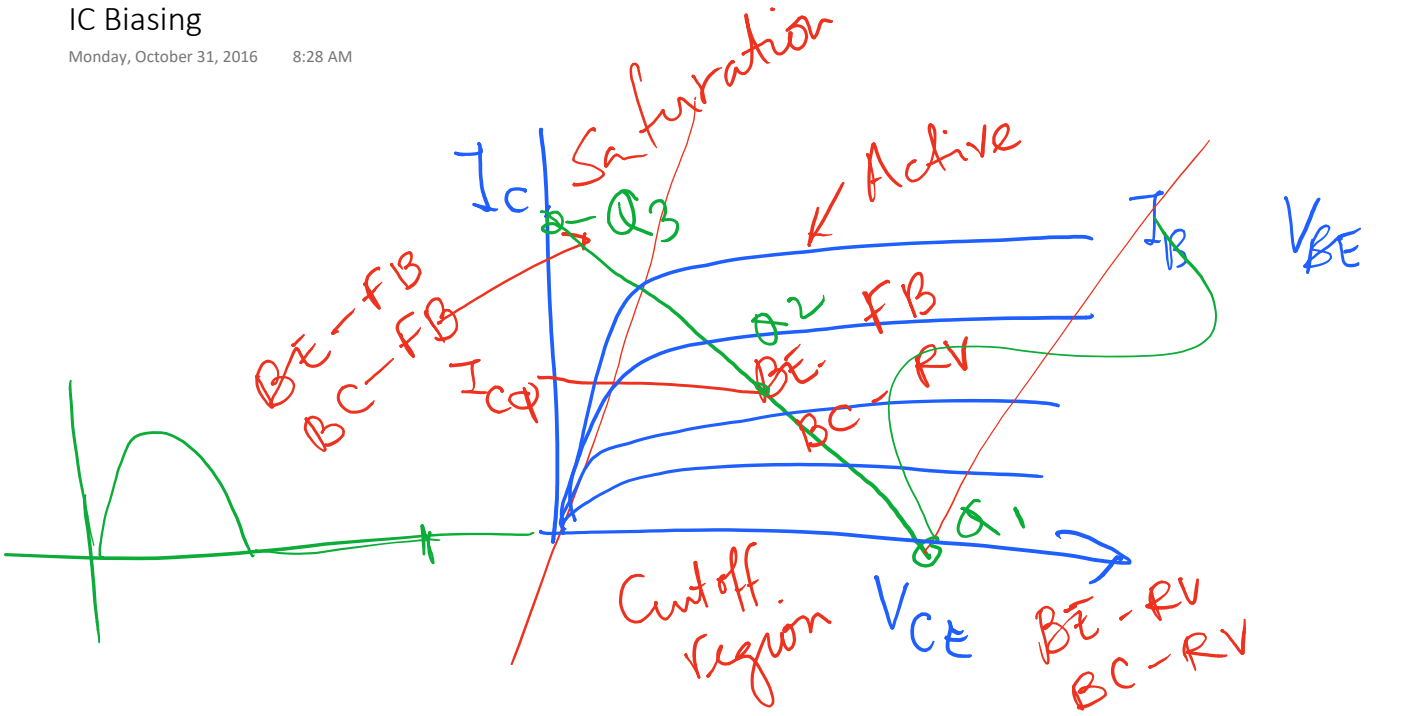
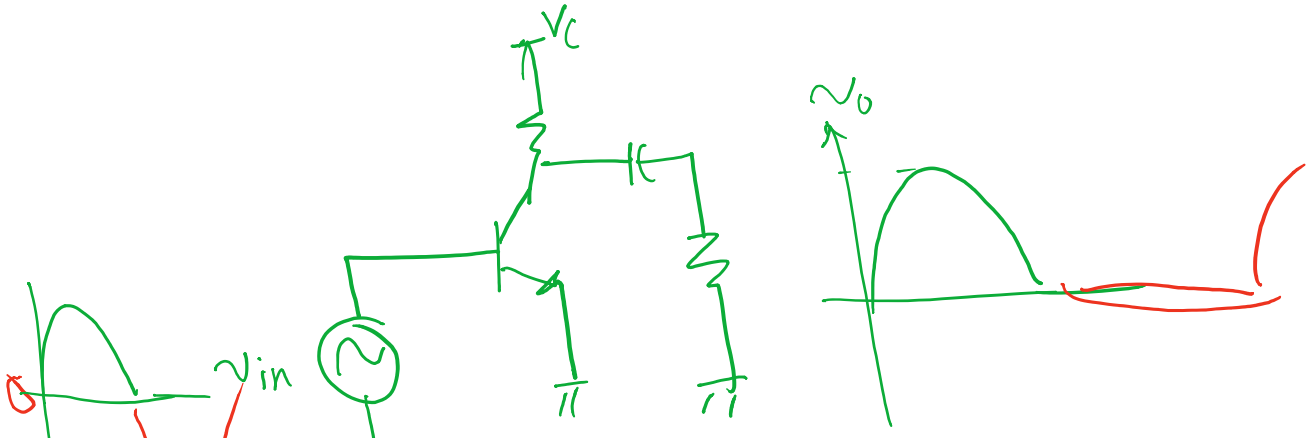
