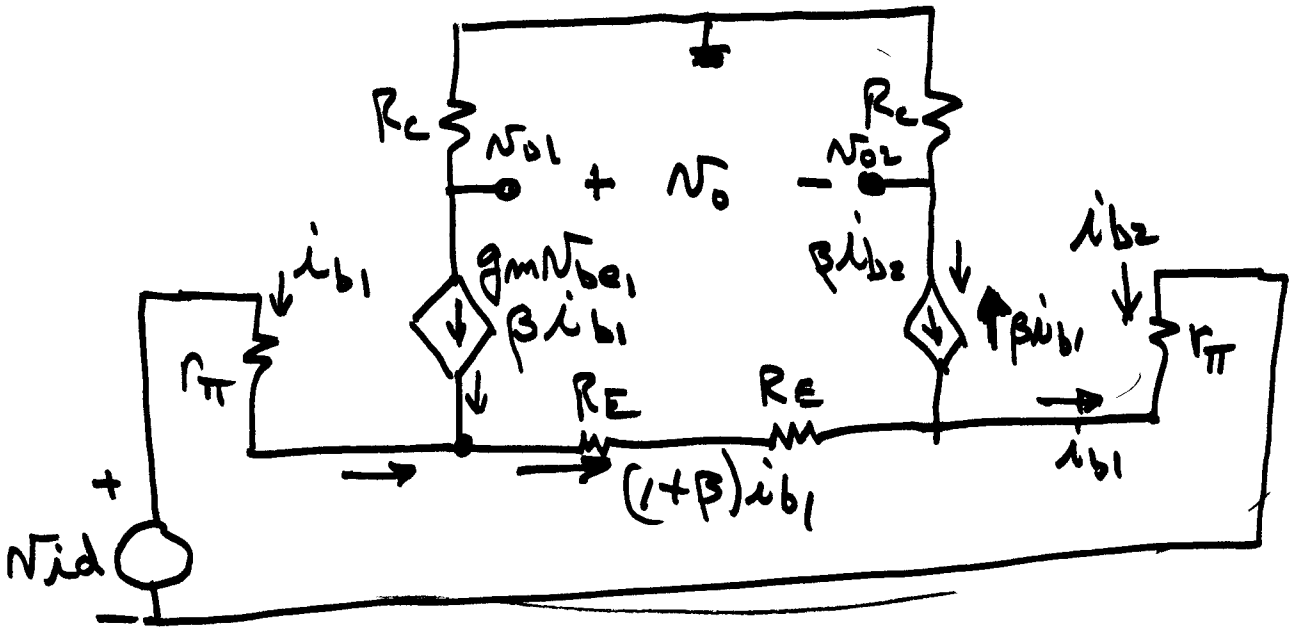


$$v_{id} = v_{i1} - v_{i2}$$

$$v_{o1} = -\beta i_{b1} R_C \qquad v_{o2} = -\beta i_b R_C$$

$$v_o = v_{o1} - v_{o2} = -2\beta i_{b1} R_C$$

$$i_2 = -i_{b1}$$

$$A_{vd} = \frac{v_o}{v_{id}}$$

$$\frac{v_o}{v_{id}} = \frac{-2\beta i_{b1} R_C}{i_{b1} R_{in}}$$

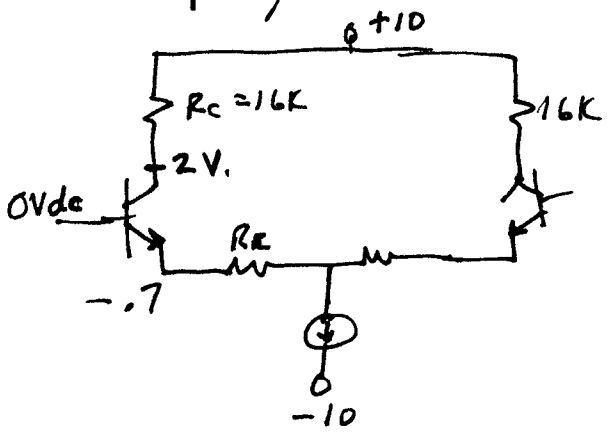
$$i_{b1} = \frac{v_{id}}{R_{in}}$$

$$A_{vd} = \frac{-2\beta R_C}{2\left(r_\pi + (1+\beta)R_E\right)} = \frac{-2\beta R_C}{R_{in}}$$

If $R_E = 0$

$$A_{vd} = -\frac{\beta R_C}{r_\pi} \qquad r_\pi = \frac{\beta V_T}{I_{cq}} \qquad = -\frac{I_{cq} R_C}{V_T}$$

Design for $R_{in} = 25K$



$\beta = 100$

$$A_v = \frac{-\beta R_c}{r_\pi + (\beta+1)R_E}$$

$$r_\pi \simeq \frac{\beta V_T}{I_{CQ}}$$

$$R_{in} = 2\left(r_\pi + (\beta+1)R_E\right) = 25K$$

Let $V_c = 2V. \Rightarrow I_c R_c = 10-2 = 8V.$

$$A_v = \frac{-2\beta R_c}{R_{in}}$$

Let $I_c = 0.5mA \rightarrow R_c = \frac{8}{.5} = 16K$

$$r_\pi = \frac{\beta V_T}{I_c} = \frac{100(.026)}{.5} \simeq 5.2K$$

$$2\left(r_\pi + (\beta+1)R_E\right) = 25K$$

$$R_E = \frac{\frac{25}{2} - r_\pi}{\beta+1} = \frac{12.5 - 5.2}{101} = 72.3\,\Omega$$

$$A_v = -\frac{2\beta R_c}{R_{in}} = -\frac{200(16)}{25} = -128$$