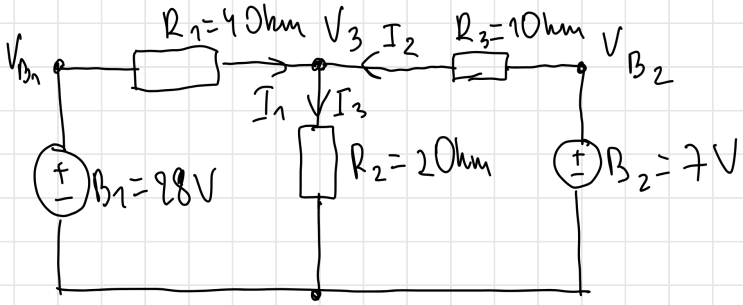
Assignment 1a



$V_0 = 0\,V$

$$I_1 + I_2 = I_3$$

$$I_1 = \frac{V_{B_1} - V_3}{R_1}, \quad I_2 = \frac{V_{B_2} - V_3}{R_3}, \quad I_3 = \frac{V_3}{R_2}$$

$$\frac{V_{B1} - V_3}{R_1} + \frac{V_{B2} - V_3}{R_3} = \frac{V_3}{R_2}$$

$$R_3 R_2 (V_{B1} - V_3) + R_1 R_2 (V_{B_2} - V_3) - R_1 R_3 V_3 = 0$$

$$R_3 R_2 V_{B1} - R_3 R_2 V_3 + R_1 R_2 V_{B2} - R_1 R_2 V_3 - R_1 R_3 V_3 = 0$$

$$R_3 R_2 V_{B1} + R_1 R_2 V_{B2} = V_3 (R_3 R_2 + R_1 R_2 + R_1 R_3)$$

$$V_3 = \frac{R_3 R_2 V_{B1} + R_1 R_2 V_{B2}}{R_3 R_2 + R_1 R_2 + R_1 R_3} = 8\,V$$

$$V_{R_1} = V_{B_1} - V_3 = 20V$$

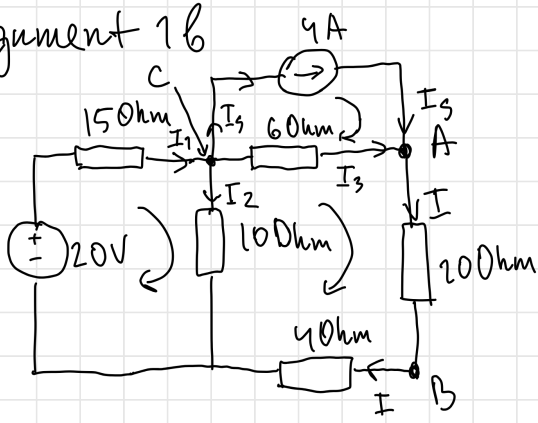
$$V_{R_2} = V_3 - 0 = 8V$$

$$V_{R_3} = V_3 - V_{B_2} = 1V$$

We can see that the current I_2 goes in the opposite direction.

$$i_{R_2} = \frac{V_3}{R_2} = \frac{8}{2} = 4A.$$

Assignment 16



A: $I = I_5 + I_3$ ✓

B: $I - I = 0$ ✓

C: $I_1 = I_5 + I_2 + I_3$ ✓

$20V = 15 \cdot I_1 + 10 I_2$

$I_3 \cdot 6 + I(20+4) - I_2 \cdot 10 = 0$

$$-I_1 + I_2 + I_3 + 0 = -4$$

$$0 + 0 + I_3 - I = -4$$

$$15I_1 + 10I_2 + 0 + 0 = 20$$

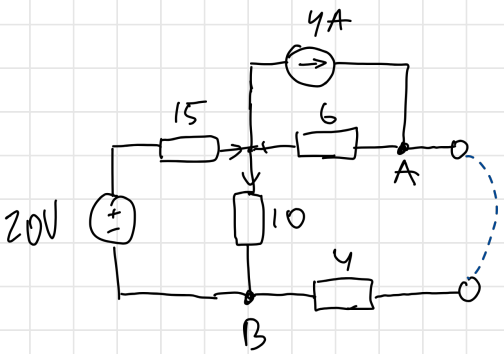
$$0 - 10I_2 + 6I_3 + 24I = 0$$

Solving using python gives $I = 0.89$ A.

$\Rightarrow$ Voltage drop across AB is $V_{AB} = IR_{20} = 0.89 \cdot 20 = 17.8$V

Step 2.

We treat our 20 Ohm resistor as a load.

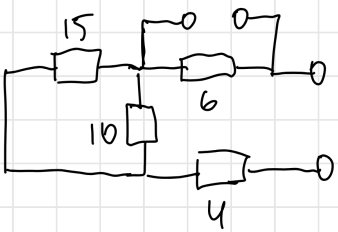


1. Find the resistance across the terminals.

As we have ideal sources

$R_{\text{voltage source}} = 0$

$R_{\text{current source}} = \infty$



$$R_{th} = 4 + 6 + \frac{10 \cdot 15}{10 + 15} = 16 \text{ Ohm}$$

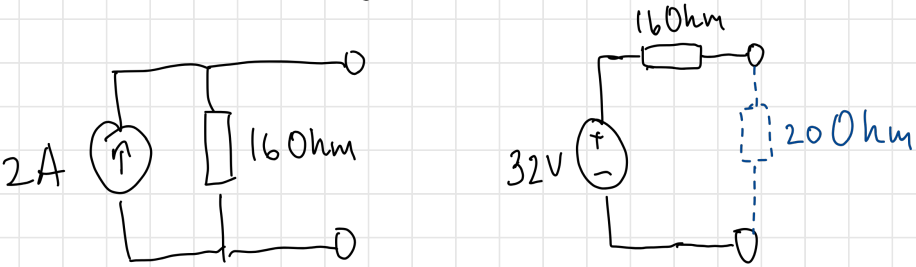
2. Now we will short the terminals to find the current passing through them.

We can use the same system of equations

but removing 20 Ohm res. in the last eq. =>

$$0 - 10 I_2 + 6 I_3 + 4 I = 0$$

Solving the system $I_N = 2$ A =>



We can check that those circuits are both correct by connecting 20 Ohm resistor to the terminal, which yields the same current 0.89 A as we've got previously.

Also the voltage across the load resistor can be found as $32 \cdot \frac{20}{36} \approx 17.8$ V.