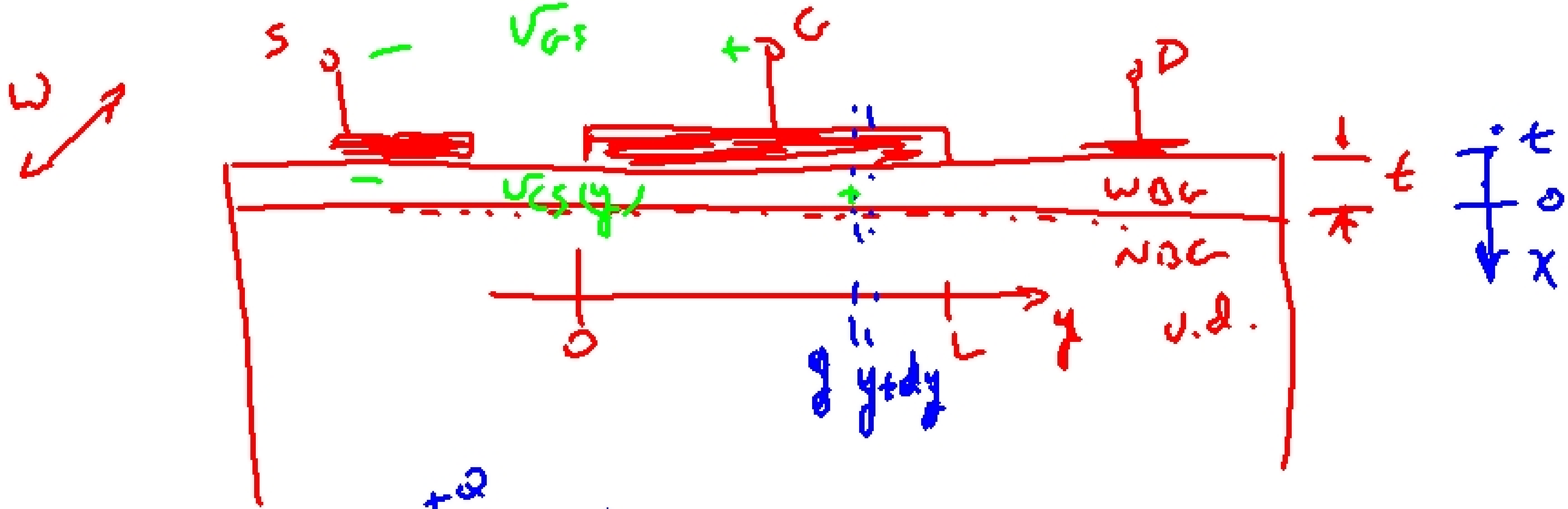
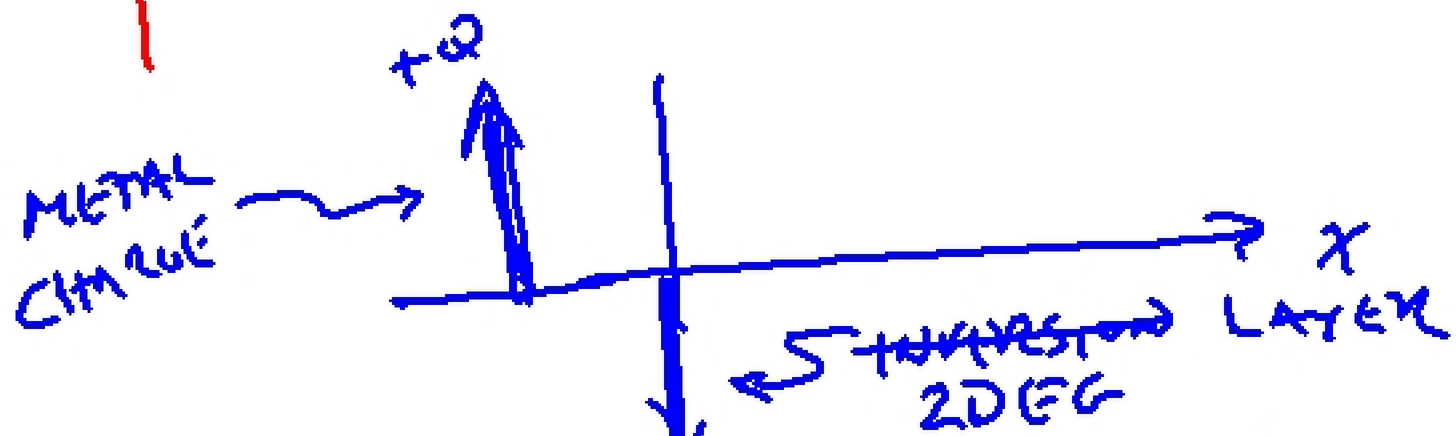




