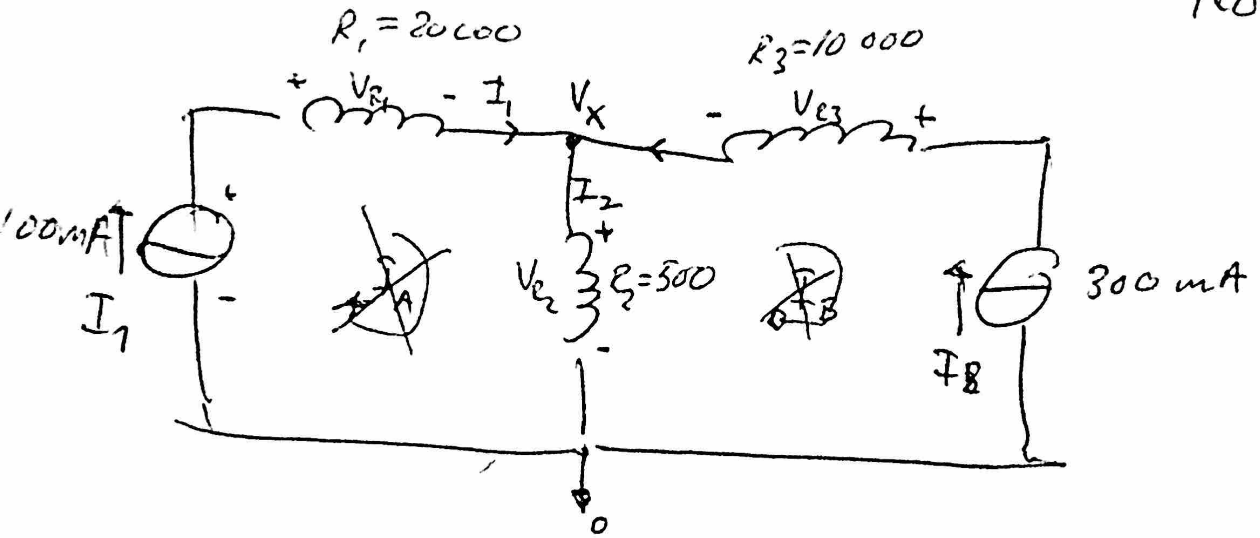
Home Assignment 2

IE1206 Embedded Electronics

Emil Ståhl

PROBLEM 7.



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

$V_{R_1} = R_1 \cdot I_1 \Rightarrow V_{R_1} = 20000 \cdot 0{,}1 \Rightarrow V_{R_1} = 2000\ V$

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

$V_{R_3} = R_3 \cdot I_B \Rightarrow V_{R_3} = 10000 \cdot 0{,}3 \Rightarrow V_{R_3} = 3000\ V$

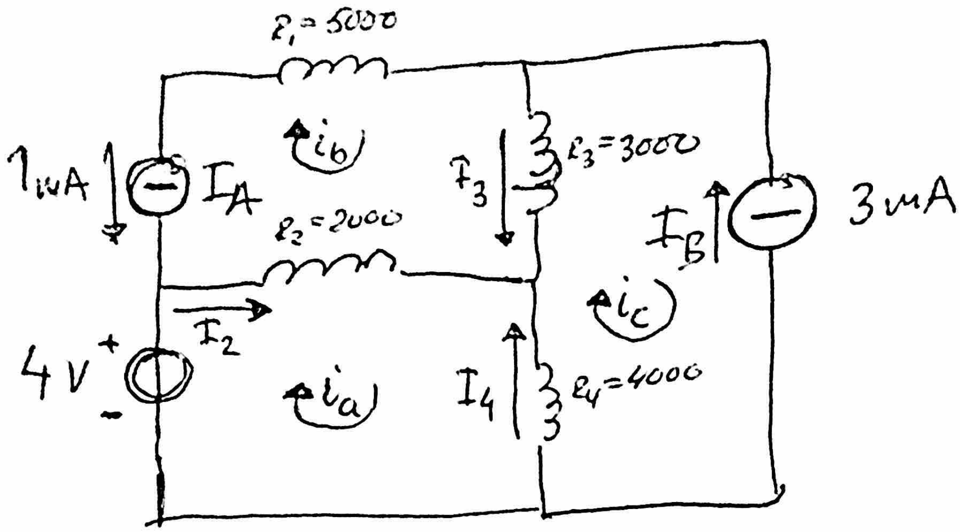
$$\left.\begin{aligned}
P_1 &= V_{R_1} \cdot I_1 \Rightarrow P_1 = 2000 \cdot 0{,}1 \Rightarrow P_1 = 200\ W \\
P_2 &= V_{R_2} \cdot I_2 \Rightarrow P_2 = 200 \cdot 0{,}4 \Rightarrow P_2 = 80\ W \\
P_3 &= V_{R_3} \cdot I_B \Rightarrow P_3 = 3000 \cdot 0{,}3 \Rightarrow P_3 = 900\ W
\end{aligned}\right\}$$

