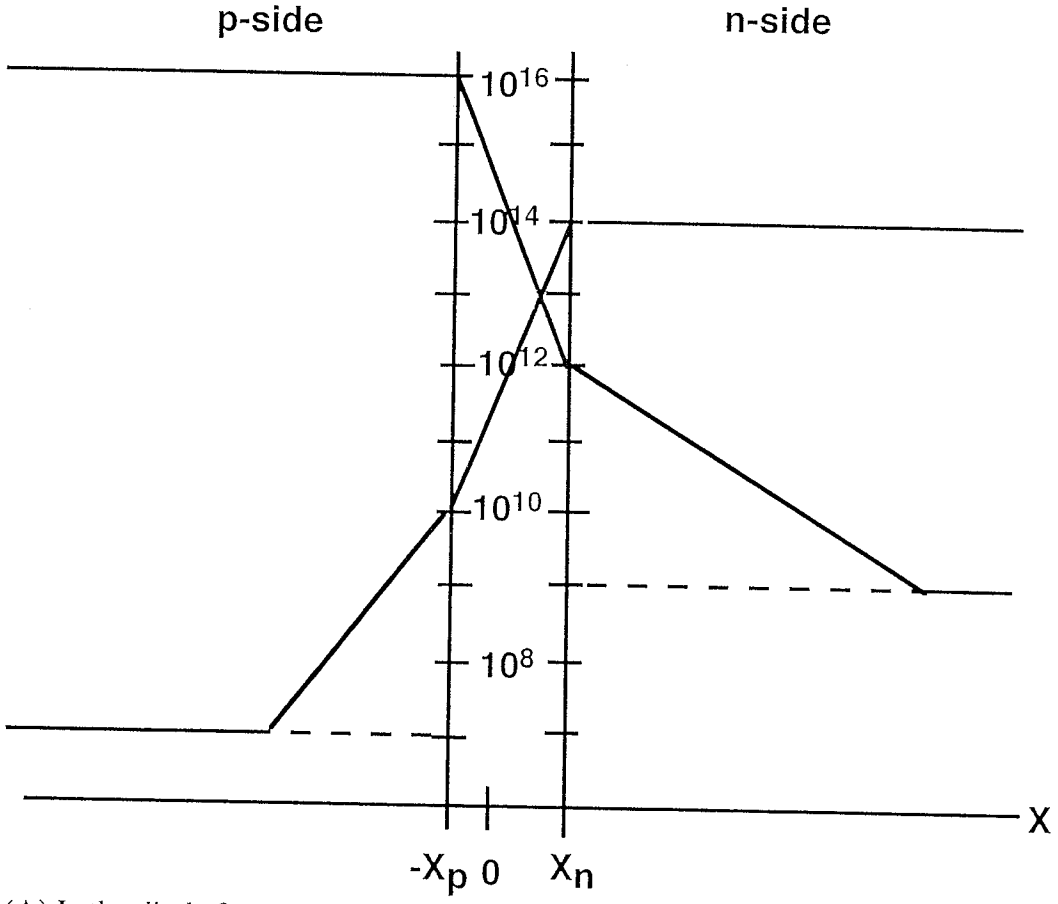
(24 pts). 1. The electron and hole concentrations are shown everywhere in a pn-junction diode. Note kT = 0.026 eV and $\ln(10^3) = 6.9$



(3 pts) (A) Is the diode forward or reverse biased? Explain how you made your determination

(3 pts) (B) What is the acceptor doping concentration on the p-side?

