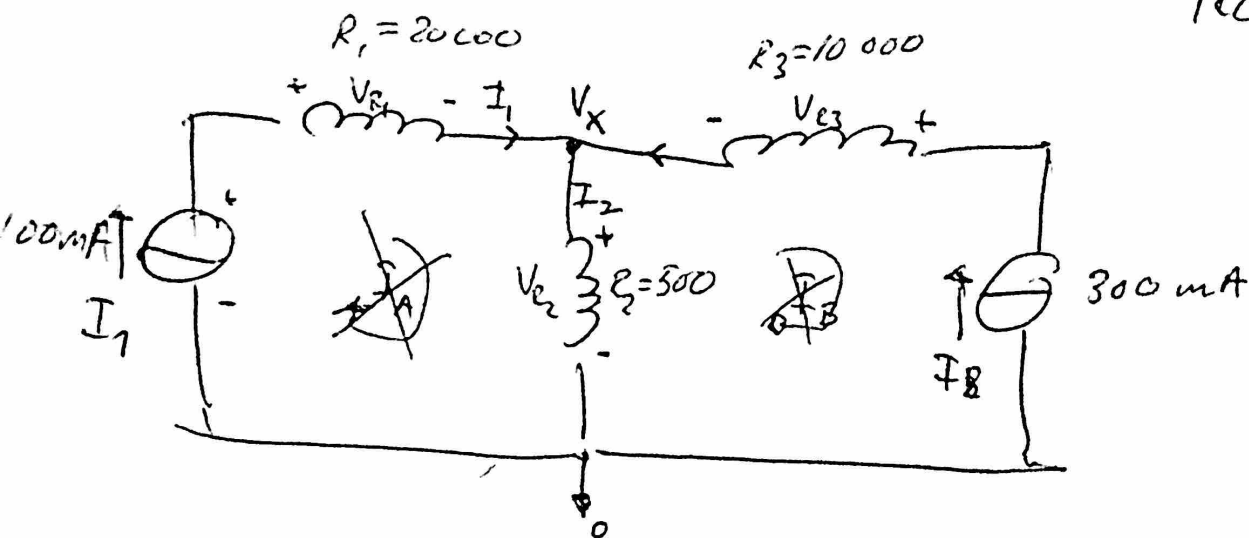


# **Home Assignment 2**

IE1206 Embedded Electronics

Emil Ståhl

# PROBLEM 1.



$$\text{KCL in } V_x \quad I_1 + I_3 = I_2 \Rightarrow 0,1 + 0,3 = 0,4$$

$$V_{R_1} = R_1 \cdot I_1 \Rightarrow V_{R_1} = 20,000 \cdot 0,1 \Rightarrow V_{R_1} = 2000 \text{ V}$$

$$V_{R_2} = R_2 \cdot I_2 \Rightarrow V_{R_2} = 500 \cdot 0,4 \Rightarrow V_{R_2} = 200 \text{ V}$$

$$V_{R_3} = R_3 \cdot I_3 \Rightarrow V_{R_3} = 10,000 \cdot 0,3 \Rightarrow V_{R_3} = 3000 \text{ V}$$

$$P_1 = V_{R_1} \cdot I_1 \Rightarrow P_1 = 2000 \cdot 0,1 \Rightarrow P_1 = 200 \text{ W}$$

$$P_2 = V_{R_2} \cdot I_2 \Rightarrow P_2 = 200 \cdot 0,4 \Rightarrow P_2 = 80 \text{ W}$$

