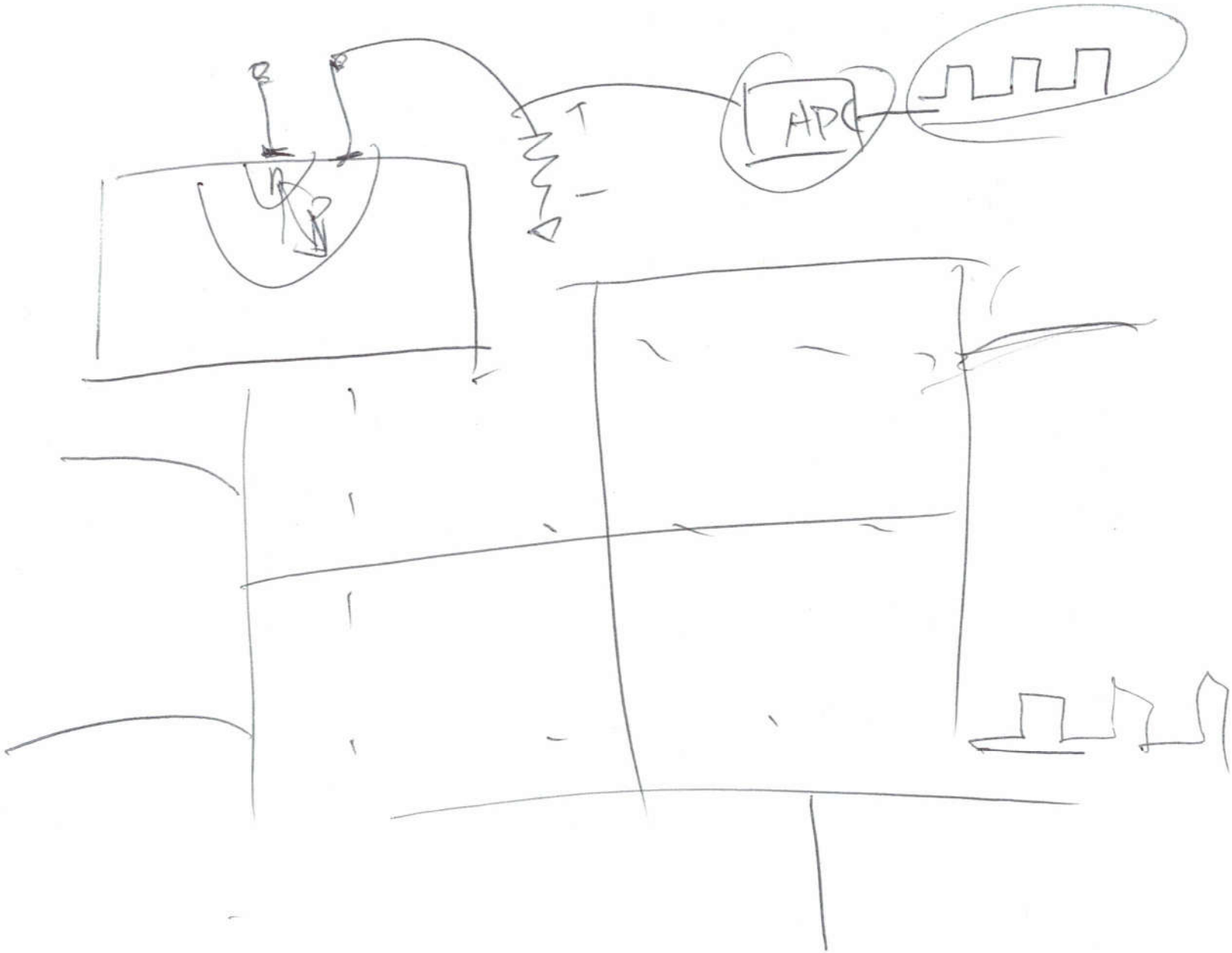
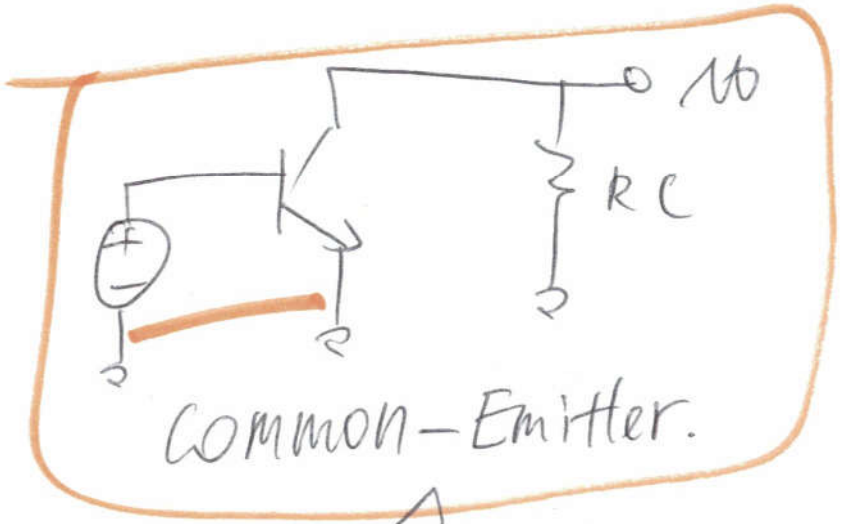
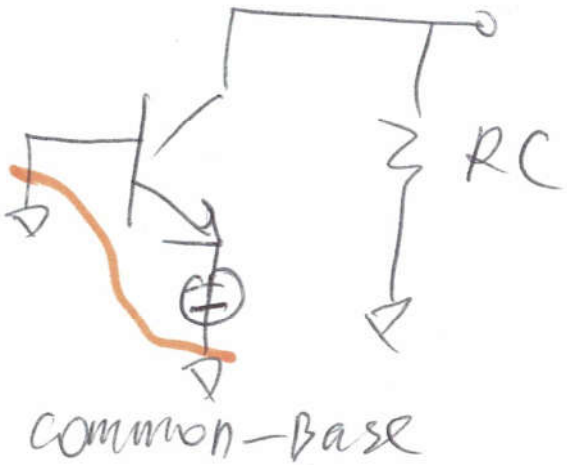
