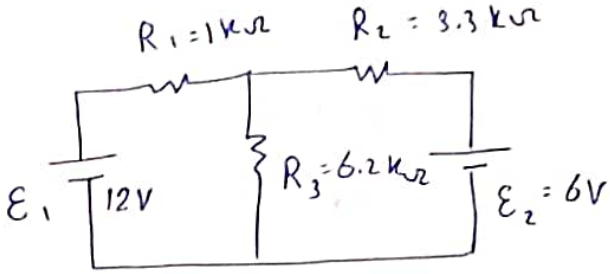
Exp: 4 Network Analysis II

Thevenin & Norton Techniques

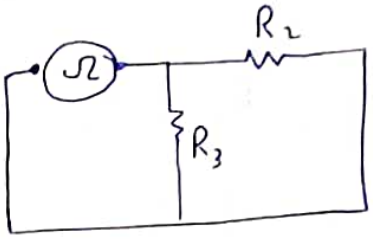
- **Thevenin:**



① Finding I_1 (let $R_L = R_1$)

① Remove R_L, kill both sources

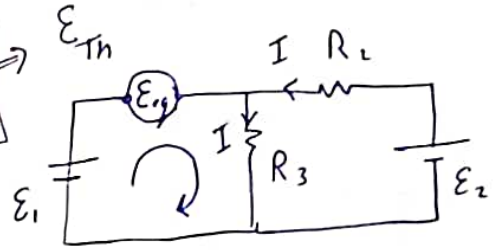
Find R_{eq} (by connecting ohmmeter)



$$\boxed{R_{eq}} = R_2 // R_3 = \frac{R_2 R_3}{R_2 + R_3}$$

$$= \frac{3.3 \times 6.2}{3.3 + 6.2} = 2.15 \text{ k}\Omega$$

② Return both sources & find $\boxed{\varepsilon_{eq}}$ (by connecting voltmeter)



no current in this branch!!

$$I = \frac{\varepsilon_2}{R_2 + R_3} = \frac{6}{3.3 + 6.2} = 0.631 \text{ mA}$$

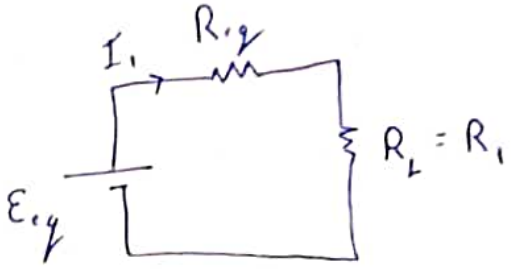
By kirchhoffs loop:

$$\varepsilon_1 - \varepsilon_{eq} - I R_3 = 0$$

$$12 - \varepsilon_{eq} - 0.631 \times 6.2 = 0$$

$$\varepsilon_{eq} = 8.088 \text{ V}$$

③ Construct Thevenin circuit:



$$I_1 = \frac{\mathcal{E}_{eq}}{R_{eq} + R_1}$$

$$= \frac{8.088}{2.15 + 1} = 2.56 \text{ mA}$$

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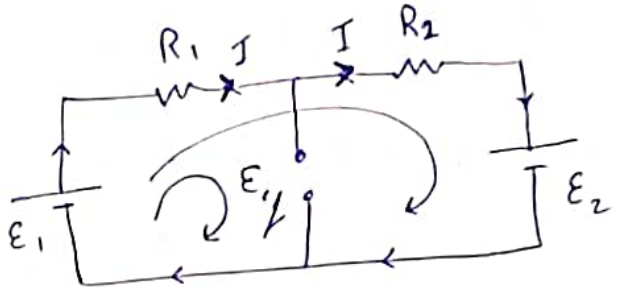
*Finding I_3:



① $R_{eq} = R_1 // R_2$

$$= \frac{R_1 R_2}{R_1 + R_2}$$

$$= \frac{1 \times 3.3}{1 + 3.3} = 0.767 \text{ k}\Omega$$

② $\mathcal{E}_{eq}$:

from the large loop: $\mathcal{E}_1 - IR_1 - IR_2 - \mathcal{E}_2 = 0$

$$I = \frac{\mathcal{E}_1 - \mathcal{E}_2}{R_1 + R_2} = \frac{12 - 6}{1 + 3.3} = 1.39 \text{ mA}$$

from the small loop: $\mathcal{E}_1 - IR_1 - \mathcal{E}_{eq} = 0$

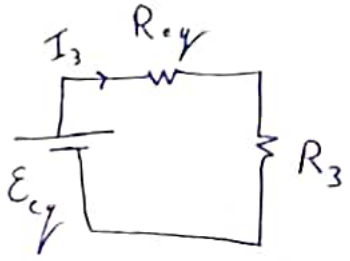
$$\mathcal{E}_{eq} = \mathcal{E}_1 - IR_1$$

$$= 12 - 1.39 \times 1$$

$$= 10.61 \text{ V}$$

③ Construct Thevenin circuit

$$I_3 = \frac{\mathcal{E}_{eq}}{R_{eq} + R_3}$$



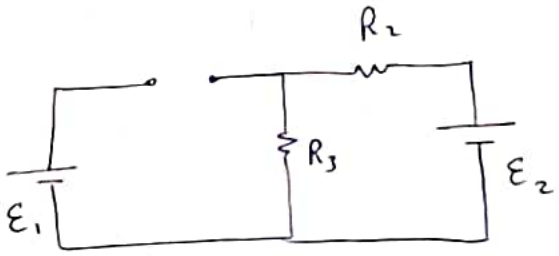
$$= \frac{10.61}{0.767 + 6.2} = 1.52 \text{ mA}$$

Find I_2 using Thevenin Technique !!

* Norton

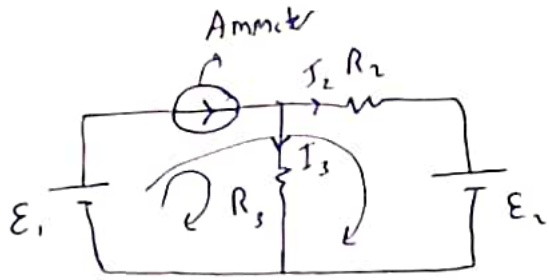
→ Finding I_1 :

① Find R_{eq} : (after killing the sources)



$$R_{eq} = R_2 // R_3 = 2.15 \text{ k}\Omega$$

② Find I_{eq} (I_{Norton})



$$I_{eq} = I_2 + I_3$$

small loop: $\mathcal{E}_1 - I_3 R_3 = 0$

$$I_3 = \frac{\mathcal{E}_1}{R_3} = \frac{12}{6.2} = 1.935 \text{ mA}$$

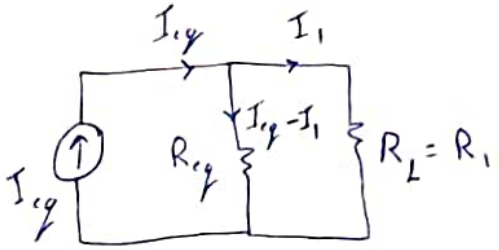
large loop: $\mathcal{E}_1 - I_2 R_2 - \mathcal{E}_2 = 0$

$$I_2 = \frac{\mathcal{E}_1 - \mathcal{E}_2}{R_2} = \frac{12 - 6}{3.3} = 1.82 \text{ mA}$$

$$I_{eq} = I_2 + I_3$$

$$= 1.935 + 1.82 = 3.753 \text{ mA}$$

(3) construct ~~The~~ Norton circuit



$$I_1 R_1 = I_{eq} (R_1 \,//\, R_{eq})$$

$$I_1 R_1 = I_{eq} \left(\frac{R_1 R_{eq}}{R_1 + R_{eq}} \right)$$

$$I_1 = \frac{3.753}{1} \left(\frac{1 \times 2.15}{1 + 2.15} \right)$$

$$= 2.56 \text{ mA}$$

Find I_2, I_3 using Norton Technique !!