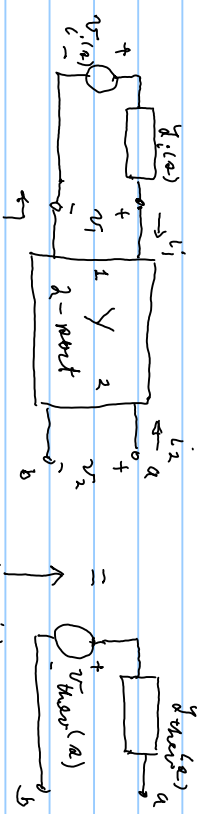


PA. 452-453 = tables of amplifiers characteristics



or determine
finding the 2-port

or determine
at "output"

$$Y_{thw} = Y_2 = \frac{-y_{21}y_{1i}}{y_{22}y_{1i} + \Delta y} \cdot v_i$$

$$i = \begin{bmatrix} i_1 \\ i_2 \end{bmatrix} = \begin{bmatrix} y_{11} & y_{12} \\ y_{21} & y_{22} \end{bmatrix} \begin{bmatrix} v_1 \\ v_2 \end{bmatrix} \Rightarrow i = Yv$$

under linearization of the 2-port:
valid for any load on a-b (= port 2)
including a short ($\Rightarrow v_2 = 0$, $-i_2$ into short)
and an open ($\Rightarrow i_2 = 0$), with these two
(or any 2 independent) measurements
we determine the two, Y_{thw} , y_{21}

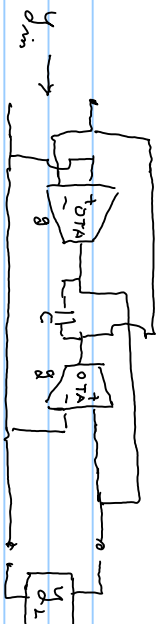
$$-i_2 = I_{ac} = \frac{-y_{21}y_{1i}}{y_{22}y_{1i} + \Delta y} \cdot v_i$$

$$\Rightarrow y_{21} = \frac{I_{ac}}{v_i} = \left(\frac{-y_{21}y_{1i}}{y_{22}y_{1i} + \Delta y} \cdot v_i \right) / v_i = \frac{y_{22}y_{1i} + \Delta y}{y_{1i} + y_{11}}$$

or find the input admittance when loaded at port 2 by y_L , replace 2 $\Leftrightarrow$ 1 in the above.

$$Y_{two} y_{in} = \frac{y_{11}y_L + \Delta y}{y_L + y_{22}}$$

Ex. 1:

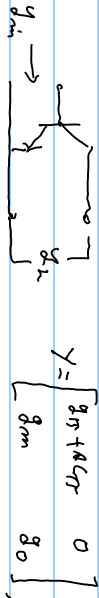


$$Y = \begin{bmatrix} g_C & -g_C + g \\ -g_C - g & g_C \end{bmatrix} = g \begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix} + g_C \begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix}$$

$$y_{in} = \frac{y_L y_L + \Delta y}{y_L + g_C} = \frac{g_C \cdot y_L + g^2}{y_L + g_C} \Rightarrow y_C = 0, y_{in} = \frac{g^2}{y_L}$$

(turns load y_L to an impedance $y_{in}/g = 1/y_L/g \Rightarrow \text{ideal}$)

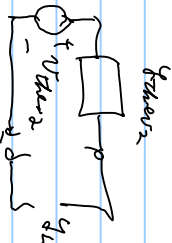
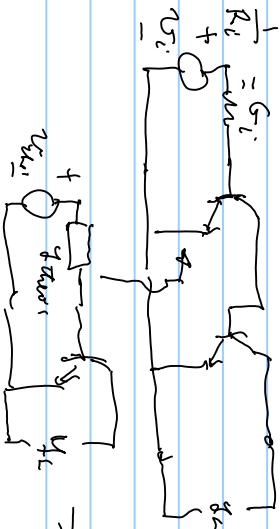
Ex. 2:



$$Y = \begin{bmatrix} g_n + g_C g_n & 0 \\ g_m & g_o \end{bmatrix}, \Delta y = g_o (g_n + g_C g_n)$$

$$y_{in} = \frac{(g_n + g_C g_n) y_L + g_o (g_n + g_C g_n)}{y_L + g_o} = (g_n + g_C g_n) \frac{(y_L + g_o)}{(y_L + g_o)} = g_n + g_C g_n \quad (\text{without } C \text{ no effect of load on input})$$

