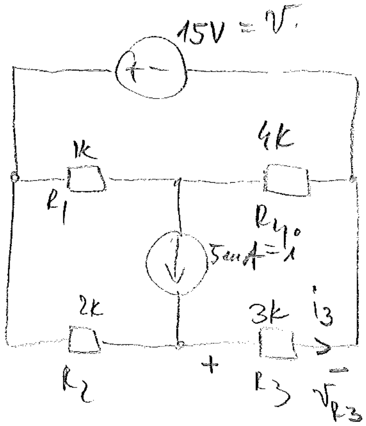
Seminar : 2

- Super-position
- Thévenin's equivalent.
- Δ-Y conversion.

Super-position principle

(1) Use super-position to find the magnitude and polarity of the voltage across $R_3 = 3k\Omega$.



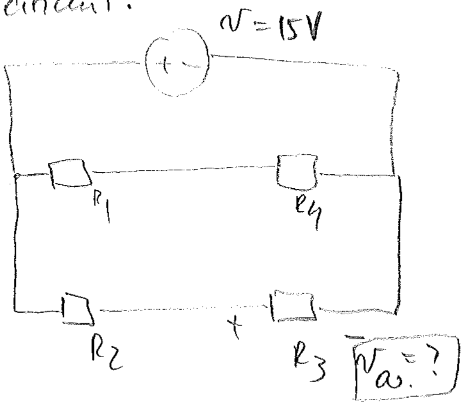
$v_{R3} = ?$

$i_{R3} = ?$

$v_{R3} = v_a + v_b$ — due to v source; due to i source.

$\boxed{v_a = ?}$

eq. circuit.



$$\boxed{v_a = \frac{R_3}{R_2 + R_3} \cdot v} \quad (1)$$

(1) + (2) =>

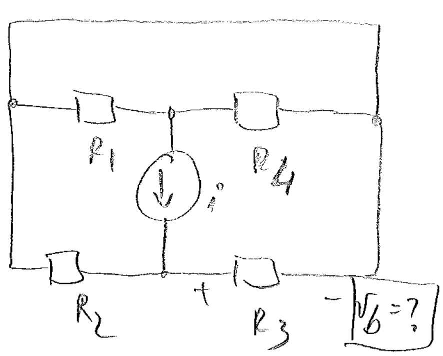
$$\boxed{v_{R_3} = v_a + v_b = \frac{R_3}{R_2 + R_3} v + \frac{R_2 R_3}{R_2 + R_3} i} \quad (3)$$

$$v_{R_3} = \frac{3}{\cancel{3+2}} \cancel{15}^{3} + \frac{2 \cdot 3}{\cancel{2+3}} \cancel{5} = 9 + 6 = 15\,V$$

$$\boxed{v_{R_3} = 15\,V}$$

$\boxed{v_b = ?}$

eq. circuit.



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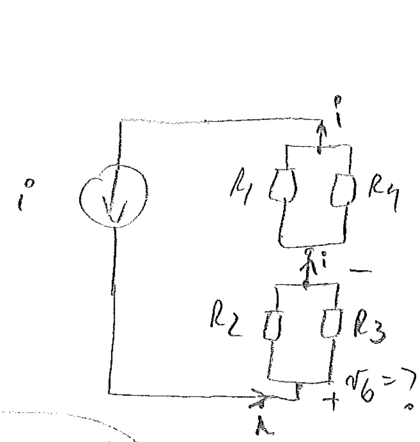

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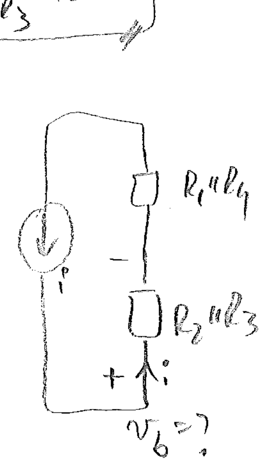
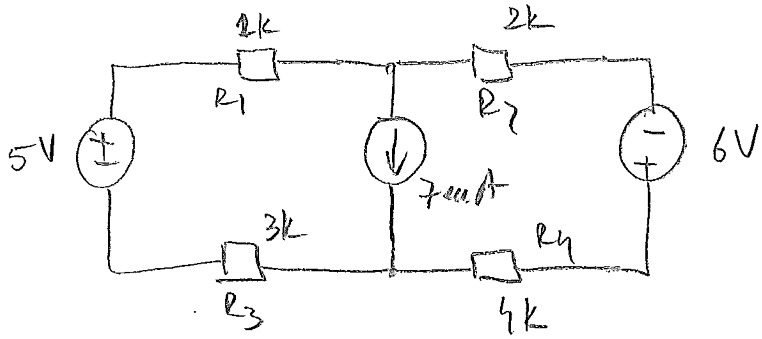


