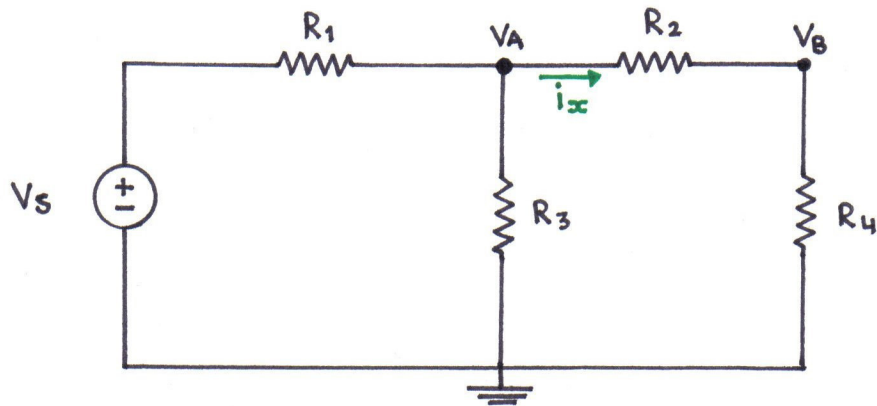


PROBLEM 1



Given $R_1 = R_2 = R_4 = 20 \Omega$, $R_3 = 10 \Omega$ and $V_s = 35V$

(a) Find the node voltages V_A and V_B

(b) Determine i_x

(a) NODE (A)
$$\frac{V_A - V_s}{R_1} + \frac{V_A}{R_3} + \frac{V_A - V_B}{R_2} = 0$$
$$\frac{V_A - 35}{20} + \frac{V_A}{10} + \frac{V_A - V_B}{20} = 0$$
$$4V_A - V_B = 35 \quad (1)$$

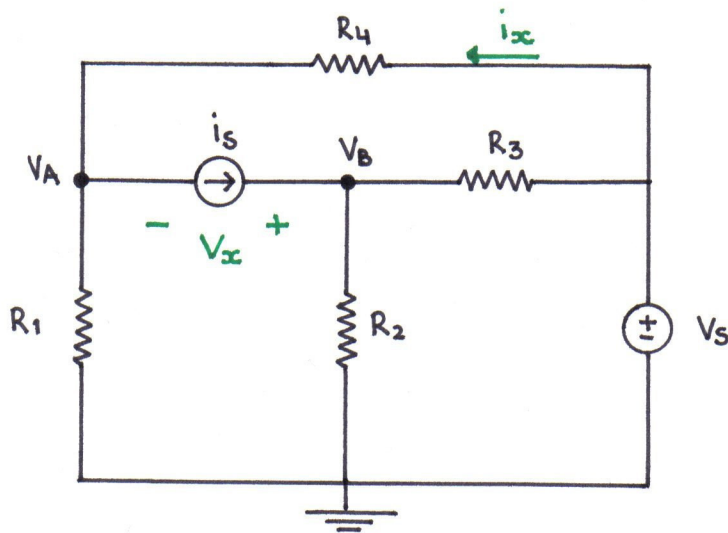
NODE (B)
$$\frac{V_B - V_A}{R_2} + \frac{V_B}{R_4} = 0$$
$$\frac{V_B - V_A}{20} + \frac{V_B}{20} = 0$$
$$V_A = 2V_B \quad (2)$$

substituting (2) in (1) $\Rightarrow 8V_B - V_B = 35 \Rightarrow V_B = 5V$

using (2) $\Rightarrow V_A = 10V$

(b)
$$i_x = \frac{V_A - V_B}{R_2} = \frac{10 - 5}{20} = \frac{1}{4} = 0.25A$$

PROBLEM 2



Given $R_1 = R_4 = 10\Omega$, $R_2 = R_3 = 20\Omega$, $V_s = 60V$ and $i_s = 2A$

- Formulate the node voltage equations
- Solve these equations and find V_A and V_B
- Determine i_x and V_x

