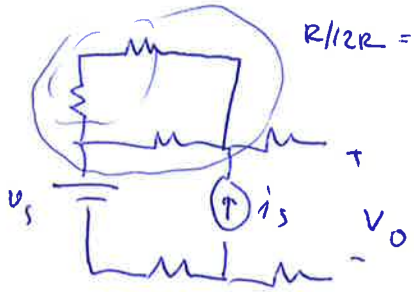
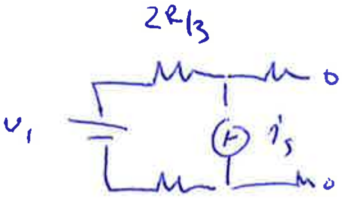
28/10-2019

1).

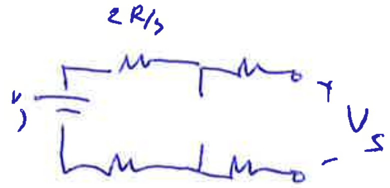
$R // 2R = \frac{2R}{3}$

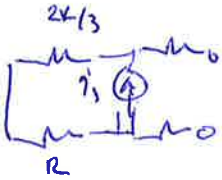


$\Rightarrow$



V_{th}: Superposition:



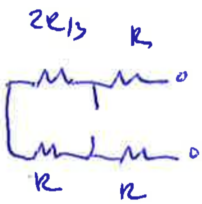


$\Leftrightarrow$ $\frac{5R}{3}$

$i_s \cdot \frac{5R}{3}$

$$\Rightarrow V_{th} = V_s + i_s \cdot \frac{5R}{3}$$

R_{th}



$$: R_{th} = 3R + \frac{2R}{3} = \frac{11R}{3}$$

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2) (v_1) $\quad V_1 = V_a$

(v_2) $$\frac{V_2 - V_1}{2R} + \frac{V_2 - V_3}{R} + \frac{V_2 - V_4 - V_c}{2R} = 0 \Rightarrow V_1\left(-\frac{1}{2R}\right) + V_2\left(\frac{2}{R}\right) + V_3\left(-\frac{1}{R}\right) + V_4\left(-\frac{1}{2R}\right) = \frac{V_c}{2R}$$

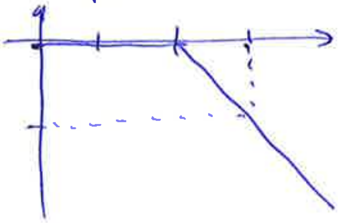
(v_3) $$\frac{V_3 - V_1}{R} + \frac{V_3 - V_2}{R} - i_s + \frac{V_3 - V_4}{R} = 0 \Rightarrow V_1\left(-\frac{1}{R}\right) + V_2\left(-\frac{1}{R}\right) + V_3\left(\frac{3}{R}\right) + V_4\left(-\frac{1}{R}\right) = i_s$$

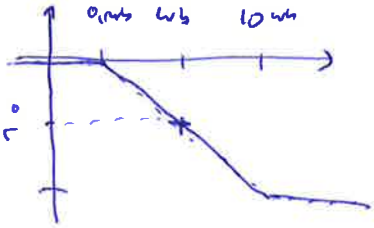
(v_4) $$\frac{V_4 - V_5}{2R} + \frac{V_4 - V_3}{R} + \frac{V_4 + V_c - V_2}{2R} = 0 \Rightarrow V_2\left(-\frac{1}{2R}\right) + V_3\left(-\frac{1}{R}\right) + V_4\left(\frac{2}{R}\right) = \frac{V_5}{2R} - \frac{V_c}{2R}$$

3) a) $\omega_b = -20dB$ $\left(|H(\omega)| = -40dB \text{ @ } 10^5 \text{ rad/s.} \right)$

$$\omega_b = \frac{1}{RC} \Rightarrow R = \frac{1}{C} \cdot \frac{1}{\omega_b} = 10^3 \Omega = 1k\Omega$$

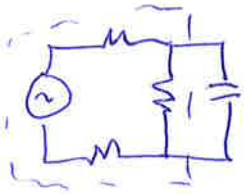
b)





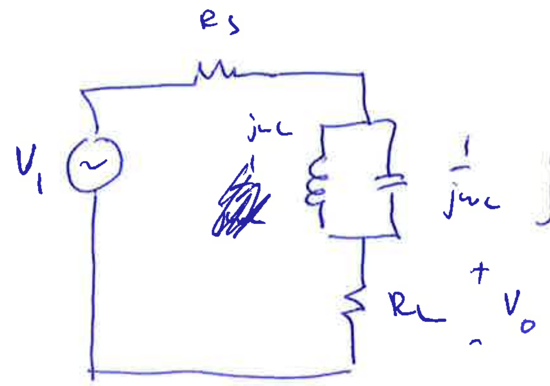
c)

