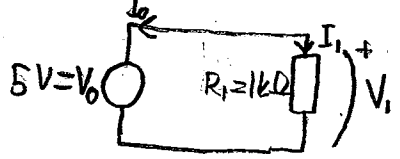
Inbyggd Elektronik 2018-03-23 #3

Node-Voltage-Method
Mesh-Current-Method
Thevenin/Norton equivalents
Superposition
} Next week

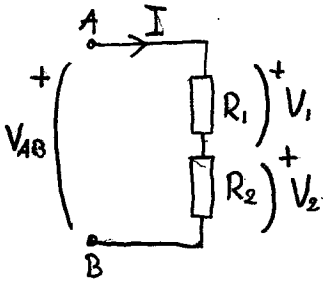


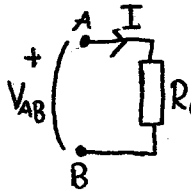
$V_1 = 5V \quad I_1 = \frac{V_1}{R_1} = \frac{5}{1k} = 5mA$

$P_1 = 5 \cdot 5_m = 25mW$

$I_0 + I_1 = 0 \Rightarrow I_0 = -I_1 = -5mA$

$P_0 = V_0 \cdot I_0 = 5 \cdot (-5m) = -25mW \qquad P_1 + P_0 = 25-25 = 0\,!!!$



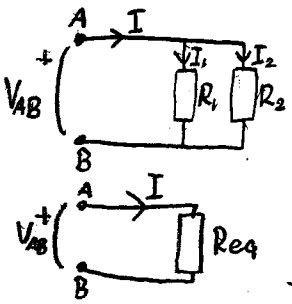


(1) $V_{AB} = V_2 + V_1 = R_2 \cdot I + R_1 \cdot I = (R_2 + R_1) I$

(2) $V_{AB} = R_{eq} \cdot I$

R

(1) and (2) is equivalent for all V_{AB}, I if $R_{eq} = R_2 + R_1$



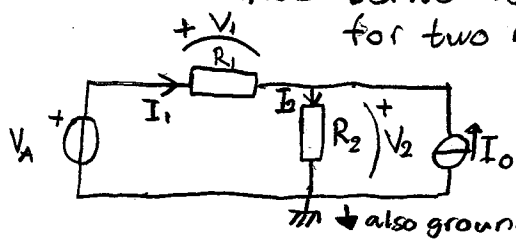
$I = I_1 + I_2 = \frac{V_{AB}}{R_1} + \frac{V_{AB}}{R_1}$

$I = \left(\frac{1}{R_1} + \frac{1}{R_2}\right) V_{AB}$

$V_{AB} = R_{eq} \cdot I$

$R_{eq} = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2}} \Rightarrow \frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} \qquad R_{eq} = \frac{R_1 R_2}{R_1 + R_2}$

TASK: Derive voltage divider (3.30) and current divider (3.32) for two resistors.



KCL: $I_1 + I_0 = I_2 = \frac{V_2}{R_2} = \frac{V_A - V_2}{R_1} + I_0$

$V_A - V_2 + R_1 I_0 = \frac{V_2}{R_2} R_1$

$V_A + R_1 I_0 = \left(1 + \frac{R_1}{R_2}\right) V_2$

$V_2 = \frac{V_A + R_1 I_0}{\left(1 + \frac{R_1}{R_2}\right)} = \frac{R_2 V_A + R_2 R_1 I_0}{R_2 + R_1}$

$R_1 = 1k\Omega \quad R_2 = 2k\Omega \quad I_0 = 30mA \quad V_A = 6V$

$V_2 = \frac{2k \cdot 6 + 2k \cdot 1k \cdot 30m}{2k + 1k} = \frac{12k}{3k} + \frac{60k}{3k} =$

$= 24\,V$

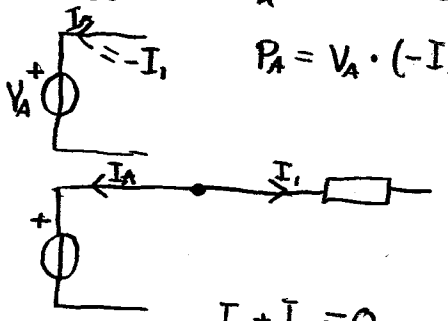
$I_2 = \frac{V_2}{R_2} = \frac{24}{2k} = 12mA \qquad P_2 = V_2 \cdot I_2 = 24 \cdot 12m = 288mW$

Look at R_1: $V_1 = V_A - V_2 = 6 - 24 = -18V$

$I_1 = I_2 - I_0 = 12m - 30m = -18mA$

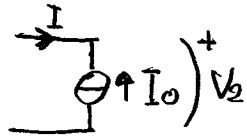
$P_1 = V_1 \cdot I_1 = (-18) \cdot (-18m) = 324mW$

Look at V_A: Passive sign convention



$P_A = V_A \cdot (-I_1) = 6 \cdot (18m) = 108mW$

$I_A + I_1 = 0$



$P_0 = V_2 \cdot (-I_0) = 24 \cdot (-30m) = -720mW$

$P_A + P_0 + P_1 + P_2 = 108 - 720 + 324 + 288 = 0$