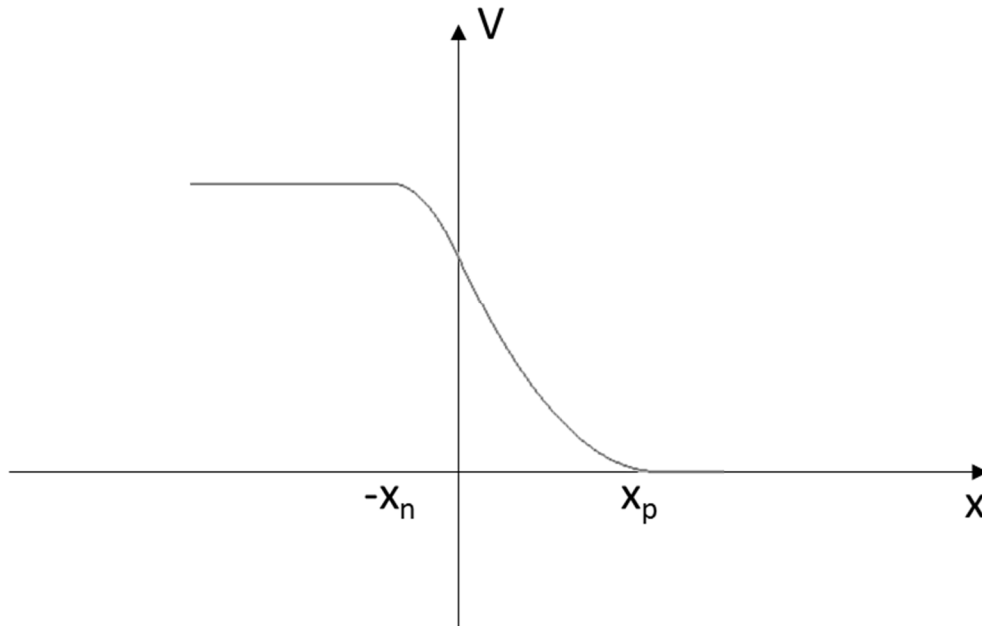
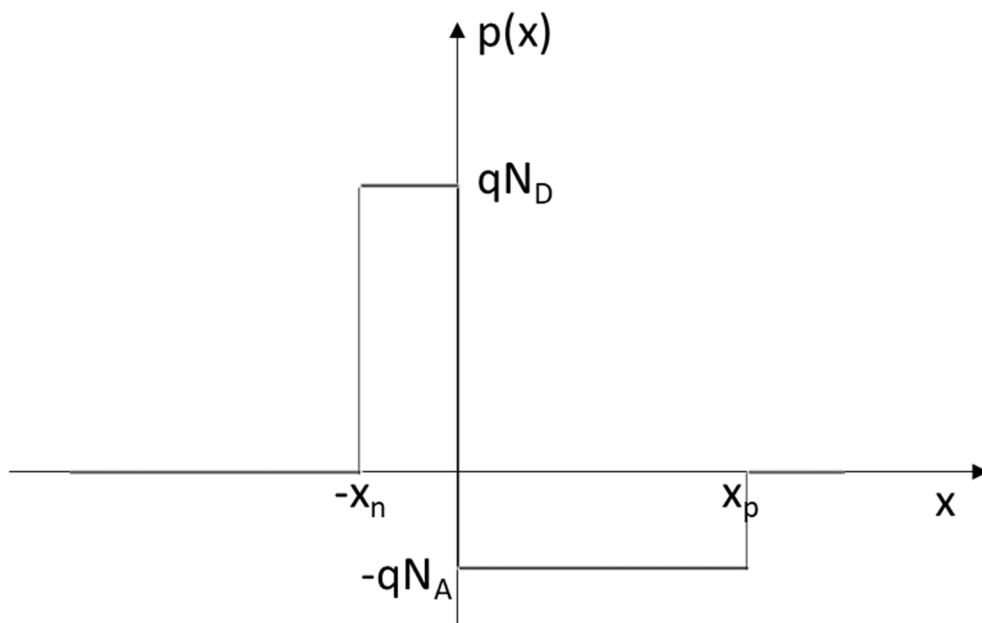


