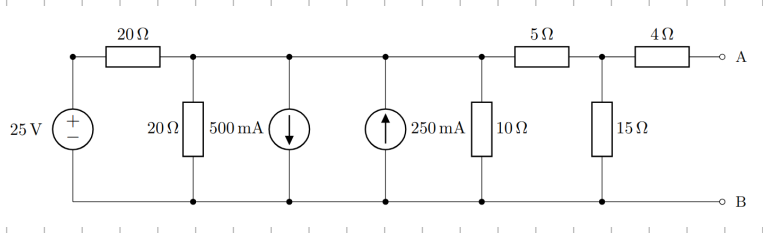
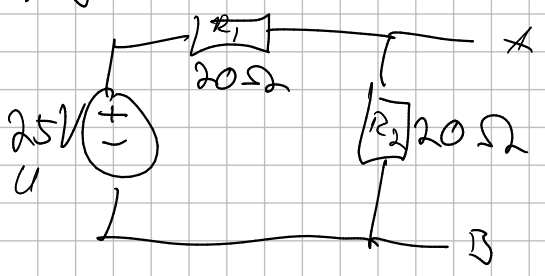
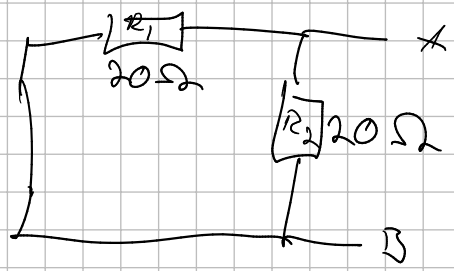
Thevenin og Norton ekvivalenter

Oppg 1



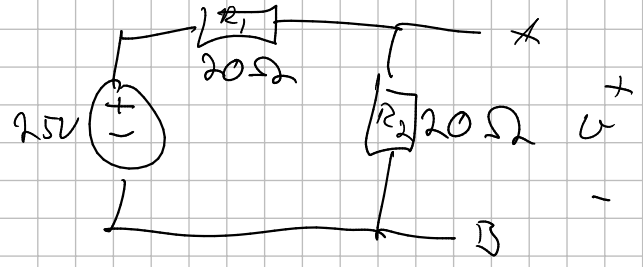


$U = 0$



$$\left(\frac{1}{R_1}+\frac{1}{R_2}\right)^{-1} = \left(\frac{R_1+R_2}{R_1 R_2}\right)^{-1} = \frac{R_1 R_2}{R_1+R_2}$$

$$R_{Th} = \frac{R_1 R_2}{R_1+R_2} = \frac{20\,\Omega \cdot 20\,\Omega}{20\,\Omega + 20\,\Omega} = \frac{400\,\Omega^2}{40\,\Omega} = 10\,\Omega$$

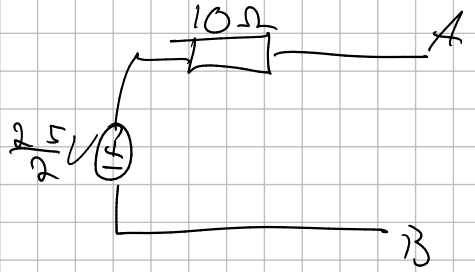


$U - U_{R_1} - U_{R_2} = 0$

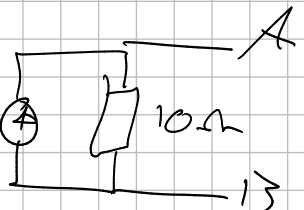
$U_{R_2} = U - U_{R_1} = I(R_1 + R_2 - R_1) = I R_2 \qquad I = \frac{U}{R} = \frac{U}{R_1+R_2}$

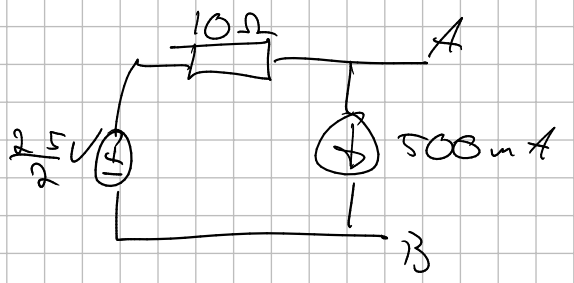
$$= U\frac{R_2}{R_1+R_2}$$

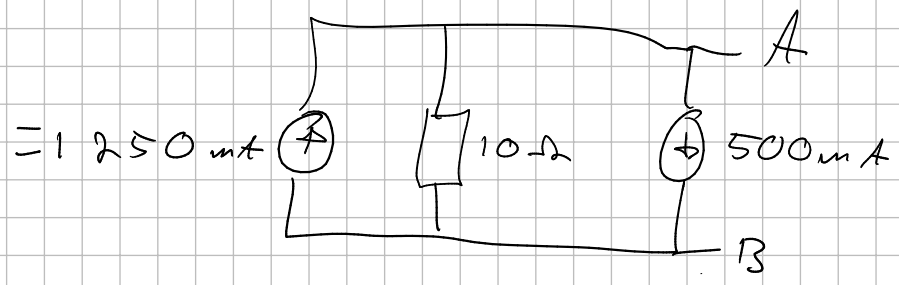
$$U_{R_2} = 25\,V \cdot \frac{20\,\Omega}{40\,\Omega} = \frac{25}{2}\,V$$



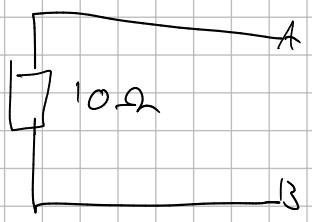
$$= I = \frac{U}{R} = \frac{25}{20} = \frac{5}{4}\,A$$





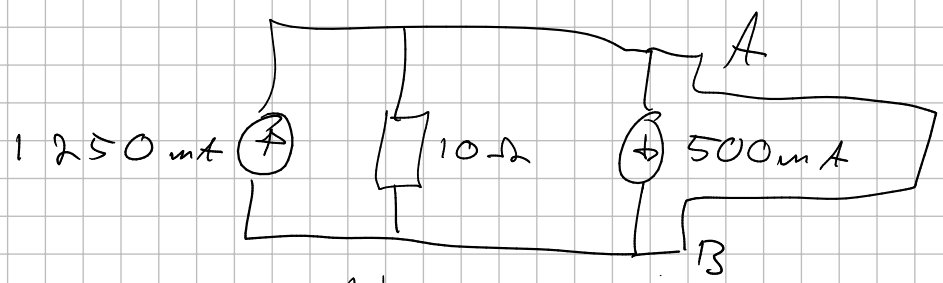


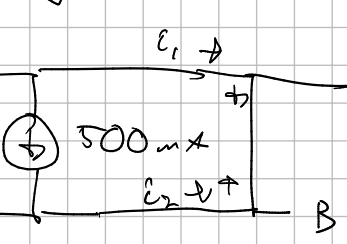
$I = 0$

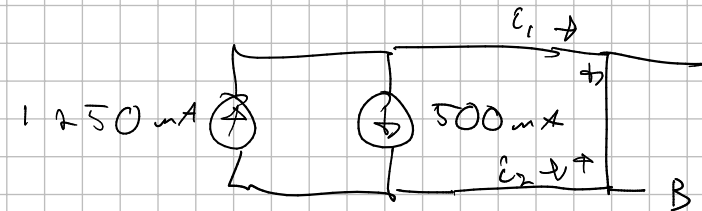


$R_n = 10\Omega$

$I_n = ?$

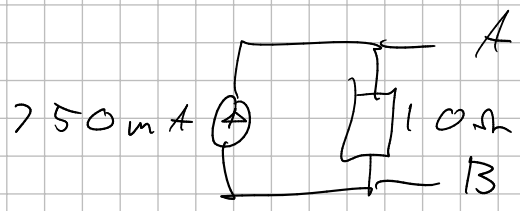


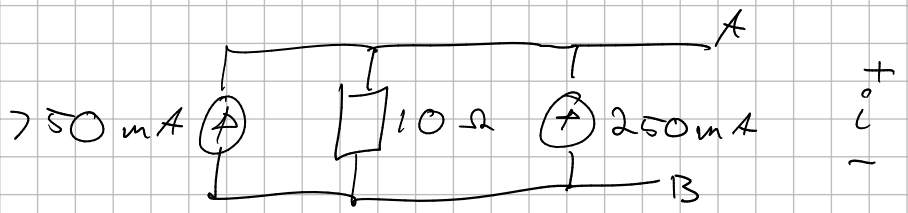




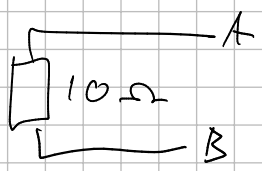
$I_n = 1250mA - 500mA$

$= 750mA$



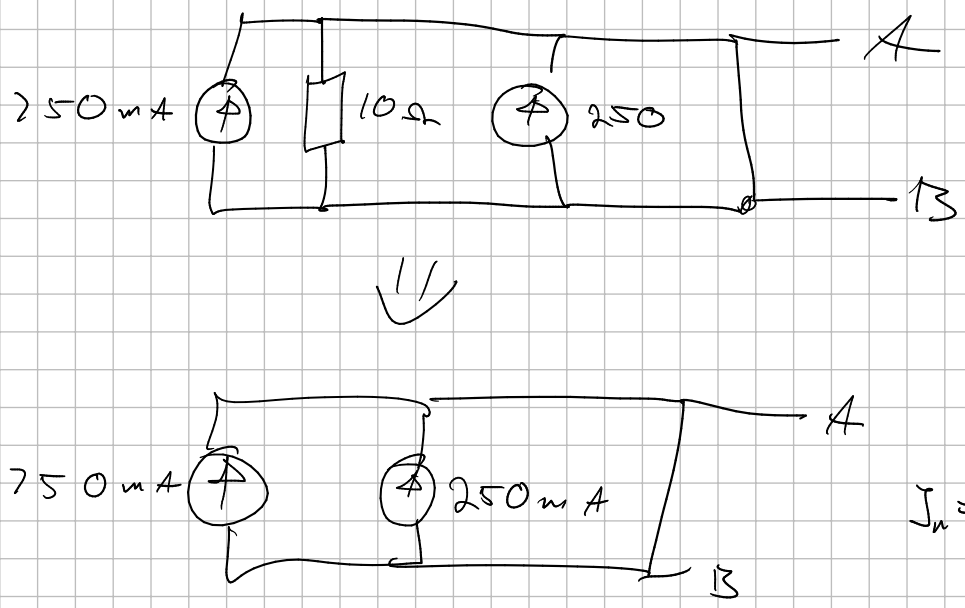


$J = 0$

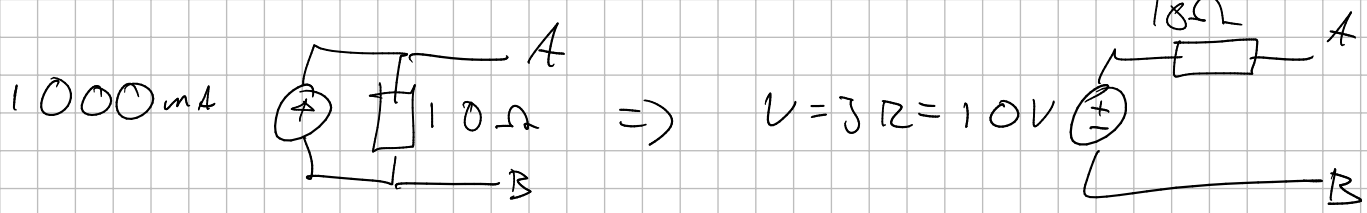


$R_n = 10\ \Omega$

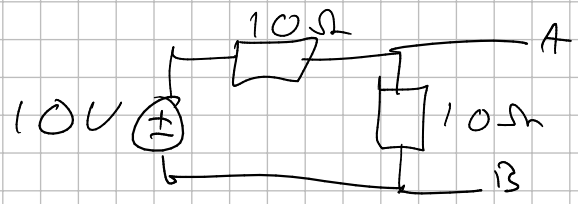
$J_n = ?$



$J_n = 1000\ mA$



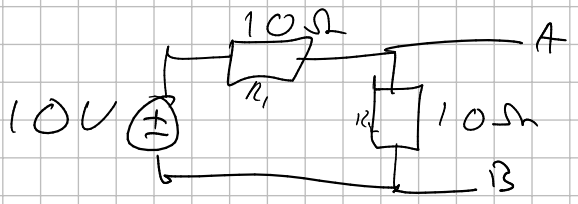
$\Rightarrow \quad V = JR = 10V$



$U = 0$

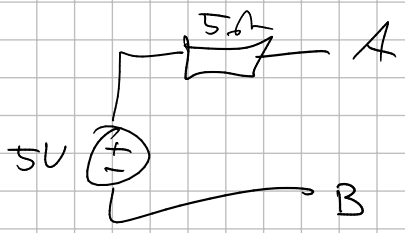
$$R_{th} = \frac{10\Omega \cdot 10\Omega}{10\Omega + 10\Omega} = \frac{100\Omega^2}{20\Omega} = 5\Omega$$

