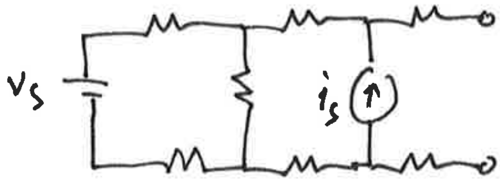
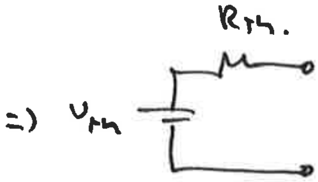
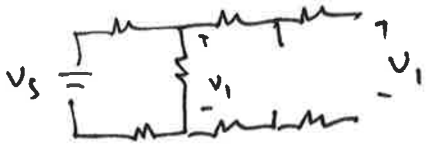
1)

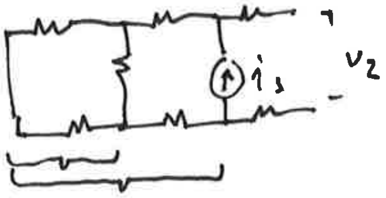




v_{th}: Superposition: →



Sp.delning: $V_1 = \frac{R}{R+2R} \cdot V_s = \frac{V_s}{3}$



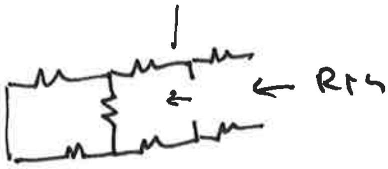
$V_2 = i_s \cdot \frac{8R}{3}$

~~R2R//~~

$R // 2R + 2R = \frac{8R}{3}$

$v_{th} = \frac{v_s}{3} + \frac{8R}{3} \cdot i_s$

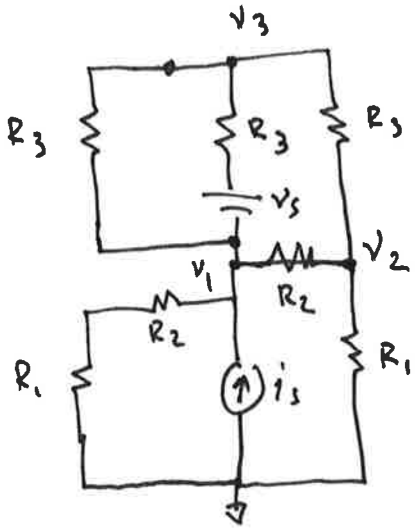
$8R/3$



R_{th} : Nollställ källor:

$R_{th} = \frac{8R}{3} + 2R = \underline{\frac{14R}{3}}$

2)



1) $\dfrac{v_1}{R_1+R_2} + \dfrac{v_1-v_2}{R_2} + \dfrac{v_1-v_3}{R_3} + \dfrac{v_1+v_s-v_3}{R_3} - i_s = 0$

2) $\dfrac{v_2-v_1}{R_2} + \dfrac{v_2}{R_1} + \dfrac{v_2-v_3}{R_3} = 0$

3) $\dfrac{v_3-v_1}{R_3} + \dfrac{v_3-v_s-v_1}{R_3} + \dfrac{v_3-v_2}{R_3} = 0$

1) $v_1\left(\dfrac{1}{R_1+R_2} + \dfrac{1}{R_2} + \dfrac{2}{R_3}\right) + v_2\left(\dfrac{-1}{R_2}\right) + v_3\left(\dfrac{-2}{R_3}\right) = i_s - \dfrac{v_s}{R_3}$

2) $v_1\left(\dfrac{-1}{R_2}\right) + v_2\left(\dfrac{1}{R_1} + \dfrac{1}{R_2} + \dfrac{1}{R_3}\right) + v_3\left(-\dfrac{1}{R_3}\right) = 0$

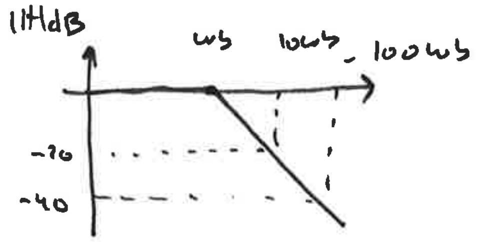
3) $v_1\left(-\dfrac{2}{R_3}\right) + v_2\left(-\dfrac{1}{R_3}\right) + v_3\left(\dfrac{3}{R_3}\right) = \dfrac{v_s}{R_3}$

