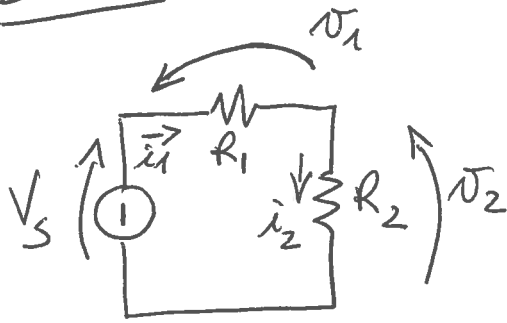


ES 7



$$V_s = 20V$$

$$R_1 = 2\Omega$$

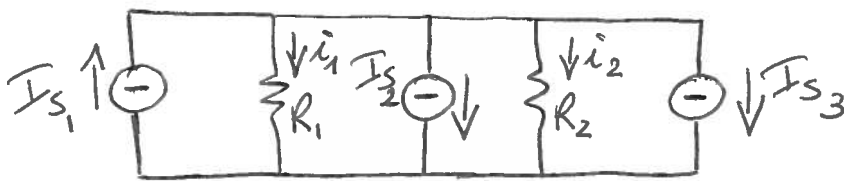
$$R_2 = 3\Omega$$

$$i_1 = i_2 = \frac{V_s}{R_1 + R_2} = 4A$$

$$v_1 = R_1 i_1 = \frac{R_1}{R_1 + R_2} V_s = 8V$$

$$v_2 = R_2 i_2 = \frac{R_2}{R_1 + R_2} V_s = 12V$$

ES 8



$$I_{s1} = 2A$$

$$R_1 = 2\Omega$$

$$I_{s2} = 3A$$

$$R_2 = 3\Omega$$

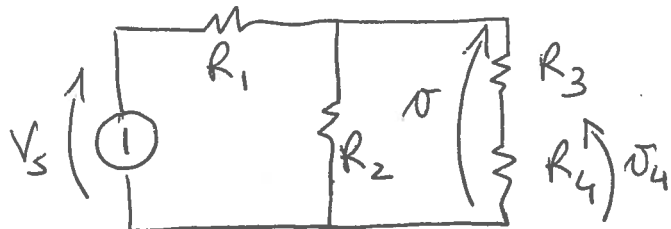
$$I_{s3} = 4A$$

$$I_s = I_{s2} + I_{s3} - I_{s1} = 5A$$

$$i_1 = \frac{R_2}{R_1 + R_2} (-I_s) = -3A$$

$$i_2 = \frac{R_1}{R_1 + R_2} (-I_s) = -2A$$

ES 9



$$V_s = 10V$$

$$R_1 = R_4 = 1\Omega$$

$$R_2 = 2\Omega$$

$$R_3 = 3\Omega$$

$$R_o = R_2 \parallel (R_3 + R_4)$$

$$= \frac{R_2(R_3 + R_4)}{R_2 + R_3 + R_4} = \frac{4}{3}\Omega$$

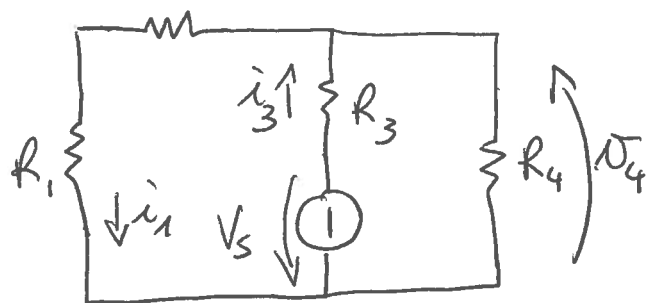


$$v = \frac{R_o}{R_1 + R_o} V_s = \frac{40}{7}V$$

$$v_4 = \frac{R_4}{R_3 + R_4} v = \frac{10}{7}V$$

ES 10

R_2

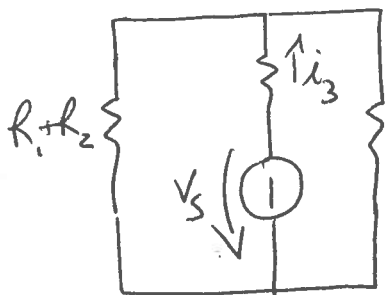


$$V_s = 6 \text{ V}$$

$$R_1 = R_2 = 1 \Omega$$

$$R_3 = 3 \Omega$$

$$R_4 = 2 \Omega$$



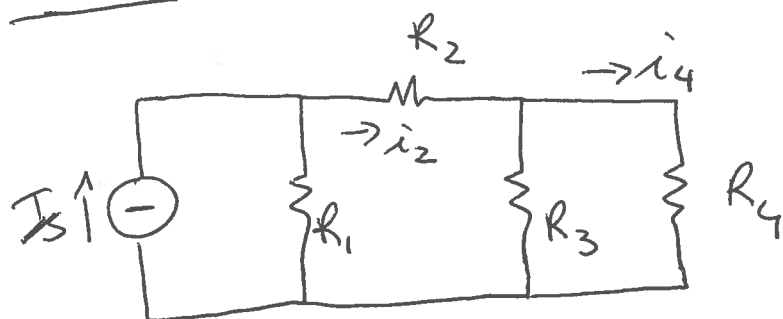
$$\begin{aligned} & \rightarrow \begin{aligned} & \text{Circuit with } R_3 \text{ in series with } R_0 = R_4 \parallel (R_1 + R_2) \\ & \text{and voltage source } V_s. \end{aligned} \\ & = \frac{R_4 (R_1 + R_2)}{R_1 + R_2 + R_3} = 1 \Omega \end{aligned}$$