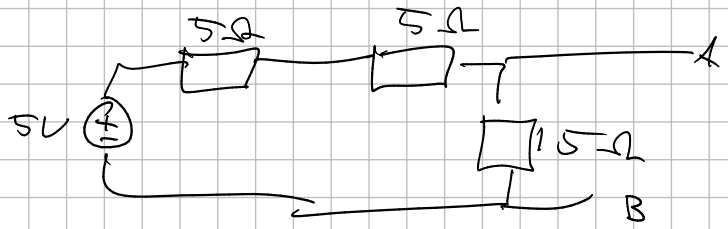
$U_{th} = ?$

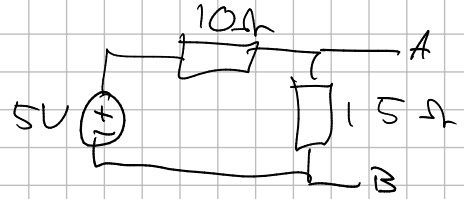


$$U_0 = U_{R_1} + U_{R_2}$$

$$U_2 = U \frac{R_2}{R_1 + R_2} = 10V \cdot \frac{10\Omega}{20\Omega} = \frac{1}{2} \cdot 10 = 5V$$

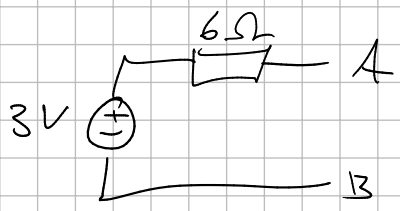


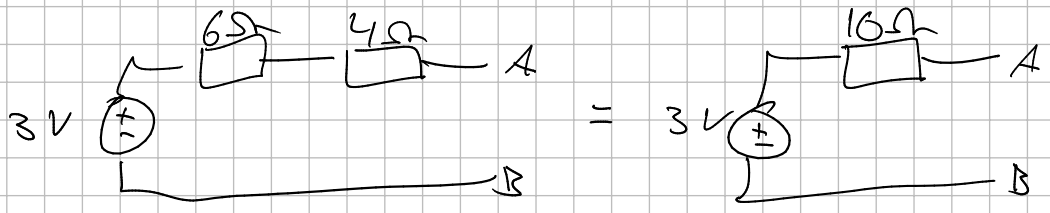




$$R_{ii} = \frac{10\Omega \cdot 15\Omega}{10\Omega + 15\Omega} = \frac{150\Omega^2}{25\Omega} = 6\Omega$$

$$U_2 = U \frac{R_2}{R_1 + R_2} = 5V \cdot \frac{15\Omega}{25\Omega} = 3V$$

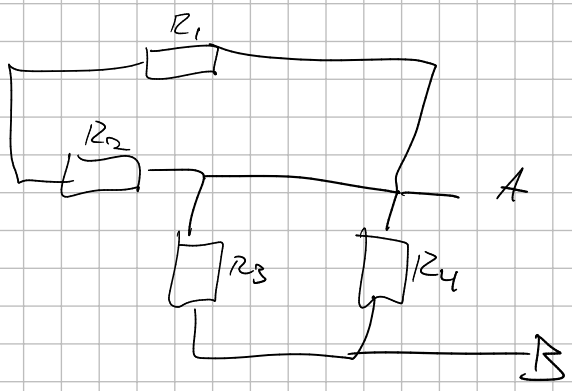




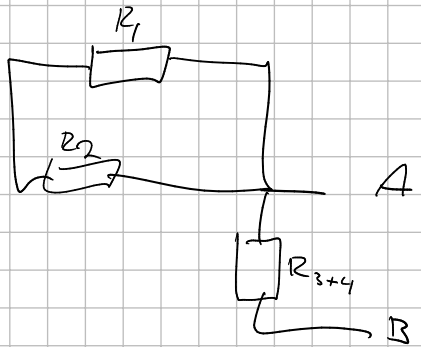
Riktig ?

Oppg 5)

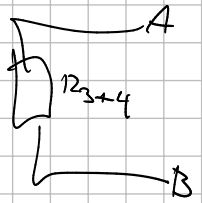
$I = U = 0$



$$R_3 \| R_4 = \frac{R_3 R_4}{R_3 + R_4} = \frac{4\,\Omega \cdot 3\,\Omega}{4\,\Omega + 3\,\Omega} = \frac{12}{7}\,\Omega$$

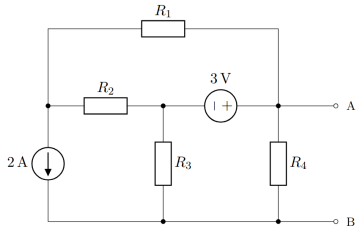


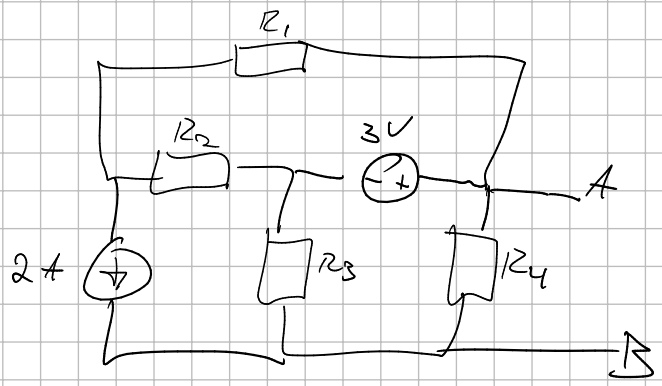
$$R_1 \| R_2 = \frac{2\,\Omega \cdot 2\,\Omega}{2\,\Omega + 2\,\Omega} = 1\,\Omega$$



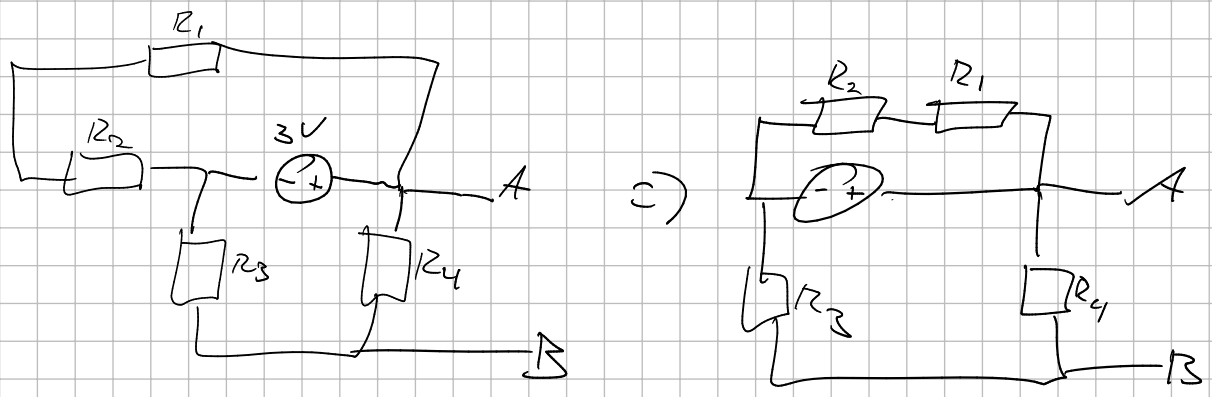
$R_{th} = \frac{12}{7}\,\Omega$

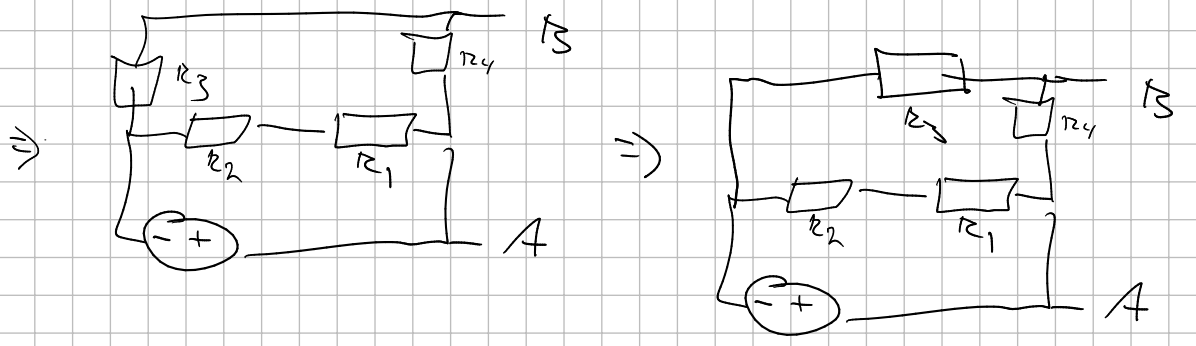
Finn Théveninekvivalenten til kretsen under når $R_1 = 2\ \Omega$, $R_2 = 2\ \Omega$, $R_3 = 4\ \Omega$ og $R_4 = 3\ \Omega$.

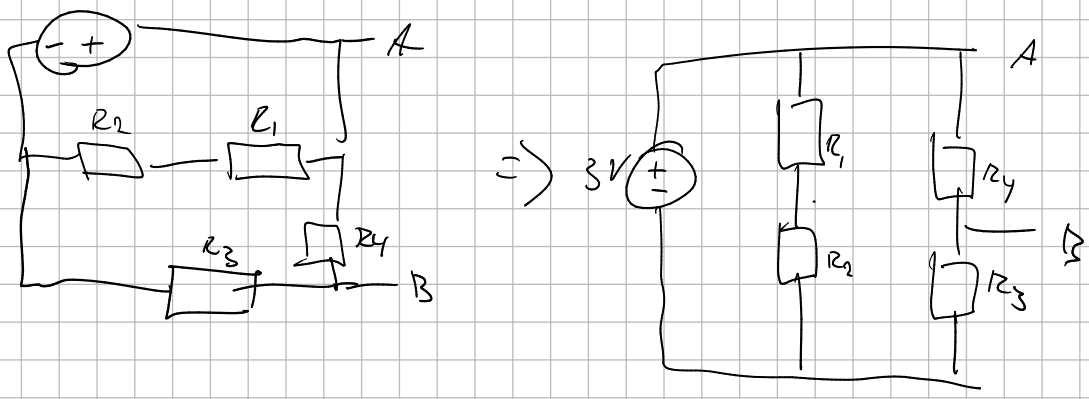




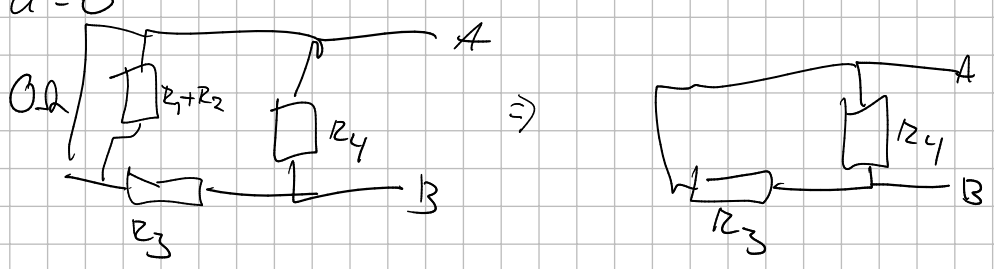
$I = 0$



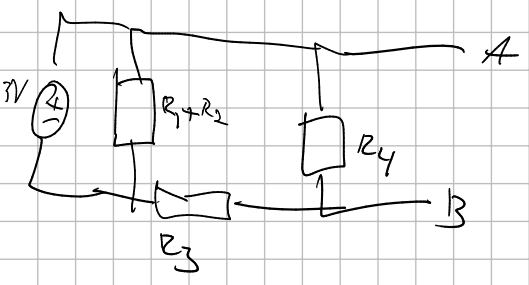




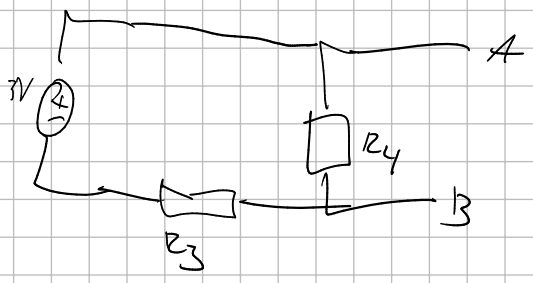
$U = 0$



$$R_{th} = \frac{R_3 R_4}{R_3 + R_4} = \frac{12}{7}\,\Omega$$



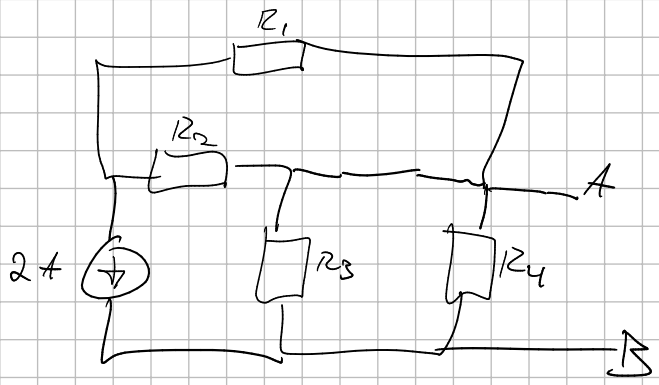
$\Rightarrow$



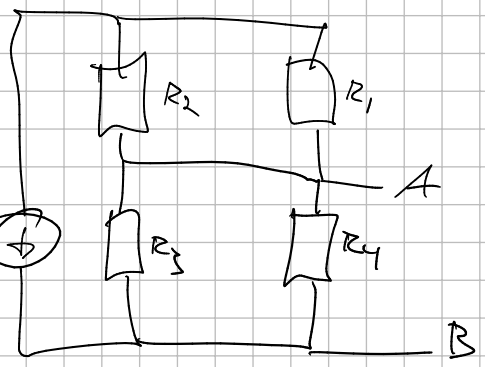
$=$

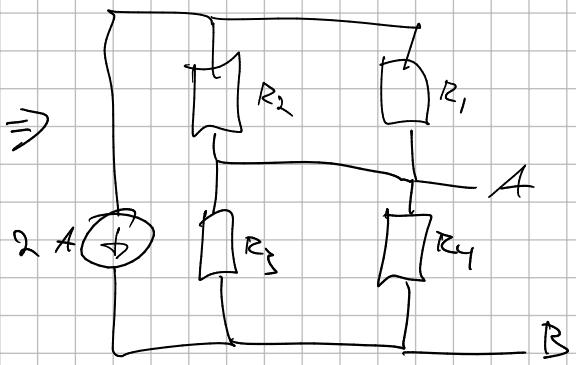
$U = U_{R_4} + U_{R_3}$

$U_{R_4} = U \cdot \frac{R_4}{R_3 + R_4} = 3\,V \cdot \frac{3\,\Omega}{7\,\Omega} = \frac{9}{7}\,V$