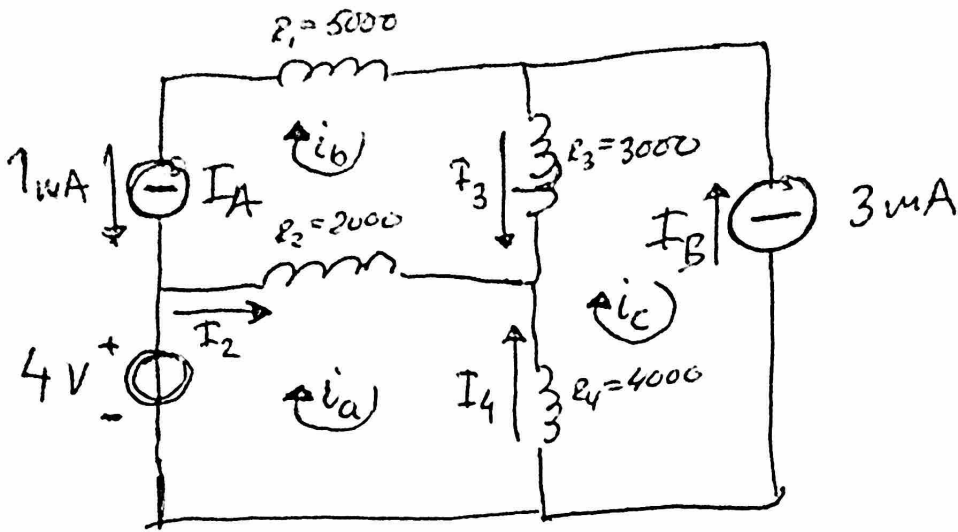
$$P_3 = V_{R_3} \cdot I_3 \Rightarrow P_3 = 3000 \cdot 0,3 \Rightarrow P_3 = 900 \text{ W}$$

$$P_1 + P_2 + P_3 = 1180 \text{ W}$$

$$\text{POWER} \times \text{TIME} = \text{ENERGY (Joules)}$$

$$1180 \cdot 3600 = 4,2 \text{ MJ (4248000)}$$

## PROBLEM 2



$$\text{KVL for the left mesh (I}_A\text{): } V_A - R_2 i_a + R_2 i_b + R_4 i_a - R_4 i_c = 0 \Rightarrow$$

$$i_c = -I_B$$

$$i_b = -I_A$$

$$\Rightarrow V_A - (R_2 - R_4) i_a - R_2 I_A + R_4 i_B = 0$$

$$i_a = \frac{V_A - R_2 I_A + R_4 i_B}{R_2 - R_4}$$

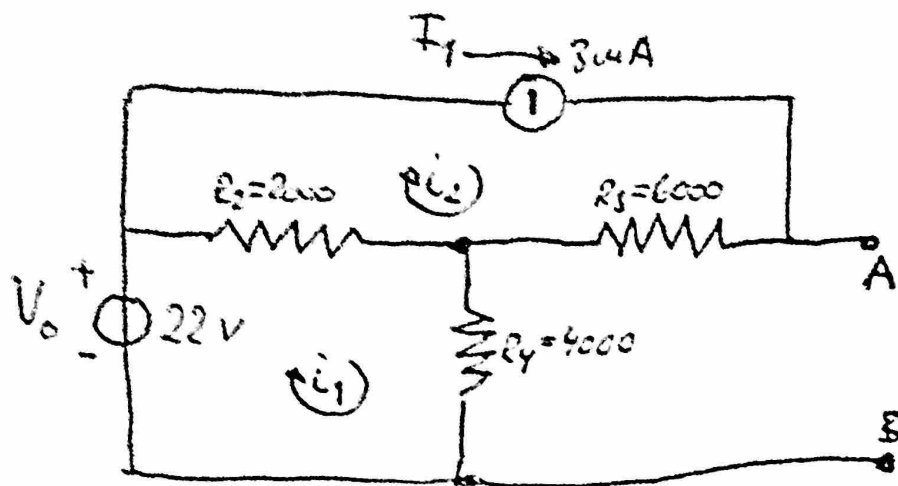
$$i_a = \frac{4 - 2000 \cdot 0,001 + 4000 \cdot 0,003}{2000 - 4000}$$

$$i_a = 0,007$$

$$I_2 = i_a$$

$$\begin{cases} I_3 = I_b - I_c \Rightarrow -0,001 + 0,003 = 0,002 \text{ A} \\ I_4 = I_a - I_c \Rightarrow -0,007 + 0,003 = -0,004 \text{ A} \\ I_2 = 0,007 \text{ A} \end{cases}$$