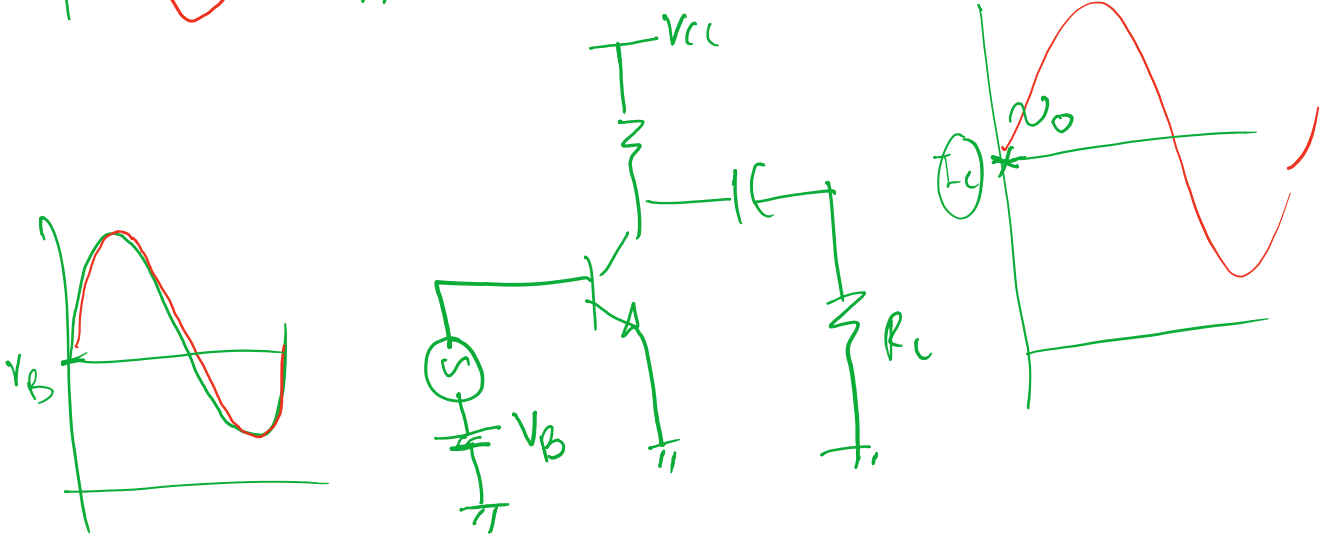
IC Biasing

