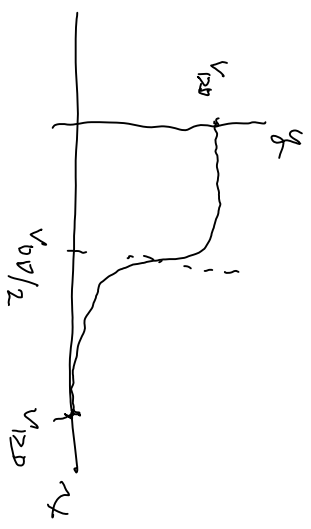
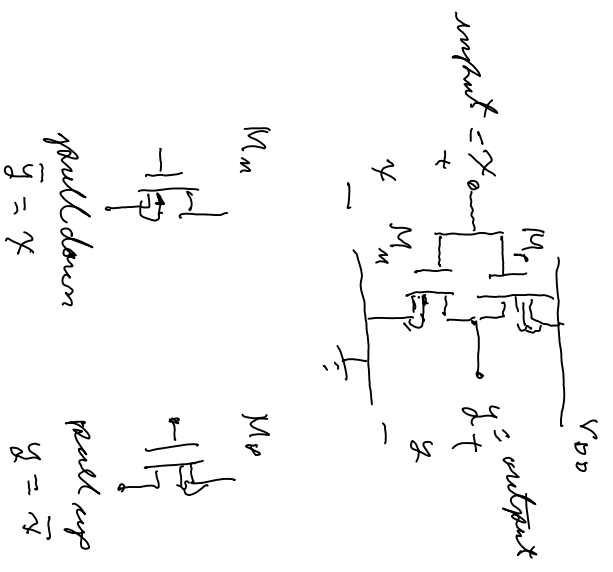


Digital circuits

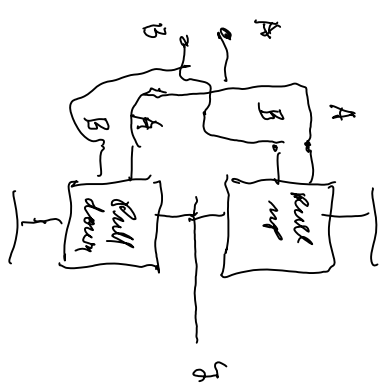
inverter, P, 1114-1135



input \Rightarrow \bar{x} \Rightarrow always stays

digital 1 $\Rightarrow V_{DD}$
digital 0 \Rightarrow pull = 0V

band \Rightarrow \bullet \rightarrow complement
 $0 \rightarrow 1$
($0 \rightarrow 1$)



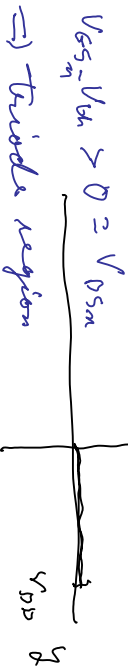
if $\kappa = 1$, V_{GS} on $M_p \neq 0 \Rightarrow$ no current fully off

V_{GS} on $M_n \neq V_{DD} \Rightarrow$ fully on

connection $i_{DP} = -i_{DN} \equiv i_{DN} = -i_{DP}$

for M_p , $V_{DS} = V_{DD}$

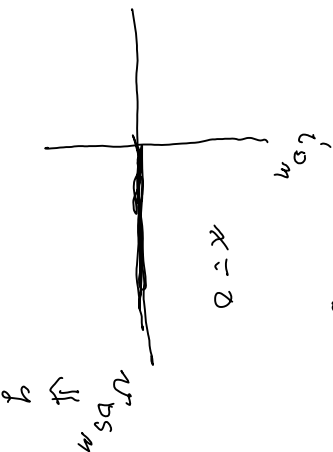
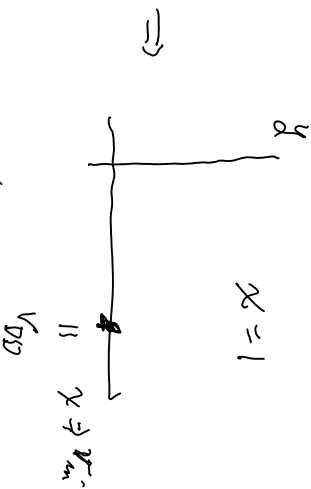
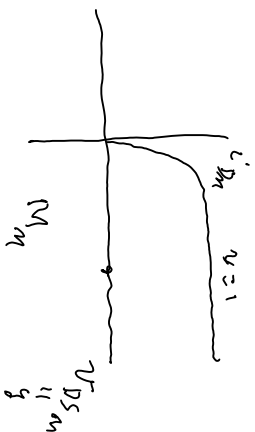
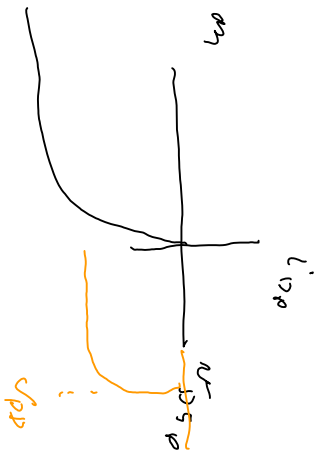
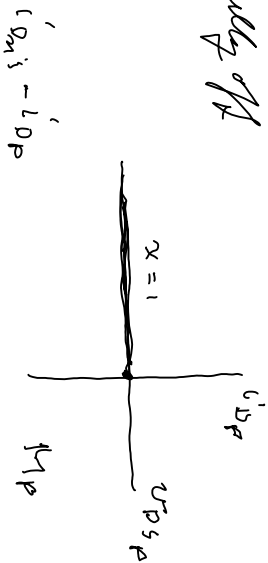
base $V_{DSM} = 0$
 $V_{GS_n} = V_{DD}$

