

ECEn 450, Winter 2010
Homework # 10
Due March 16, 5:00 pm

From the text Semiconductor Devices, Physics and Technology, do the following problems:

Chapter 7, problems 1, 6

Chapter 3, problems 20

Chapter 12, problems 12, 16

Also complete the following problems:

10.1 (a) Consider a Schottky diode at $T = 300\text{K}$ formed with tungsten on n-type silicon. Let $N_D = 5 \times 10^{15} \text{ cm}^{-3}$ and assume a cross-sectional area of $A = 5 \times 10^{-4} \text{ cm}^2$. Determine the forward-bias voltage required to obtain a current of 1 mA, 10 mA, and 100 mA. (b) Repeat part (a) if the temperature is increased to $T = 400 \text{ K}$.

10.2 The reverse saturation current densities in a pn junction diode and a Schottky diode are $5 \times 10^{-12} \text{ A/cm}^2$ and $7 \times 10^{-8} \text{ A/cm}^2$, respectively, at $T=300\text{K}$. The cross-sectional area of the pn junction diode is $A = 8 \times 10^{-4} \text{ cm}^2$. Determine the cross-sectional area of the Schottky diode so that the difference in forward-bias voltages to achieve 1.2 mA is 0.265 V.

Homework Helps and Hints:

12.12 For ideal gas, the gas constant is different for different unit systems.

Gas Constant

8.314472 (J)(K ⁻¹)(mol ⁻¹)
0.08205746 (L)(atm)(K ⁻¹)(mol ⁻¹)
62.3637 (L)(torr)(K ⁻¹)(mol ⁻¹)
1.987 (cal)(K ⁻¹)(mol ⁻¹)

$$1\text{atm} = 1.01325 \times 10^5 \text{ Pa} = 760\text{mmHg} = 760\text{Torr}$$

10.1 Refer to Fig 3 on P.227 for barrier height Φ_{Bn}