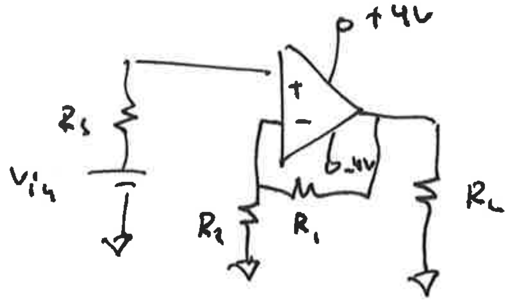
1).

a) $i_L = G_m \cdot V_2 = A_v \cdot V_1 \cdot \frac{R_{i2}}{R_{o1} + R_1 + R_{i2}} \cdot G_m = A_v \cdot G_m \cdot \frac{R_{i2}}{R_{o1} + R_1 + R_{i2}} \cdot V_{in}$

b) $i_L = A_v \cdot G_m \cdot V_{in}$

---

2)



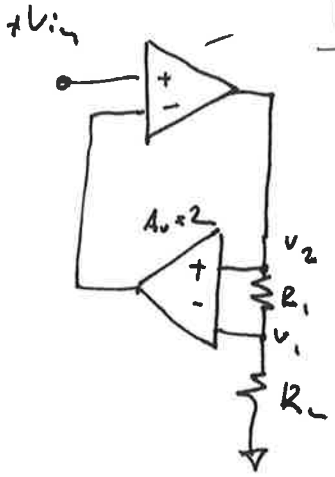
$A_v = \frac{4}{0{,}1} = 40$

$A_v = 1 + \frac{R_1}{R_2}$; Ex $R_1 = 39\,k\Omega$

$R_2 = 1k\Omega$

---

3)



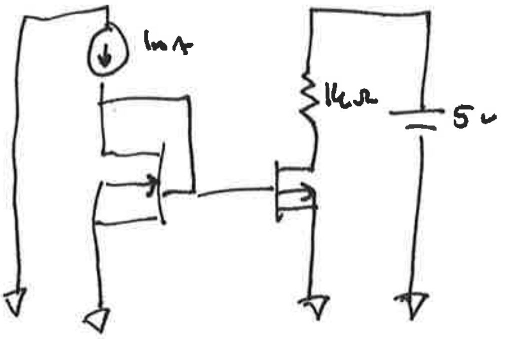
$\boxed{V_n = V_p = V_{in}}$

$2(V_2 - V_1) = V_{in}$

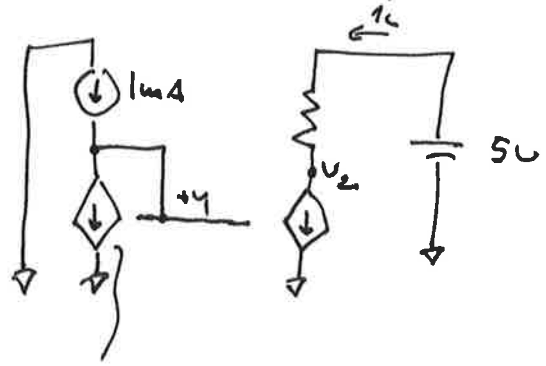
KCL på V_1 : $\frac{V_1 - V_2}{R_1} = \frac{V_1}{R_L} = i_L$

$\Rightarrow \frac{V_{in}}{2 \cdot R_1} = i_L$

4)



Mättnads område.



$i_{d_1} = K_1(V_{gs} - V_T) =$

$= 10^{-3}(V_1 - V_T)$

a) $i_{d_1} = 1\text{mA} \Rightarrow (V_1 - V_T) = 1$

$\Rightarrow \underline{\underline{V_1 = 3V}}$

b) $i_L = 2 \cdot 10^{-3}(V_1 - 2) = \underline{\underline{2mA}}$

c) $V_2 = 5V - i_L \cdot R = 5 - 10^3 \cdot 2 \cdot 10^{-3} = \underline{\underline{3V}}$

~~SDI~~ $3 \geq 3 - 2 = 1$ <u>ok!</u> <u>Mättnadsområdet!</u>

5)