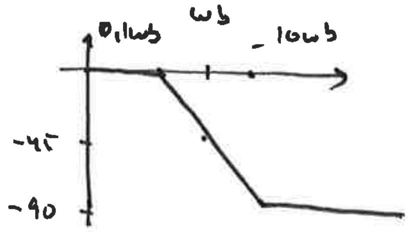
---

3) a) $|H(\omega_0)|_{dB} = -40dB \Rightarrow \omega_0 = 100 \cdot \omega_b \Rightarrow \omega_b = 10^3 \text{ rad/s}$

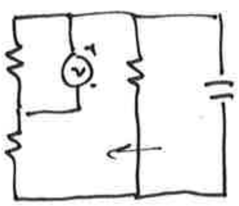
$\omega_b = \dfrac{1}{RC} \Rightarrow C = \dfrac{1}{\omega_b \cdot R} = \dfrac{1}{10^3 \cdot 10^3} = 10^{-6} = \underline{\underline{1\mu F}}$

b)



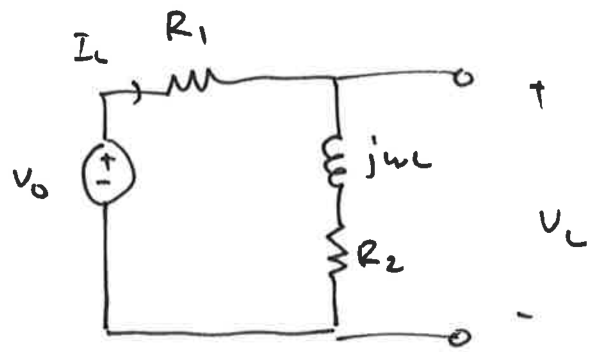


c)



$R_{th} = R//R = \dfrac{R}{2} \Rightarrow \underline{\underline{\omega_b = \dfrac{2}{RC}}}$

4)



a) $$I_L = \frac{V_0}{Z_L + R_1} = \frac{V_0}{R_1 + R_2 + j\omega L} = \frac{V_0 (R_1 + R_2 - j\omega L)}{(R_1+R_2)^2 + (\omega L)^2}$$

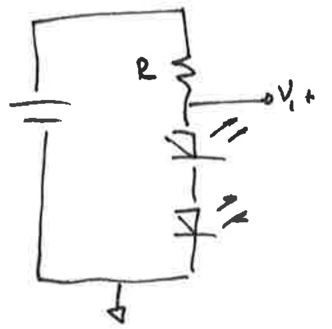
b) $$V_L = I_2 \cdot Z_L = V_0 \cdot \frac{R_2 + j\omega L}{R_1 + R_2 + j\omega L} = \frac{\sqrt{R_2^2 + (\omega L)^2}}{\sqrt{(R_1+R_2)^2 + (\omega L)^2}} \cdot e^{j\left(\frac{\omega L}{R_2} - \frac{\omega L}{R_1+R_2}\right)} \cdot V_0$$

c) $$v(t) = V_0 \cdot \frac{\sqrt{R_2^2 + (\omega L)^2}}{\sqrt{(R_1+R_2)^2 + (\omega L)^2}} \cdot \cos\left(\omega t + \frac{\omega L R_1}{R_2 (R_1 + R_2)}\right)$$

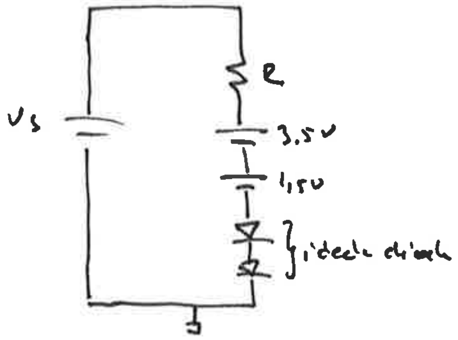
d) $$S = \frac{1}{2} V I^* \quad \frac{1}{2} V_0^2 \cdot \frac{R_2 + j\omega L}{(R_1+R_2)^2 + (\omega L)^2}$$

$$: P = Re(S) = \frac{V_0^2}{2} \cdot \frac{R_2}{(R_1+R_2)^2 + (\omega L)^2}$$

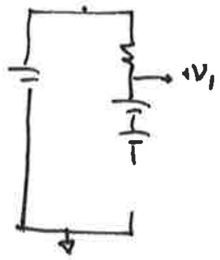
5)