$$V_4 = \frac{R_0}{R_0 + R_3} (-V_s) = -\frac{3}{2} \text{ V}$$

$$V_3 = \frac{R_3}{R_0 + R_3} (-V_s) \Rightarrow i_3 = \frac{V_3}{R_3} = -\frac{V_s}{R_0 + R_3} = -\frac{3}{2} \text{ A}$$

$$i_1 = \frac{V_4}{R_1 + R_2} = -\frac{3}{4} \text{ A}$$

ES 11



$$I_S = 5A$$

$$R_1 = 3\Omega$$

$$R_2 = 1\Omega$$

$$R_3 = R_4 = 2\Omega$$

A circuit diagram showing a current source I_S in parallel with resistor R_1 . This is followed by a series resistor R_2 , and then a parallel combination of resistors R_3 and R_4 . The current through R_2 is labeled i_2 . The equivalent resistance of R_3 and R_4 in parallel is calculated as:

$$R_3 \parallel R_4 = \frac{R_3 R_4}{R_3 + R_4} = 1\Omega \quad \left[\Rightarrow = \frac{R_3}{2} = \frac{R_4}{2} \right]$$

A circuit diagram showing a current source I_S in parallel with resistor R_1 . This is followed by a series resistor R_2 , and then a parallel combination of resistors R_3 and R_4 . The current through R_2 is labeled i_2 . The total equivalent resistance is calculated as:

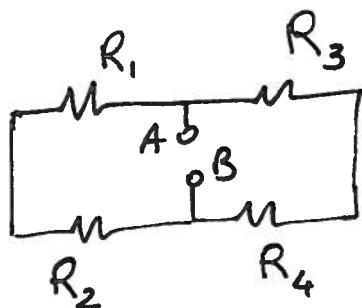
$$R_2 + (R_3 \parallel R_4) = 2\Omega = R_0$$