$P_1 + P_2 + P_3 = 1180\ W$

POWER × TIME = ENERGY (JOULE)

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

PROBLEM 2



KVL for the left mesh (I_a): $V_A - R_2 i_a + R_2 i_b + R_4 i_a - R_4 i_c = 0$

$i_c = -I_B$

$i_b = -I_A$

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

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

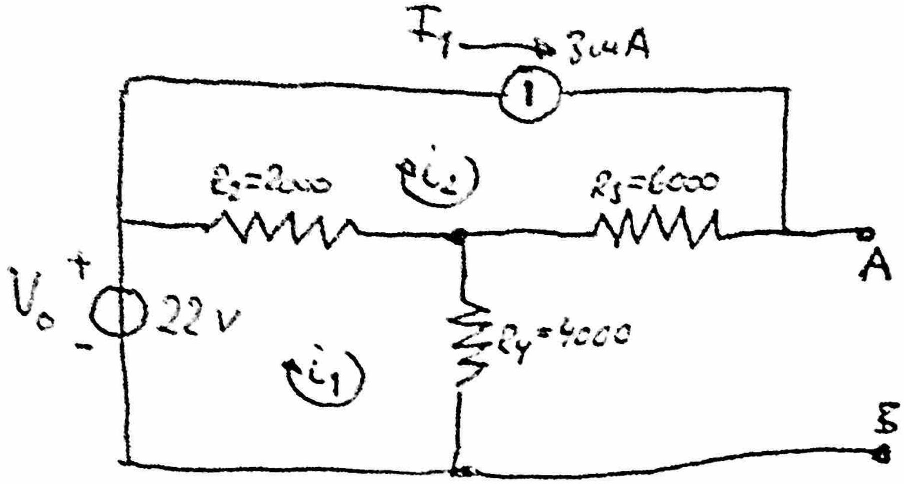
$$i_a = \frac{4 - 2000 \cdot 0{,}001 + 4000 \cdot 0{,}003}{2000 - 4000}$$

$$i_a = 0{,}007$$

$$I_2 = i_a$$

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

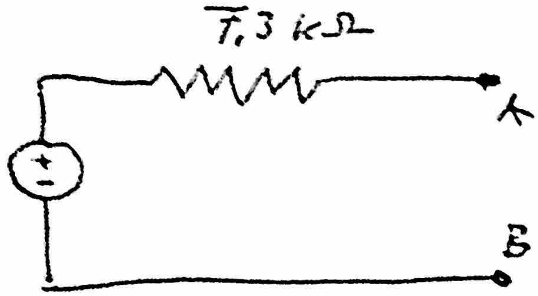
PROBLEM 4



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

$R_{TH} = \frac{R_2 \cdot R_4}{R_2 + R_4} = \frac{2000 \cdot 4000}{2000 + 4000} = \frac{8000\,000}{6000} + 6000$

