PH3104 Problem Set 7

Q 1) Using the Ebers-Moll model sketch the input and output charactersitics for a pnp transistor in the CB mode. Use the parameters

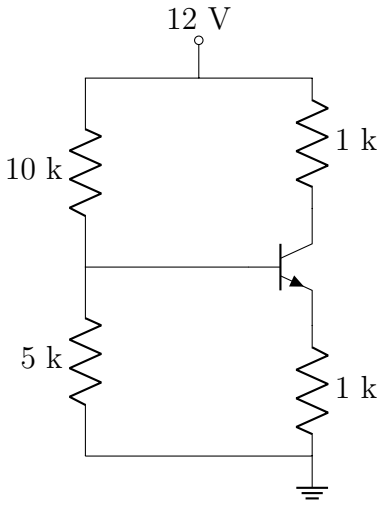
$$\alpha_F = 0.97, \alpha_R = 0.78,\ I_{ES} = 1.0 \times 10^{-15}\text{A}$$

(For an ideal transistor we have a relation $\alpha_F I_{ES} = \alpha_R I_{CS}$ - this should give you the other parameter). To plot the output characteristics you will have to rewrite the Ebers-Moll equations to express I_C in terms of I_E and V_{CB}.

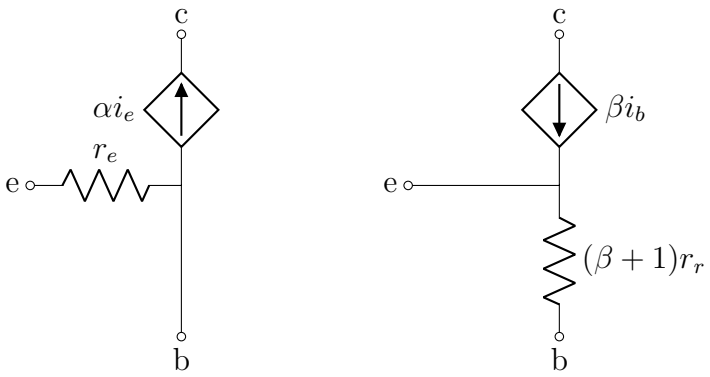
Be careful to choose the right range (and sign) of voltage and current values while plotting. Your plot should cover both the active and and saturation regions.

Q 2) For the transistor above determine the value of V_{CE} where the collector current vanishes for $I_B = 10\,\mu\text{A}$ and $I_B = 50\,\mu\text{A}$, respectively.

Q 3) Consider the approximate model for the transistor in the active region. Take $V_\gamma = 0.7\,\text{V}$ and $\beta = 100$. Determine the voltages V_{BE}, V_{CE} and currents I_B, I_C for the circuit below



Q 4) Prove that the two approximate ac models of the npn BJT shown below are equivalent



where

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