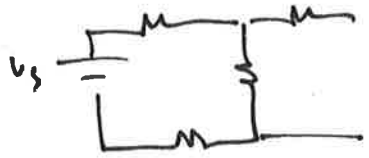
2018-10-29

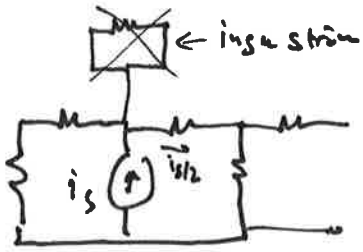
1a)



$R_{th} = 2R // R + R = \frac{5R}{3}$

$V_{th} = V_s \cdot \frac{R}{3R} = \frac{V_s}{3}$

b)



$R_{th} = 3R // R + R = \frac{7R}{4}$

$V_{th} = \frac{i_s \cdot \frac{3}{4}R}{2} = i_s \cdot R/2$

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2. $\frac{V_1}{2R_1} + \frac{V_1 - V_2}{R_2} + \frac{V_1 + V_s - V_3}{R_2 + R_3} = 0 \Rightarrow V_1\left(\frac{1}{2R_1} + \frac{1}{R_2} + \frac{1}{R_2+R_3}\right) + V_2\left(\frac{-1}{R_2}\right) + V_3\left(\frac{-1}{R_2+R_3}\right) = \frac{-V_s}{R_2+R_3}$

$\frac{V_2}{R_1} + \frac{V_2 - V_1}{R_2} + i_s = 0 \Rightarrow V_1\left(\frac{-1}{R_2}\right) + V_2\left(\frac{1}{R_1} + \frac{1}{R_2}\right) = -i_s$

$\frac{V_3}{R_2} - i_s + \frac{V_3 - (V_1 + V_s)}{R_2+R_3} = 0 \Rightarrow V_1\left(\frac{-1}{R_2+R_3}\right) + V_3\left(\frac{1}{R_2} + \frac{1}{R_2+R_3}\right) = i_s + \frac{V_s}{R_2+R_3}$

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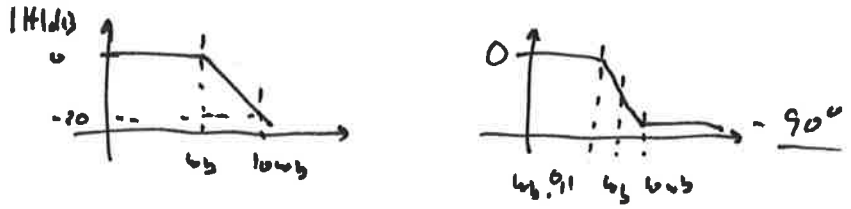
3. a) $\omega_b = \frac{1}{RC} = 10^3 \text{ rad/s} \Rightarrow R = \frac{1}{10^3 \cdot 10^{-6}} = 1\text{k}\Omega$

b)



c) $R_{th} = 2R // R = \frac{2R}{3} \Rightarrow \omega_b = \frac{3}{2RC}$

4 a) $$V_L = V_s \cdot \frac{R + \frac{1}{j\omega C}}{2R + \frac{1}{j\omega C}} = \frac{1 + j\omega RC}{1 + 2j\omega RC} \cdot V_s$$

b) $$V_L = \frac{\sqrt{1 + (\omega RC)^2}}{\sqrt{1 + (2\omega RC)^2}} \cdot e^{j(\arctan(\omega RC) - \arctan(2\omega RC))}$$

$$\Rightarrow v_L(t) = \frac{\sqrt{1 + (\omega RC)^2}}{\sqrt{1 + (2\omega RC)^2}} \cdot \cos(\omega t + \arctan(\omega RC) - \arctan(2\omega RC))$$

c) $$I_L = \frac{V_s}{2R + \frac{1}{j\omega C}} = \frac{j\omega C}{1 + 2j\omega RC} \cdot V_s$$

d) $$S = \frac{V \cdot I^*}{2} = \frac{|V_s|^2}{2} \cdot \frac{-j\omega C \cdot (1 + j\omega RC)}{1 + (2\omega RC)^2} = \frac{|V_s|^2}{2} \frac{\omega^2 RC^2 - j\omega C}{1 + (2\omega RC)^2}$$

$$P = \mathrm{Re}(S) = \frac{V_s^2}{2} \frac{\omega^2 RC^2}{1 + (2\omega RC)^2}$$

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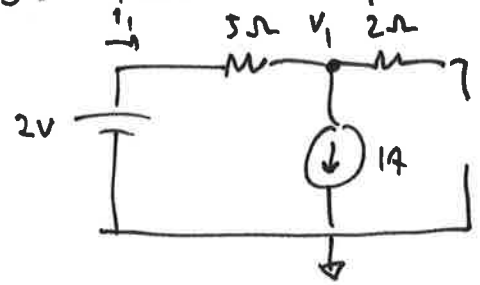
5. Gissa backspänd.



$$V_1: \quad \frac{V_1 - 2}{5} = -1 \Rightarrow V_1 = -3\,\mathrm{V}$$

D Ok! → D_1 backspänd.

$$\Rightarrow I_1 = 1\,\mathrm{A}$$

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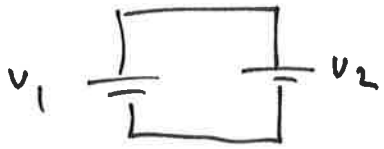
6)

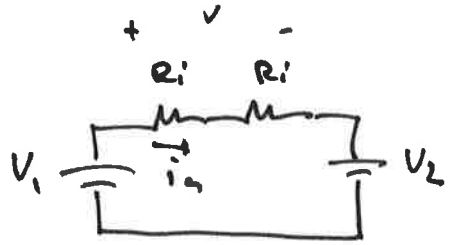


a) Nej! Bryter mot KVL dvs:

KVL: $V_1 - V_2 = 0 \Rightarrow V_1 = V_2$. Men enligt uppgift: $V_2 > V_2$

Kan alltså ej realiseras med ideala komponenter!

b)



$$i_a = \frac{V_1 - V_2}{2R_i}$$

c) $$P_{R_i} = i_a \cdot V = \frac{V_1 - V_2}{2R_i} \cdot V_1 - V_2 = \frac{(V_1 - V_2)^2}{2 \cdot R_i}$$

d) $$P_{V_2} = -i_a \cdot V_2 = -\frac{(V_1 - V_2)^2}{2 \cdot R_i} \cdot V_2$$

El-energi → Kemisk energi!

$$E = P_{V_2} \cdot t_0 = \frac{(V_1 - V_2)^2 \cdot V_2}{2 \cdot R_i} \cdot t_0$$ (energi: effekt. tid!)