$$i_2 = \frac{R_1}{R_0 + R_1} I_S = 3A$$



$$i_4 = \frac{R_3}{R_3 + R_4} i_2 = \frac{3}{2} A$$

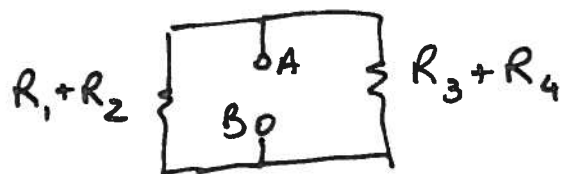
ES 12



$$R_1 = R_3 = R_4 = 1 \Omega$$

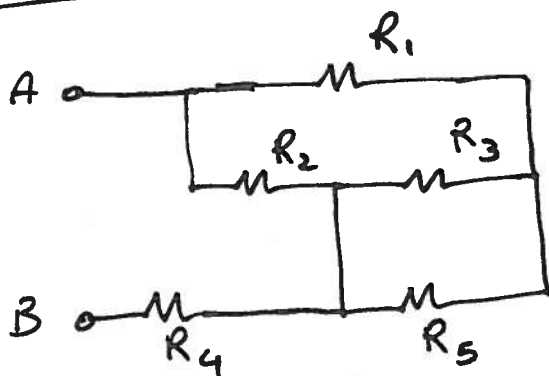
$$R_2 = 4 \Omega$$

$$R_{eq} = ?$$



$$R_{eq} = \frac{(R_1 + R_2)(R_3 + R_4)}{R_1 + R_2 + R_3 + R_4} = \frac{10}{7} \Omega$$

ES 13



$$R_1 = \frac{2}{3} \Omega$$

$$R_2 = R_5 = 2 \Omega$$

$$R_3 = 4 \Omega$$

$$R_4 = 1 \Omega$$

$$R_{eq} = ?$$

R_3 ed R_5 sono in parallelo

$$R_{35} = R_3 \parallel R_5 = \frac{R_3 R_5}{R_3 + R_5}$$

R_{35} è in serie con $R_1 \rightarrow R_{135} = R_1 + R_{35}$

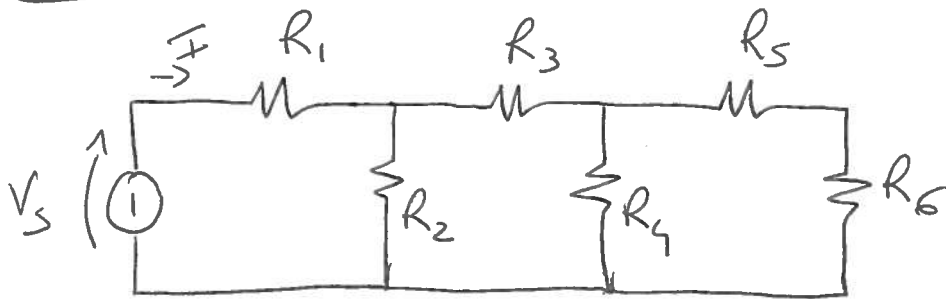
R_{135} è in parallelo con R_2

$$R_0 = \frac{R_2 \left(R_1 + \frac{R_3 R_5}{R_3 + R_5} \right)}{R_1 + R_2 + \frac{R_3 R_5}{R_3 + R_5}} = \frac{R_1 R_2 (R_3 + R_5) + R_2 R_3 R_5}{(R_1 + R_2)(R_3 + R_5) + R_3 R_5}$$

R_0 è in serie con R_4

$$R_{eq} = R_4 + R_0 = 2 \Omega$$

ES 14



$$V_s = 50V$$

$$R_1 = R_3 = R_5 = R_6 = 2 \Omega$$

$$R_2 = R_4 = 4 \Omega$$

$$I = ?$$

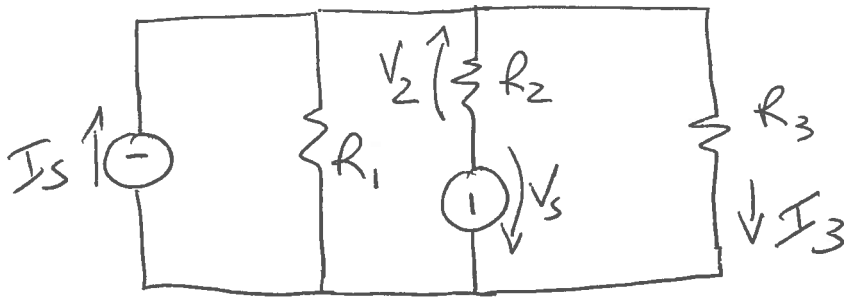


$$\frac{R_4(R_5 + R_6)}{R_4 + R_5 + R_6}$$

$$V_s \uparrow \text{ (1) } R_1 \parallel R_2 \parallel \left(R_3 + \frac{R_4(R_5 + R_6)}{R_4 + R_5 + R_6} \right) = R_0$$

$$V_s \uparrow \text{ (1) } R_1 \parallel R_2 \parallel R_0 = \frac{R_0 R_2}{R_0 + R_2}$$