$\Rightarrow$

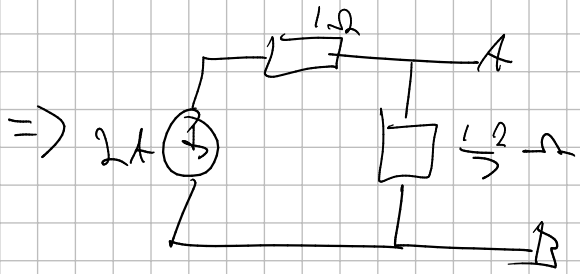




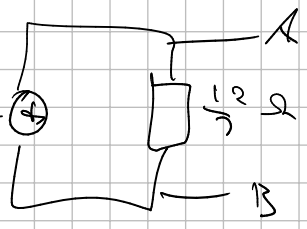
$\Rightarrow$

$R_2 \| R_1 = \frac{R_2 R_1}{R_2 + R_1} = \frac{2\,\Omega \cdot 2\,\Omega}{4\,\Omega} = 1\,\Omega$

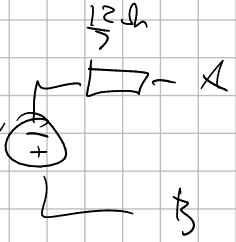
$R_3 \| R_4 = \frac{4\,\Omega \cdot 3\,\Omega}{7\,\Omega} = \frac{12}{7}\,\Omega$



$\Rightarrow$



$\Rightarrow$



$U_{th} = \frac{9}{7} - \frac{24}{7} = -\frac{15}{7}\,V \qquad R_{th} = \frac{12}{7}\,\Omega$

Digitaltechnik

Übung 1

a)

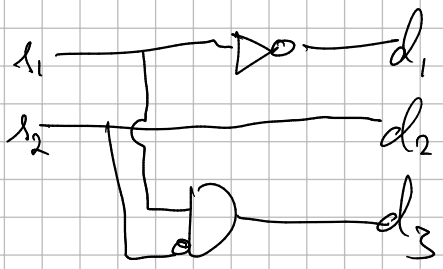
s_1	s_2	d_1	d_2	d_3
0	0	1	0	0
0	1	1	1	0
1	0	0	0	1
1	1	0	1	0

b) $d_1 = \overline{s_1}$

$d_2 = s_2$

$d_3 = s_1 \overline{s_2}$

c)



e)

s_1	s_2	d_1	d_2	d_3	t
0	0	1	0	0	1
0	1	1	1	0	1
1	0	0	0	1	0
1	1	0	1	0	0

Eksamen vår 2024

Oppg 1)

a) $\tau = RC \qquad T \simeq \tau \ln 3$

$\frac{1}{T} = D \qquad D = 299.6 \text{ Hz}$

$\frac{1}{\tau \ln 3} = D$

$\frac{1}{\tau} \simeq D \ln 3$

$\frac{1}{RC} \simeq D \ln 3$

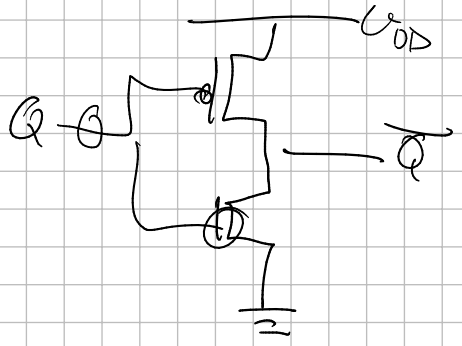
$C = (RD \ln 3)^{-1}$

$C = 3{,}03\ \mu F$

b) For å generere en tone så vil vi ikke at vår knott skal være koblet mot jord, for da vil vi få en konstant spenning på 0 og ingen tone

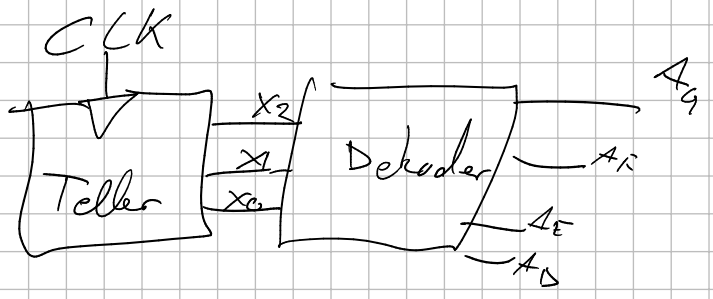
For å få tone må vi derfor ha A_D høy, Da vil knotten oppføre seg som normalt og generere en tone

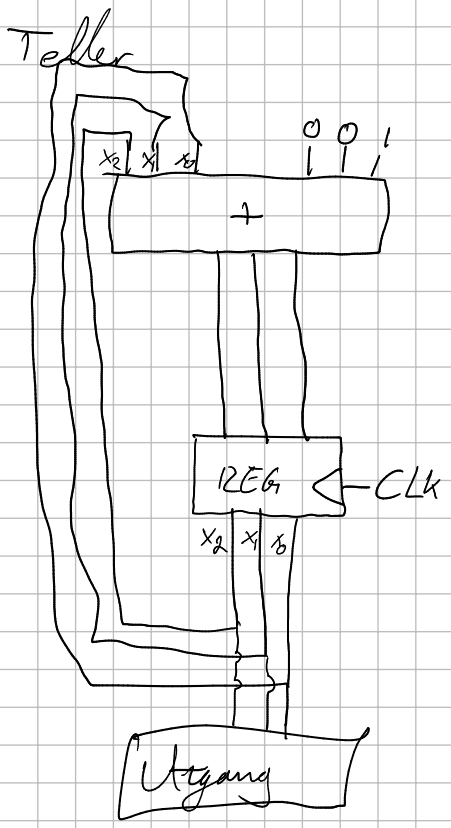
Om A_D hadde vært lav så hadde vi fått likespenning

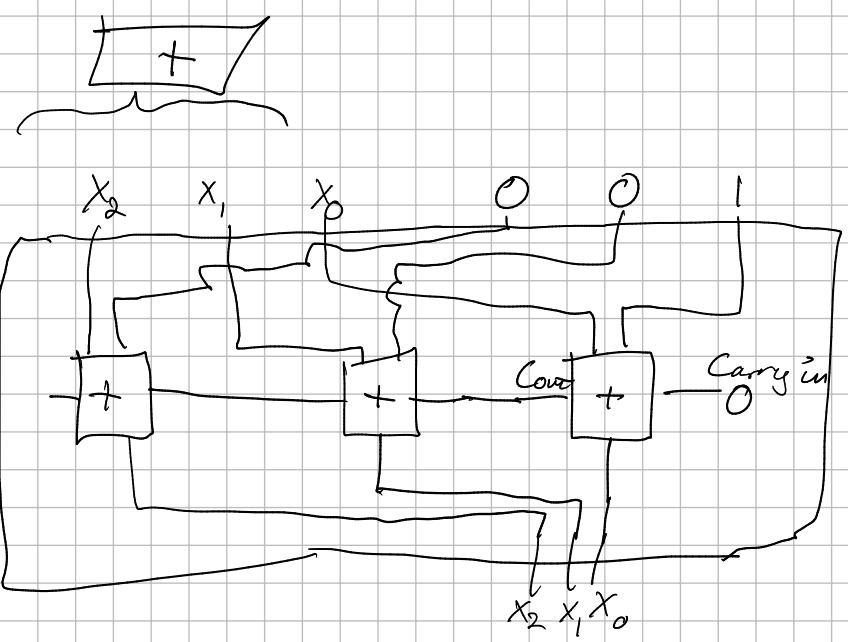


c) Teller fra 0 til og med 7 altså 3 bit $\Rightarrow X = X_2 X_1 X_0$

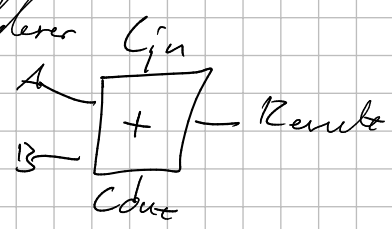
X_2	X_1	X_0	A_G	A_F	A_E	A_D
0	0	0	1	0	0	0
0	0	1	1	0	0	0
0	1	0	1	0	0	0
0	1	1	0	1	0	0
1	0	0	0	0	1	0
1	0	1	0	0	1	0
1	1	0	0	0	0	1
1	1	1	0	0	0	1

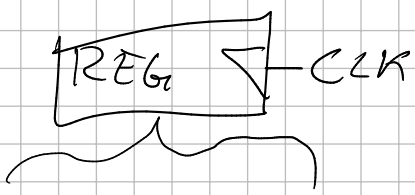


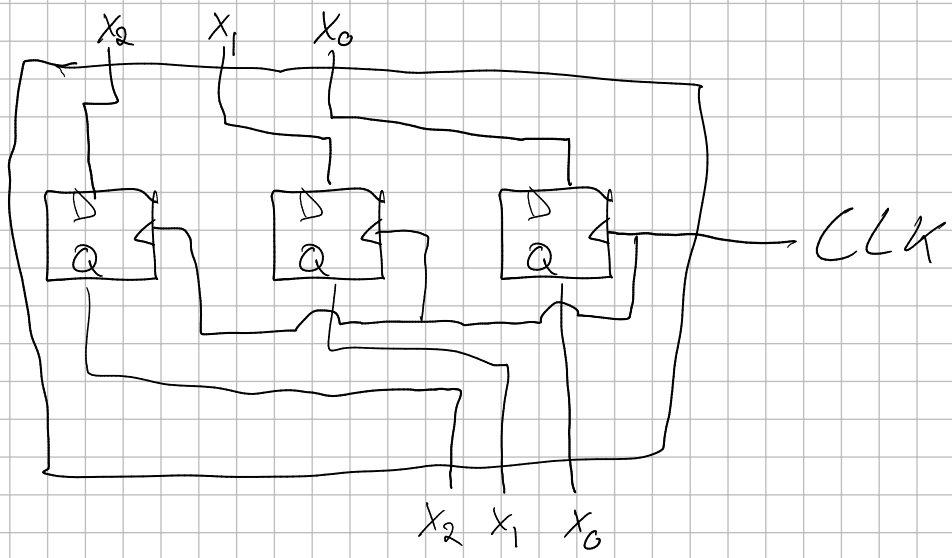




En bitt adderer







Dekoder

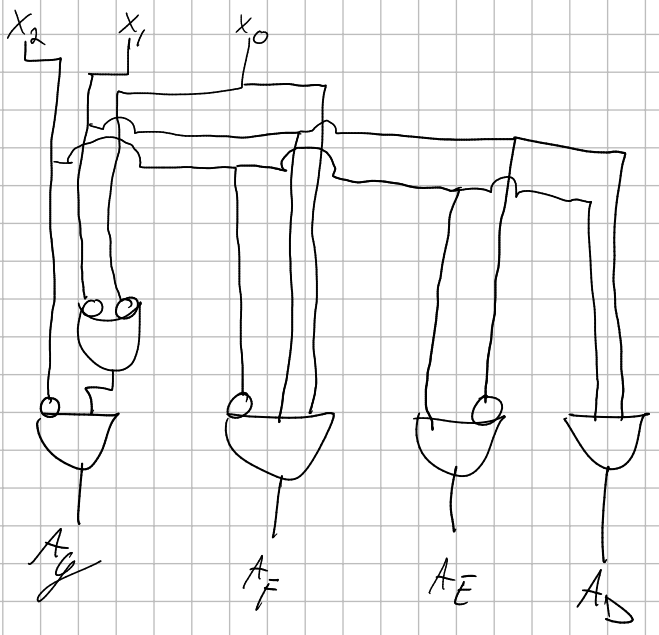
X_2	X_1	X_0	A_G	A_F	A_E	A_D
0	0	0	1	0	0	0
0	0	1	1	0	0	0
0	1	0	1	0	0	0
0	1	1	0	1	0	0
1	0	0	0	0	1	0
1	0	1	0	0	1	0
1	1	0	0	0	0	1
1	1	1	0	0	0	1