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



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

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

$4400\, i_1 = 28$

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

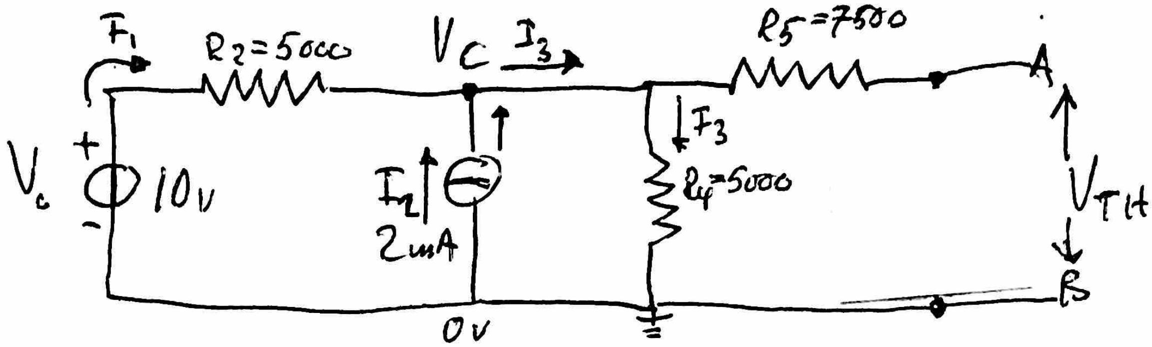
$i_1 = 0{,}0063 \approx 6{,}3\ mA$

$V_{TH} = 0{,}0063 \cdot \frac{R_3 \cdot R_4}{R_3 + R_4} \Rightarrow 0{,}0063 \cdot \frac{6000 \cdot 4000}{6000 + 4000}$

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

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

PROBLEM 5

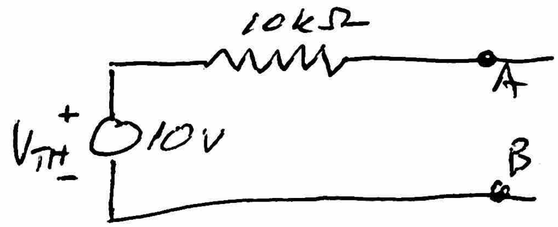


$$R_{TH} = \frac{\overset{R_2}{5000} \cdot \overset{R_4}{5000}}{5000 + 5000} + \overset{R_5}{7500}$$

$$R_{TH} = \frac{25\,000\,000}{10\,000} + 7500$$

$$R_{TH} = 25\,000 + 7500$$

$$R_{TH} = 10\,000\ \Omega$$



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

?

$V_{TH} = V_0$

NOTERING! EFTERSOM ATT DET ÄR SAMMA RESISTANS I URSPRUNGLIGA KRETSEN OCH THEVEINS EKVIVALENT SÅ MÅSTE DET VARA SAMMA SPÄNNING SOM V_0-(10V)

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

$$I_1 + I_2 - I_3 = 0$$

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

$$\frac{10 - V_c}{5000} \cdot 5000 + 0{,}002 \cdot 5000 - \frac{V_c \cdot 5000}{5000} = 0 \cdot 500$$

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

$$-2V_c + 20 = 0$$

$$V_c = 10\ \text{V}$$

$$V_A = 10\ \text{V}$$

$$V_{TH} = 10\ \text{V}$$

PROBLEM 6

MOTSVARANDE VÄRDEN SOM I UPPGIFT 5.

$R_{TH} = 10\ \Omega$

$V_{TH} = 10\ V$

MAXIMERAD EFFEKT DÅ $R_{TH} = R_L$

$$P = i^2 \cdot R_L = \left(\frac{V_{TH}}{R_{TH}+R_L}\right)^2 \cdot R_L$$

MAXIMAL EFFEKT:

$$P_{MAX} = \frac{V_{TH}^2 \cdot R_L}{(2R_L)^2} = \frac{10^2 \cdot 10}{(2 \cdot 10)^2} = 2{,}5\ W$$

$$P_{MAX} = 2{,}5\ W$$