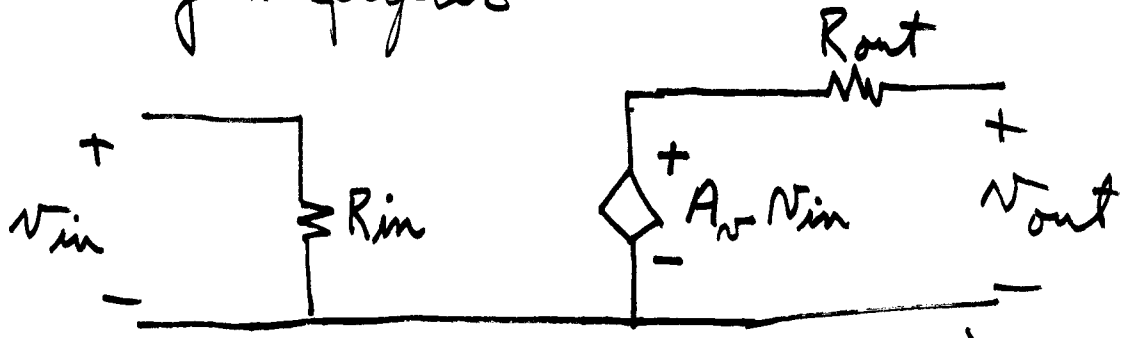
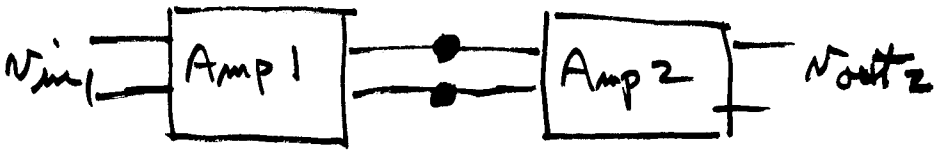
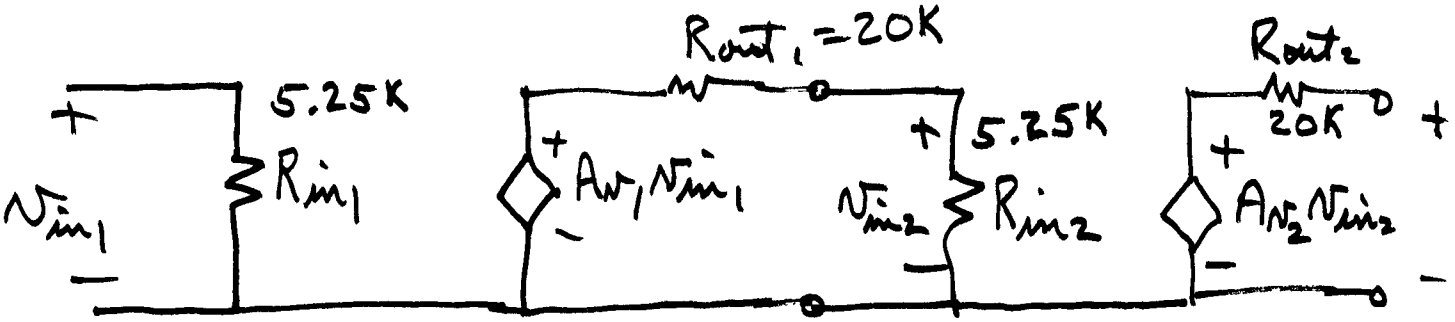
Any Amplifier