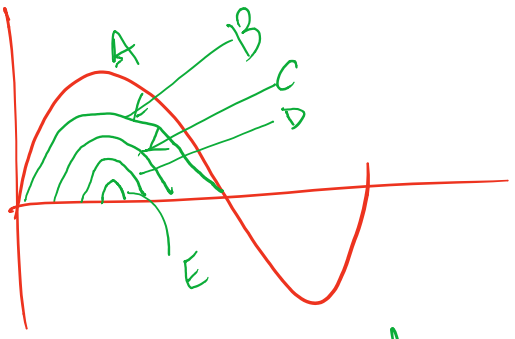
Monday, October 31, 2016 8:28 AM

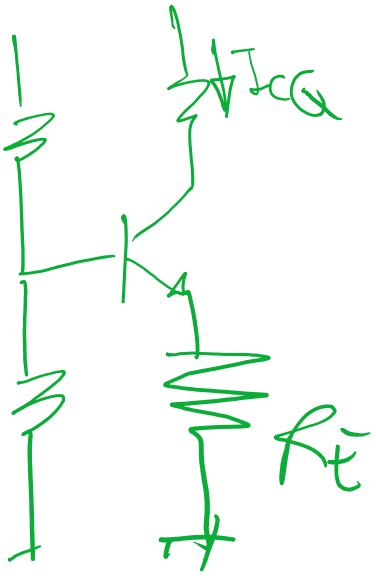


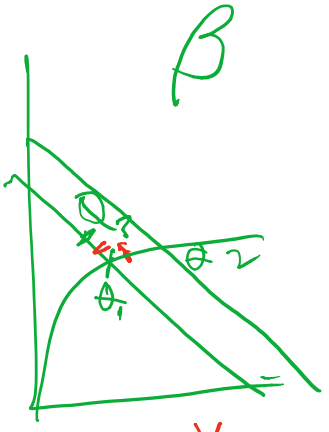


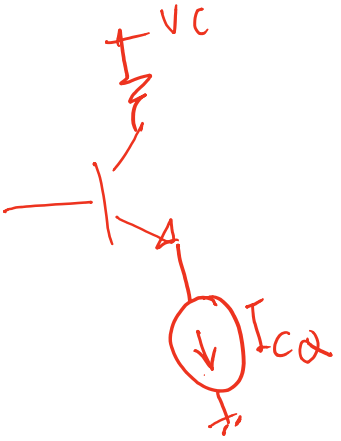


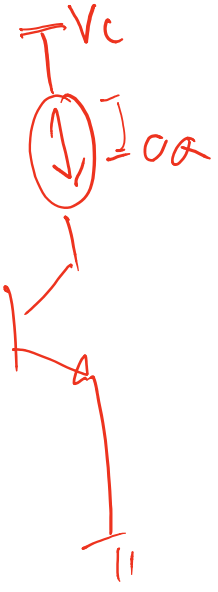
1 A B



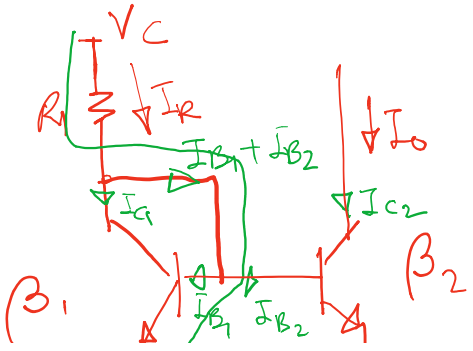






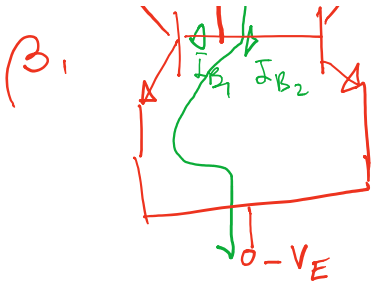


* 2 transistor current source (Basic Current source)



$\beta_1 = \beta_2 = \beta$

$V_A = \infty \qquad r_o = \infty$



$V_A = \infty \quad r_o = \infty$

$V_C = I_R R_1 + V_{BE_1} - V_E$

$I_C = \beta I_B$

$\therefore R_1 = \dfrac{V_C + V_E - V_{BE_1}}{I_R}$

$V_{BE_1} = V_{BE_2} \rightarrow I_{B_1} = I_{B_2} \rightarrow I_{C_1} = I_{C_2} = I_o$