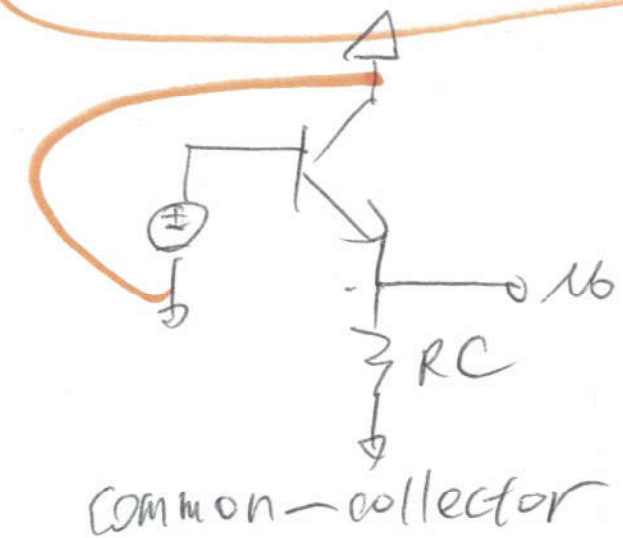
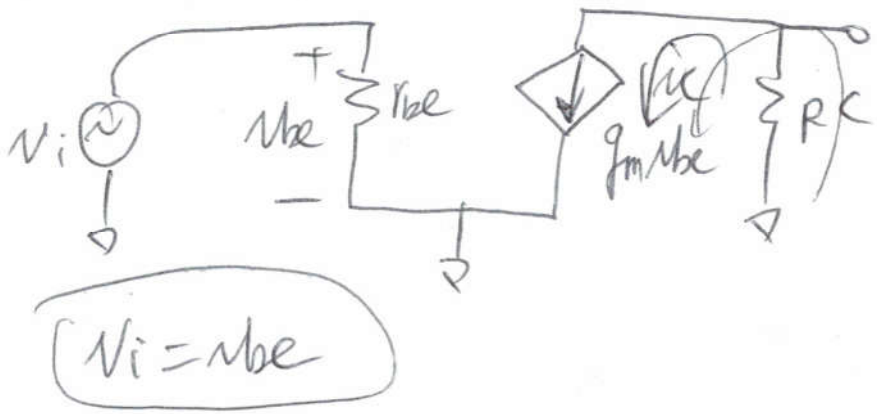