$A_G = \overline{X_2}\,\overline{X_1}\,\overline{X_0} + \overline{X_2}\,\overline{X_1}\,X_0 + \overline{X_2}\,X_1\,\overline{X_0} = \overline{X_2}(\overline{X_1}\,\overline{X_0} + \overline{X_1}\,X_0 + X_1\,\overline{X_0}) = \underline{\overline{X_2}(\overline{X_1} + \overline{X_0})}$

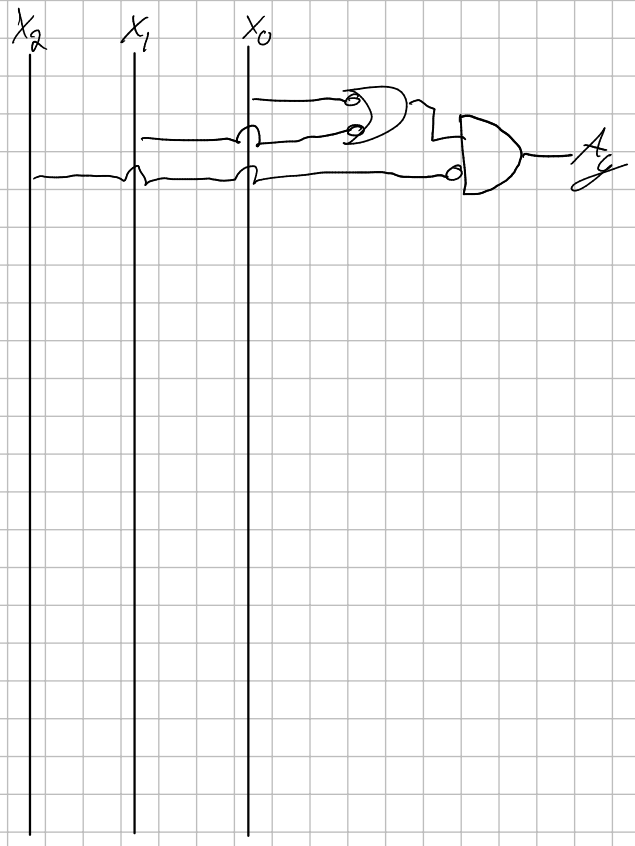
$A_F = \underline{\overline{X_2}\,X_1\,X_0}$

$A_E = X_2(\overline{X_1}\,\overline{X_0} + \overline{X_1}\,X_0) = \underline{X_2\,\overline{X_1}}$

$A_D = \underline{X_2\,X_1}$

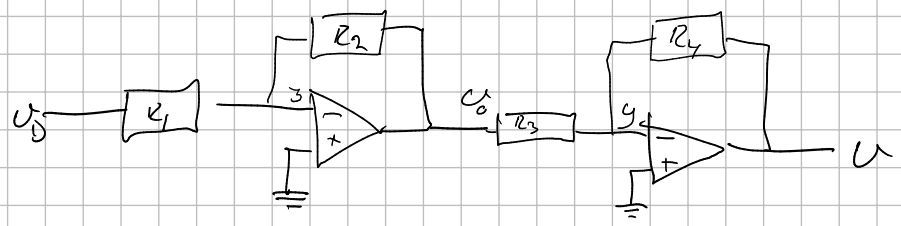


Riktig krets



Krets

d) Superpozicija



$x_1 - x_0 = 0$

$x_1 = 0$

$x_0 = y = 0$

$i_{R_1} = i_{R_2}$

$\frac{U_D - y}{R_1} = \frac{y - U_0}{R_2}$

$\frac{U_D}{R_1} = -\frac{U_0}{R_2} \quad | \cdot R \qquad R_1 = R_2 = R$

$U_D = -U_0$

$U_0 = -U_D$

$i_{R_3} = i_{R_4}$

$y = 0$

$\frac{U_0 - y}{R_3} = \frac{y - U}{R_4} \quad | \cdot R \quad R_3 = R_4 = R$

$U_0 = -U$

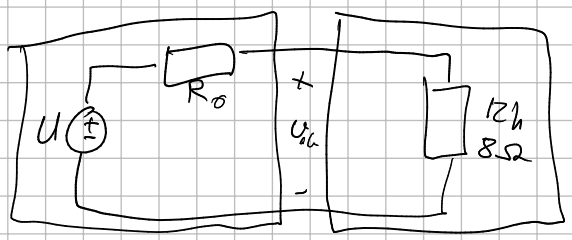
$U = -U_0 = -(-U_D)$

$U = U_D$

Superpozicija

$U = U_0 + U_E + U_F + U_G$

e)



$U = 5\ V \qquad U_{ab} = 0{,}5\ V$

$U_{ab} = U \frac{R_h}{R_0 + R_h}$

$R_0 + R_h = U \frac{R_h}{U_{ab}}$

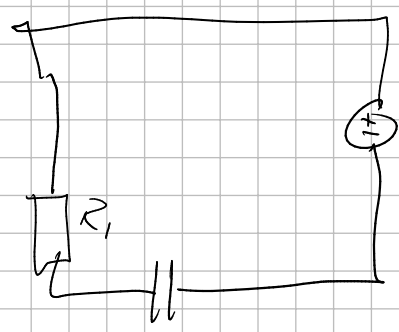
$R_0 = R_h \left(\frac{U}{U_{ab}} - 1 \right) = 72\ \Omega$

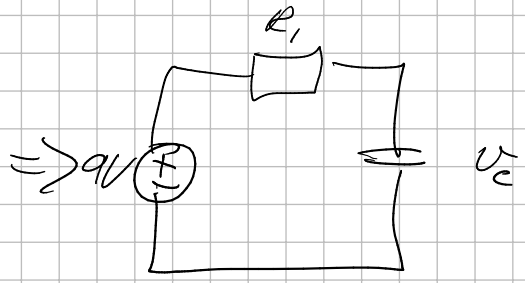
f)

Cruly

$v_i - v_x = 0$

g)





$U = v_c + RC \frac{d}{dt} v_c \qquad \tau = RC$

$v(t) = 9 - 9\, e^{-\frac{1}{RC}t} = 9(1 - e^{-\frac{1}{RC}t})$

$v(30) = 2$

$9(1 - e^{-\frac{30}{RC}}) = 2$

$1 - e^{-\frac{30}{RC}} = \frac{2}{9}$

$-e^{-\frac{30}{RC}} = \frac{2}{9} - 1 = -\frac{7}{9}$

$e^{-\frac{30}{RC}} = \frac{7}{9}$

$-\frac{30}{RC} = \ln(7) - \ln(9)$

$R_1 = -\frac{30}{C(\ln(7) - \ln(9))}$

$R_1 = 1{,}2\,M\Omega$

4) $P = UI = \frac{U^2}{R} = 5$

$R_2 = \frac{U^2}{5} = \frac{8^2}{5} \approx 6{,}2\ \Omega$

Ehrenrunde 2023

Aufg 1)

a)

CLK	Q_3	Q_2	Q_1	Q_0
0	0	0	0	1
1	1	0	0	0
2	0	1	0	0
3	0	0	1	0
4	1	0	0	1
5	1	1	0	0
6	0	1	1	0
7	1	0	1	1
8	0	1	0	1
9	1	0	1	0
10	1	1	0	1
11	1	1	1	0
12	1	1	1	1
13	0	1	1	1
14	0	0	1	1
15	0	0	0	1

Baued

b) $T > 30\ ns$

$\frac{1}{f} > \frac{1}{30\ ns}$

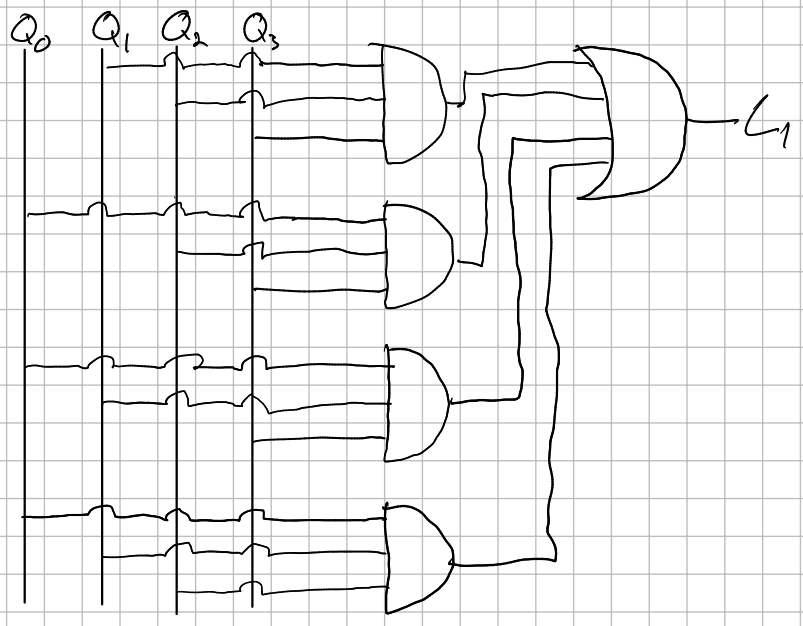
$F > 33 \cdot 10^6\ Hz$

c) $Z_1(Q_0, Q_1, Q_2, Q_3) = ?$

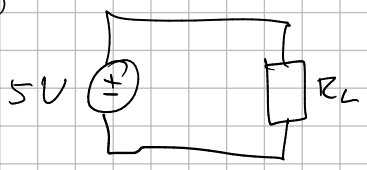
Q_0	Q_1	Q_2	Q_3	Z_1
0	0	0	0	0
0	0	0	1	0
0	0	1	0	0
0	0	1	1	0
0	1	0	0	0
0	1	0	1	0
0	1	1	0	0
0	1	1	1	1
1	0	0	0	0
1	0	0	1	0
1	0	1	0	0
1	0	1	1	1
1	1	0	0	0
1	1	0	1	1
1	1	1	0	1
1	1	1	1	1

$Z_1 = Q_1Q_2Q_3 + Q_0Q_2Q_3 + Q_0Q_1Q_3 + Q_0Q_1Q_2 + Q_0Q_1Q_2Q_3$

$= Q_1Q_2Q_3 + Q_0Q_2Q_3 + Q_0Q_1Q_3 + Q_0Q_1Q_2$



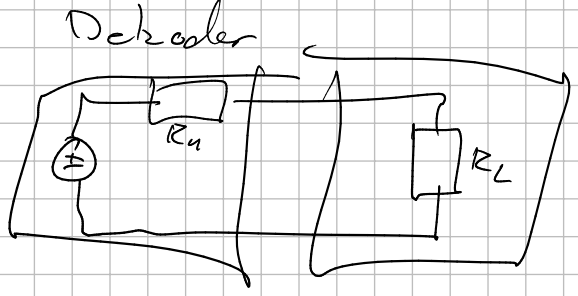
d)



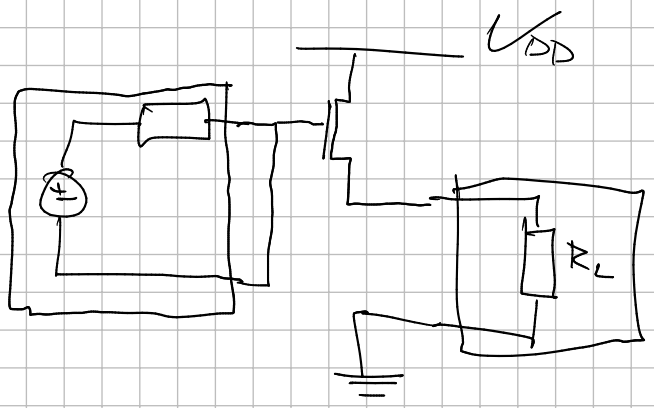
$P = UI = \frac{U^2}{R} = 12,5\ W$

$R_L = \frac{25}{12,5} = 2\Omega$

e)



f)



Oppg 2)

a)

$U_0 = 5V \quad R_0 = 0,1\Omega \quad R_K = 0,1\Omega \quad R_L = 2\Omega$

A:

$U_D = 0$

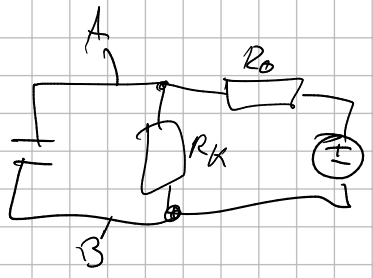
B:

$U_D = U_0 \frac{R_K}{R_0 + R_K} = 2,5V$

C:

$U_D = U_0 \frac{R_L}{R_0 + R_L} = 4,76V$

c)



