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Courses » Introduction to Solid State Physics

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Unit 11 - Introductory Semiconductor Physics

Register for Certification exam

Course outline

Assignment 10

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

Due on 2019-04-10, 23:59 IST.

1) The band gap of a semiconducting material is 1.18 eV and it has no impurities . If and the effective masses of hole and electrons are taken to be the same as the free electron mass, the number density of electrons in the conduction band (or the number density of holes in the valence band) of this material at 300K will be of the order of *1 point*

- $10^{15} m^{-3}$
- $10^{19} m^{-3}$
- $10^{23} m^{-3}$
- $10^{29} m^{-3}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$10^{15} m^{-3}$

2) A highly pure germanium sample is at room temperature (300K). If the band gap of germanium is 0.7eV, the temperature at which the conductivity of a sample of germanium is 25% higher than that at the room temperature is close to *1 point*

- 405K
- 305K
- 325K
- 375K

this material will be at about

- -11.3 meV
- -5.6 meV
- -1.3 meV
- -0.7 meV

No, the answer is incorrect.
Score: 0

Accepted Answers:
-0.7 meV

4) In a particular semiconductor, there are $10^{19}\ donors/m^3$ and conduction level is 1 meV below the bottom of the conduction band. If the effective mass of electrons in conduction band is $m_e^* = 0.01 m_e$, the number density of conduction electrons at 2K will be of close to ***1 point***

- $7.8 \times 10^{15} m^{-3}$
- $2.8 \times 10^{16} m^{-3}$
- $5.0 \times 10^{17} m^{-3}$
- $1.2 \times 10^{18} m^{-3}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$1.2 \times 10^{18} m^{-3}$

5) In the problem above, the Fermi level is about ***1 point***

- 0.88 meV above the donor leve
- 0.54 meV above the donor level
- 0.35 meV above the donor level
- 0.18 meV above the doneor level

No, the answer is incorrect.
Score: 0

Accepted Answers:
0.35 meV above the donor level

6) A sample of silicon contains 10^{-4} atomic percent of phosphorus donors which are all singly ionized at room temperature. If the mobility of electrons in silicon is $0.15 m^2 V^{-1} s^{-1}$, the extrinsic resistivity of this material is (silicon atomic weight is 28 and its density is $2300 kgm^{-3}$) ***1 point***

- $1.3 \times 10^{-3} \Omega m$
- $8.4 \times 10^{-4} \Omega m$
- $5.5 \times 10^{-4} \Omega m$
- $9.7 \times 10^{-5} \Omega m$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$8.4 \times 10^{-4} \Omega m$

7) It may be generally expected that an intrinsic semiconductor will Hall coefficient $R_H = 0$ because of equal number of electrons and holes. However, difference in the mobility of the carriers gives a non-zero Hall coefficient. If the number of electrons and holes is n and their mobility μ_e and μ_h, respectively then (keep in mind that the transverse field is such that the current in that direction vanishes) ***1 point***

- $R_H = \frac{1}{ne}(\frac{\mu_h - \mu_e}{\mu_h + \mu_e})^3$
- $R_H = \frac{1}{ne}(\frac{\mu_h - \mu_e}{\mu_h + \mu_e})^2$
- $R_H = \frac{1}{ne}\frac{\mu_h^2 - \mu_e^2}{(\mu_h + \mu_e)^2}$
- $R_H = \frac{1}{ne}(\frac{\mu_h^2 - \mu_e^2}{\mu_h^2 + \mu_e^2})$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$R_H = \frac{1}{ne}\frac{\mu_h^2 - \mu_e^2}{(\mu_h + \mu_e)^2}$

8) For silicon semiconductor with band gap 1.12eV, position of the Fermi level at 300K,$m_e^* = 0.12m_0$ and $m_h^* = 0.28m_0$ is ***1 point***

- 0.57eV
- 1.14eV
- 2.5eV
- 0.27eV

No, the answer is incorrect.
Score: 0

Accepted Answers:
0.57eV

9) The electrical conductivity of intrinsic Silicon at 300K , having electron mobility $\mu_e = 0.15m^2V^{-1}s^{-1}$ and hole mobility $\mu_e = 0.05m^2V^{-1}s^{-1}$ is close to ***1 point***

- $3.84\Omega - m^{-1}$
- $38.4\Omega - m^{-1}$
- $1.42\Omega - m^{-1}$
- $14.2\Omega - m^{-1}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$3.84\Omega - m^{-1}$

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