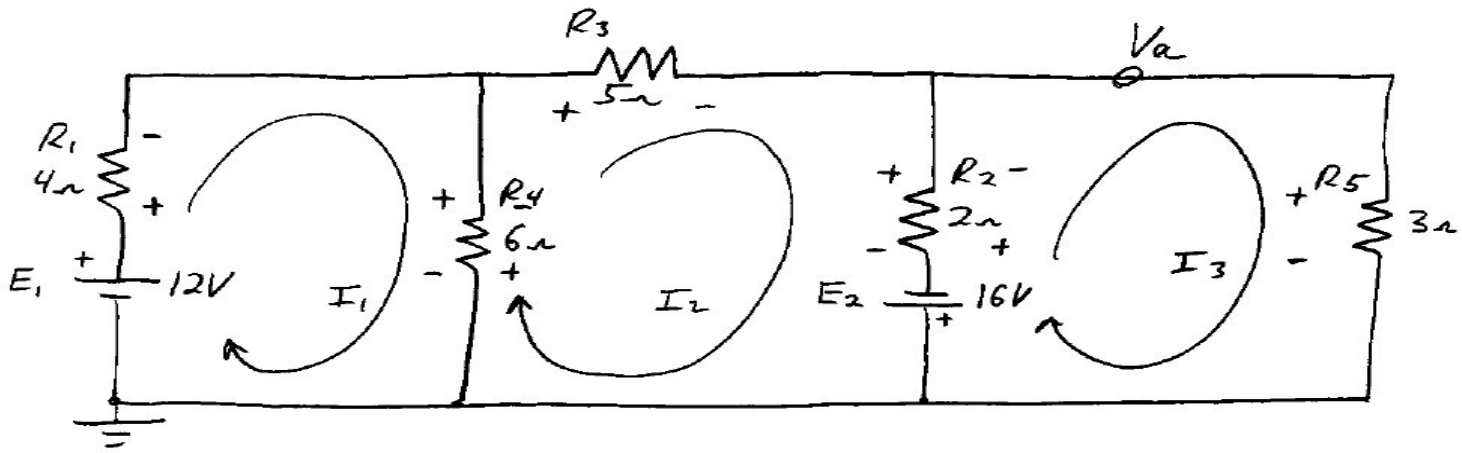
REDRAWN (PLANAR NETWORK)



Loop 1 : $E_1 - I_1 R_1 - I_1 R_4 + I_2 R_4 = 0$

$-I_1 (R_1 + R_4) + I_2 R_4 = -E_1$

$I_1 (R_1 + R_4) - I_2 R_4 + 0 I_3 = E_1 \longrightarrow 10 I_1 - 6 I_2 + 0 I_3 = 12 \quad (1)$

Loop 2 : $I_1 R_4 - I_2 R_4 - I_2 R_3 - I_2 R_2 + I_3 R_2 + E_2 = 0$

$I_1 R_4 - I_2 (R_2 + R_3 + R_4) + I_3 R_2 = -E_2$

$-I_1 R_4 + I_2 (R_2 + R_3 + R_4) - I_3 R_2 = 16 \rightarrow -6 I_1 + 13 I_2 - 2 I_3 = 16 \quad (2)$

Loop 3 : $-E_2 + I_2 R_2 - I_3 R_2 - I_3 R_5 = 0$

$I_2 R_2 - I_3 (R_2 + R_5) = E_2$

$0 I_1 - R_2 I_2 + (R_2 + R_5) I_3 = -E_2 \rightarrow 0 I_1 - 2 I_2 + 5 I_3 = -16 \quad (3)$

Solve :

$$\begin{aligned} 10 I_1 - 6 I_2 + 0 I_3 &= 12 \\ -6 I_1 + 13 I_2 - 2 I_3 &= 16 \\ 0 I_1 - 2 I_2 + 5 I_3 &= -16 \end{aligned}$$

$I_1 = 2.372 \text{ A}$
$I_2 = 1.954 \text{ A}$
$I_3 = -2.419 \text{ A}$

$V_a = (I_3)(R_5) = \boxed{-7.26 \text{V}}$

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