ECE 305 Spring 2018
Homework 5 Solution

1. a)



b



c)

$$V_{bi} = \frac{kT}{q} \ln \left(\frac{N_D N_A}{n_i^2} \right) = 0.026 \ln \left(\frac{3 \times 10^{16} \times 10^{16}}{10^{20}} \right) = 0.75 \text{ V}$$

d)

$$W = \sqrt{\frac{2K_s \epsilon_0 V_{bi}}{q} \left(\frac{N_A + N_D}{N_A N_D} \right)} = 0.3614 \text{ } \mu\text{m}$$

$$\frac{x_n}{x_p} = \frac{N_A}{N_D} = \frac{1}{3}$$

$$x_n = \frac{1}{4} \times W = 0.09 \text{ } \mu\text{m}$$

$$x_p = \frac{3}{4} \times W = 0.27 \text{ } \mu\text{m}$$

e)

$$V_{bi} = 0.5 \text{ W } \epsilon(0)$$

$$\epsilon(0) = 2 \frac{V_{bi}}{W} = 2 \frac{0.75}{0.3614 \times 10^{-4}} \text{ V/cm}$$

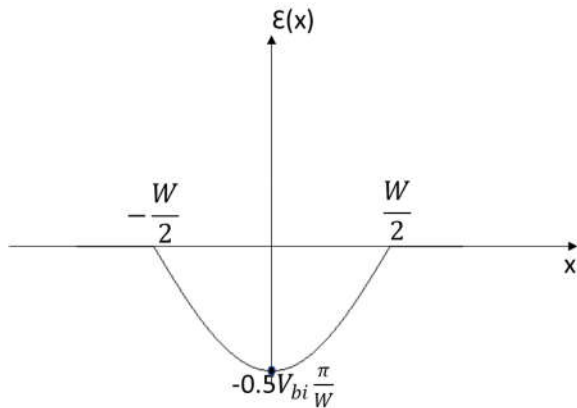
$$= 4.15 \times 10^4 \text{ V/cm}$$

2.

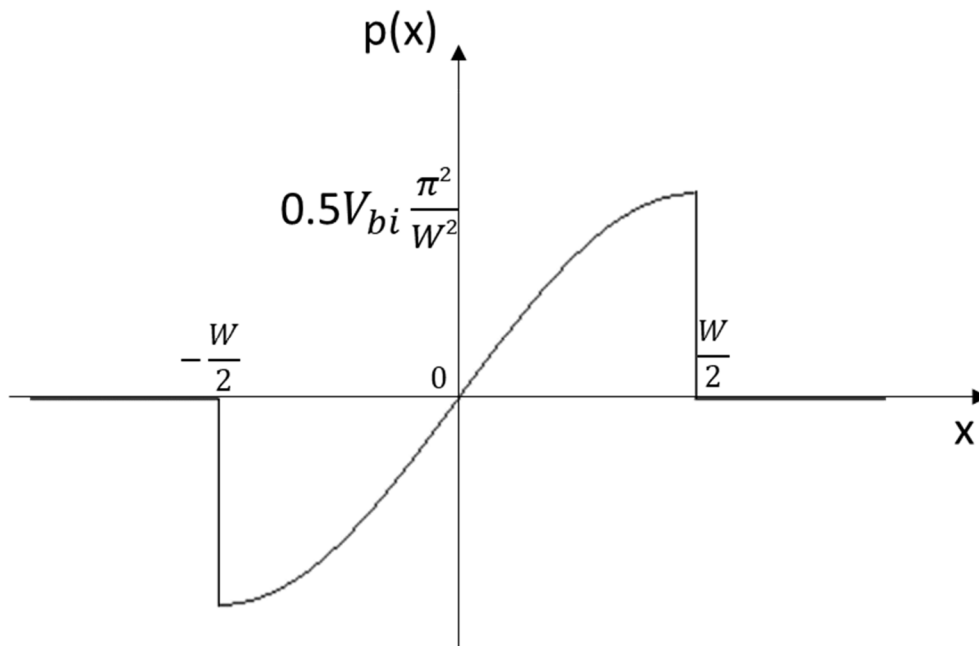
a)

$$\epsilon(x) = \frac{dV}{dx} = -0.5 V_{bi} \frac{\pi}{W} \cos\left(\frac{\pi}{W} x\right)$$

b)



c) Charge density should be multiplied by $q/(K_s\epsilon_o)$



d) $N_D - N_A = p(x)/q = 1/q \frac{dE}{dx} = 0.5 \frac{V_{bi}}{K_s\epsilon_o} \frac{\pi^2}{W^2} \sin\left(\frac{\pi x}{W}\right)$

e) Should be multiplied by $q/(K_s\epsilon_o)$