$\Leftrightarrow$



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

4)



$$Z_{LC} = j\omega L \,//\, \frac{1}{j\omega C} = \frac{j\omega L \cdot \frac{1}{j\omega C}}{j\omega L + \frac{1}{j\omega C}} = \frac{j\omega L}{1-\omega^2 LC} = Z_{LC}$$

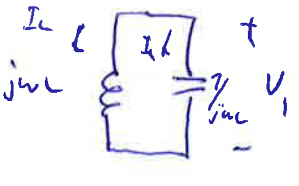
a) Sp. deling: $V_0 = \frac{R_L}{R_S + R_L + Z_{LC}} \cdot V_1 = \frac{R_L}{R_S + R_L + \frac{j\omega L}{1-\omega^2 LC}} \cdot V_1$

b) $V_0(t) = \frac{R_L}{\sqrt{(R_S + R_L)^2 + \left(\frac{\omega L}{1-\omega^2 LC}\right)^2}} \cdot \cos\left(\omega t - \arctan \frac{\omega L}{(1-\omega^2 LC)(R_S + R_L)}\right)$

c) $Z_{LC} \to \infty$ då $\omega^2 = \frac{1}{LC} \Rightarrow \omega = \frac{1}{\sqrt{LC}}$

↳ gir at $V_0 \to 0$!

d) Då $Z_{LC} \to \infty \Rightarrow$ all spenning V_1 falle over Z_{LC}.



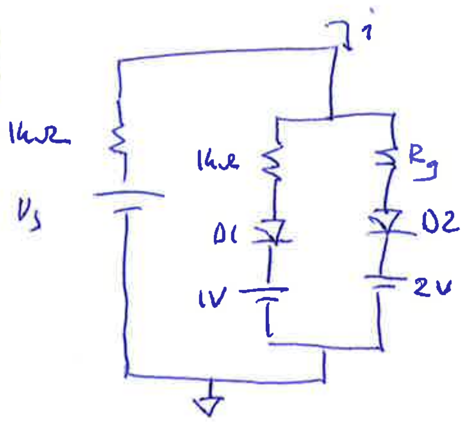
$I_C = \frac{V_1}{1/j\omega C} = V_1 \cdot j\omega C \quad I_C^* = -V_1^* \cdot j\omega C$

$I_L = \frac{V_1}{j\omega L} \quad I_L^* = \frac{V_1^* \cdot j}{\omega L}$

$S_C = \frac{V \cdot I^*}{2} = -\frac{|V_1|^2}{2} \cdot \omega C \cdot j \Rightarrow Q_C = Im(S_C) = -\frac{|V_1|^2}{2} \cdot \omega C$

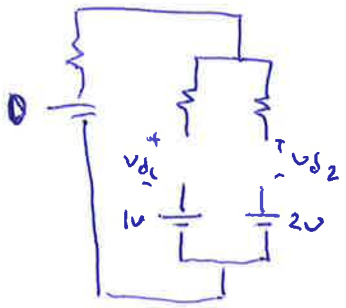
$S_L = \frac{V_1 \cdot I_L^*}{2} = \frac{|V_1|^2}{2} \cdot \frac{1}{\omega L} \Rightarrow Q_L = Im(S_L) = \frac{|V_1|^2}{2} \cdot \frac{1}{\omega L}$

5)



a) $V_s = 0V \Rightarrow i = 0A$: D1 och D2 backspända.

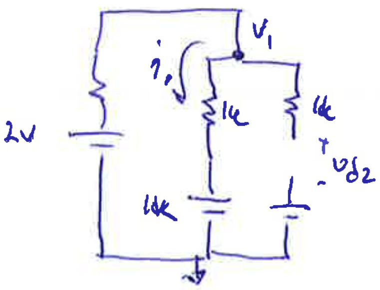
$\Rightarrow i_r = i_g = 0A$



Kontroll: $V_{d1} = 0 - 1 = -1 \leq 0$ ok!

$V_{d2} = 0 - 2 = -2 < 0$ ok!

b) $V_s = 2V$: $\Rightarrow$ D1 framspänd, D2 backspänd.



KCL på V_1: $\frac{V_1 - 2}{10^3} + \frac{V_1 - 1}{10^3} = 0 \Rightarrow V_1 = 1{,}5V$

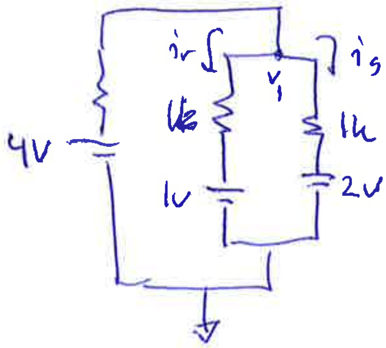
$i_r = \frac{1{,}5 - 1}{10^3} = 0{,}5mA$

$i_g = 0A$

Kontroll: $i_r > 0$ ok!