A	B	C	C'
0	0	1	0
0	1	0	1
1	0	0	1
1	1	0	1

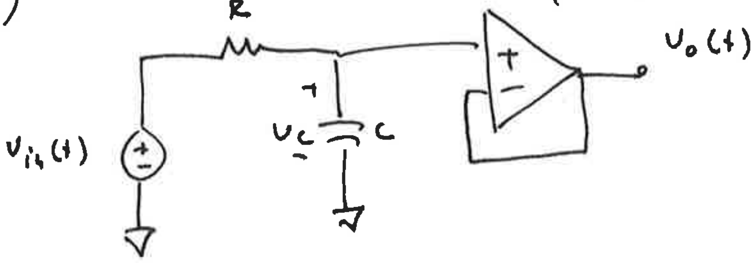
$\xrightarrow{}$ inverterare

A/B 0: PMOS på, NMOS av

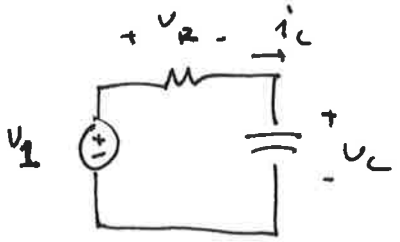
A/B 1: PMOS av, NMOS på

6)

Buffer, så $v_o(t) = v_c(t)$



a)



$$i_c = C \cdot \frac{dv_c}{dt}$$

$$-v_{in} + v_R + v_c = 0$$

$$v_R = i_c \cdot R \Rightarrow$$

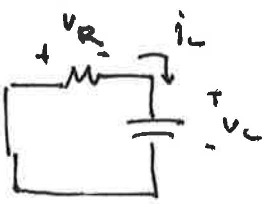
$$v_c' + \frac{v_c}{RC} = \frac{v_1}{RC} \quad ; \quad RC = \tau$$

$$\Rightarrow \left(v_c \cdot e^{t/\tau}\right)' = \frac{v_1}{\tau} \cdot e^{t/\tau} \Rightarrow \int_0^t \left(v_c(t)\, e^{t/\tau}\right)' dt = \frac{v_1}{\tau} \int_0^t e^{t/\tau} \cdot dt$$

$$\Rightarrow \Big[v_c(t) \cdot e^{t/\tau}\Big]_0^t = v_1 \Big[e^{t/\tau}\Big]_0^t \overset{v_c(0)=0}{\Rightarrow} v_c(t) \cdot e^{t/\tau} = v_1 \cdot e^{t/\tau} - 1$$

$$\Rightarrow v_c(t) = \underline{\underline{v_1\left(1 - e^{-t/\tau}\right)}} \quad , \quad v_c(t_0) = v_1\left(1 - e^{-t_0/\tau}\right)$$

b) $v_{in} = 0$



$$v_R + v_c = 0 \qquad v_R = i_c \cdot R = v_c' \cdot RC$$

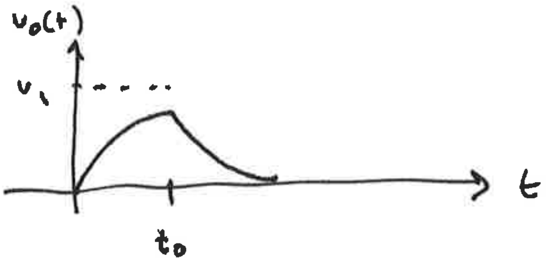
$$v_c' + \frac{v_c}{RC} = 0 \Rightarrow v_c' + \frac{v_c}{\tau} = 0 \Rightarrow \left(v_c \cdot e^{t/\tau}\right)' = 0$$

$$\Rightarrow \int_{t_0}^{t} \left(v_c \cdot e^{t/\tau}\right)' dt = \Big[v_c \cdot e^{t/\tau}\Big]_{t_0}^{t} = v_c(t) \cdot e^{t/\tau} - v_c(t_0) \cdot e^{t_0/\tau}$$

b) $v_c(t) = v_c(t_0) \cdot e^{(t_0-t)/\tau} = \underline{v_1 (1 - e^{-t_0/\tau}) \cdot e^{(t_0-t)/\tau}}$

c) $v_c(t_0) = v_1$ om $\underline{\underline{t >> RC}}$

d)



eller