$$I = \frac{V_s}{R_1 + \frac{R_0 R_2}{R_0 + R_2}} = \frac{25}{2} A$$

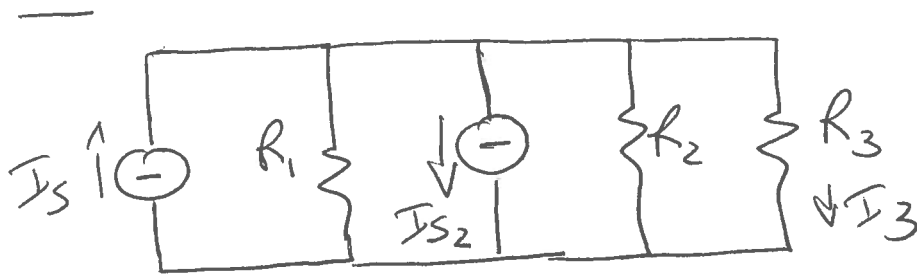


$$I_s = 4 \text{ A}$$

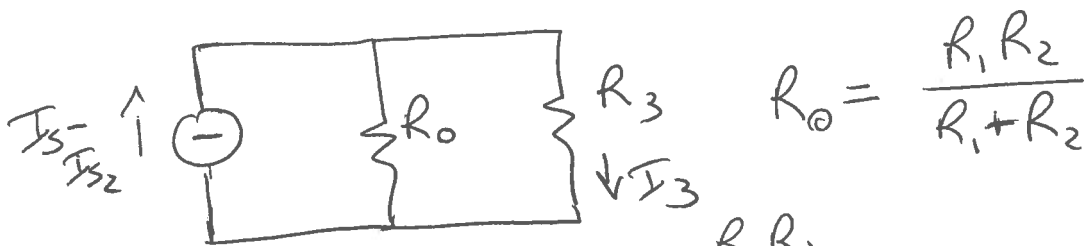
$$V_s = 3 \text{ V}$$

$$R_1 = R_2 = 2 \Omega$$

$$R_3 = 1 \Omega$$



$$\text{con } I_{s2} = \frac{V_s}{R_2} = \frac{3}{2} \text{ A}$$

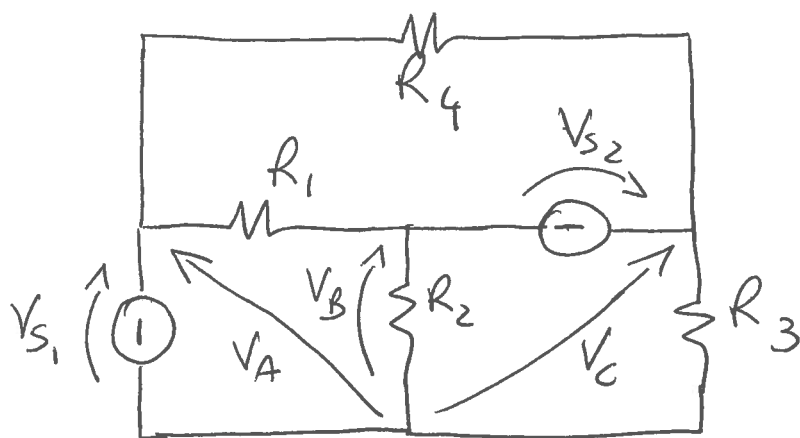


$$I_3 = (I_s - I_{s2}) \frac{\frac{R_1 R_2}{R_1 + R_2}}{R_3 + \frac{R_1 R_2}{R_1 + R_2}}$$

$$= \frac{R_1 R_2}{R_3(R_1 + R_2) + R_1 R_2} (I_s - I_{s2}) = \frac{5}{4} \text{ A}$$