APC









$$V_{out} = -i_c R_C$$

$$= -g_m V_{be} R_C$$

$$\frac{V_{out}}{V_{be}} = -g_m R_C$$

$$\frac{I_C}{I_E} = \alpha = \frac{I_C}{I_C + I_B} = \frac{\beta I_B}{\beta I_B + I_B} = \frac{\beta I_B}{(\beta+1) I_B}$$

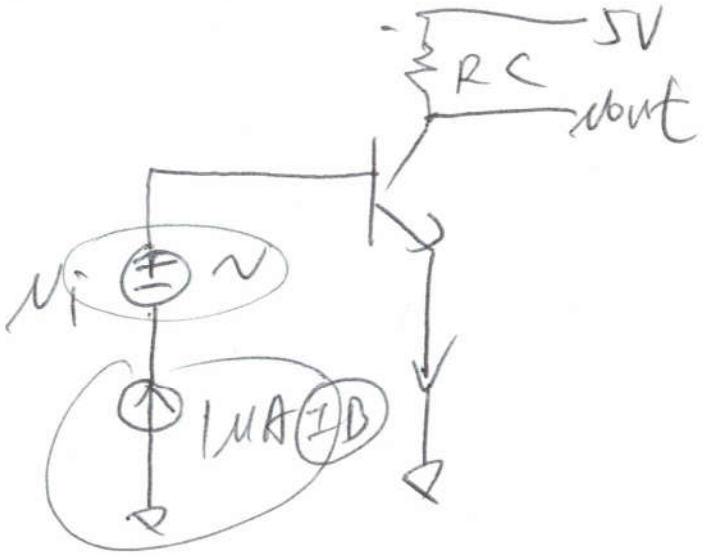
$$\alpha = \frac{\beta}{1+\beta}$$

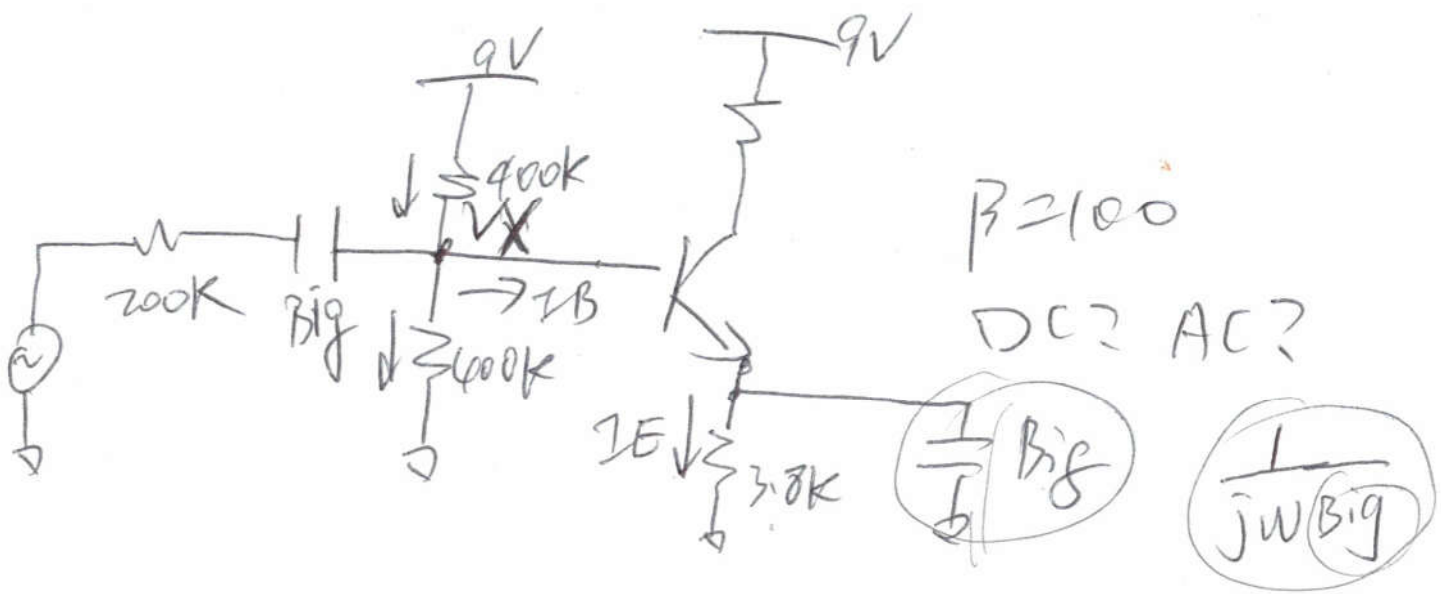
$$I_B \cdot \beta = I_C$$

$$\alpha + \alpha\beta = \beta$$

