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Courses » Semiconductor Devices and Circuits

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Unit 7 - Week 6 : PN Junction

Course outline

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Assignment 6

The due date for submitting this assignment has passed.
As per our records you have not submitted this assignment.

Due on 2018-09-12, 23:59 IST.

Note: Use thermal voltage = 0.026 V at 300 K.

1) While analysing the electrostatics of an ideal PN junction, we used "depletion approximation". What does this approximation mean? ***1 point***

- The term refers to an undoped region near the PN junction.
- The term refers to a region near the PN junction where the electron and hole concentrations are much less than the intrinsic carrier concentration.
- The term refers to a region near the PN junction where the electron and hole concentrations are much less than the doping densities.
- None of the above

No, the answer is incorrect.
Score: 0

Accepted Answers:
The term refers to a region near the PN junction where the electron and hole concentrations are much le than the doping densities.

2) Consider an ideal silicon PN junction at $T = 300\ K$ with doping densities $N_A = 10^{17}\ /cc$ and $N_D = 10^{15}\ /cc$. Assume intrinsic carrier concentration, $n_i = 10^{10}\ /cc$. Calculate the built-in potential in the junction. ***1 point***

- 0.56 V
- 0.9 V
- 0.25 V
- 0.72 V

$43.7\,\mu A$

$12.5\,\mu A$

$22.5\,nA$

$105.5\,\mu A$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$43.7\,\mu A$

4) Assume an ideal PN junction with the doping density in P-side is higher compared to that in n-side. Which of the following comments is correct regarding the spread of the depletion region in n and p sides. ***1 point***

- Depletion region is extended more inside p-doped region compared to n-doped region.
- Depletion region is extended more inside n-doped region compared to p-doped region.
- Depletion region is extended equally inside n and p doped regions.
- Depletion widths inside both n and p doped regions become zero at thermal equilibrium.

No, the answer is incorrect.
Score: 0

Accepted Answers:
Depletion region is extended more inside n-doped region compared to p-doped region.

5) The magnitude of the current through a practical PN junction diode, which is subjected to a low reverse bias, is observed to increase slowly with the increase in applied voltage in the reverse direction. Which one of the following is the most possible reason for this non-ideal behavior? ***1 point***

- Recombination of electron-hole pairs in the depletion region.
- Impact of series resistance.
- High level injection of minority carriers that surpass the background doping concentration.
- Generation of electron-hole pairs in the depletion region.

No, the answer is incorrect.
Score: 0

Accepted Answers:
Generation of electron-hole pairs in the depletion region.

6) Consider an ideal Si PN junction diode with $N_a = 10^{18}\ cm^{-3}$ and $N_d = 10^{16}\ cm^{-3}$. The layout area of the diode is $10^{-4}\ cm^2$. Calculate the junction capacitance (depletion capacitance) at $T = 300\ K$. ***1 point***
Assume $n_i = 10^{10}\ cm^{-3}$ and the dielectric constant of Si $= 11.8$.

- 12.56 pF
- 35.6 nF
- 3.14 pF
- 1.05 pF

No, the answer is incorrect.
Score: 0

Accepted Answers:
3.14 pF

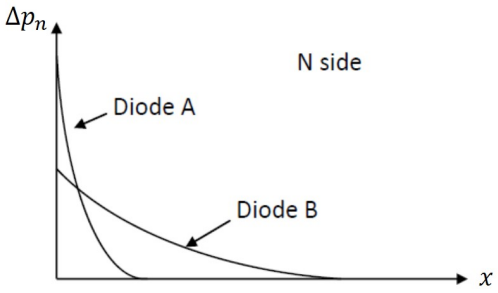
7) An ideal PN junction diode is forward biased moderately such that the applied bias is much greater than the thermal voltage. How much voltage is needed to increase the diode current by a factor of 10 at $T = 300\ K$? ***1 point***

- 26 mV
- 60 mV
- 85 mV
- 120 mV

No, the answer is incorrect.
Score: 0

Accepted Answers:
60 mV

8) Following figure shows the spatial distribution of excess minority carrier (hole) concentration on the n-side of two ideal P^+N diodes A and B maintained at the room temperature. ***1 point***



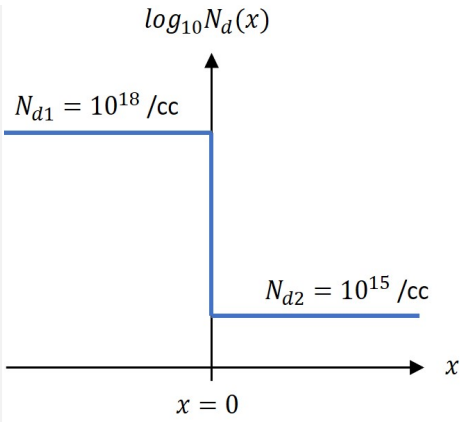
Assume low-level injection condition prevails. The P-side doping, N-side doping, the cross-sectional area and the hole mobility are the same in both the diodes. Which of the following statements is **NOT** correct?

- Both the junctions are forward biased.
- Diode A has a higher applied bias.
- Diode A has a higher minority carrier (hole) lifetime.
- Diode A has a higher current.

No, the answer is incorrect.
Score: 0

Accepted Answers:
Diode A has a higher minority carrier (hole) lifetime.

9) Semiconductor devices often contain "high-low" junctions for which the doping density changes magnitude, but not sign. The figure below shows such a high-low step junction. ***1 point***



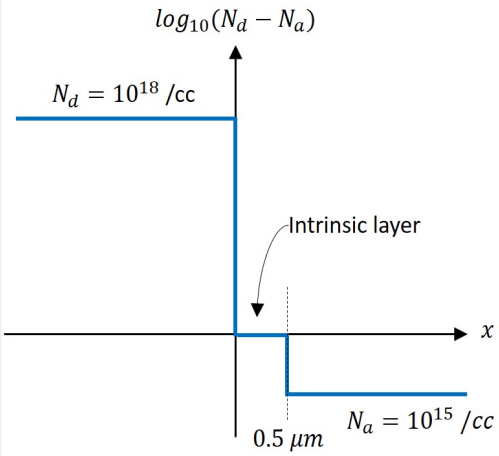
Calculate the built-in potential of the above high-low junction at $T = 300\ K$

- 0 V
- 0.026 V
- 0.18 V
- 0.39 V

No, the answer is incorrect.
Score: 0

Accepted Answers:
0.18 V

10) The figure below shows the doping profile in a PN junction diode, where a thin intrinsic layer is inserted at the junction. ***1 point***



Calculate the total depletion width at $T = 300\ K$.
Assume the depletion approximation and the dielectric constant of the material $= 11.8$.

- $0.7\ \mu m$
- $25.1\ \mu m$
- $5.6\ \mu m$
- $0.48\ \mu m$

No, the answer is incorrect.
Score: 0

Accepted Answers:

$0.7\,\mu m$

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