$V_{d2} = 1{,}5 - 2 = -0{,}5V$ ok!

c) $V_s = 4V$ D1 och D2 framspända.



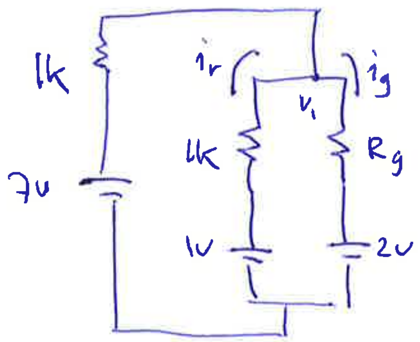
KCL på V_1 $\frac{V_1 - 4}{10^3} + \frac{V_1 - 1}{10^3} + \frac{V_1 - 2}{10^3} = 0$

$\Rightarrow V_1 = \frac{7}{3} V$

$i_r = \frac{\frac{7}{3} - 1}{10^3} = \underline{\frac{4}{3} mA}$ $i_g = \frac{\frac{7}{3} - 2}{10^3} = \underline{\frac{1}{3} mA}$

Kontroll: $i_r > 0$ ok.
$i_g > 0$ ok.

d)



Både D1 och D2 ska vara framspänd.

$i_r = i_g$

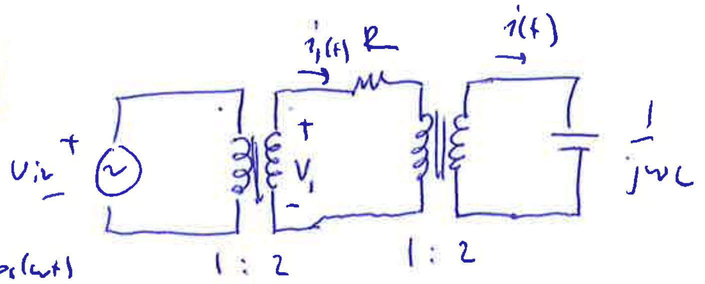
$$\frac{V_1 - 7}{10^3} + \overbrace{\frac{V_1 - 1}{10^3}}^{i_r} + \overbrace{\frac{V_1 - 2}{R_g}}^{i_g} = 0$$

Om $i_r = i_g$: $\frac{V_1 - 7}{10^3} - \frac{2 \cdot (V_1 - 1)}{10^3} = 0 \Rightarrow \underline{\underline{V_1 = 3V}}$

$i_r = \frac{3 - 1}{10^3} = 2mA \Rightarrow i_g = 2 \cdot 10^{-3} = \frac{3 - 2}{R_g}$

$\Rightarrow R_g = \frac{1}{2 \cdot 10^3} = \underline{\underline{0{,}5 k\Omega}}$ Kontroll: $\underline{i_r = i_g > 0}$!

6)

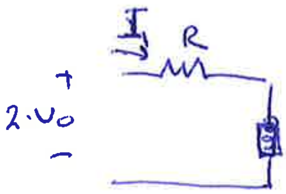


$V_{in} = V_0 \cdot \cos(\omega t)$

$\downarrow j\omega$

$$V_1 = \frac{N_2}{N_1} \cdot V_0 = 2 \cdot V_0$$

$\frac{1}{j\omega C}$ impedanstransformeras:



$$\left(\frac{N_1}{N_2}\right)^2 \cdot \frac{1}{j\omega C} = \frac{1}{j\omega 4C}$$

$$I_1 = \frac{2 \cdot V_0}{R + \frac{1}{j\omega C \cdot 4}} = \frac{2 \cdot j\omega 4 \cdot C}{1 + j\omega 4CR} \cdot V_0 = \frac{8 \cdot j\omega C}{1 + j\omega 4C \cdot R} \cdot V_0$$

I_1 är den (komplexa) ström som flyter in på primärsidan i Transformator 2.

$$\Rightarrow I = \frac{N_1}{N_2} \cdot I_1 = \frac{I_1}{2} = \frac{4 \cdot j\omega C}{1 + j\omega 4RC} \cdot V_0$$

$$\Rightarrow i(t) = \frac{4\omega C \cdot V_0}{\sqrt{1 + (\omega 4RC)^2}} \cdot \cos\left(\omega t + \frac{\pi}{2} - \arctan \omega 4RC\right)$$