$\Rightarrow$

$$R_{th} = \frac{R_K R_0}{R_K + R_0} = \frac{0{,}1 \cdot 0{,}1}{0{,}2} = \frac{0{,}01}{0{,}2} = 0{,}05\,\Omega$$

$$U_{th} = U \frac{R_K}{R_K + R_0} = 5 \frac{0{,}1}{0{,}2} = 2{,}5\,V$$

$$u(t) = \frac{5}{2} - \left(0 - \frac{5}{2}\right) e^{-\frac{1}{RC}t}$$

$$= \frac{5}{2} + \frac{5}{2} e^{-\frac{1}{RC}t}$$

$u(T_K) \geq 4$

$$\frac{5}{2} + \frac{5}{2} e^{-\frac{1}{RC}T_K} \geq 4$$

$$\frac{5}{2} e^{-\frac{1}{RC}T_K} \geq 4 - \frac{5}{2} = \frac{8}{2} - \frac{5}{2} = \frac{3}{2}$$

$$e^{-\frac{1}{RC}T_K} \geq \frac{3}{5}$$

$$-\frac{1}{RC} T_K \geq \ln\left(\frac{3}{5}\right)$$

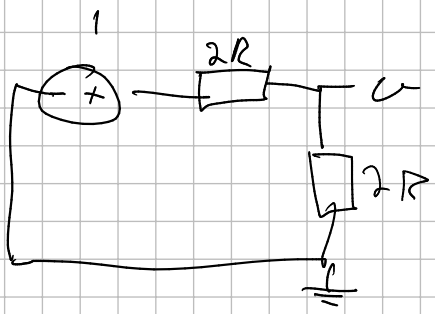
$$C \geq -\frac{T_K}{R \ln\left(\frac{3}{5}\right)}$$

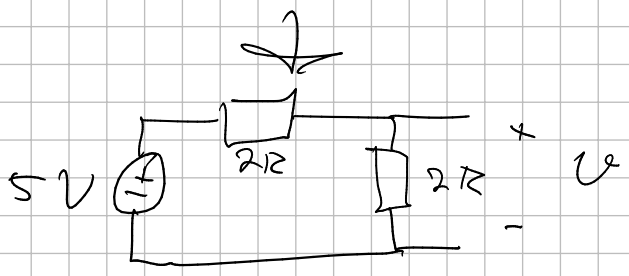
$$\underline{\underline{C \geq 391\,\mu F}}$$

d) $P = U I$ Bitches

Задача 3

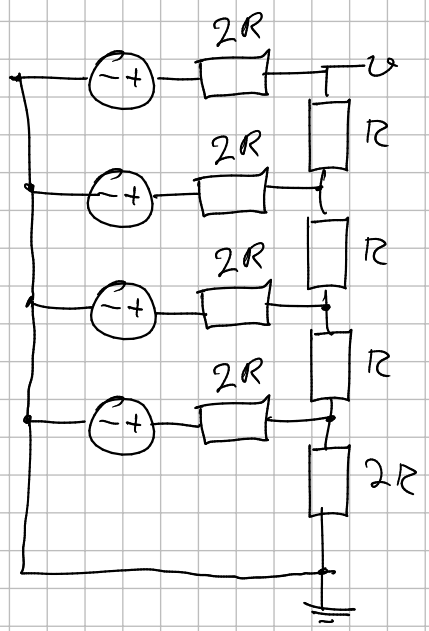
a) $Q_3Q_2Q_1Q_0 = 1000$



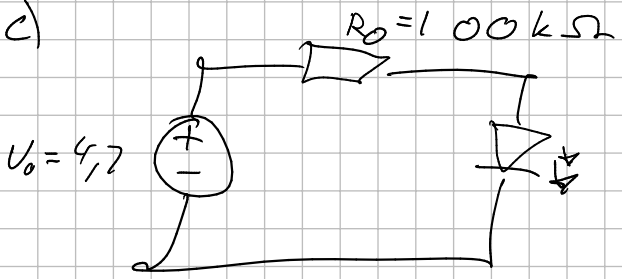


$$v = U \frac{2R}{2R + 2R} = \frac{1}{2}U = \underline{2{,}5V}$$

b) $Q_3 Q_2 Q_1 Q_0 = 1\ 1\ 1\ 1$ $\quad R_0 = R$?



c)



$V_0 = V_{R_0} + V_D$

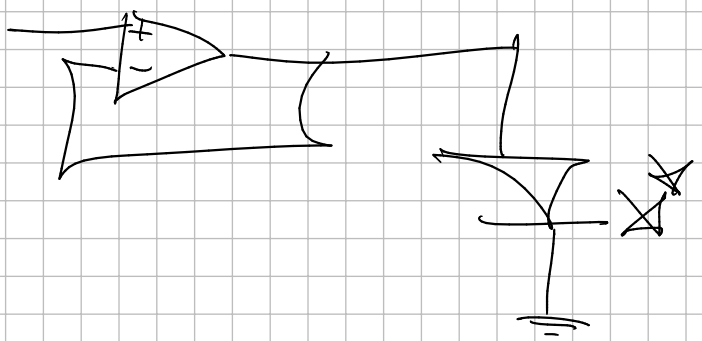
$V_D = V_0 - V_{R_0}$

$V_D = V_0 - Ri$

$V_D = 4,7 - 100k\Omega \cdot 0045mA$

$V_D = \underline{0,20V}$

d) BUFFER



Eksamen Vår 2023

Oppgave 1

a) $P = 10\,W \qquad R = 1000\,\Omega$

$P = U I \qquad I = \frac{U}{R}$

$P = \frac{U^2}{R}$

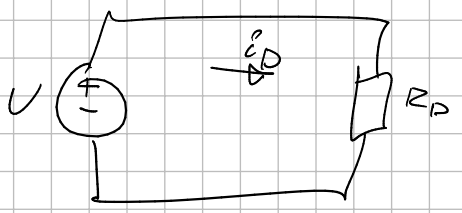
$PR = U^2$

$U = \sqrt{PR}$

$\underline{\underline{U = 100\,V}}$ Uprakzisk!

b) 1. Sann
2. Usann
3. Usann
4. Usann
5. Usann
6. Sann

c)



$R_D = \left(\frac{1}{R} + \frac{1}{R} + \frac{1}{R} + \frac{1}{R} + \dots\right) = \left(\frac{10}{R}\right)^{-1} = \frac{R}{10}$

$i = \frac{U}{R} = \underline{\underline{1\,A}}$

d) $R_A = \left(\frac{1}{R} + \frac{1}{R} + \dots\right)^{-1} = \left(\frac{11}{R}\right)^{-1} = \frac{R}{11}$

$R_D = \frac{R}{10} \qquad R_E = \frac{R}{11}$

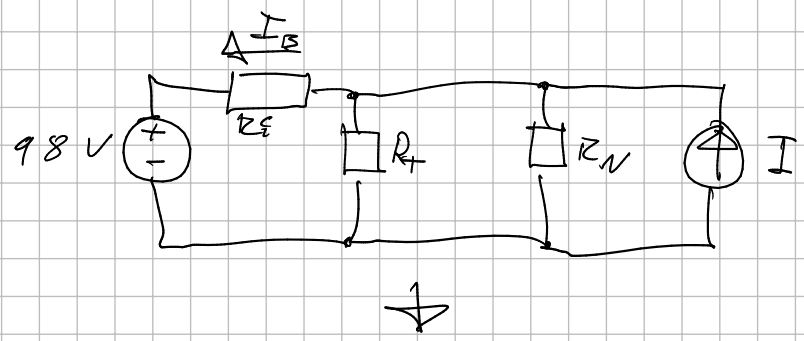
$R_{ADD} = \frac{R}{31} \qquad R_{DE} = \frac{R}{21} \qquad R_B = \frac{R}{6}$

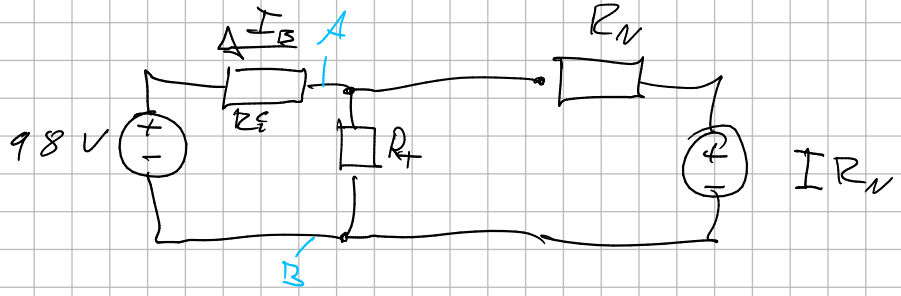
$R_T = \left(\frac{1}{R_{ADD}} + \frac{1}{R_{DE}} + \frac{1}{R_B} + \frac{1}{R_E}\right)^{-1} = \left(\frac{31}{R} + \frac{21}{R} + \frac{6}{R} + \frac{11}{R}\right)^{-1} = \underline{\frac{R}{69}} = \frac{1000}{69}$

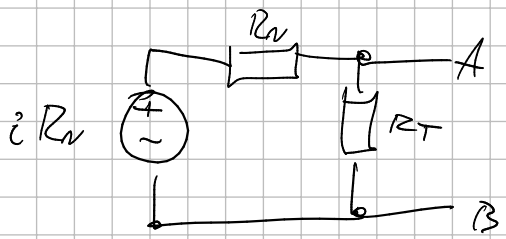
$I = \frac{U}{R} = 6{,}9\,A$

e)

$R_i = 1\,\Omega \qquad R_T = \frac{1000}{69}\,\Omega \qquad R_N = 100\,\Omega$

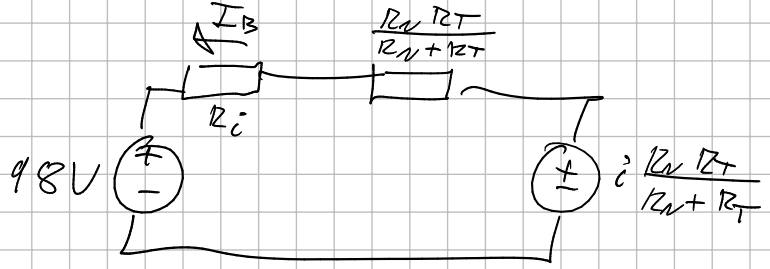






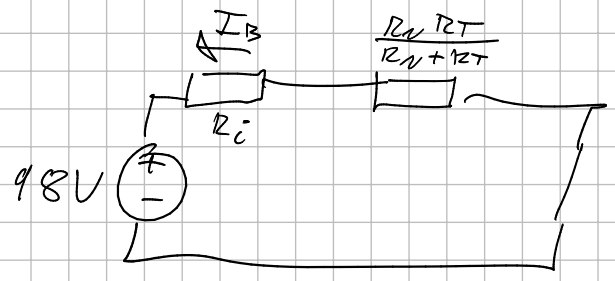
$$R_{TH} = \frac{R_N R_T}{R_N + R_T}$$

$$U_{R_T} = i R_N \frac{R_T}{R_N + R_T} = \frac{i R_N R_T}{R_N + R_T}$$



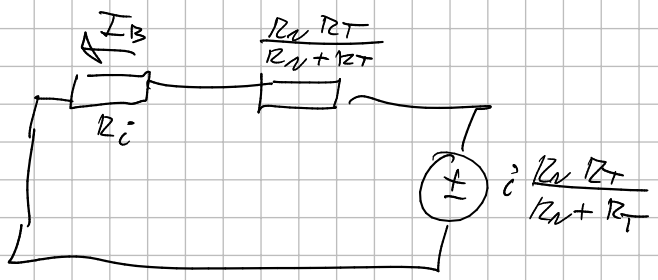
$$R_{TOT} = R_i + \frac{R_N R_T}{R_N + R_T}$$

$$i_0 = \frac{U}{R} = \frac{98}{R_i + \frac{R_N R_T}{R_N + R_T}}$$



$$i_0 = \frac{U}{R} = \frac{i \frac{R_V R_T}{R_V + R_T}}{R_i + \frac{R_V R_T}{R_V + R_T}}$$

$$I_B = \frac{i \frac{R_V R_T}{R_V + R_T}}{R_i + \frac{R_V R_T}{R_V + R_T}} - \frac{98}{R_i + \frac{R_V R_T}{R_V + R_T}}$$



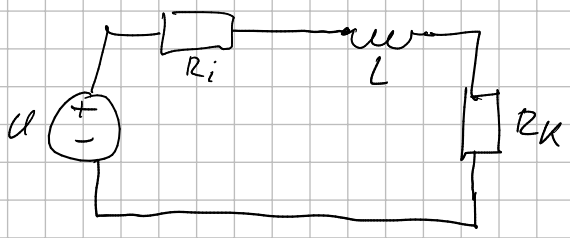
$$R_h = \frac{R_V R_T}{R_V + R_T} =$$

$$I_B = \frac{i R_h}{R_i + R_h} - \frac{98}{R_i + R_h} = \frac{i R_h - 98}{R_i + R_h}$$

$$i R_h - 98 = I_B (R_i + R_h) \qquad I = 1\,A$$

$$i = \frac{I_B (R_i + R_h) + 98}{R_h} = 8{,}821\,A$$

A) $R_i = 1\,\Omega \quad U = 100\,V \quad R_D = \frac{R}{10} = 100\,\Omega \quad R_K = 1\,\Omega$



$$v(t) = L \frac{d}{dt} i(t)$$

$$U = v_{R_i} + L \frac{d}{dt} i + v_{R_K}$$

$$= L \frac{d}{dt} i + i R_i + i R_K$$

$$= L \frac{d}{dt} i + i (R_i + R_K)$$

$$\frac{d}{dt} i + \frac{(R_i + R_K)}{L} i = \frac{U}{L} \qquad R_i + R_K = 2\,\Omega$$

$$\frac{d}{dt} i + \frac{2}{L} i = \frac{U}{L} \qquad | \cdot e^{\frac{2}{L} t}$$

$$\frac{d}{dt} \left(i \cdot e^{\frac{2}{L} t} \right) = \frac{U}{L} e^{\frac{2}{L} t} \quad | \int dt$$

$$i \, e^{\frac{2}{L} t} = \frac{U}{L} \cdot \frac{L}{2} \cdot e^{\frac{2}{L} t} + C$$