$$\alpha = (1-\alpha)\beta$$

$$\beta = \frac{\alpha}{1-\alpha}$$





$$\begin{cases} \dfrac{9-Vx}{400k} - \dfrac{Vx}{400k} = I_B \\ I_B = \left(\dfrac{Vx-0.7}{3.8k}\right) / (\beta+1) \end{cases}$$

$$\frac{9-Vx}{400k} - \frac{Vx}{400k} = \frac{Vx-0.7}{(3.8k)\cdot 101}$$

$$9 - Vx - Vx = Vx - 0.7$$

$$9.7 = 3Vx$$

$$Vx = 3.23V$$

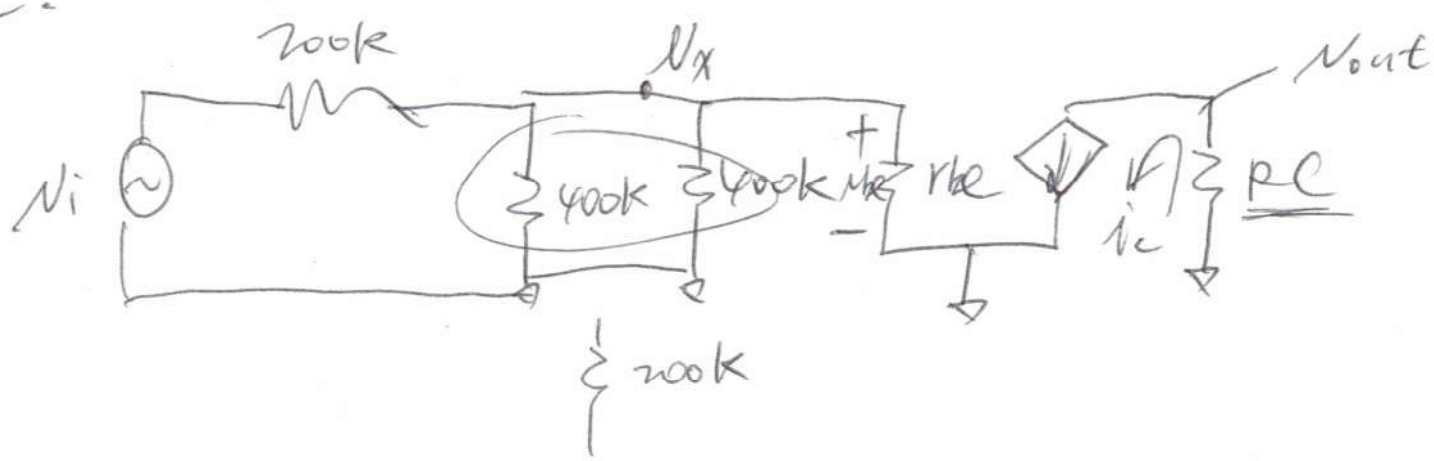
$$I_B = \frac{Vx-0.7}{3.8k\cdot 101} = 6.5\mu A$$

