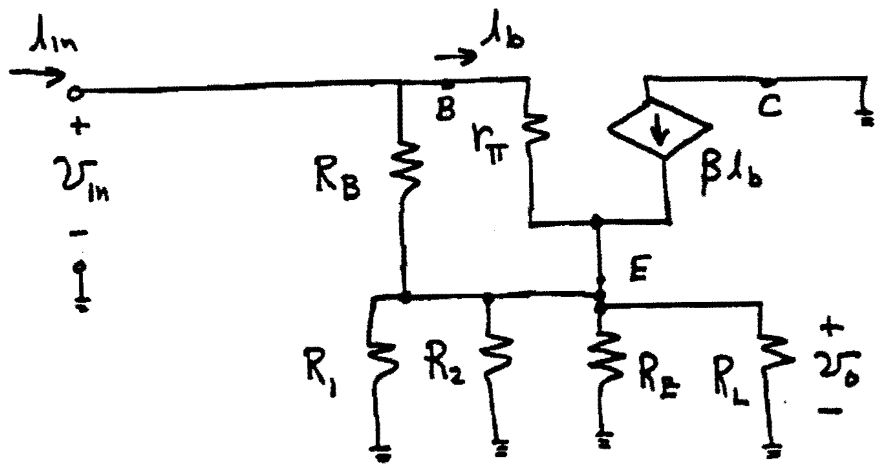
Problem 4.56



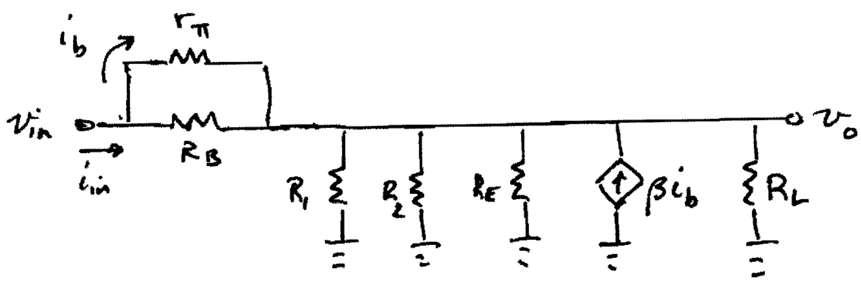
Let $R_L' = R_1 || R_2 || R_E || R_L$

$$v_o = R_L'\left(i_b + \beta i_b + \frac{r_\pi i_b}{R_B}\right) \qquad v_{in} = r_\pi i_b + v_o$$

$$A_v = \frac{v_o}{v_{in}} = \frac{R_L'\left(1 + \beta + \frac{r_\pi}{R_B}\right)}{r_\pi + R_L'\left(1 + \beta + \frac{r_\pi}{R_B}\right)}$$

$$i_{in} = \frac{v_{in} - v_o}{R_B || r_\pi} = \frac{v_{in} - A_v v_{in}}{R_B || r_\pi} \qquad z_{in} = \frac{v_{in}}{i_{in}} = \frac{R_B || r_\pi}{1 - A_v}$$

ANOTHER VIEW OF THE SMALL SIGNAL MODEL THAT IS (PERHAPS) EASIER TO ANALYZE:

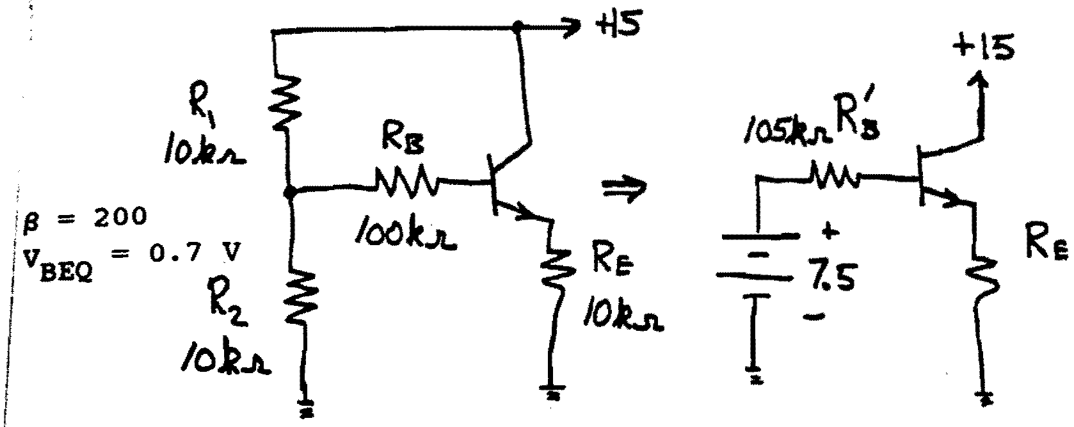


Problem 4.57

See ~~the next page~~ below for the dc equivalent circuit from which we have:

$$I_{BQ} = (7.5 - V_{BEQ})/[R'_B + (\beta + 1)R_E] = 3.21\ \mu A$$

$$I_{CQ} = \beta I_{BQ} = 0.643\ mA \qquad r_\pi = \beta V_T/I_{CQ} = 8.09\ k\Omega$$

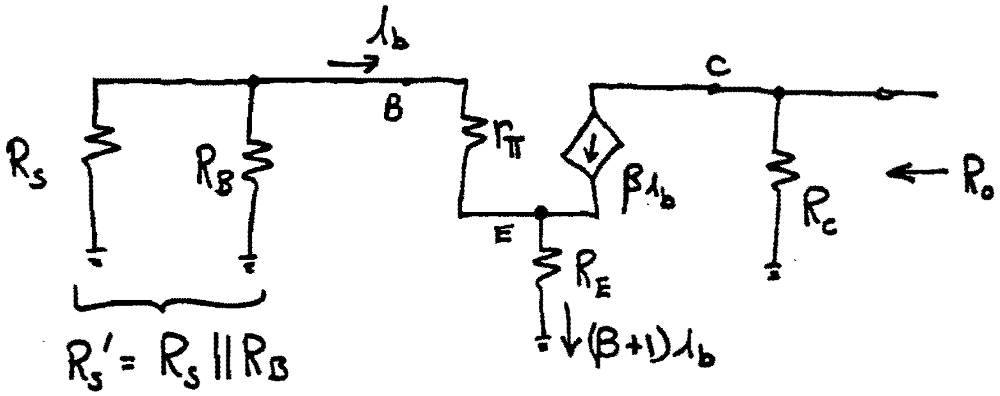


Then using the formulas from Problem 4.56, we have:

$$R'_L = R_1||R_2||R_E||R_L = 1.95\ k\Omega$$

$$A_v = 0.9798 \qquad Z_{in} = 370\ k\Omega$$

Problem 4.55



$$R'_S i_b + r_\pi i_b + (\beta + 1)R_E i_b = 0 \quad \Rightarrow \quad i_b = 0$$

Therefore we conclude that the βi_b acts as an open circuit and we have $R_o = R_C$.