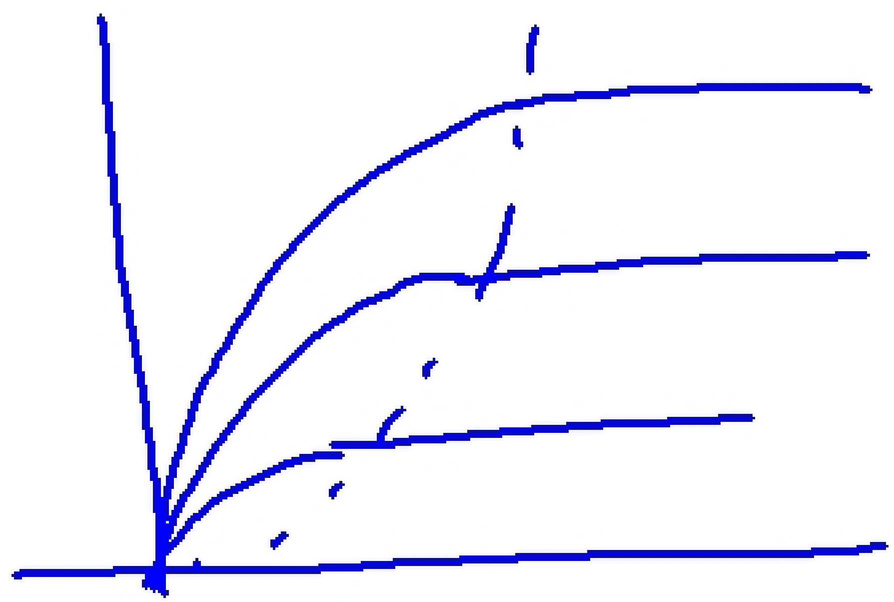
$$Q = CV$$

$$q n_e(y) = -\frac{\epsilon_s}{t}\Big(\overbrace{v_{GS} - v_{CS}(y)}^{v_{GC}(y)} - V_T\Big)$$

$$\int_0^L i_D\,dy = W\,\frac{\epsilon_s}{t}\int_0^{v_{DS}} \left[v_{GS} - v_{CS}(y) - V_T\right]\mu_e\,\frac{\partial v_{CS}}{\partial y}\,\cancel{dy}$$

$$i_D L = W \frac{\epsilon_s}{t} \mu_e \int (v_{GS} - v_{CS} - V_T)\, dv_{CS}$$

$$i_D = \frac{W}{L} \frac{\epsilon_s}{t} \mu_e \left[(v_{GS} - V_T) v_{DS} - \frac{v_{DS}^2}{2} \right]$$



$$i_D = \frac{W}{L} \frac{\epsilon}{t} \frac{\mu_e}{2} (V_{GS} - V_t)^2$$

Find

$$\omega_T = \frac{3}{2} \frac{\mu_e (V_{GS} - V_T)}{L^2}$$ w.o. vel sat.

$$= \frac{s_{sat}}{L}$$ w. vel. sat.