$\Rightarrow$ ideala dioder med knäspänningar.



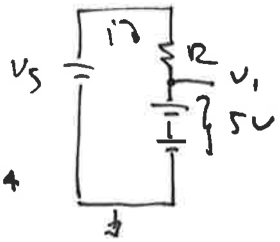
a) Backspänd tills $V_s \geq 3.5 + 1.5 = \underline{5.0V}$



$i = 0$ (KCL!)

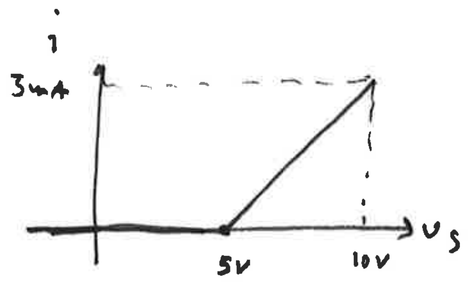
$V_1 = V_s$

Framspänd då $V_s \geq 5$

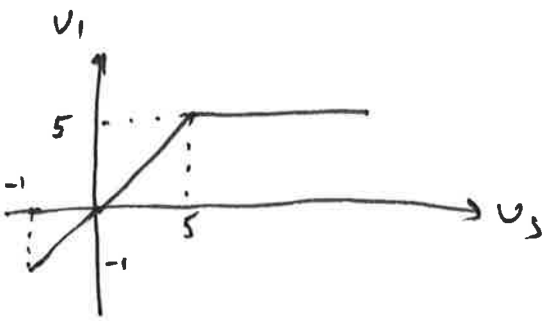


$$i = \frac{V_s - 5}{R} = \underline{\frac{V_s - 5}{10^3} A} = (V_s - 5)\,mA$$

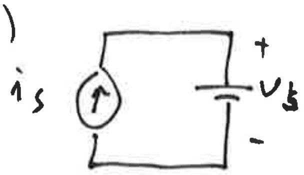
b)



c)



6) a)

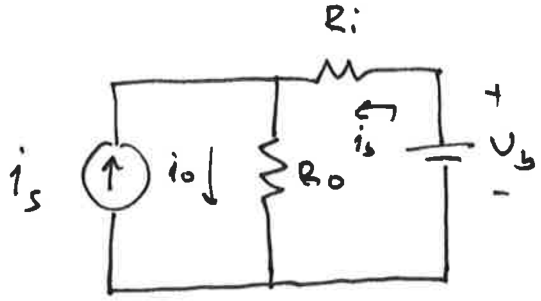


Ja, går att realisera!

Strömkälla: ger strömmen i_s oavsett spänning

Spänningskälla: ger spänningen V_b –"– ström!

b)



Superposition:

$$i_b = -\frac{R_o}{R_i+R_o}\cdot i_s + \frac{V_b}{R_i+R_o}$$

$$i_o = \frac{R_i}{R_i+R_o}\cdot i_s + \frac{V_b}{R_i+R_o}$$

b) effekt i batteriet: $P_b = -i_b\cdot V_b = \frac{+R_o\cdot i_s\cdot V_b}{R_i+R_o} + \frac{-V_b^2}{R_i+R_o}$

Om $P_b > 0$: batteriet laddas upp!

c) Förluster: effektförbrukning i resistanserna.

$$P_F = i_o^2\cdot R_o + i_b^2\cdot R_i = \frac{1}{(R_i+R_o)^2}\left(R_o\left((R_i\cdot i_s) + V_b\right)^2 + R_i(-R_o\cdot i_s + V_b)^2\right)$$

$P_F \geq 0$