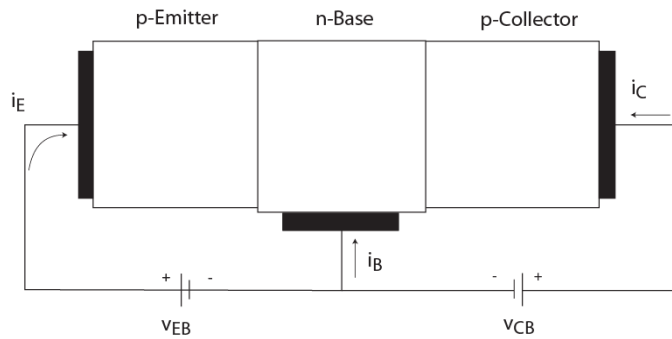


## Tutorial #9

## Problem 1 pnp Bipolar Junction Transistor

**Parameters for pnp BJT:**

$$N_{aE} = 10^{18} \text{ cm}^{-3} \quad N_{dB} = 10^{16} \text{ cm}^{-3}$$

$$N_{aC} = 10^{15} \text{ cm}^{-3} \quad D_{nE} = 20 \text{ cm}^2/\text{s}$$

$$D_{nC} = 30 \text{ cm}^2/\text{s} \quad D_{pB} = 10 \text{ cm}^2/\text{s}$$

$$A_E = 100 \text{ } \mu\text{m}^2 \quad L_B = 1.0 \text{ } \mu\text{m}$$

$$L_E = 2.0 \text{ } \mu\text{m} \quad L_C = 3.0 \text{ } \mu\text{m}$$

- $L_E$  and  $L_C$  are the distances between the contacts and the abrupt junctions.  $L_B$  is the distance between the base-emitter and base-collector abrupt junctions. **Note that  $L_E$ ,  $L_B$  and  $L_C$  are not widths of the quasi-neutral regions in the Emitter, Base and Collector.**
  - Assume that recombination only occurs at the contacts and that there is no recombination in the quasi-neutral regions or the space charge regions.
- a) What are the thermal equilibrium values of the potential barrier for the base-emitter ( $\phi_{BE}$ ) and base-collector ( $\phi_{BC}$ ) junctions?
  - b) What is the width of the quasi-neutral base region,  $W_B$  at equilibrium?
  - c) What is  $\beta_F$  (ignore the effect of the depletion region under forward bias for this calculation)?

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