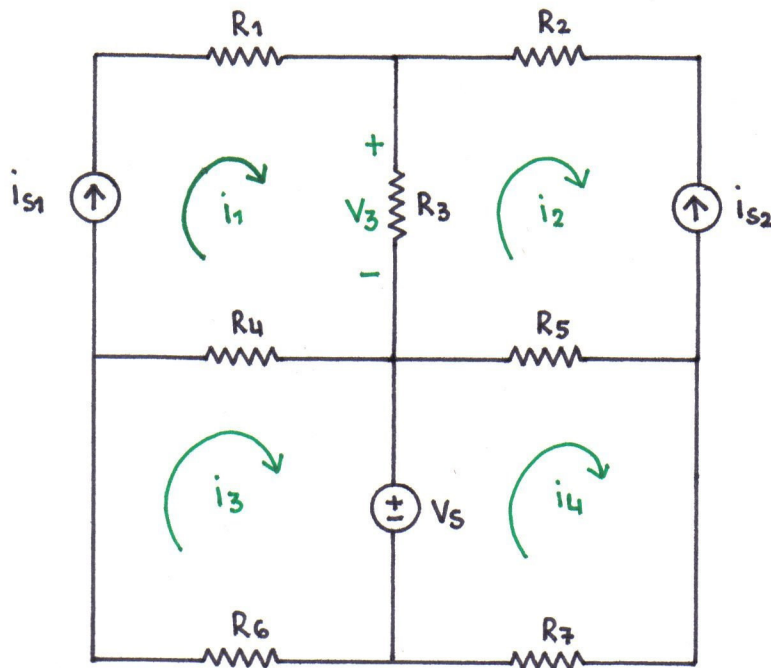
$$\begin{aligned} \text{(a)} \quad \frac{V_A}{R_1} + \frac{V_A - V_s}{R_4} &= -i_s & \Rightarrow & \quad 2V_A = V_s - 10i_s \\ \frac{V_B}{R_2} + \frac{V_B - V_s}{R_3} &= i_s & \Rightarrow & \quad 2V_B = V_s + 20i_s \end{aligned}$$

$$\begin{aligned} \text{(b)} \quad 2V_A &= 60 - 20 \\ 2V_B &= 60 + 40 & \Rightarrow & \quad \begin{cases} V_A = 20V \\ V_B = 50V \end{cases} \end{aligned}$$

$$\text{(c)} \quad i_x = \frac{V_s - V_A}{R_4} = \frac{60 - 20}{10} = 4A$$

$$V_x = V_B - V_A = 50 - 20 = 30V$$

PROBLEM 3



Given :

$$R_1 = R_2 = R_3 = 5\Omega$$

$$R_4 = R_5 = 10\Omega$$

$$R_6 = R_7 = 20\Omega$$

$$i_{s1} = 10\text{A}$$

$$i_{s2} = 1\text{A}$$

$$V_s = 40\text{V}$$

- (a) Find the mesh currents i_1, i_2, i_3 and i_4
 (b) Determine V_3

(a)

$$i_1 = i_{s1} = 10\text{A}$$

$$i_2 = -i_{s2} = -1\text{A}$$

$$\begin{cases} R_4 (i_3 - i_1) + R_6 i_3 = -V_s \\ R_5 (i_4 - i_2) + R_7 i_4 = V_s \end{cases}$$

$$\Rightarrow \begin{cases} (R_4 + R_6) i_3 = R_4 i_1 - V_s \\ (R_5 + R_7) i_4 = R_5 i_2 + V_s \end{cases}$$

$$\begin{cases} 30 i_3 = 10 \cdot 10 - 40 = 60 \\ 30 i_4 = 10 \cdot (-1) + 40 = 30 \end{cases}$$

$$i_3 = 2\text{A}$$

$$i_4 = 1\text{A}$$

(b) $V_3 = R_3 (i_1 - i_2) = 5 \cdot (10 + 1) = 55\text{V}$