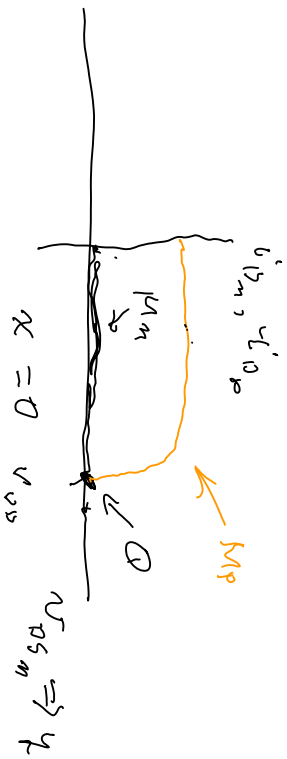


if $\kappa = 0$

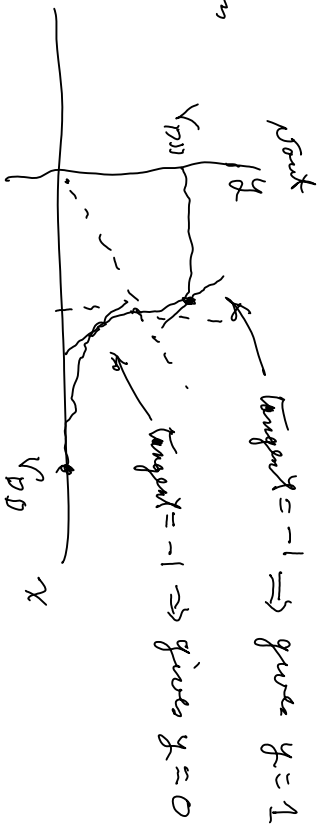
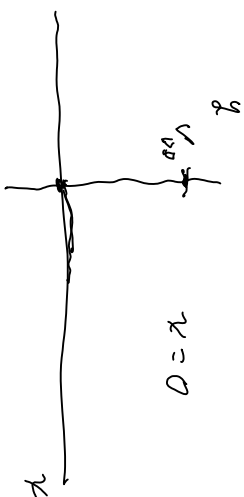
V_{GS} on $M_p = -V_{DD}$, M_p is fully on

for $M_n \Rightarrow$ fully off





then continuously vary between

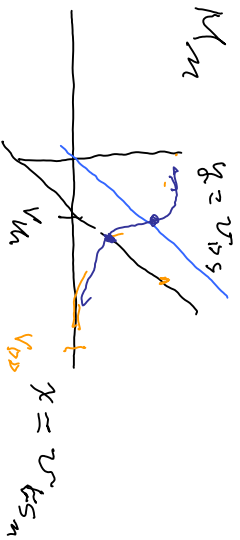


at mid point, $M_m = \frac{1}{2} k_p$

$$V_{GS_m} = \frac{V_{DD}}{2}, \quad V_{DS_m} = \frac{V_{DD}}{2} \Rightarrow \text{if } V_{GS_m} > 0 \text{ then } V_{GS_m} = \frac{V_{DD}}{2} - V_{th} < V_{DS_m} = \frac{V_{DD}}{2} \Rightarrow M_m \text{ is } M_p$$