$$\omega_T = \frac{g_m}{C_{gs}}$$

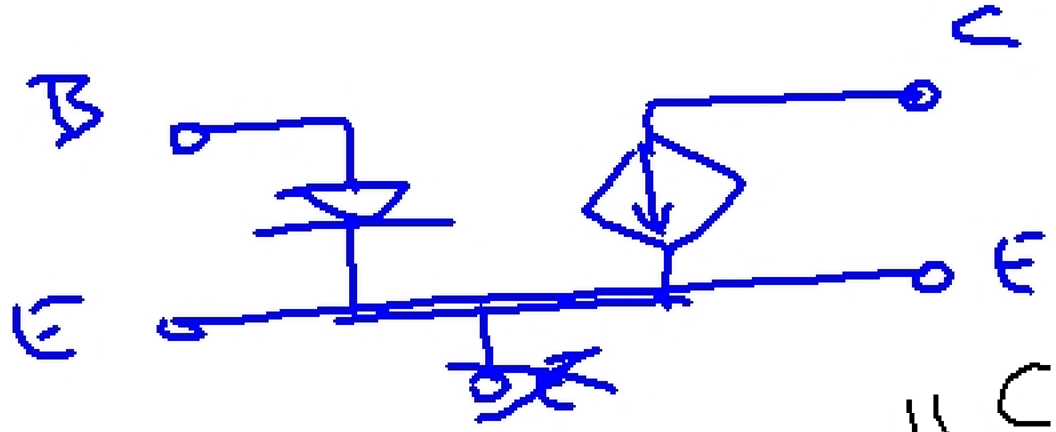
GOOD SPEED METRIC FOR SWITCHING

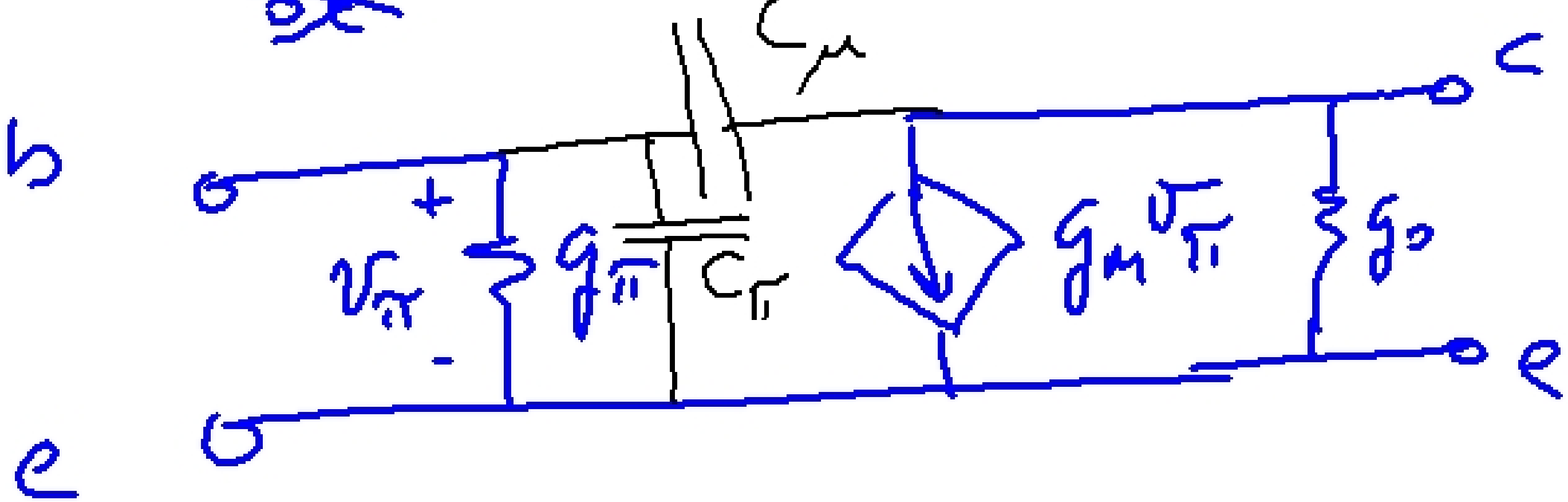
$\omega_{max} \equiv$ UNITY POWER GAIN FREQ WITH MATCHED SOURCE AND LOAD IMPEDANCES

$$= \sqrt{\frac{\omega_T}{4 R_g C_{gd}}} = \sqrt{\frac{g_m}{4 R_g C_{gd} C_{gs}}}$$

GOOD METRIC FOR μ-WAVE AMPL.