$$V_2 \Rightarrow V_2 = R_3 I_3 + V_s = \frac{17}{4} \text{ V}$$

ES 16



$$V_{S1} = 12V$$

$$V_{S2} = 10V$$

$$R_1 = 2\Omega$$

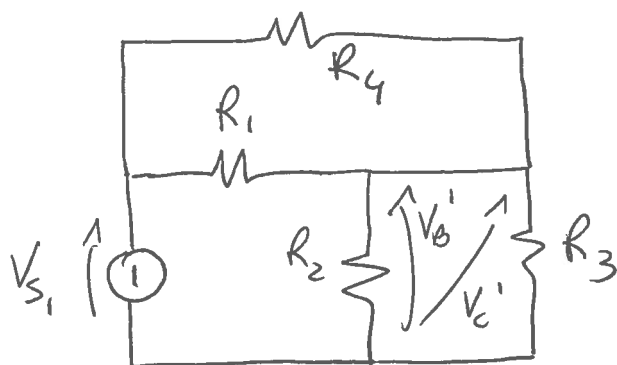
$$R_2 = 12\Omega$$

$$R_3 = R_4 = 8\Omega$$

$$V_A = V_{S1} = 12V$$

$$V_A = ? \quad V_B = ? \quad V_C = ?$$

SOVRAPPOSIZIONE



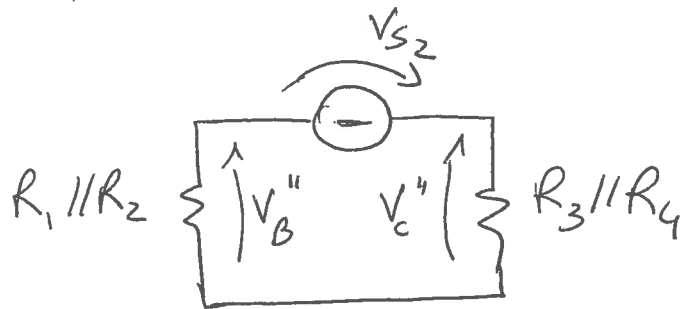
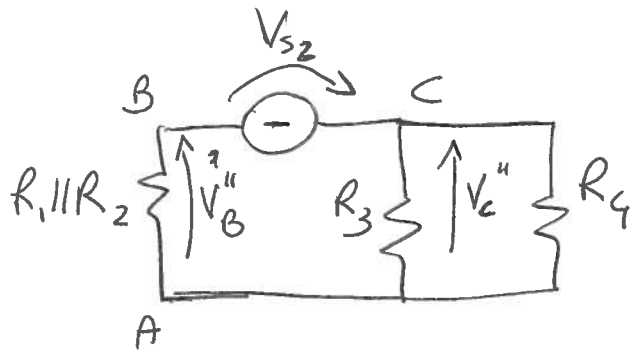
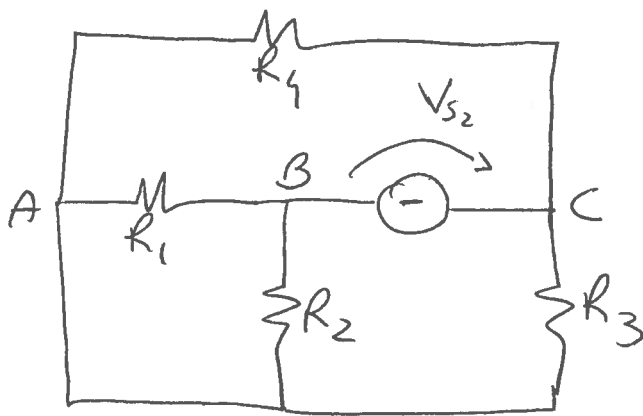
$$V_B' = V_C'$$

R_1 e R_4 sono in parallelo



$$V_B' = V_C' = \frac{R_2 \parallel R_3}{R_1 \parallel R_4 + R_2 \parallel R_3} V_{S1}$$

$$= \frac{R_2 R_3 (R_1 + R_4)}{R_1 R_4 (R_2 + R_3) + R_2 R_3 (R_1 + R_4)} V_{S1} = 9V$$



$$V_C'' = \frac{R_3 R_4 (R_1 + R_2)}{R_3 R_4 (R_1 + R_2) + R_1 R_2 (R_3 + R_4)} V_{S2} = 7V$$

$$V_B'' = - \frac{R_1 R_2 (R_3 + R_4)}{R_3 R_4 (R_1 + R_2) + R_1 R_2 (R_3 + R_4)} V_{S2} = -3V$$

$$V_B = V_B' + V_B'' = 6V$$

$$V_C = V_C' + V_C'' = 16V$$