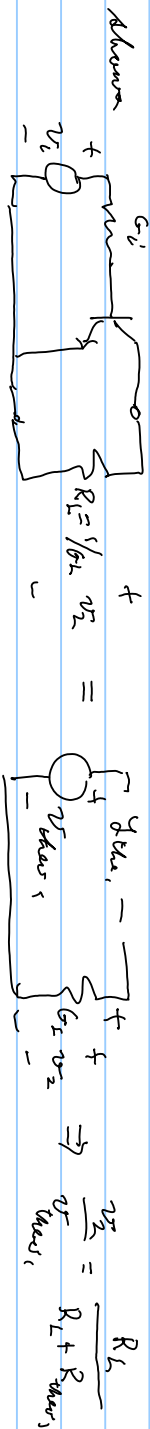
Ex. 3



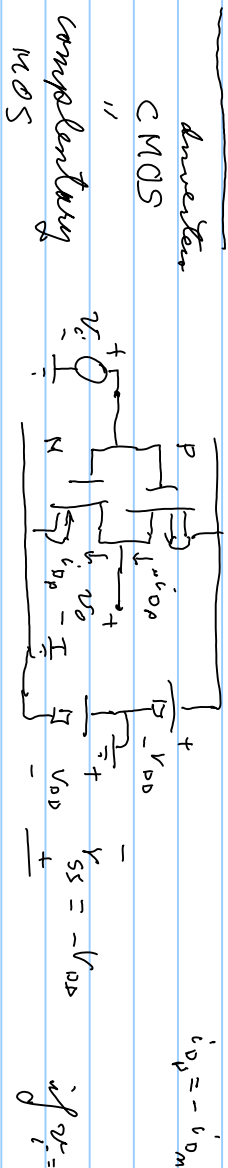
$$v_{th1} = \frac{g_{m2} v_i + \Delta_g}{g_i + g_{m1}} = \frac{g_o G_i + g_o (g_{m1} + \Delta_{C1})}{g_i + (g_{m1} + \Delta_{C1})}$$

$$v_{thout} = \frac{-g_{m1} g_i}{g_{m2} g_i + \Delta_g} v_i = \frac{-g_{m1} G_i}{[g_o G_i + g_o (g_{m1} + \Delta_{C1})]} v_i$$

} apply to second stage



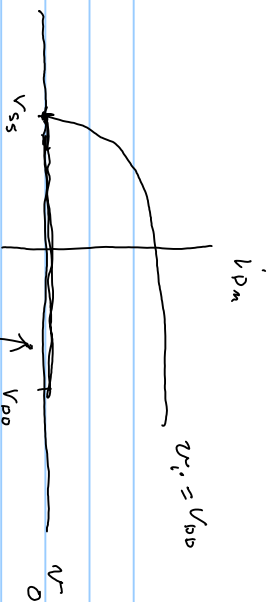
$$\frac{v_2}{v_1} = \frac{1/g_{m1}}{1/g_{m1} + 1/g_{m2}} \Rightarrow \frac{v_2}{v_1} \rightarrow 0 \text{ as } R \rightarrow \infty$$



if $v_i = v_o$ then $v_{o2} = v_o - (v_{ss})$

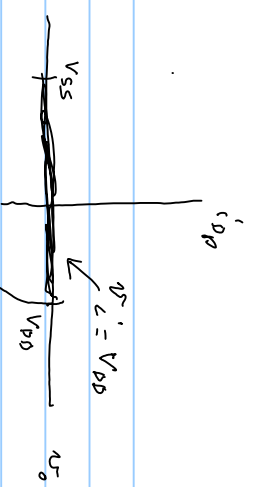
$v_{ss} = v_o - (v_{ss})$

$\Rightarrow$ in saturation



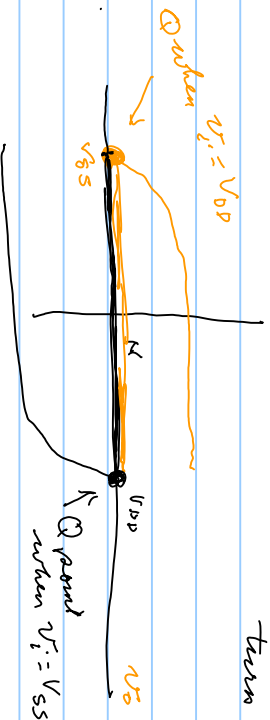
$$v_i = +V_{SS} < 0$$

$$i_{DPM} - i_{DP}$$



$$v_i = V_{SS} < 0$$

turn over to get $-i_{DP}$

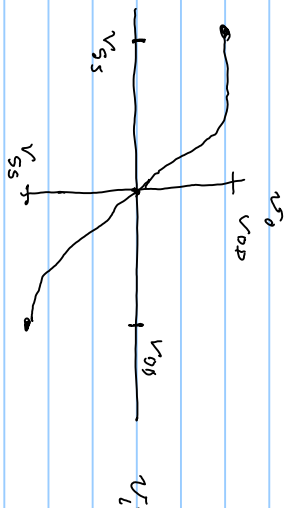


$$v_i = V_{DD}$$

Q point when $v_i = V_{SS}$

$$v_i = V_{SS} < 0$$

$$v_i = V_{DD} > 0$$



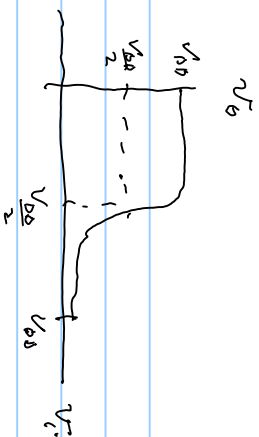
gives an answer

if NMOS & PMOS are

truly complementary

the 2nd & 4th quadrants are negative

if more $V_{SS} \approx 0$

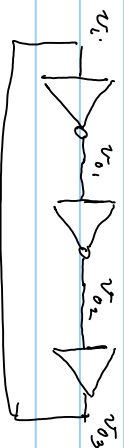


here @ $v_i = 0$ or V_{DD} no power is taken as one $i'_b = 0$

power in is $V_{DD} i_b$

'i' in a resting state no power is taken

Ring oscillator



used as clock determinator for speed of chips