$\dot{i}\, e^{\frac{2}{L}t} = \frac{1}{2} U e^{\frac{2}{L}t} + C \quad | \cdot e^{-\frac{2}{L}t}$

$i(t) = \frac{1}{2} U + C e^{-\frac{2}{L}t}$

$i(0) = 0$

$C + \frac{1}{2} U = 0$

$C = -\frac{1}{2} U$

$i(t) = \frac{1}{2} U - \frac{1}{2} U e^{-\frac{2}{L}t}$

$= \frac{1}{2} U \left(1 - e^{-\frac{2}{L}t}\right)$

$i(0{,}01) < 1\ A$

$\frac{1}{2} U \left(1 - e^{-\frac{2}{L}\tau}\right) < 1$

$1 - e^{-\frac{2}{L}\tau} < \frac{2}{U}$

$-e^{-\frac{2}{L}\tau} < \frac{2}{U} - 1$

$e^{-\frac{2}{L}\tau} > 1 - \frac{2}{U}$

$-\frac{2}{L}\tau > \ln\left(1 - \frac{2}{U}\right)$

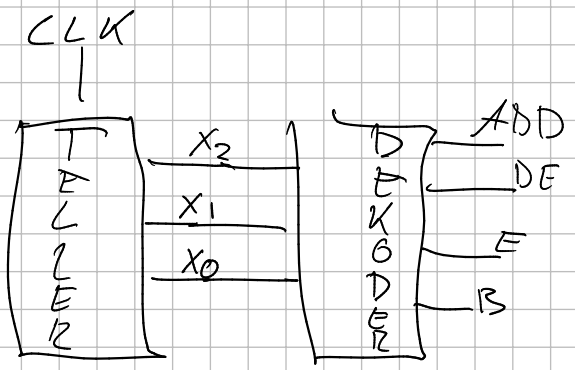
$L < -\frac{2\tau}{\ln\left(1 - \frac{2}{U}\right)}$

$L < 0{,}99\ H$

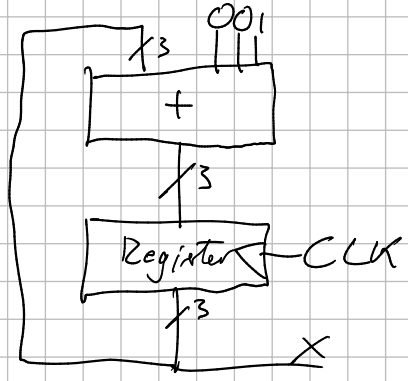
Fehl rei

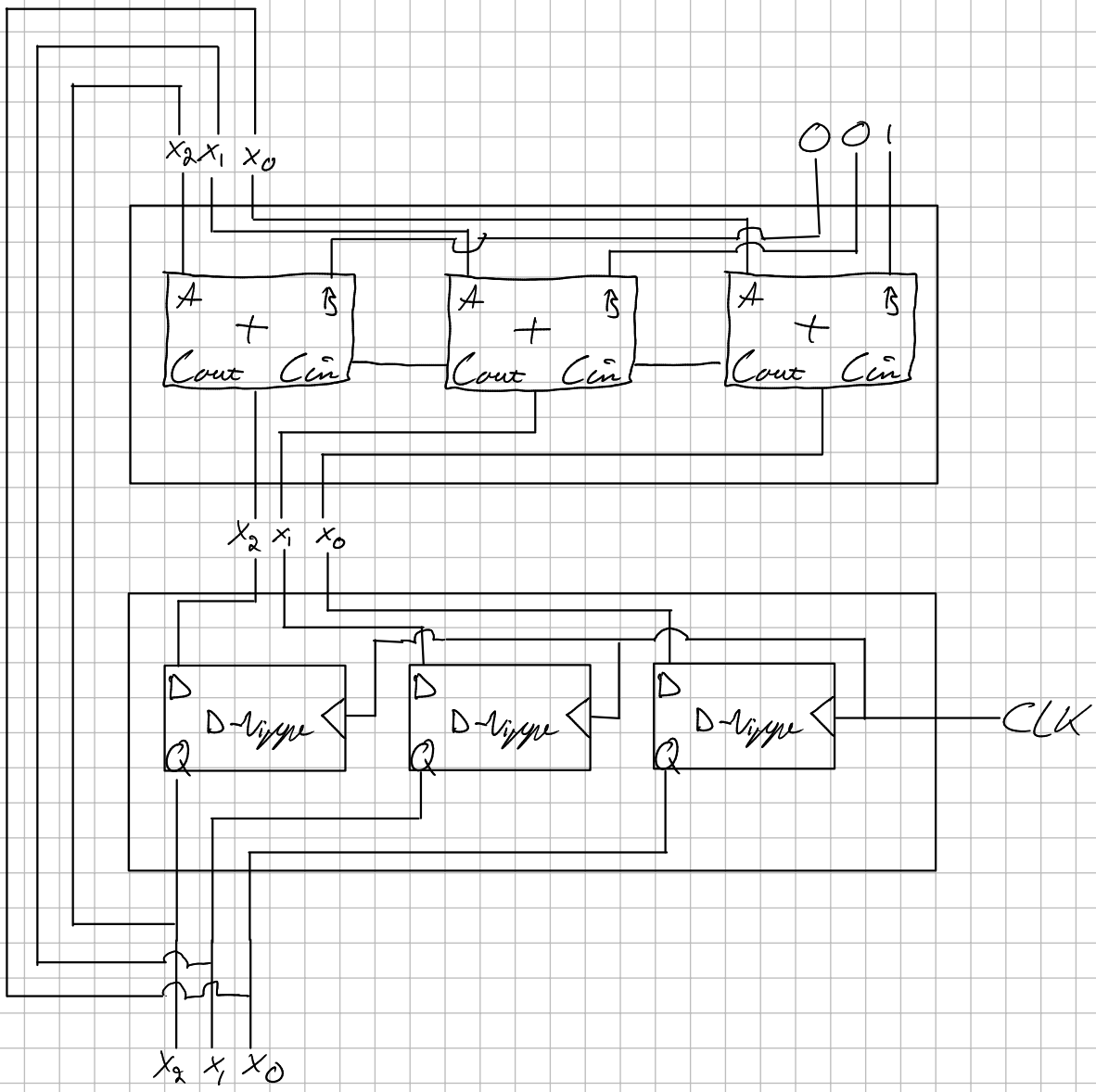
Oppgave 2

a)



Teller




x_2 x_1 x_0
0
0
1
A
B
+
Cout
Cin
x_2 x_1 x_0
D
Q
D-flip-type
CLK
x_2 x_1 x_0

Dekoder

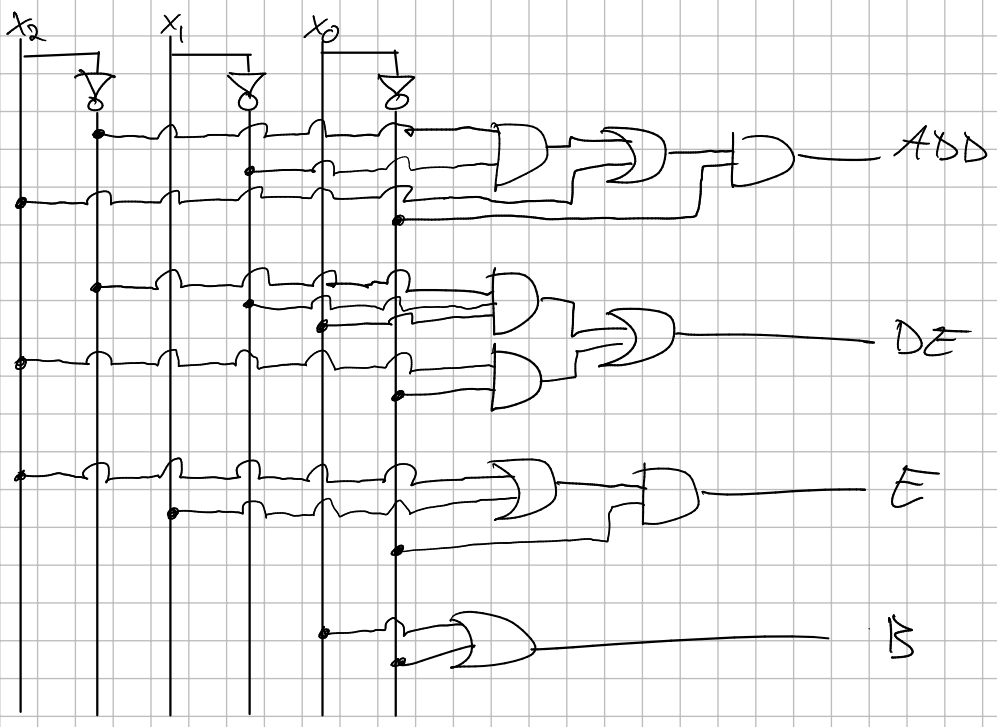
x_2	x_1	x_0	ADD	DE	E	B
0	0	0	1	0	0	1
0	0	1	0	1	0	1
0	1	0	0	0	1	1
0	1	1	0	0	0	1
1	0	0	1	1	0	1
1	0	1	0	0	0	1
1	1	0	1	1	0	1
1	1	1	0	0	0	1

$$ADD = \overline{x_2}\,\overline{x_1}\,\overline{x_0} + x_2\,\overline{x_1}\,\overline{x_0} + x_2\,x_1\,\overline{x_0}$$
$$= \overline{x_0}(\overline{x_2}\,\overline{x_1} + x_2\,\overline{x_1} + x_2\,x_1)$$
$$= \overline{x_0}(\overline{x_2}\,\overline{x_1} + x_2)$$

$$DE = \overline{x_2}\,\overline{x_1}\,x_0 + x_2\,\overline{x_1}\,\overline{x_0} + x_2\,x_1\,\overline{x_0}$$
$$= \overline{x_2}\,\overline{x_1}\,x_0 + \overline{x_0}(x_2\,\overline{x_1} + x_2\,x_1)$$
$$= \overline{x_2}\,\overline{x_1}\,x_0 + x_2\,\overline{x_0}$$

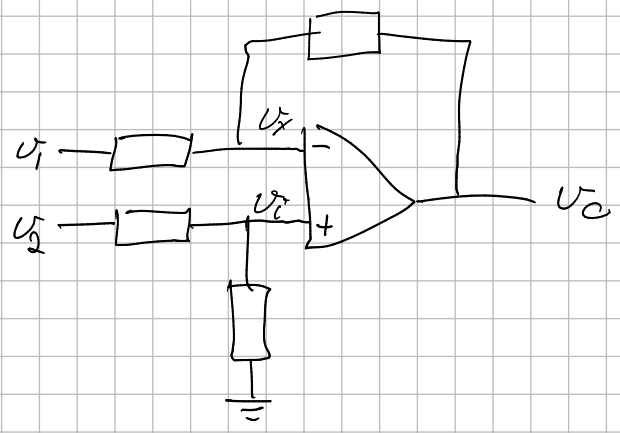
$$E = \overline{x_2}\,x_1\,\overline{x_0} + x_2\,\overline{x_1}\,\overline{x_0} + x_2\,x_1\,\overline{x_0}$$
$$= \overline{x_0}(\overline{x_2}\,x_1 + x_2\,\overline{x_1} + x_2\,x_1)$$
$$= \overline{x_0}(x_2 + x_1)$$

$$B = x_0 + \overline{x_0}$$



Oppgave 3

a)