(4)

$$I_E = (\beta+1)\cdot I_B = 65\,\mu A$$

$$I_C = \beta \cdot I_B = 650\,\mu A$$

AC:



$$\begin{cases} i_c = g_m V_{be} = \dfrac{I_C}{V_T}\cdot V_x \\ V_x = \dfrac{r_{be} // 200k}{(r_{be} // 200k) + 200k}\cdot V_i \end{cases}$$

$$r_{be} = \frac{V_T}{I_B}$$

$$V_{out} = -V_c \cdot RC$$

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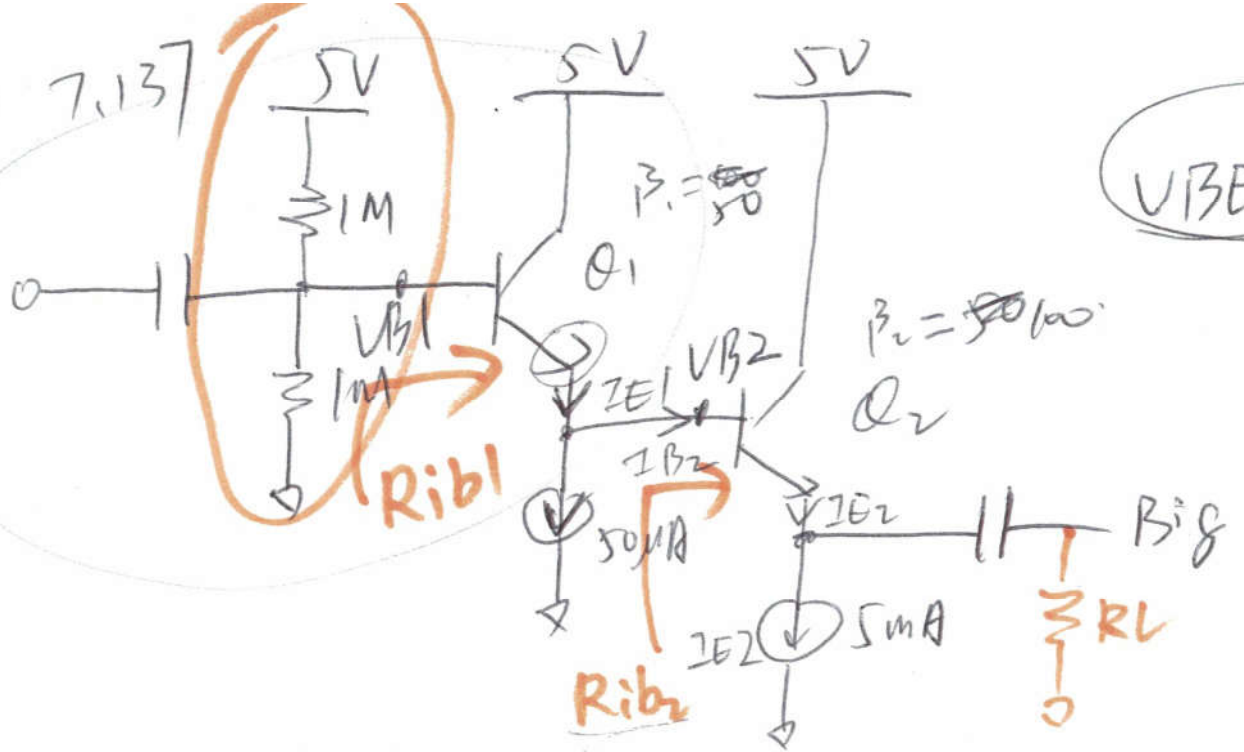