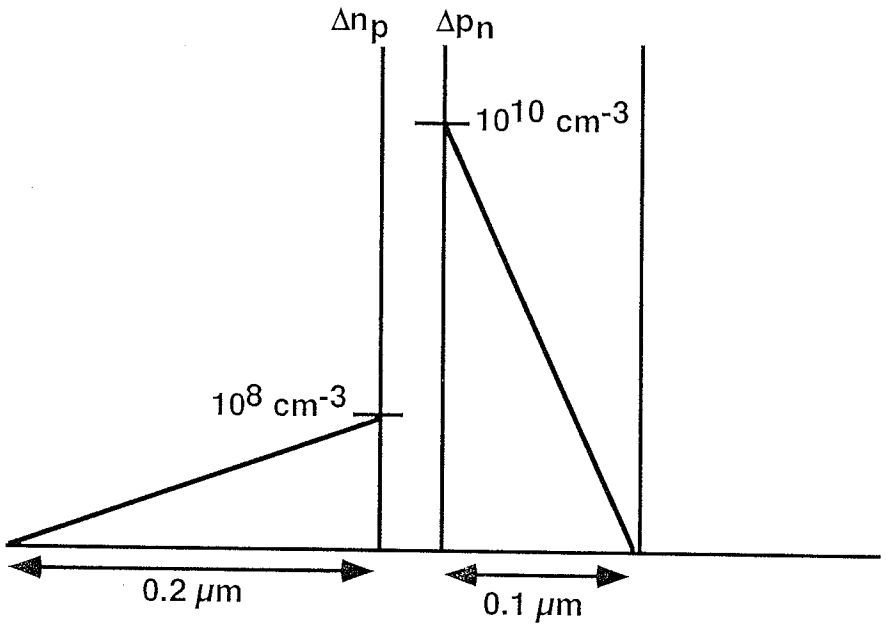
(3 pts) (C) what is the donor doping concentration on the n-side?

(5 pts) (D) What is the intrinsic carrier concentration?

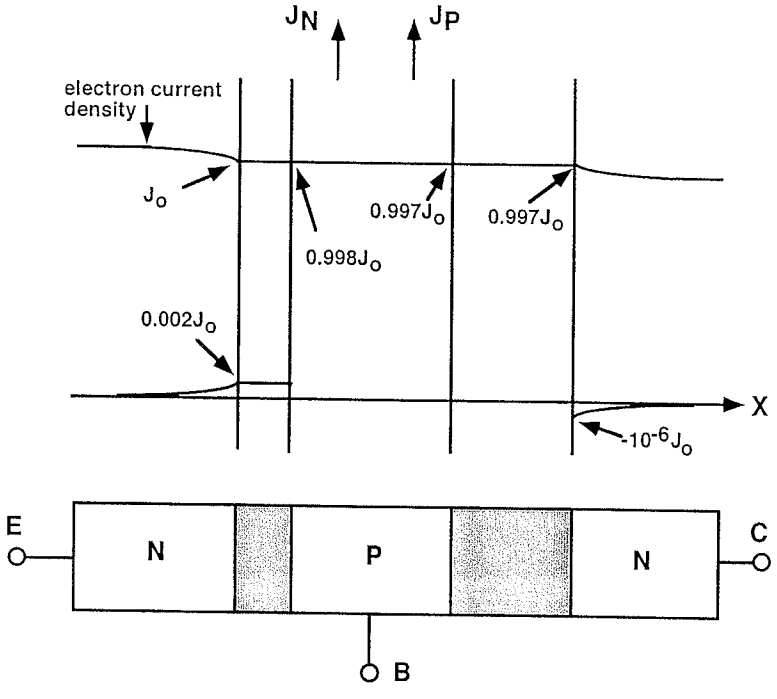
(5 pts) (E) Do low-level injection conditions hold in the neutral regions? Explain how you draw your conclusion.

(5 pts) (F) What is the bias applied to the diode?

(25 pts) 2. Shown is the distribution of excess minority carriers in the emitter and base of a BJT. The emitter region is also very short compared to a diffusion length hence the similar carrier profiles in the emitter and base regions. No recombination occurs in the emitter-base depletion region. If the diffusion coefficent for holes in the base is Dp = 12 cm^2/s and for electrons in the emitter is Dn = 36 cm^2/s, what is the β of this transistor? ($1\mu m = 1x10^{-6}$ m).



(28 pts) 3. The electron and hole current densities in a BJT biased in the forward-active mode are plotted below.



(7 pts) (A) Determine the base transport factor

(7 pts) (B) Determine the emitter injection efficiency

(7 pts) (C) What is the base current?

(7 pts) (D) Determine the beta of the transistor

(23 pts) 4. Explain how current gain is obtained from a BJT.