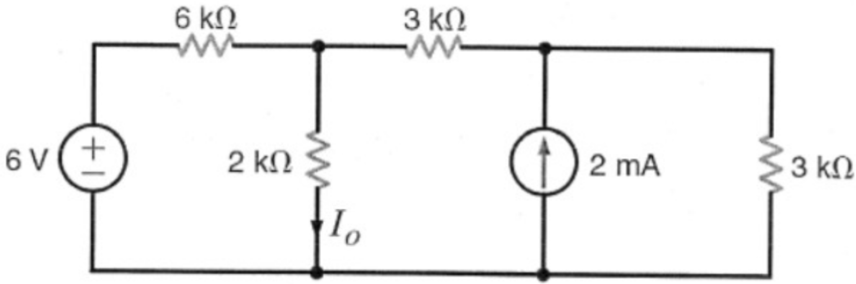
CIRCUIT THOERY TUTORIALS

October 16, 2018

Example 1

Find I_o in the network using superposition



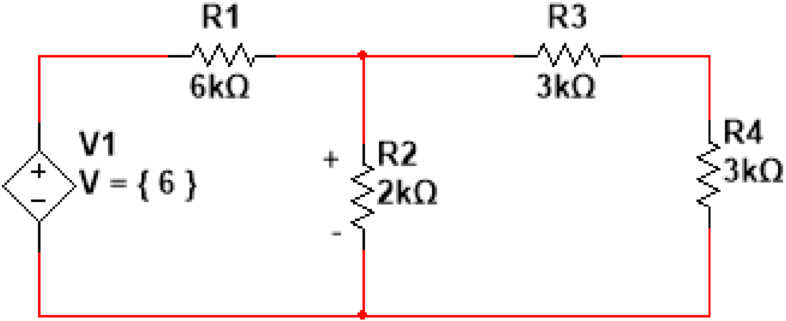
Solution

Rules in superposition theorem:

- Eliminate all but one source of power within a network at a time
- use series/parallel analysis to determine voltage drops (and/or currents) within the modified network for each power source separately
- All other voltage sources are replaced by wires (shorts), and all current sources with open circuits (breaks)
- Once voltage drops and/or currents have been determined for each power source working separately, the values are all "superimposed" on top of each other (added algebraically) to find the actual voltage drops/currents with all sources active.

Solution

Elliminating the current source



Solution

The effective resistance of R_2, R_3 and R_4 will be

$$R_{eff} = R_2 // (R_3 + R_4)$$

$$R_{eff} = 1.5\ k\Omega$$

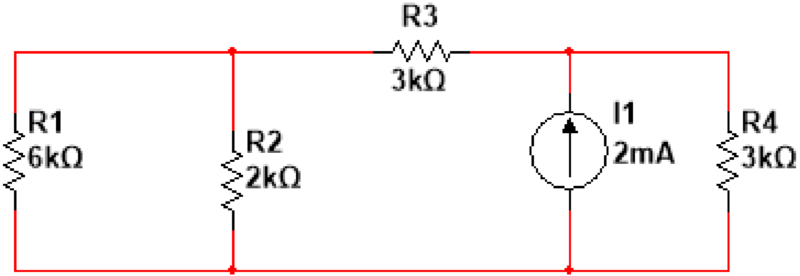
The voltage drop across the resistor R_2

$$V_{ol} = 6 \left(\frac{R_{eff}}{R_{eff} + R_1} \right) = 1.2\ V$$

$$I_{ol} = \frac{V_{ol}}{R_2} = 0.6\ mA$$

Solution

Elliminating the voltage source



Solution

The effective resistance of R_1, R_2 and R_3 will be

$$R_{eff} = (R_1 // R_2) + R_3$$

$$R_{eff} = 4.5\ k\Omega$$

The current through resistor R_2

$$I_1 = 2 \times 10^{-2} \left(\frac{R_4}{R_{eff} + R_4} \right) = 0.8\ mA$$

$$I_{o2} = I_1 \left(\frac{R_1}{R_1 + R_2} \right) = 0.6\ mA$$

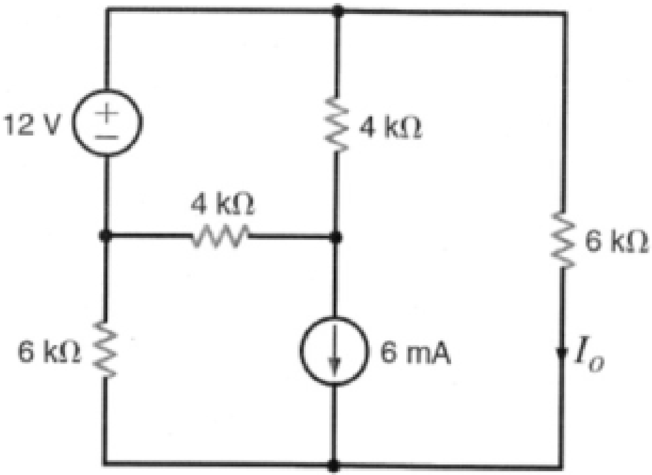
Solution

The total current moving through R_2 due to both sources will be the algebraic sum of I_{o1} and I_{o2}

$$I_0 = I_{o1} + I_{o2} = 1.2\ mA$$

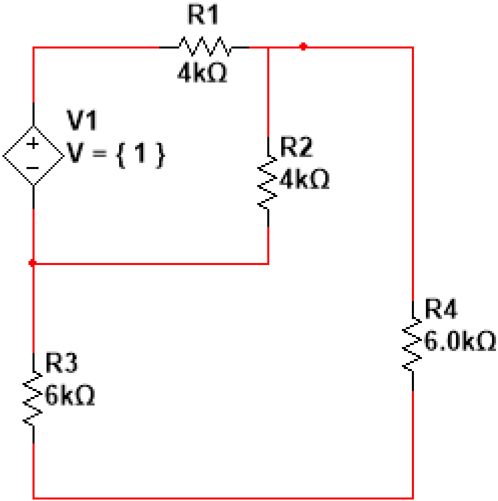
Example 2

Find I_o in the network using superposition



Solution

Elliminating the current source



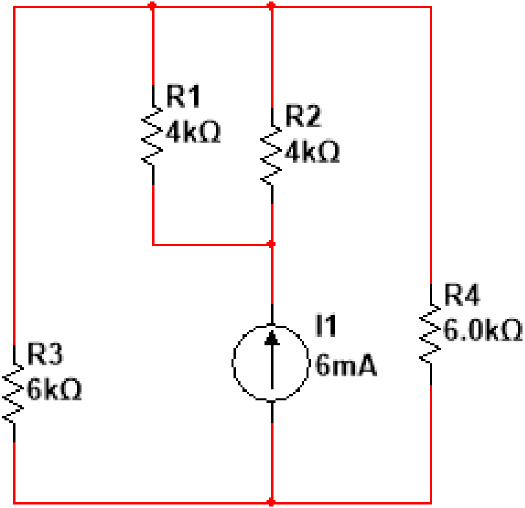
Solution

$$12 = I_{o1}(6\ k + 6\ k)$$

$$I_{o1} = 1\ mA$$

Solution

Elliminating the voltage source



Solution

$$I_{o2} = -6 \times 10^{-3} \left(\frac{6000}{6000 + 6000} \right)$$

$$I_{o2} - 3 \ mA$$

Therefore the total current will be

$$I_o = I_{o1} + Io2 = -2 \ mA$$

TRY WORK

Find I_o in the network using superposition