SMALL SIGNAL LINEAR EQUIV CKT for BJT





$$g_m = \frac{q}{kT}|I_c| \qquad g_\pi = \frac{g_m}{\beta_F} \qquad g_o = \frac{|I_c|}{V_A}$$

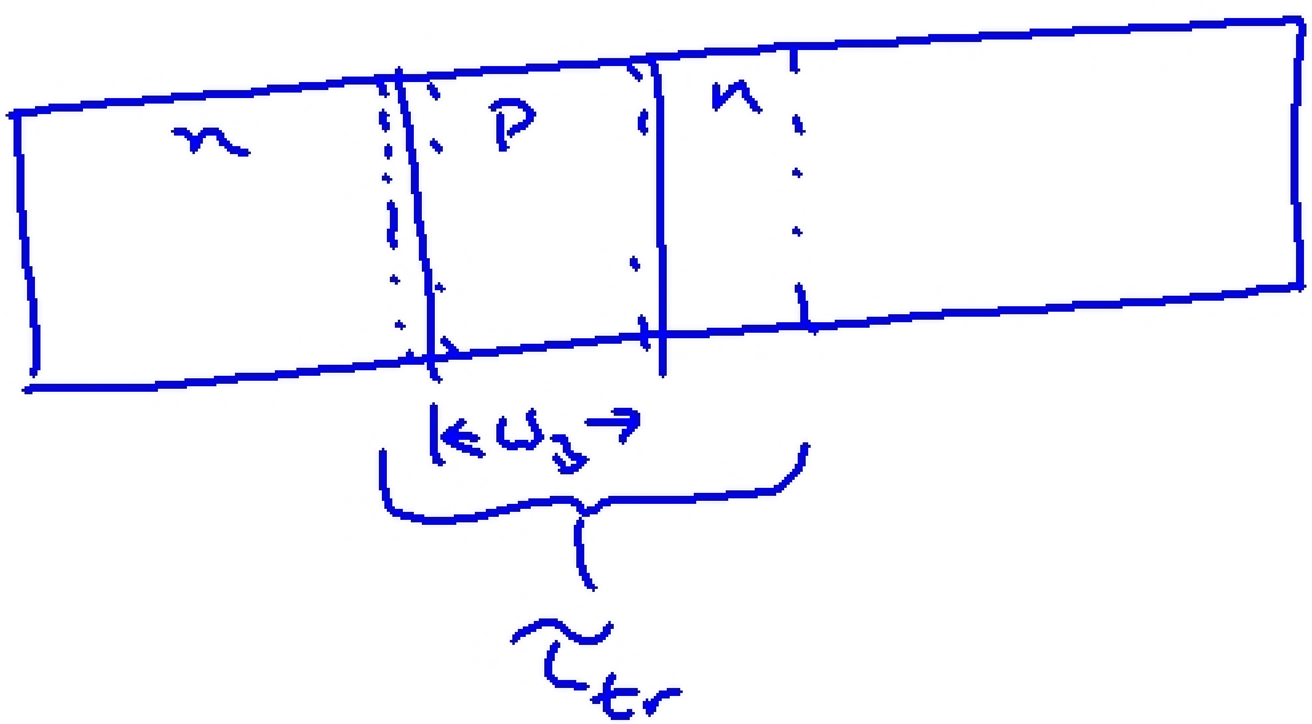
$$C_\mu = C_{cb,depl} \qquad C_\pi = C_{eb,depl} + g_m \tau_{b,tr}$$

$W_B^{*2}/2D_{eB}$

FOR BJT WE FIND

$$\omega_T = \frac{g_m}{C_\pi} = \frac{\cancel{g_m}\ \frac{qI_c}{kT}}{\cancel{C_{e,dep}} + \cancel{g_m}\frac{qI_c}{kT}\tau_{trb}}$$

$$\lim_{I_c \to \infty} \omega_T = \frac{1}{\tau_{trb}}$$



$$\omega_T \approx \frac{1}{\tau_{trB}} = \frac{2D_{eB}}{W_B^{*2}}$$

FIND

$$\omega_{max}(BJT) = \sqrt{\frac{\omega_T}{4R_bC_{bc}}}$$

$$\left[\text{vs } \sqrt{\frac{\omega_T}{4R_gC_{gd}}} \text{ IN FET}\right]$$