$v_i - v_x = 0$

$v_i = v_x$

$$\frac{v_2 - v_i}{R} = \frac{v_i - 0}{R}$$

$v_2 - v_i = v_i$

$v_2 = 2v_i$

$v_i = \frac{1}{2} v_2$

$$\frac{v_1 - v_x}{R} = \frac{v_x - v_o}{R}$$

$v_1 - v_x = v_x - v_o$

$v_1 - 2v_x = -v_o$

$v_1 - 2 \cdot \frac{1}{2} v_2 = -v_o$

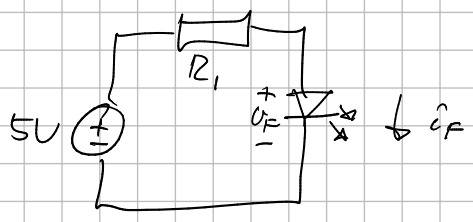
$v_1 - v_2 = -v_o$

$\underline{\underline{v_o = v_2 - v_1}}$

Eksamen høst 22

a) Uten den så må all spenningsfallet være på dioden, noe som medfører masse strøm som den kanskje ikke takler

b)



$$U = U_{R_1} + U_F$$

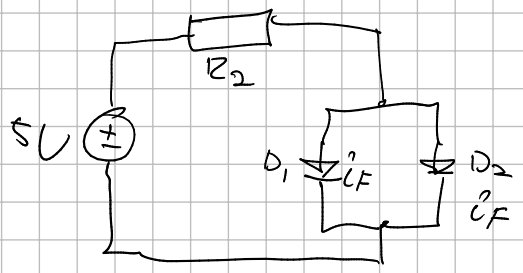
$$U = i \cdot R_1 + U_F$$

$$i \cdot R_1 = U - U_F$$

$$R_1 = \frac{U - U_F}{i}$$

$$R_1 = 125\,\Omega$$

c)



$$U = U_{R_2} + U_F$$

$$U = 2 i_F R_2 + U_F$$

$$2i \cdot R_2 = U - U_F$$

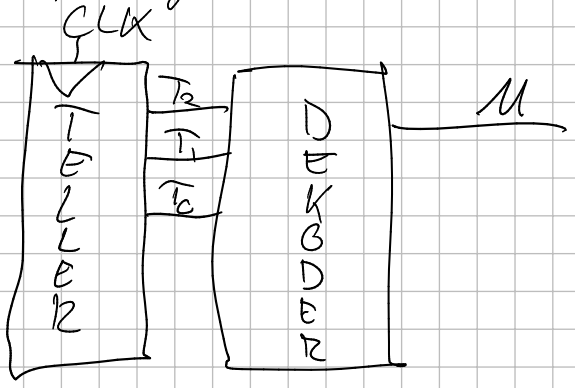
$$R_2 = \frac{U - U_F}{2i}$$

$$R_2 = 62{,}5\,\Omega$$

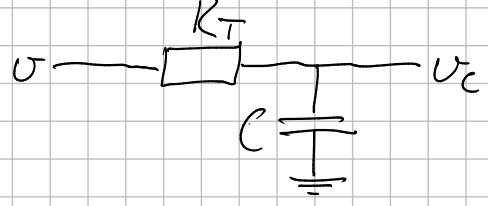
d) Gul vil lyse mørkest da den lyser sterkest ved lavest spenning

Задача 2

Модуль генератора



Задача 3



$U = U_{R_T} + U_C$ $\quad i(t) = C \frac{d}{dt} U(t)$

$U = RC \frac{d}{dt} U_C + U_C$

$\frac{d}{dt} U_C + \frac{1}{RC} U_C = \frac{U}{RC}$ $\quad \frac{1}{RC} = \lambda$

$\frac{d}{dt} U_C + \lambda U_C = \lambda U$

$\frac{d}{dt}(U_C e^{\lambda t}) = \lambda U e^{\lambda t} \quad | \cdot \int dt$

$U_C e^{\lambda t} = \frac{1}{\lambda} \lambda U e^{\lambda t} + C$

$U_C = U + C e^{-\frac{1}{RC} t}$

$U_C(0) = 0$

$U + C = 0$

$C = -U$

$U_C(t) = U(1 - e^{-\frac{1}{RC} t})$

$U = 5 \qquad T = 0{,}1 \qquad C = 100\,nF$

$v_C(T) = 4$

$$U\left(1 - e^{-\frac{1}{RC}T}\right) = 4$$

$$1 - e^{-\frac{1}{RC}T} = \frac{4}{U}$$

$$-e^{-\frac{1}{RC}T} = \frac{4}{U} - 1$$

$$e^{-\frac{1}{RC}T} = 1 - \frac{4}{U}$$

$$-\frac{1}{RC}T = \ln\left(1 - \frac{4}{U}\right)$$

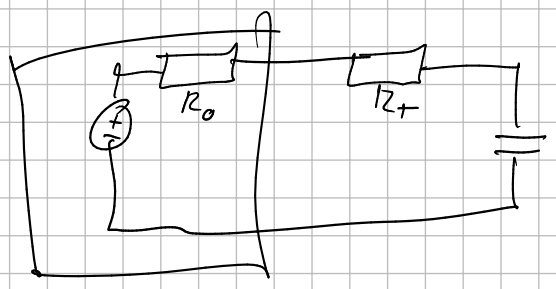
$$R = -\frac{T}{C\ln\left(1 - \frac{4}{U}\right)}$$

$$\underline{\underline{R = 0{,}6\,M\Omega}}$$

b) Strømmen som lader opp kondensatoren vil være annerledes enn det som ble beregnet på. Vil derfor oppføre seg annerledes

c) Fordi det ikke går strøm gjennom en OP-AMP

d)

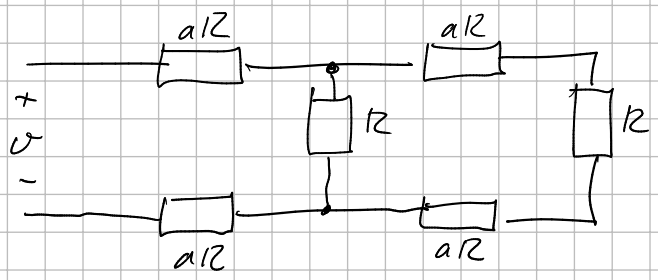


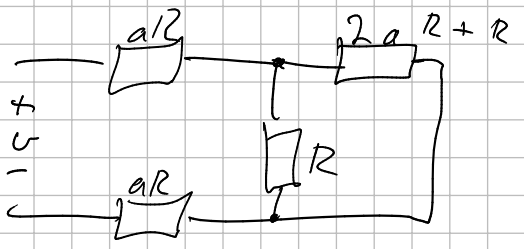
$R_0 = R_T(0{,}12) - R_T(0{,}1)$

$\underline{\underline{R_0 = 124\,k\Omega}}$ Gaming

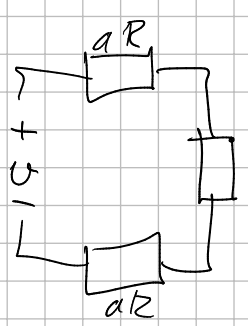
Oppgave 4

a)





$$\frac{(R(2a+1))\cdot R}{(2aR+R)+(R)} = \frac{R^2(2a+1)}{2aR+2R} = \frac{R(2a+1)}{2a+2}$$



$$R\frac{2a+1}{2a+2}$$

$$R_T = 2aR + R\frac{2a+1}{2a+2} = R\left(2a + \frac{2a+1}{2a+2}\right) = R\left(\frac{2a(2a+2)+2a+1}{2a+2}\right)$$

$$= R\left(\frac{4a^2+4a+2a+1}{2a+2}\right) = R\left(\frac{4a^2+6a+1}{2a+2}\right)$$

$$P = UI \qquad I = \frac{U}{R_T}$$

$$P = \frac{U^2}{R_T} = U^2\cdot\left(R\frac{4a^2+6a+1}{2(a+1)}\right)^{-1} = \frac{U^2}{R}\cdot\frac{2(a+1)}{4a^2+6a+1}$$

b) Så tynne ledninger som mulig blir Areal = 0, som tilsvarer ingen ledning

Ekzamen var 22

Qrup 1)

a) $R_L = 4\,\Omega \qquad u = 12\,V$

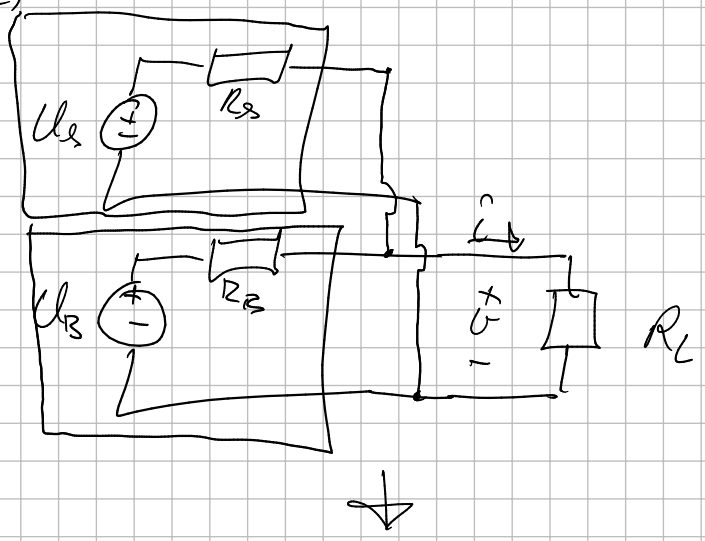
$P = UI \qquad I = \frac{U}{R}$

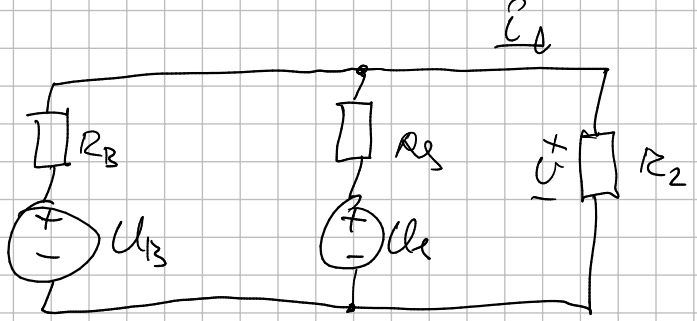
$P = \frac{U^2}{R} = \frac{144}{4} = \underline{\underline{36\,W}}$

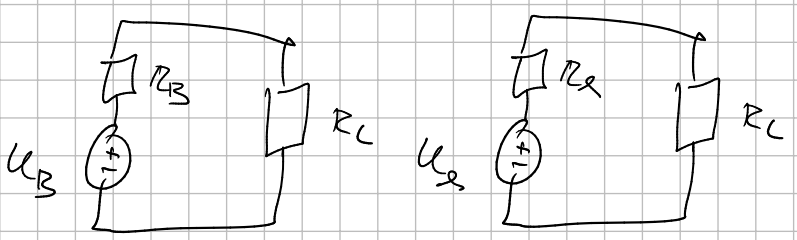
b) $R_T = \left(\frac{10}{4\Omega}\right)^{-1} = \frac{4}{10}\,\Omega$

$I = \frac{U}{R} = \frac{12}{\frac{4}{10}\,\Omega} = \frac{120}{4\,\Omega} = 30\,A$

c)







$$i = \frac{U_B}{R_B + R_L} + \frac{U_1}{R_1 + R_L}$$

$U_1 = 11\,V \qquad R_1 = 0{,}5\,\Omega$

$U_B = 10\,V \qquad R_B = 1\,\Omega$

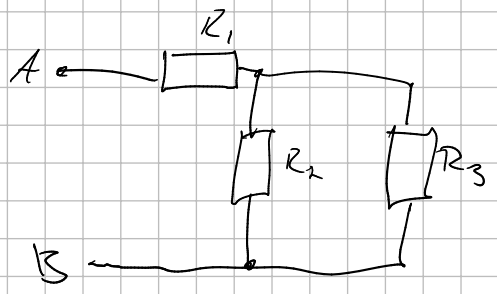
$R_L = 4\,\Omega$

$i = 4{,}44\,A$

d) Fordi solcellen utleverer mer strøm enn batteriet, så lader batteriet

e) $R_{AB} = 4\,\Omega$ $\quad R_1 = 2\,\Omega$ $\quad R_2 = 3\,\Omega$ $\quad R_3 = 6\,\Omega$

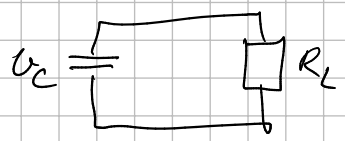
$$\frac{3 \cdot 6}{3+6} = \frac{18}{9}\,\Omega = 2\,\Omega$$



f) $E = \frac{1}{2} C V^2$??

g) $U_0 = 12\,V$

$U_0 = v_C + v_{RL}$



$U_0 = v_C + R_L C \frac{d}{dt} v_C(t)$

$\frac{d}{dt} v_C + \frac{1}{RC} v_C = \frac{1}{RC} U_0 \qquad \lambda = \frac{1}{RC}$

$\frac{d}{dt} v_C + \lambda v_C = \lambda U_0$

$\frac{d}{dt}\left(v_C e^{\lambda t}\right) = \lambda U_0 e^{\lambda t} \quad \Big|\int dt$

$v_C e^{\lambda t} = U_0 e^{\lambda t} + C$

$v_C(t) = U_0 + C e^{-\frac{1}{RC} t} \qquad U_0 = 0\,?$

$v_C(t) = C e^{-\frac{1}{RC} t}$

$v_C(0) = 12\,V$

$C = 12$

$v_C(t) = 12\, e^{-\frac{1}{RC} t}$

$u_c(T) = 10\,V$

$12\,e^{-\frac{1}{RC}T} = 10$

$e^{-\frac{1}{RC}T} = \frac{10}{12}$

$-\frac{1}{RC}T = \ln\left(\frac{10}{12}\right)$

$T = -RC\ln\left(\frac{10}{12}\right)$

$T = 1458\,s$

h) $v(t) = A\cos(2\pi f t)$

$i = 50\,A \qquad A = 325\,V \qquad f = 50\,Hz$

$P = u\,i$

$= i\int_0^t A\cos(2\pi f s)\,ds = i\left[\frac{A}{2\pi f}\sin(2\pi f s)\right]_0^t = i\frac{A}{2\pi f}\sin(2\pi f t)$