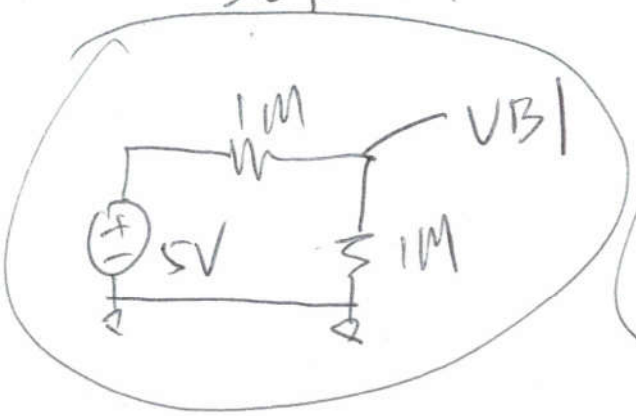
$\beta_1 = \beta_2 = 100$

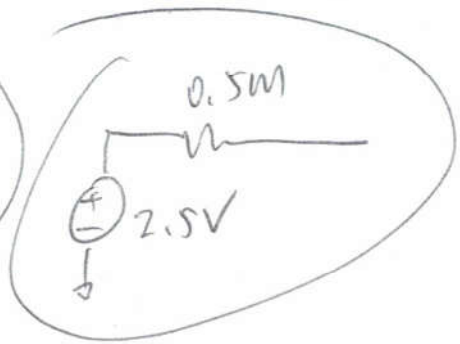
$V_{BE} = 0.7V$

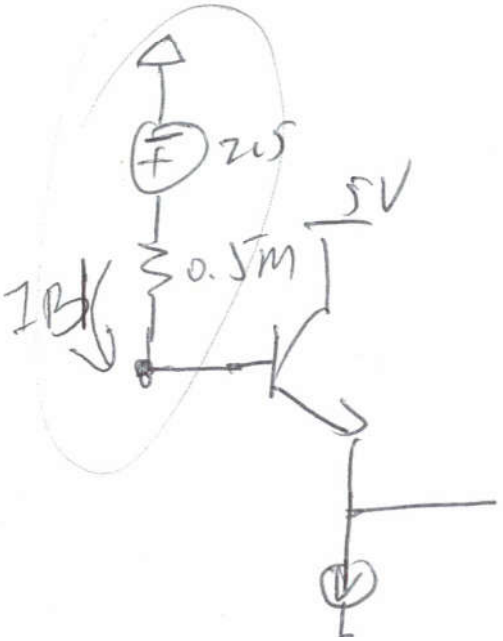
① Find I_{E1}, I_{E2}, V_{B1}, V_{B2}

$I_{E2} = 5mA$, $I_{B2} = \frac{I_{E2}}{1+\beta_2} = \frac{5mA}{101} = 50\mu A$

$I_{E1} = 50\mu A + 50\mu A = 0.1mA$





