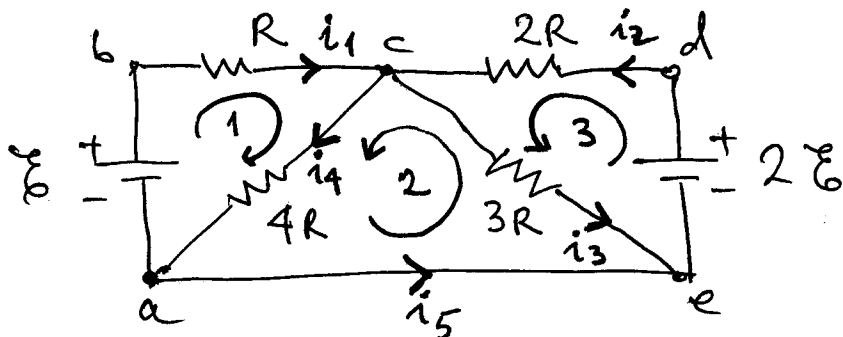


21. 38

$$R = 1 \text{ k}\Omega, \quad \mathcal{E} = 250 \text{ V}$$

find the magnitude and direction of the current in the horizontal wire a-e.



we have 3 joints (a, c, e) $\Rightarrow 3 - 1 = 2$ eqns for currents
 3 independent loops (1, 2, 3) $\Rightarrow 3$ eqn.

$$\Rightarrow (a) \quad i_4 = i_5 + i_1$$

$$(e) \quad i_2 = i_3 + i_5$$

$$(1) \quad \mathcal{E} = Ri_1 + 4Ri_4$$

$$(2) \quad 0 = 4Ri_4 - 3Ri_3$$

$$(3) \quad 2\mathcal{E} = 2Ri_2 + 3Ri_3$$

5 equations
 5 unknowns

i_1, i_2, i_3, i_4, i_5

but we care for i_5

$$(a), (e) \Rightarrow i_4 = i_1 + i_5, \quad i_2 = i_3 + i_5 \quad \begin{matrix} \text{into (1), (2)} \\ (3) \end{matrix}$$

$$\mathcal{E} = Ri_1 + 4R(i_1 + i_5)$$

$$0 = 4R(i_1 + i_5) - 3Ri_3$$

$$2\mathcal{E} = 2R(i_3 + i_5) + 3Ri_3$$

$$\rightarrow i_1 = \frac{\mathcal{E} - 4Ri_5}{5R}$$

$$\rightarrow i_3 = \frac{2\mathcal{E} - 2Ri_5}{5R}$$

$$4R \left(\frac{\mathcal{E} - 4Ri_5}{5R} + i_5 \right) = 3R \cdot \frac{2\mathcal{E} - 2Ri_5}{5R} \Rightarrow i_5 = \frac{\mathcal{E}}{5R} = +50 \cdot 10^{-3} \text{ A}$$