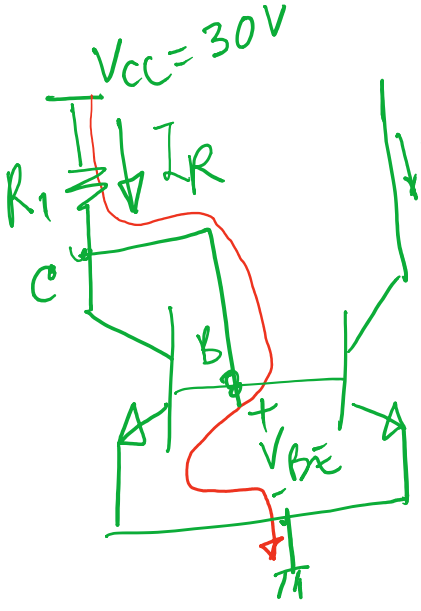
$I_R = I_{C_1} + I_{B_1} + I_{B_2} = I_{C_1} + 2I_{B_1}$

$= I_{C_1} + \dfrac{2I_{C_1}}{\beta}$

$= I_{C_1}\left[1 + \dfrac{2}{\beta}\right] = I_o\left[1 + \dfrac{2}{\beta}\right]$

$\therefore \boxed{I_o = \dfrac{I_R}{1 + \frac{2}{\beta}}}$

$V_{CC} = I_R R_1 + V_{BE_1}$



$\therefore R_1 = \dfrac{V_{cc} - V_{BE_1}}{I_R}$

$I_R = I_o\left[1 + \dfrac{2}{\beta}\right]$

$= 5_m\left[1 + \dfrac{2}{100}\right]$

$30 - 0.7 = 5745\Omega$

$$R_1 = \frac{30 - 0.7}{5.1\mu} = 5.745\,M\Omega$$

$$= 5_M\left[1 + \frac{1}{100}\right]$$

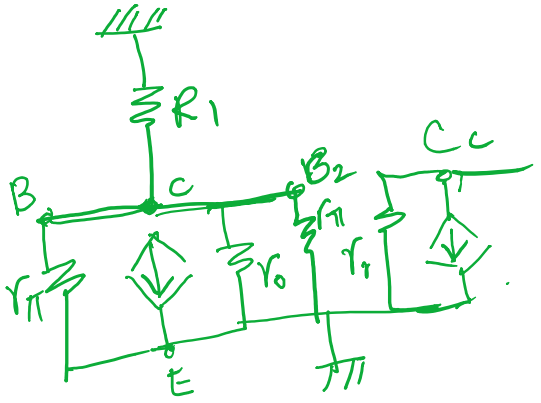
$$= 5.1\mu$$

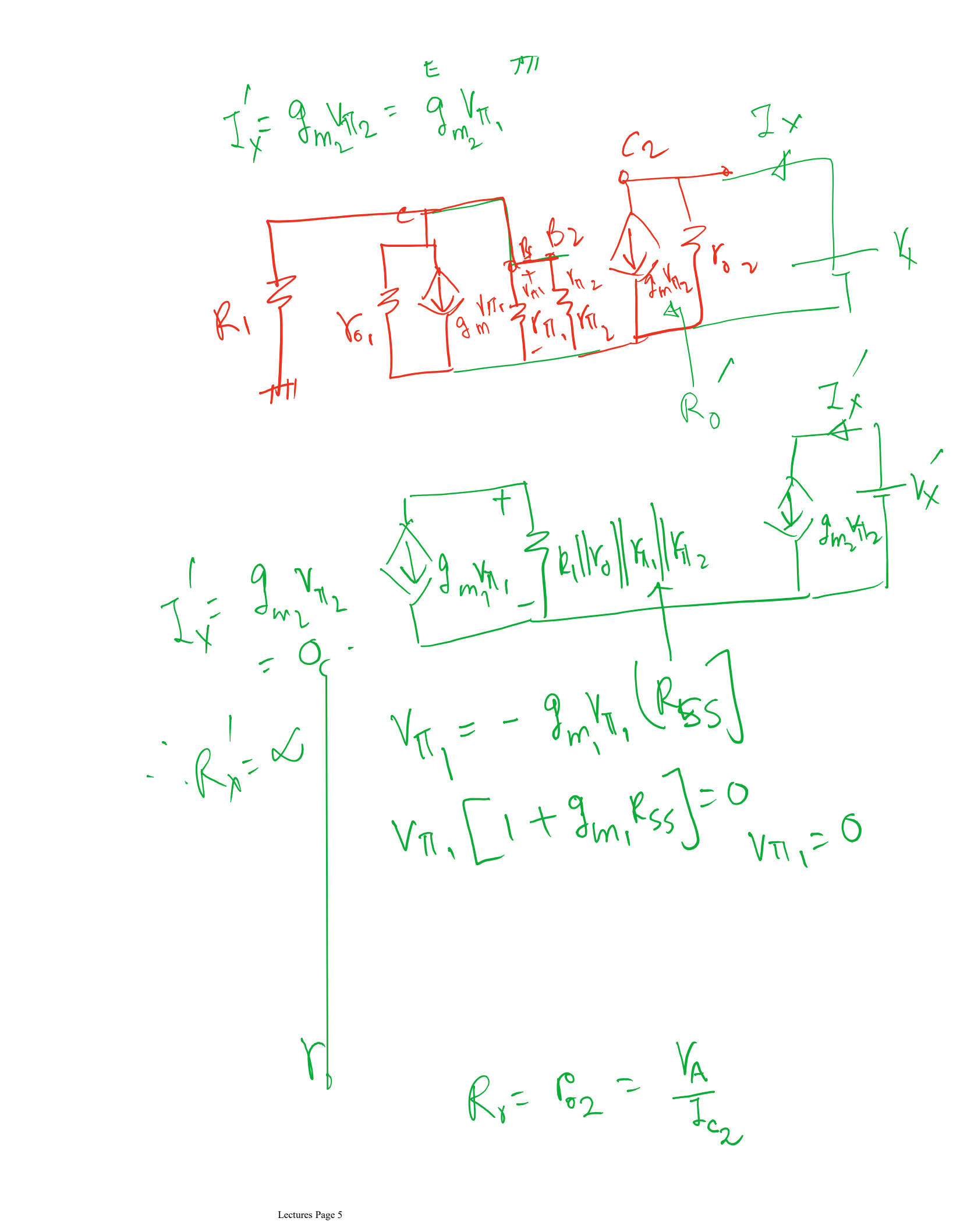
$$I_C = I_S\left[e^{\frac{V_{BE}}{V_T}} - 1\right]\left[1 + \frac{V_{CE}}{V_A}\right]$$

