 55$

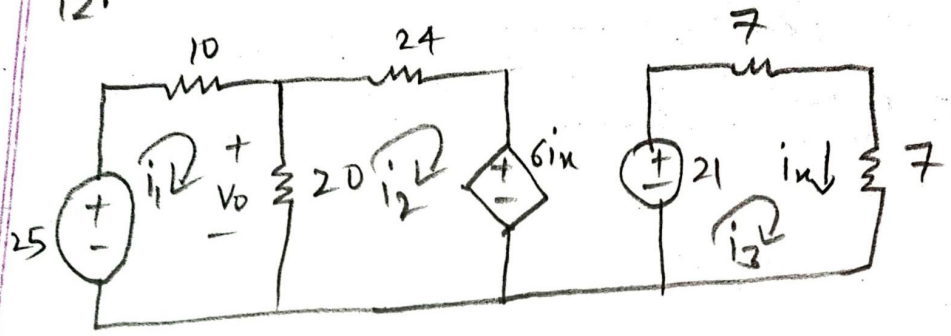
$\Rightarrow \quad 7i_1 - 2V_0 = 55 \quad$ —— (1)

(1), (11) $\Rightarrow$

$i_1 = 15\,A$

$V_0 = 25\,V$

12.



mesh1

$-25 + 10i_1 + 20(i_1 - i_2) = 0$

$\Rightarrow 30i_1 - 20i_2 = 25$ ___ (1)

mesh2

$20(i_2 - i_1) + 24i_2 + 6i_3 = 0$

$\Rightarrow -20i_1 + 44i_2 + 6i_3 = 0$

$\Rightarrow -20i_1 + 44i_2 = -9$ — (11)

mesh3

$-21 + 7i_3 + 7i_3 = 0$

$\Rightarrow 14i_3 = 21$

$\Rightarrow i_3 = 1.5$

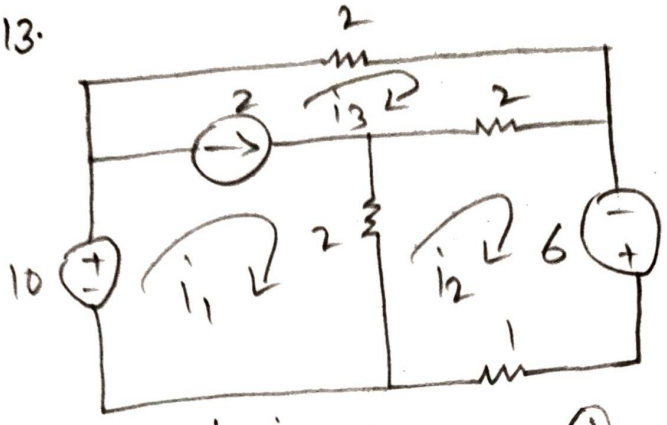
$i_1 = 1$ $\quad i_2 = \frac{1}{4}$

$i_1 = i_2 + i$

$\Rightarrow i = 0.75$

$\therefore V_0 = 20 \times 0.75 = 15\,V$

13.



$i_1 - i_3 = 2$ ——— (1)

mesh2

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

$\Rightarrow -2i_1 + 5i_2 - 2i_3 = 6$ ——— (II)

Super mesh 1,3

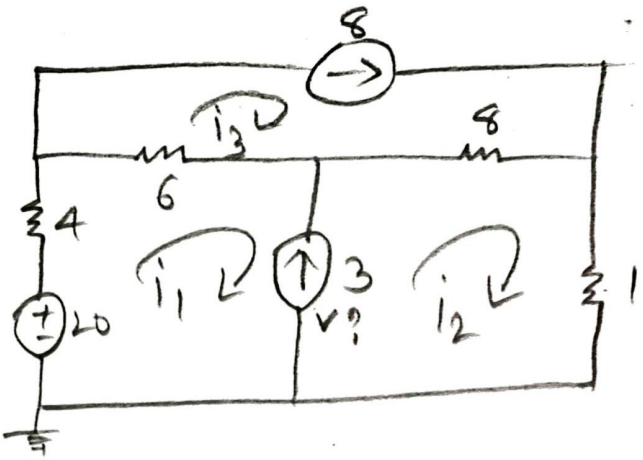
$-10 + 2i_3 + 2(i_3 - i_2) + 2(i_1 - i_2) = 0$

$\Rightarrow 2i_1 - 4i_2 + 2i_3 = 10$ ——— (III)

$\therefore i_1 = 7, \quad i_2 = 6 \quad i_3 = 5$

$P_{1\Omega} = 1 \cdot 6^2 = 36\,W$

14.



$i_3 = 8$, $i_2 - i_1 = 3$ — ①

Supermesh 1,3

$$-20 + 4i_1 + 6(i_1 - 8) + 8(i_2 - 8) + i_2 = 0$$

$$\Rightarrow \quad 10i_1 + 9i_2 = 132 \text{ — ②}$$

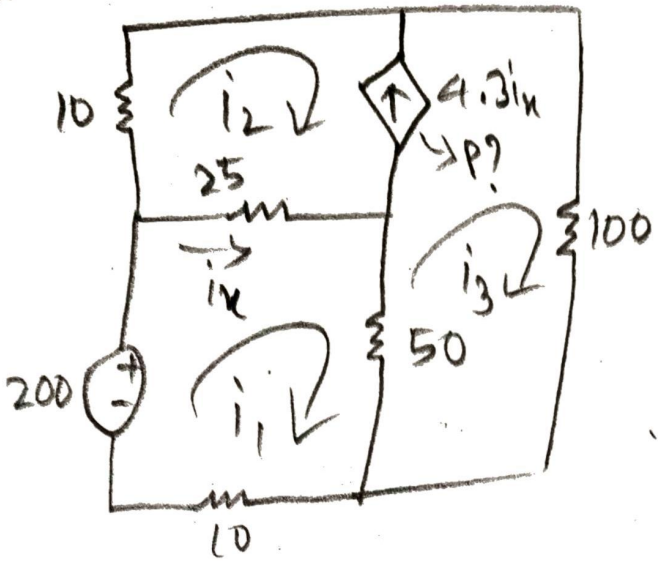
$$\therefore i_1 = 5.52631 \quad i_2 = 6.52631$$

mesh1

$$-20 + 4(i_1) + 6(i_1 - 8) + V = 0$$

$$\Rightarrow V = 12.73$$

15.



mesh2

$10 \times 5.7 + V + 25(4.6$

$\Rightarrow V = -29.5$

$\therefore P = -29.5 \times 4.3(4.6 - 5.$

$i_x = i_1 - i_2$, $i_3 - i_2 = 4.3(i_1 - i_2)$

$\Rightarrow 4.3i_1 - 3.3i_2 - i_3 = 0$ ——— (I)

mesh1

$-200 + 25(i_1 - i_2) + 50(i_1 - i_3) + 10i_1 = 0$

$\Rightarrow 85i_1 - 25i_2 - 50i_3 = 200$ ——— (II)

Supermesh 2,3

$10i_2 + 100i_3 + 50(i_3 - i_1) + 25(i_2 - i_1) = 0$

$\Rightarrow -75i_1 + 35i_2 + 150i_3 = 0$ — (III)

$\therefore i_1 = 4.6$ $i_2 = 5.7$ $i_3 = 0.97$