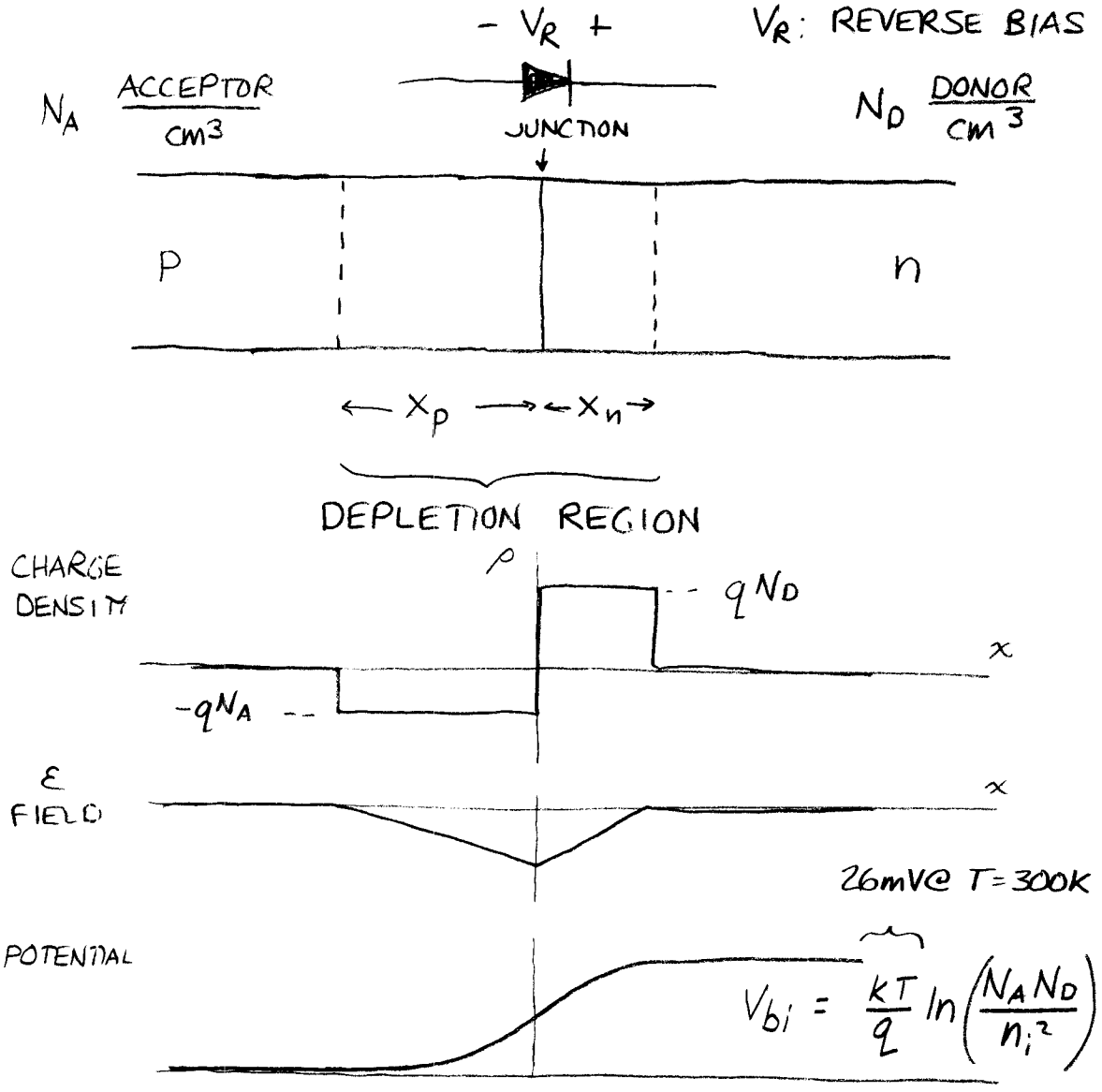
# P-N JUNCTION DEPLETION REGION

$V_R$: REVERSE BIAS




FOR STEP JUNCTION

$n_i = 1E+10 \ /cm^3$ FOR Si @ T=300K

$$X_n = \sqrt{\frac{2 K_s \varepsilon_o (V_{bi} + V_R)}{q_e} \frac{N_A}{N_D (N_A + N_D)}} \quad [1]$$

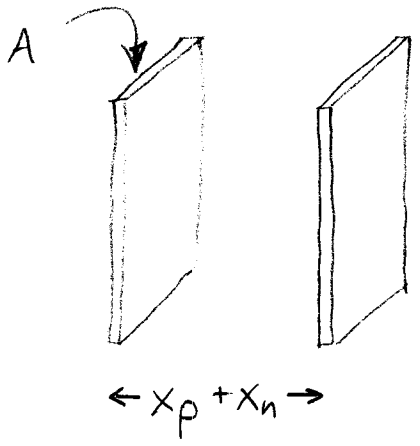
$$X_p = \sqrt{\frac{2 K_s \varepsilon_o (V_{bi} + V_R)}{q_e} \frac{N_D}{N_A (N_A + N_D)}} \quad [2]$$

$\varepsilon_o = 8,85\ E-14$ F/cm

$K_s = 11.8$ FOR Si

$q_e = 1,6\ E-19$ coul

# PARALLEL PLATE CAPACITANCE (small signal)




$$C_{J(TOTAL)} = \underbrace{\epsilon}_{K_S \varepsilon_0 \text{ (Si)}} \frac{A}{d} \quad \begin{matrix} \} \text{ JUNCTION AREA} \\ \} X_p + X_n \end{matrix}$$

$$C_j \text{ PER UNIT AREA} = \frac{\epsilon}{d} = \frac{K_S \varepsilon_0}{(X_p + X_n)}$$

SUBSTITUTING FROM $X_p, X_n$ EQUATIONS [1], [2]

$$C_j = \sqrt{\frac{q_e K_S \varepsilon_0}{2(V_{bi} + V_R)} \frac{N_A N_D}{(N_A + N_D)}} \qquad [3]$$

NOTE IF $N_D >> N_A$ THEN [3] SIMPLIFIES TO

$$\boxed{C_j \approx \sqrt{\frac{q_e K_S \varepsilon_0}{2(V_{bi} + V_R)} N_A} \qquad [3A]}$$

DEPENDS ONLY ON LIGHTLY DOPED REGION