$$\boxed{v_b = R_2 \parallel R_3 \cdot i} \quad (2)$$

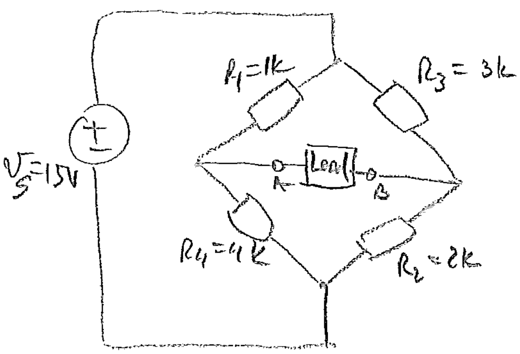
(2) Use super-position to find the power (absorbed/delivered) by the ② current source of 7mA.



Thévenin's equivalent

(3) Use Thévenin's theorem to find the load voltage and current if the load is (a) a resistance $R_L = 1k\Omega$

(b) a 10V voltage source with the ⊕ at terminal A.



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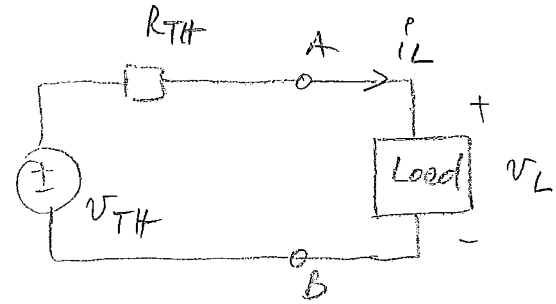
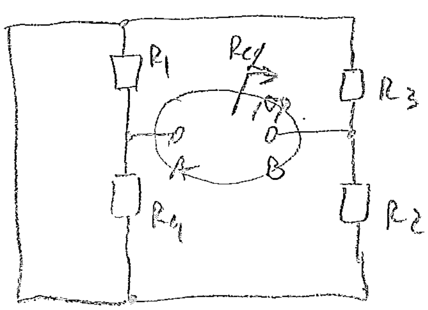


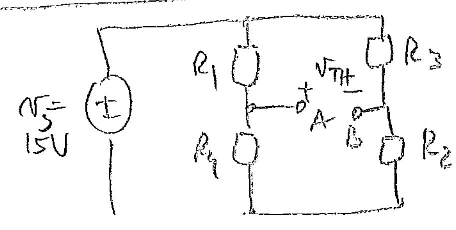
$\boxed{R_{TH} = R_{eq} = ?}$



$$R_{eq} = R_{TH} = R_1 \| R_4 + R_3 \| R_2$$

$$= 1\|4 + 3\|2 = \frac{1\cdot 4}{5} + \frac{3\cdot 2}{3+2} = \frac{4+6}{5} = 2k$$

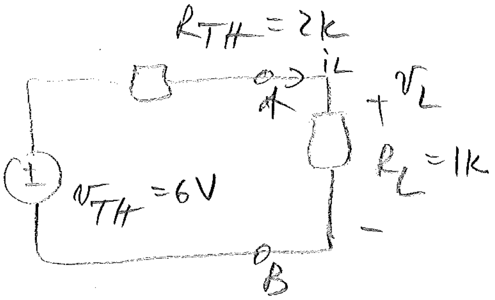
$\boxed{v_{TH} = v_{oc} = ?}$



$$v_{TH} = v_{oc} = v_A - v_B = \frac{R_4}{R_1+R_4} v_S - \frac{R_2}{R_2+R_3} v_S$$

$$v_{TH} = \left(\frac{R_4}{R_1+R_4} - \frac{R_2}{R_2+R_3}\right) v_S = 6V.$$

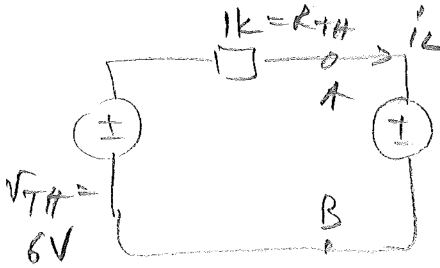
(a)



$$\boxed{v_L = \frac{R_L}{R_L + R_{TH}} \cdot v_{TH} = \frac{1}{1+2} \cdot 6 = 3V}$$

$$\boxed{i_L = \frac{v_L}{R_L} = \frac{3V}{1k} = 3\,mA}$$

(b)



$$\boxed{v_L = 10V}$$

$$\boxed{i_L = \frac{v_{TH} - v_L}{R_{TH}} = -\frac{4V}{2k\Omega} = -2\,mA}$$

(c) Find the voltage v :