$A_v V_{in} = (-381) V_{in}$

V_{in} (in this case) $= V_{i_1} - V_{i_2}$



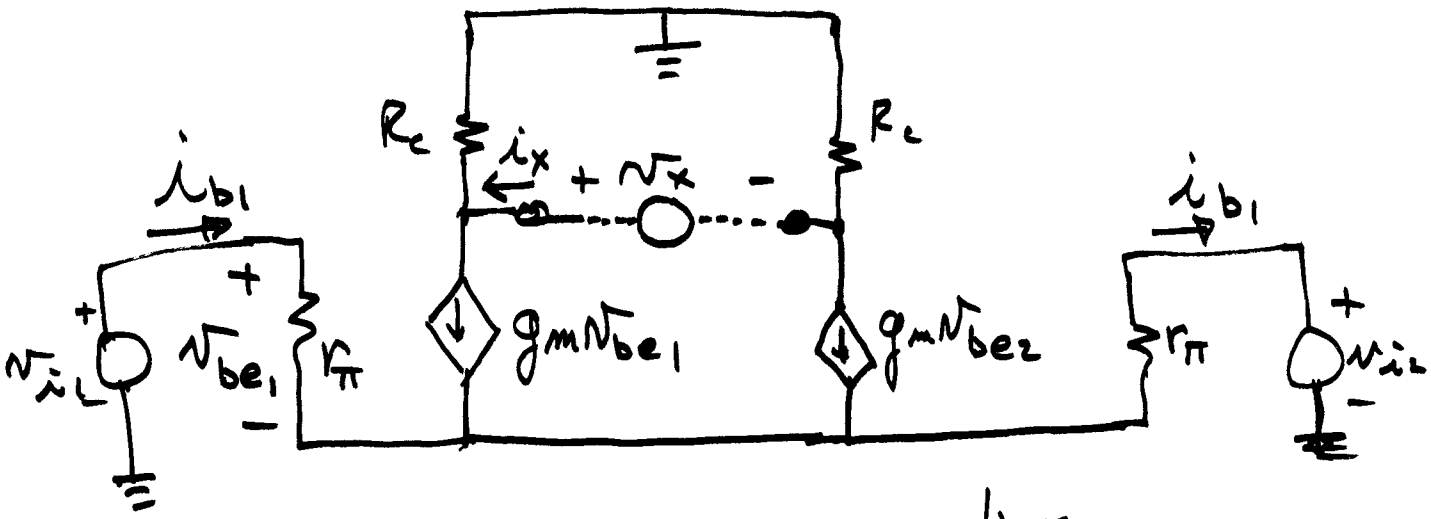


$A_{V_1} = A_{V_2} = -381$

$$V_{in_2} = (A_{V_1} V_{in_1}) \left[\frac{5.25K}{25.25K} \right]$$

$$\frac{V_{in_2}}{V_{in_1}} = -79 = \frac{V_{o1}}{V_{in}}$$

$$\frac{V_{o2}}{V_{in_1}} = (-79)(-381) \approx 30{,}000$$



$$R_{in} = \frac{v_{i1} - v_{i2}}{i_{b1}}$$

$$i_{b1} = \frac{v_{i1} - v_{i2}}{2 r_\pi}$$

KVL

$$v_{i1} - v_{i2} = i_{b1} r_\pi + i_{b1} r_\pi$$

$$= i_{b1}(2 r_\pi)$$

$$R_{in} = 2 r_\pi$$

FROM THE EXAMPLE:

$$r_\pi = \frac{\beta V_T}{I_{CQ}} = \frac{100(.026)}{.99 mA} = 2.63 \; K\Omega$$

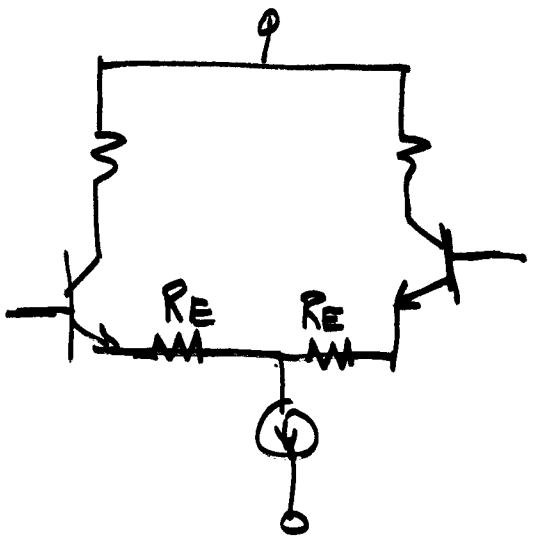
$$R_{in} = 5.25 \; K\Omega$$

R_{OUT}: APPLY VOLTAGE v_x; LET $v_{i1} = v_{i2} = 0$

$$R_{OUT} = \frac{v_x}{i_x} = 2R_c$$

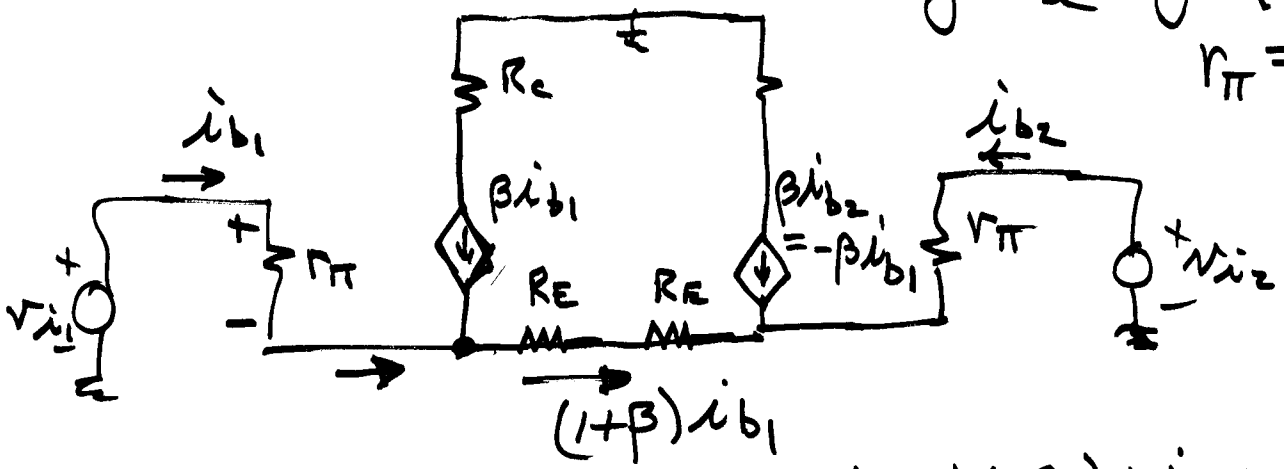
... EXAMPLE: $2R_c = 20K$

TO GET HIGHER R_{in} :



$$g_m V_{be} = g_m (i_b r_\pi) = \beta i_b$$

$$r_\pi = \frac{\beta}{g_m}$$



KVL: $v_{i1} - v_{i2} = i_b r_\pi + i_b (1+\beta)(2R_E) + i_b r_\pi$

$$= i_b \left[2 \left(r_\pi + (1+\beta) R_E \right] \right.$$

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