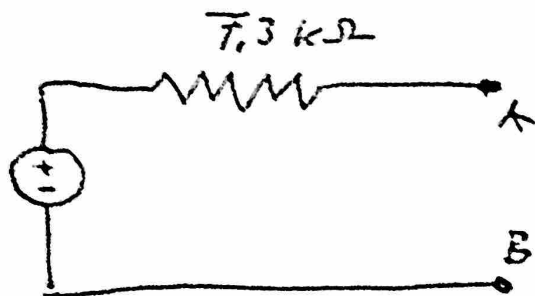
# PROBLEM 4



$$R_{TH} = 2000 // 4000 + 6000$$

$$R_{TH} = \frac{R_2 \cdot R_4}{R_2 + R_4} = \frac{2000 \cdot 4000}{2000 + 4000} = \frac{8000000}{6000} + 6000$$

$$R_{TH} = 1333 \approx 1,3 \text{ k}\Omega + 6000 = 7,3 \Omega$$



$$-V_0 + R_2(i_1 - i_2) + R_4 \cdot i_1 = 0$$

$$-22 + 2000(i_1 - 0,003) + 2400 \cdot i_1 = 0$$

$$4400 i_1 = 28$$

$$i_1 = \frac{28}{4400}$$

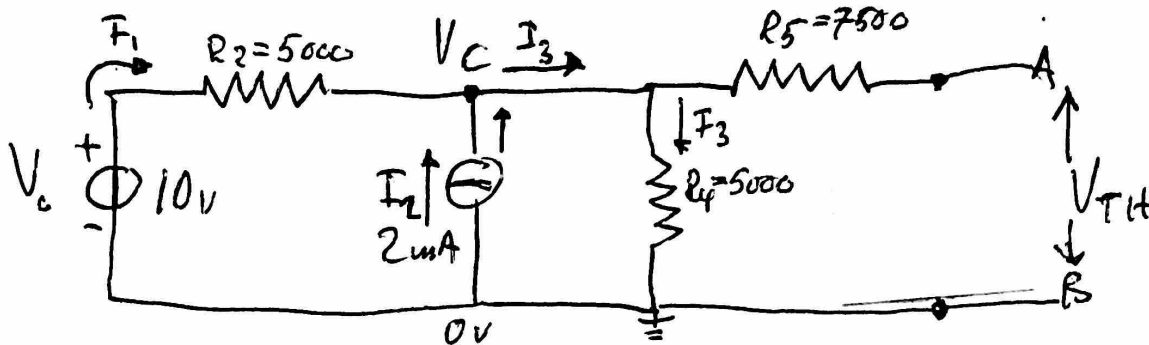
$$i_1 = 0,0063 \approx 6,3 \mu\text{A}$$

$$V_{TH} = 0,0063 \cdot \frac{R_2 \cdot R_4}{R_2 + R_4} \Rightarrow 0,0063 \cdot \frac{6000 \cdot 4000}{6000 + 4000}$$

$$V_{TH} = 0,0063 \cdot 2400$$

$$V_{TH} = 15,12 \text{ V}$$

# PROBLEM 5

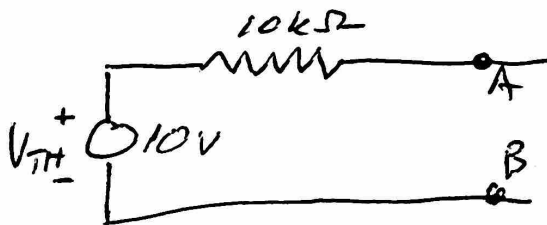


$$R_{TH} = \frac{R_2 \cdot R_4}{R_2 + R_4} + R_5$$

$$R_{TH} = \frac{5000 \cdot 5000}{5000 + 5000} + 7500$$

$$R_{TH} = 25000 + 7500$$

$$R_{TH} = 10000 \Omega$$



$$V_{TH} = R_{TH} \cdot I_{sc}$$

NOTERING! EFTERSOM ATT DET ÄR SAMMA RESISTANS I URSPRUNGLIGA KRETSEN OCH THEVEINS EKVIVALENT SÅ MÅSSE DET VARA SAMMA SPÄNNING SOM  $V_{O.}(10V)$

$$V_c = V_A = V_{TH}$$

$$I_1 + I_2 - I_3 = 0$$

$$\frac{10 - V_c}{5000} + 0,002 - \frac{V_c - 0}{5000} = 0$$

$$\frac{10 - V_c}{5000} \cdot 5000 + 0,002 \cdot 5000 - \frac{V_c \cdot 5000}{5000} = 0 \cdot 5000$$

$$10 - V_c + 10 - V_c = 0$$

$$-2V_c + 20 = 0$$

$$V_c = 10V$$

$$V_A = 10V$$

$$V_{TH} = 10V$$