Fuck deg

$P = u\,i \qquad u = 12 \qquad i = 50 \qquad P = 50 \cdot 12 = 600\,W$

Oppg 2)

a) N: $0 \to 23_{10}$, Trenger 5-bit (32 mulige tall)

M: $0 \to 40$, Trenger 6-bit (64 mulige tall)

b) Dette gidder jeg faktisk ikke

Oppg 31

a) $\mathcal{E} = 1 \quad R_3 = 2\,\Omega$

$U_0 = 2\,V$

b) $U = 12\,V \qquad U_i - U_x = 0$

$U_i = U_x$

$U_x = U_0$

$$U_i = U \frac{R_2}{R_1 + R_2}$$

$U_i(R_1 + R_2) = U R_2$

$U_i R_1 + U_i R_2 = U R_2$

$U R_2 - U_i R_2 = U_i R_1$

$R_2(U - U_i) = U_i R_1$

$$R_2 = \frac{U_i R_1}{U - U_i} = \frac{2 \cdot 10000\,\Omega}{12 - 2} = \frac{2000}{10} = 200\,\Omega$$

Eksamen høst 21

Oppg 1)

a) $\omega = k i \qquad i = \frac{U}{R}$

$= k \frac{U}{R}$

$U = \frac{\omega R}{k} \qquad k = 20, \quad R = 9 \quad \omega = 10$

$U = \frac{10 \cdot 9}{20} = \frac{90}{20} = \frac{9}{2} = \underline{\underline{4{,}5\,V}}$

b) $U = 12\,V \quad R_i = 1\,\Omega$

$\omega = k \frac{U}{R}$

$\omega = 20 \cdot \frac{12}{10} = \frac{240}{10} = 24$ rpm

c) $\omega = k \frac{U}{R} \qquad R = R_m + R_i + R_s$

$R_m + R_i + R_s = k \frac{U}{\omega}$

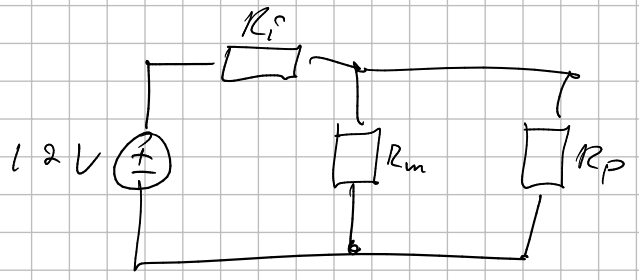
$R_s = k \frac{U}{\omega} - R_i - R_m$

$R_s = 20 \cdot \frac{12}{12} - 1 - 9$

$= 20 - 10$

$= \underline{10\,\Omega}$

d)



$\omega = k\, i = k\frac{U}{R} \qquad i = \frac{\omega}{k}$

$\omega = ?$
$k = 20$
$R_m = 9\,\Omega$
$R_i = 1\,\Omega$

$i_{R_i} = i_{R_m} + i_{R_P} \qquad R_T = R_i + \frac{R_m R_P}{R_m + R_P} = \frac{R_i(R_m + R_P) + R_m R_P}{R_m + R_P}$

$$\frac{\omega}{k} = I\frac{R_P}{R_m + R_P} = \frac{U}{R_T}\frac{R_P}{R_m + R_P} = U\frac{R_m + R_P}{R_i(R_m + R_P) + R_m + R_P}\cdot\frac{R_P}{R_m + R_P} = U\frac{R_P}{R_i(R_m + R_P) + R_m + R_P}$$

$$\frac{\omega}{k} = U\frac{R_P}{R_i(R_m + R_P) + R_m + R_P}$$

$$\frac{\omega}{k}\left(R_i R_m + R_i R_P + R_m + R_P\right) = U R_P$$

$$\frac{\omega}{k}\left(R_P(R_i + 1) + R_m(R_i + 1)\right) = U R_P$$

$$\frac{\omega}{k} R_P(R_i + 1) + \frac{\omega}{k} R_m(R_i + 1) = U R_P$$

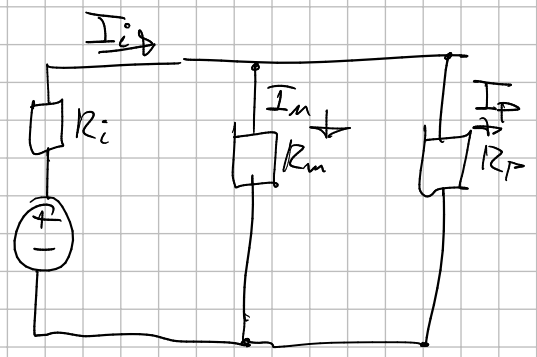
$$\frac{\omega}{k} R_P(R_i + 1) - U R_P = -\frac{\omega}{k}(R_i + 1)$$

$$R_P\left(\frac{\omega}{k}(R_i + 1) - U\right) = -\frac{\omega}{k}(R_i + 1)$$

$$R_P = \frac{-\frac{\omega}{k}(R_i + 1)}{\frac{\omega}{k}(R_i + 1) - U} = \frac{-\frac{12}{20}\cdot 2}{\frac{12}{20}\cdot 2 - 12} = \frac{-\frac{24}{20}}{\frac{24}{20} - \frac{240}{20}} = \frac{-24}{-216} =$$

Klare Fall Gruß

d)



$$w = k I_m \Rightarrow I_m = \frac{w}{k} = \frac{12}{20} = 0{,}6\,A$$

$$I_i = I_m + I_p$$

$$I_i = I_m + I_i \frac{R_m}{R_m + R_p}$$

$$I_i - I_m = I_i \frac{R_m}{R_m + R_p}$$

$$(I_i - I_m)(R_m + R_p) = I_i R_m$$

$$R_m + R_p = \frac{I_i R_m}{I_i - I_m}$$

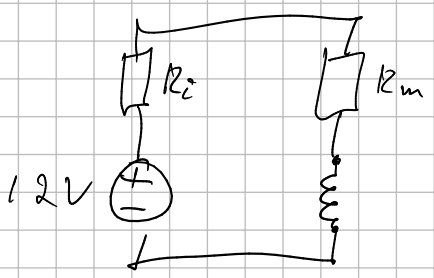
$$R_p = \frac{I_i R_m}{I_i - I_m} - R_m$$

$$I_i = \frac{U}{R_i} = \frac{12}{1} = 12\,A$$

$$R_p = \frac{12 \cdot 9}{12 - 0{,}6} - 9 =$$

Fuck dette

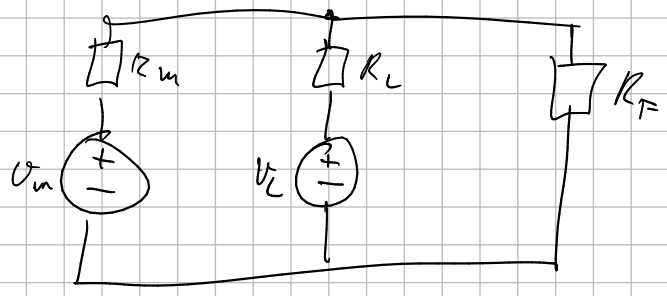
f)



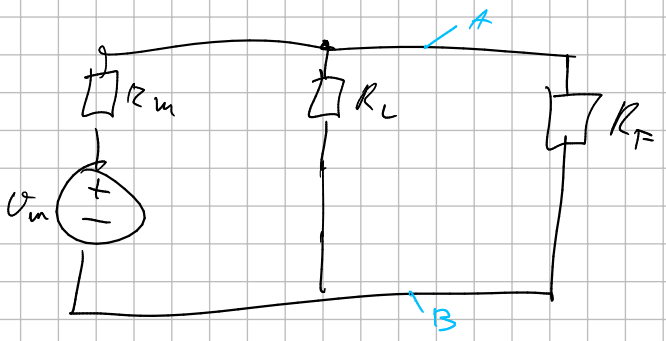
$\Rightarrow$ Fuck dig

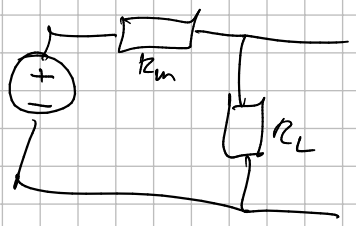
Oppg 2)

a)

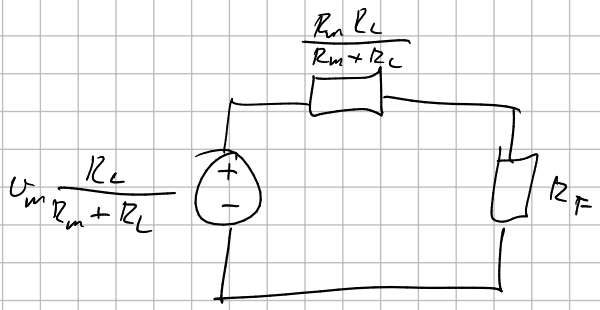


b)



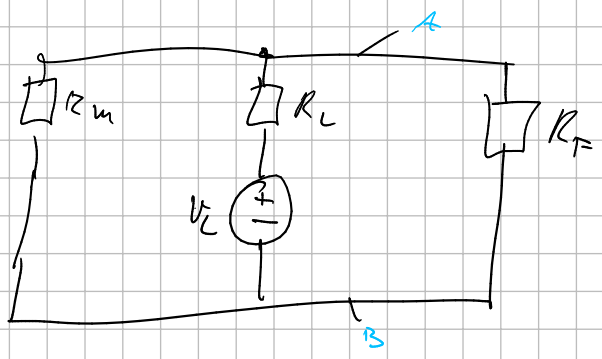


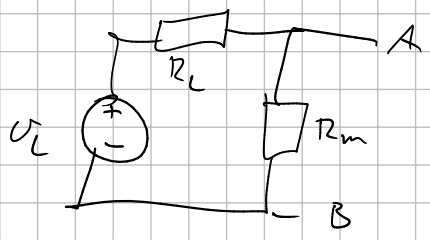
$$R_{th} = \frac{R_m R_L}{R_m + R_L} \qquad v_{th} = v_m \frac{R_L}{R_m + R_L}$$



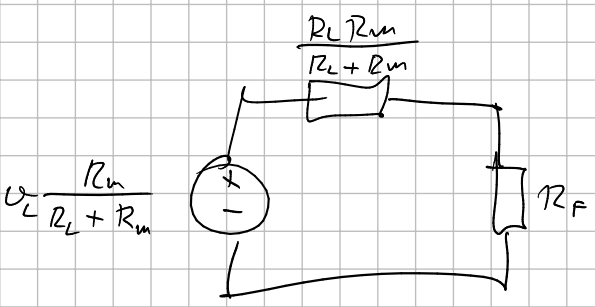
$$v_{R_T} = \left(v_m \frac{R_L}{R_m + R_L}\right) \cdot \left(\frac{R_T}{R_T + \frac{R_m R_L}{R_m + R_L}}\right) = \left(v_m \frac{R_L}{R_L + R_m}\right) \cdot \left(\frac{R_T (R_m + R_L)}{R_T (R_m + R_L) + R_m R_L}\right)$$

$$= v_m \frac{R_L R_T}{R_T (R_m + R_L) + R_m R_L}$$





$$R_{th} = \frac{R_L R_m}{R_L + R_m} \qquad V_{th} = V_L \frac{R_m}{R_L + R_m}$$



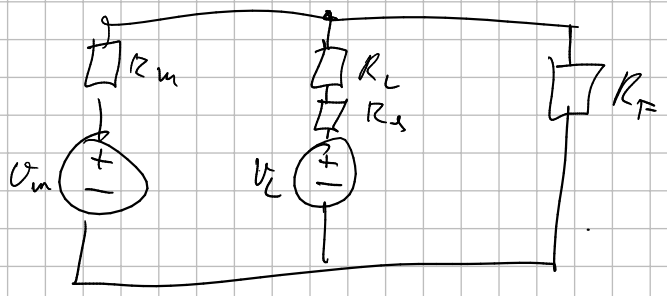
$$V_{R_2} = \left(V_L \frac{R_m}{R_L + R_m}\right) \cdot \left(\frac{R_F}{R_F + \frac{R_L R_m}{R_L + R_m}}\right) = \left(V_L \frac{R_m}{R_L + R_m}\right) \left(\frac{R_F (R_L + R_m)}{R_F (R_L + R_m) + R_L R_m}\right)$$

$$= V_L \frac{R_m R_F}{R_F (R_L + R_m) + R_L R_m}$$

$$V_F = V_m \frac{R_L R_F}{R_F (R_m + R_L) + R_m R_L} + V_L \frac{R_m R_F}{R_F (R_L + R_m) + R_L R_m}$$

$$V_F = \frac{R_F}{R_F R_m + R_F R_L + R_m R_L} \left(V_m R_L + V_L R_m\right)$$

c)



$v_F' = \frac{1}{2} v_F$

$$v_F = \frac{R_F}{R_F R_m + R_F R_L + R_m R_L}\left(v_m R_L + v_L R_m\right)$$

$v_F' =$

Dette gidder jeg faenmeg ikke