$$\frac{I_{C_2}}{I_{C_1}} = \frac{I_S\left[e^{\frac{V_{BE_2}}{V_T}} - 1\right]\left[1 + \frac{V_{CE_2}}{V_A}\right]}{I_S\left[e^{\frac{V_{BE_1}}{V_T}} - 1\right]\left[1 + \frac{V_{CE_1}}{V_A}\right]} \qquad \left[V_{BE_1} = V_{BE_2}\right]$$

$$= \frac{1 + V_{CE_2}/V_A}{1 + \frac{V_{CE_1}}{V_A}} = \frac{1 + \frac{V_{CE_2}}{V_A}}{1 + \frac{V_{BE_1}}{V_A}}$$

$V_{CE_1} = V_{BE_1}$ connected together




$I_x' = g_{m_2} V_{\pi_2} = g_{m_2} V_{\pi_1}$
E
π
C_2
I_x
C
B_2
R_1
r_{o_1}
$g_m V_{\pi_1}$
$r_{\pi_1} \| r_{\pi_2}$
r_{o_2}
V_x
R_0
I_x'
V_x'
$g_{m_1} V_{\pi_1}$
$R_1 \| r_o \| r_{\pi_1} \| r_{\pi_2}$
$g_{m_2} V_{\pi_2}$
$I_x' = g_{m_2} V_{\pi_2} = 0$
$\therefore R_x' = \infty$
$V_{\pi_1} = -g_{m_1} V_{\pi_1} (R_{ss})$
$V_{\pi_1} [1 + g_{m_1} R_{ss}] = 0$
$V_{\pi_1} = 0$
r_o
$R_x = r_{o_2} = \frac{V_A}{I_{C_2}}$