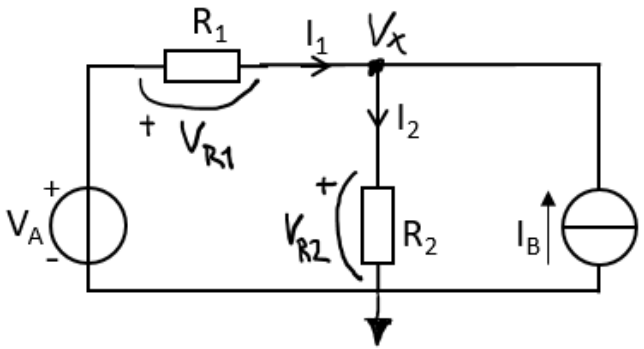
Node Voltage Method

1. Assign a potential (V_1, V_2, V_3.....V_N) to all nodes in the circuit
2. Assign 0 to one of the nodes (commonly called ground in electrical circuits)
3. Use KCL in every node and express the currents in the node potentials
4. Solve the equations to find all the potentials (V_1, V_2, V_3.....V_N) in all the nodes
5. Determine all voltages and currents in the circuit from the now known potentials (V_1, V_2, V_3.....V_N)



R_1=18 kΩ, R_2=12 kΩ
V_A=6 V, I_B=3 mA

Determine I_1 and I_2

KCL in V_x: $I_1 + I_B = I_2 \Rightarrow \frac{V_A - V_x}{R_1} + I_B = \frac{V_x - 0}{R_2} \Rightarrow \frac{V_A}{R_1} + I_B = V_x\left[\frac{1}{R_2} + \frac{1}{R_1}\right]$

$\Rightarrow V_x = \frac{\frac{V_A}{R_1}}{\frac{R_1}{R_2} + 1} + \frac{I_B}{\frac{1}{R_2} + \frac{1}{R_1}} = \frac{R_2 V_A}{R_1 + R_2} + \frac{R_1 R_2 I_B}{R_1 + R_2} = \frac{12 \cdot 6}{12+18} + \frac{12 \cdot 18}{12+18} \cdot 3 = \frac{12}{5} + \frac{12 \cdot 18}{10} = 12\left[\frac{2+16}{10}\right] = 24V$

$I_1 = \frac{V_A - V_x}{R_1} = \frac{6 - 24}{18} = \frac{-18}{18} = -1\,mA$

$I_2 = \frac{V_x - 0}{R_2} = \frac{24}{12} = 2\,mA$

CHECK: $I_1 + I_B = I_2$

$-1 + 3 = 2$ ✓