X

NPTEL

reviewer3@nptel.iitm.ac.in ▾

Courses » Semiconductor Devices and Circuits

Announcements Course Ask a Question Progress Mentor FAQ

Unit 4 - Week 3 : Density of States, Fermi Function and Doping

Assignment 3

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

Due on 2018-09-05, 23:59 IST.

1) Given an energy band diagram, how can one find the electric field? *1 point*

- It is proportional to E_C.
- It is proportional to minus E_C.
- It is proportional to the slope of E_C.
- It is proportional to the minus of the slope of E_C.

No, the answer is incorrect.
Score: 0

Accepted Answers:
It is proportional to the slope of E_C.

2) Consider an n-type semiconductor at $0K$ temperature. Where do you expect the Fermi level to be? *1 point*

- Inside the valence band.
- Inside the conduction band.
- Near the middle of the band-gap.
- Between the donor level and the conduction band.

No, the answer is incorrect.
Score: 0

Accepted Answers:
Between the donor level and the conduction band.

ce De

- 0.2 eV
- 0.56 eV
- 0.16 eV
- 0.92 eV

No, the answer is incorrect.
Score: 0

Accepted Answers:
0.92 eV

4) As temperature increases from 0K to high temperature, the carrier concentration goes through three regions. In what order does the transition occur? ***1 point***

- Intrinsic, extrinsic, freezeout
- Freezeout, extrinsic, intrinsic,
- Freezeout, intrinsic, extrinsic
- Intrinsic, freezeout, extrinsic

No, the answer is incorrect.
Score: 0

Accepted Answers:
Freezeout, extrinsic, intrinsic,

5) An intrinsic germanium wafer is doped with a shallow acceptor density of $3n_i/2$, where n_i is the intrinsic carrier concentration. At temperature T, all the acceptors are ionized. Calculate the hole density at temperature T. ***1 point***

- $2n_i$
- $3n_i/2$
- $n_i/2$
- n_i

No, the answer is incorrect.
Score: 0

Accepted Answers:
$2n_i$

6) Under which condition the position of the Fermi level in an intrinsic bulk semiconductor lies exactly at the middle of the band-gap at a non-zero temperature T? ***1 point***

- When effective mass of electrons = effective mass of holes.
- When mobility of electrons > mobility of holes
- When the energy band-gap > 2kT
- Fermi level of an intrinsic semiconductor will always lie at the middle of the band-gap.

No, the answer is incorrect.
Score: 0

Accepted Answers:
When effective mass of electrons = effective mass of holes.

7) Assume two semiconductors A and B have the same effective density of states both at the conduction band edge (N_C) and the valence band edge (N_V). The intrinsic carrier concentration of A ***1 point***

and B at $300K$ are respectively $1.5e10\,cm^{-3}$ and $3.2e7\,cm^{-3}$. What is the band-gap of semiconductor B if the semiconductor A has a band-gap of $1.12\,eV$?

- 1.12 eV
- 1.44 eV
- 1.92 eV
- 0.74 eV

No, the answer is incorrect.
Score: 0

Accepted Answers:
1.44 eV

8) The probability of a state being filled by an electron at energy $E_C - kT$ is equal to the probability of a state being filled by a hole at energy $E_C - 3kT$. Where is the Fermi level located? ***1 point***

- $3kT$ above the valence band edge.
- $3kT$ below the valence band edge.
- $2kT$ above the conduction band edge.
- $2kT$ below the conduction band edge.

No, the answer is incorrect.
Score: 0

Accepted Answers:
$2kT$ below the conduction band edge.

9) A silicon wafer is doped with $10^{16}\,cm^{-3}$ arsenic atoms. The donor level E_d is located at $54\,meV$ below E_C. What percentage of the donor atoms are ionized at $T = 77\,K$? [Assume, $N_C(T = 77K) = 4.2 \times 10^{18}\,cm^{-3}$ and the degeneracy factor of donor level, $g_D = 2$] ***1 point***

- 100 %
- 65.5 %
- 22.3 %
- 10.9 %

No, the answer is incorrect.
Score: 0

Accepted Answers:
22.3 %

10) For a certain semiconductor, the densities of states in the conduction and valence bands are $g_C(E) = A(E - E_C)$ and $g_V(E) = B(E_V - E)$ respectively, where A and B are two non-zero constants. Assume Boltzmann distribution for both types of carrier. Consider the reference potential energy level at the valence band edge, i.e. $E_V = 0$. E_C is the energy at the conduction band edge. If $A = 2B$, compute the intrinsic Fermi energy at $300\,K$. ***1 point***

- $E_C/2 - 9\,meV$
- $E_C/2 + 9\,meV$
- $E_C - 26\,meV$

$E_C + 26\,meV$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$E_C/2 - 9\,meV$

Previous Page End