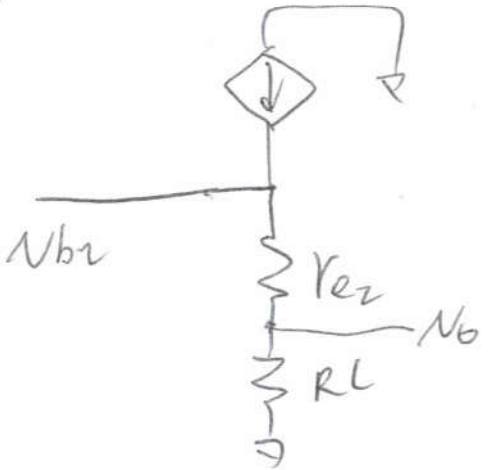


$V_{B1} = 2.5 - 0.5M \cdot I_{B1} =$

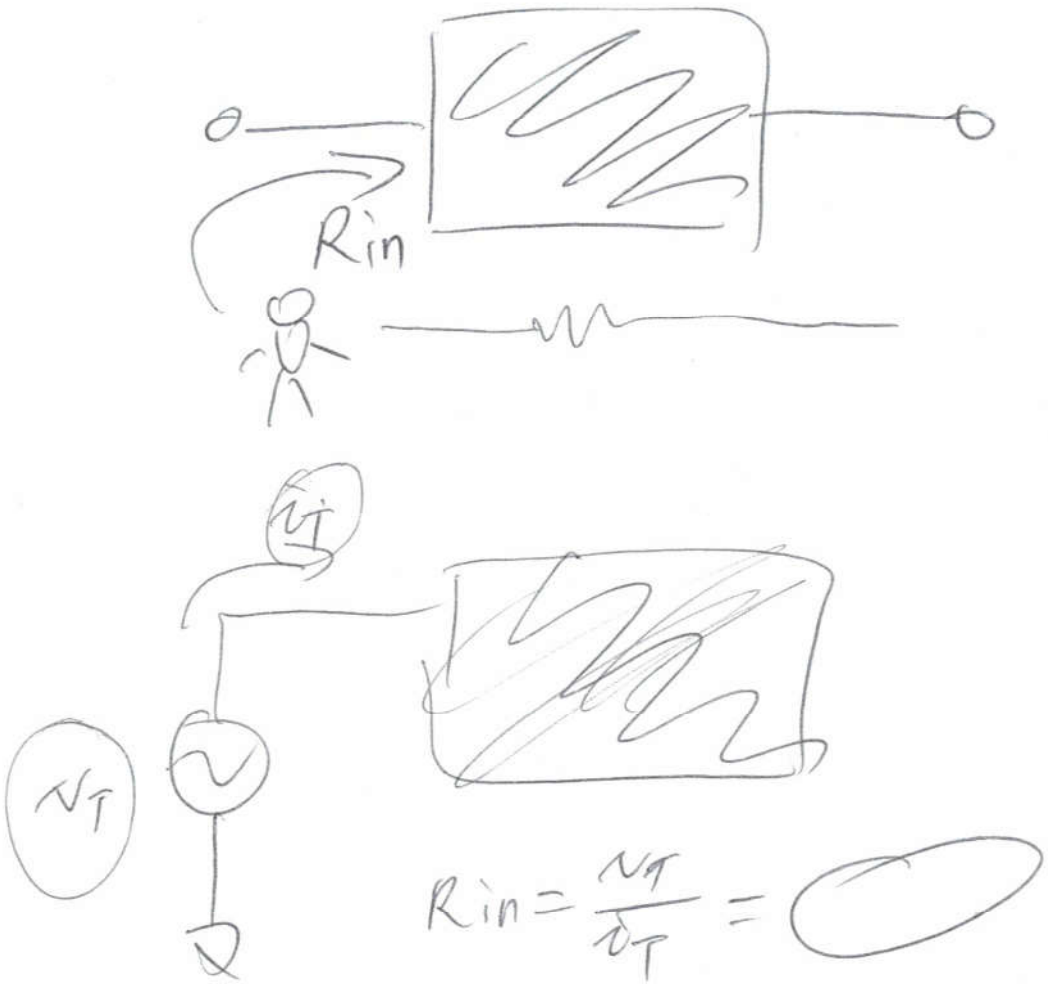
$I_{B1} = \frac{I_{E1}}{\beta + 1} =$

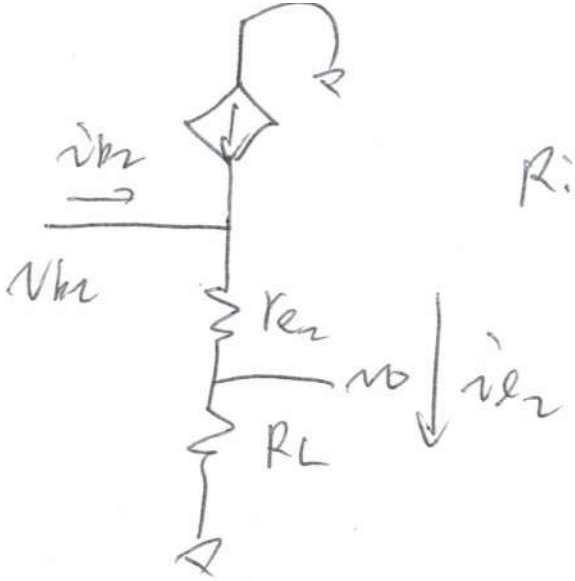
$V_{B2} = V_{B1} - 0.7V =$

(2) if we have a RL, ~~$\frac{v_o}{v_{in}}$~~ $\frac{v_o}{v_{in}}$? R_{ib2} ?