Phase the transition between saturation & triode, for M_m

where $V_{GS_m} = V_{GS_m} - V_{th} \Rightarrow g = 1 - V_{th}$

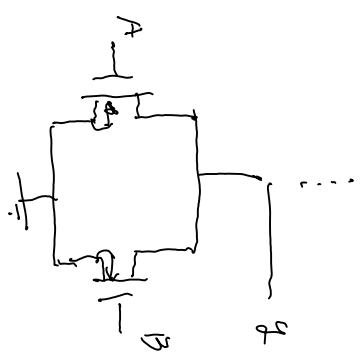


both M_m & M_p all in saturation



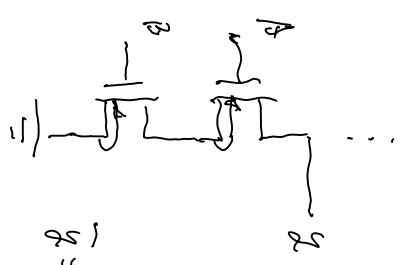
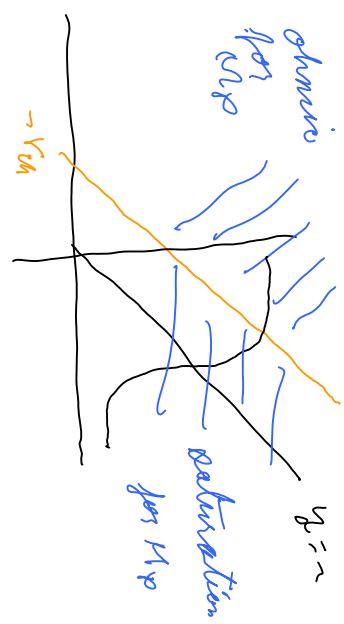
page 118 gives Fig. 14.25

gate p. 1093 gives main idea



pull down \swarrow nor

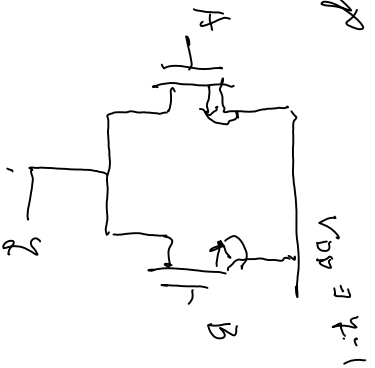
$$y = A + B \Rightarrow y = \overline{A + B} = \overline{A} \cdot \overline{B}$$



pull down \swarrow and

$$y = A \cdot B \Rightarrow y = \overline{\overline{A \cdot B}} = \overline{\overline{A} + \overline{B}}$$

pull up



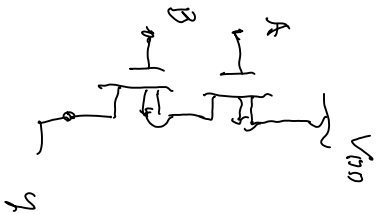
$$y = A + \bar{B}$$

=

$$\bar{y} = \overline{(A + \bar{B})}$$

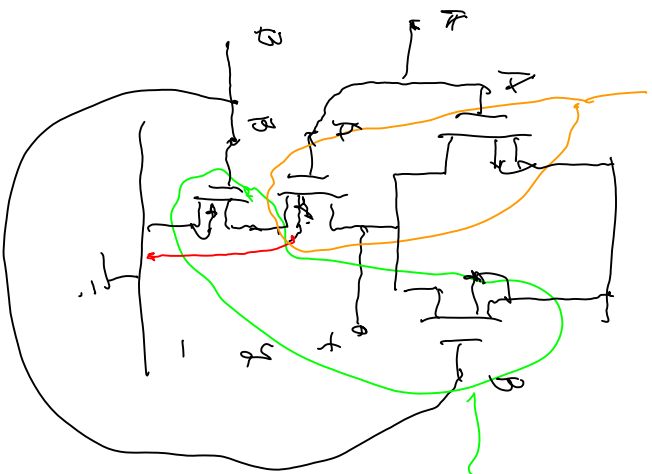
$$= A \cdot B$$

mand



$$y = A \cdot \bar{B}$$

if we connect \Rightarrow a mand gate \Rightarrow pull up & pull down give mand



PMOS network

NMOS network

a 2 input NAND gate

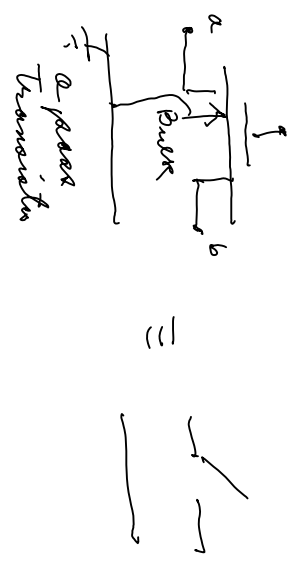
peer transmission, P. 1200

P. 1193

avg 15, 15

total 00 switches

P. 1193 avg 15, 141



if a = down or b = arrive

if a = arrive or b = down

a problem with the Kulk