$$\begin{cases} \frac{v_o}{v_{in}} = \frac{R_L}{r_{e2} \| R_L} \\ \text{(R)}.\ r_{e2} = \frac{V_T}{I_{B2}} \end{cases}$$

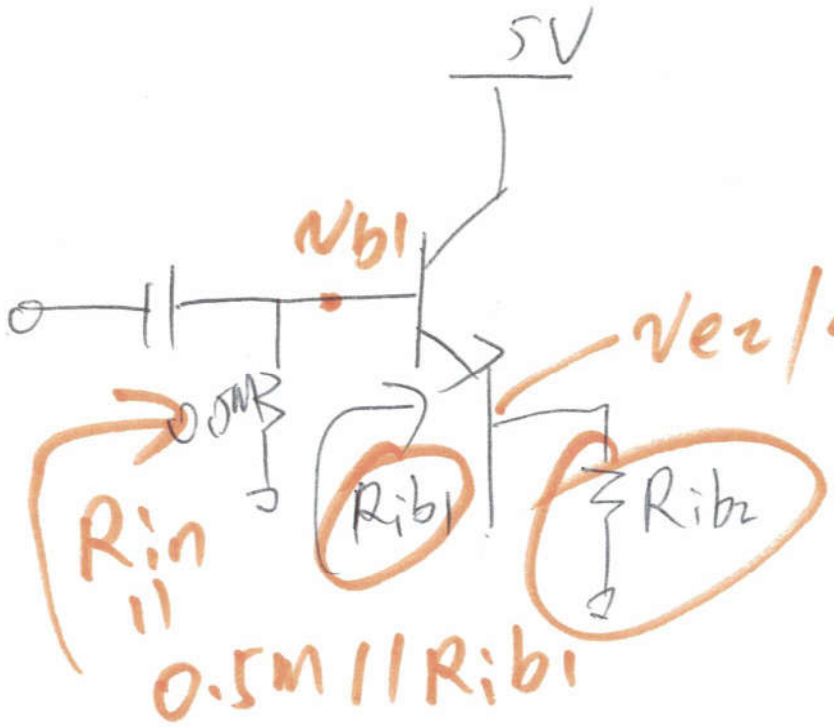

R_{in}
v_T
v_T
$R_{in} = \frac{v_T}{i_T} =$



$$R_{ib2} = \frac{v_{b2}}{i_{b2}} = \frac{v_{b2}}{\left(\frac{v_{e2}}{1+\beta_2}\right)} = \frac{v_{b2}}{i_{e2}}(1+\beta_2)$$

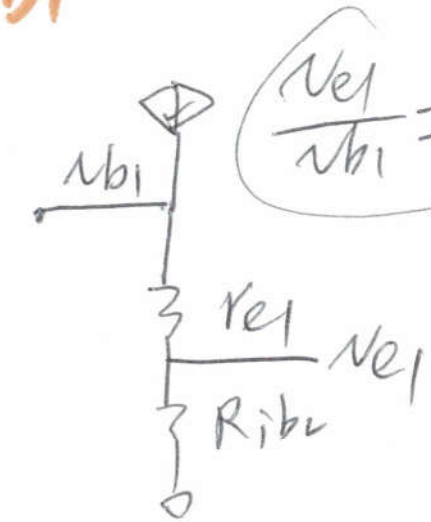
$$r_{e2} + R_L$$

$$v_{e2} = \frac{v_y}{2}$$



(3)

$$v_{e2}/v_{b1} =$$



$$\frac{v_{e1}}{v_{b1}} = \frac{R_{ib2}}{r_{e1}+R_{ib2}}$$

(4) The overall gain

$$\frac{v_o}{v_i} = \frac{v_{e2}}{v_{b2}} \cdot \frac{v_{e1}}{v_i} = \frac{v_{e2}}{v_i} = \frac{v_o}{v_i}$$