Unit 4 - Week 3 : Carrier transport, generation and recombination in semiconductors

Assignment-3

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

Due on 2020-02-19, 23:59 IST.

1) Consider a n-type semiconductor with conductivity 10^{2} (Ohm-cm)$^{-1}$. It has electron mobility of 2000 cm^2/V-s and a hole mobility of 500 cm^2/V-s. Determine the donor concentration. *1 point*

- 12.50×10^{18} m^3
- 4.17×10^{15} cm^3
- 6.25×10^{15} m^3
- 12.50×10^{18} cm^3

No, the answer is incorrect.
Score: 0
Accepted Answers:
12.50×10^{18} cm^3

2) Shallow trap levels in p-type semiconductor reside at which position within the band gap? *1 point*

- Deep below valence band
- Just above valence band
- Just below conduction band
- above valence band but closer to Fermi level

No, the answer is incorrect.
Score: 0
Accepted Answers:
Just above valence band

3) Where do R-G centers lie within the bandgap of n-type semiconductor? *1 point*

- Above valence band
- Closer to mid-gap states
- Below conduction band
- Deep below the valence band

No, the answer is incorrect.
Score: 0
Accepted Answers:
Closer to mid-gap states

4) Which of the following is invalid for R-G center recombination process? *1 point*

- Radiative recombination
- Non-radiative recombination
- Shockley read hall recombination
- Photon release after recombination

No, the answer is incorrect.
Score: 0
Accepted Answers:
Radiative recombination

5) Carrier life time in a semiconductor increases with *1 point*

- decreasing impurity concentration
- increasing trap density
- decreasing trap density
- increasing donor concentration

No, the answer is incorrect.
Score: 0
Accepted Answers:
decreasing impurity concentration
decreasing trap density

6) For a n-type semiconductor under perturbation (light or thermal), under steady state condition, which of the following is likely to be true (Δp.=steady state excess minority (hole) charge carrier concentration)? *1 point*

- $\Delta n < 0$
- $\Delta p > 0$
- $\Delta p = 0$
- $\Delta n = 0$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$\Delta p = 0$
$\Delta n = 0$

7) For low level injection in an p-type semiconductor at transient conditions, which is most likely to happen? (Δn.=equilibrium excess minority charge carrier concentration, Δn.=equilibrium excess minority charge carrier concentration on n side) *1 point*

- $\Delta n_p >> \Delta p$.
- $\Delta n_p = 0$
- Δp. ~ 0, $\Delta n_p << p_o$
- $\Delta n_p << \Delta n$.

No, the answer is incorrect.
Score: 0
Accepted Answers:
Δp. ~ 0, $\Delta n_p << p_o$
$\Delta n_p << \Delta n$.

8) Which of the following statements is(are) false? *1 point*

- Direct bandgap semiconductors have larger absorption coefficient.
- Absorption in direct bandgap semiconductors involves only photons.
- Absorption in indirect band gap involves only photon absorption or emission.
- Both energy and momentum are required to conserved during the process of absorption.

No, the answer is incorrect.
Score: 0
Accepted Answers:
Absorption in indirect band gap involves only photon absorption or emission.
Both energy and momentum are required to conserved during the process of absorption.

9) In the continuity equation for minority carriers, which of the following is correct (dn/dt = rate of change of electron concentration)? *1 point*

$$dn/dt = (1/q)\nabla J_N + (dn/dt)_{\text{thermal R-G}} + (dn/dt)_{\text{others}}$$

- $(1/q)\nabla J_n$ depicts change of electron diffusion and drift current
- If $(dn/dt)_{.....} \neq 0$, shallow traps recombination dominates over deep trap recombination
- $(1/q)\nabla J_n$ depicts electron drift current change due to the electric field only
- It is for a p-type semiconductor.

No, the answer is incorrect.
Score: 0
Accepted Answers:
$(1/q)\nabla J_n$ depicts change of electron diffusion and drift current
It is for a p-type semiconductor.

10) Which of the factors does not affect surface recombination? *1 point*

- Surface trap density
- Capture cross section
- Thermal velocity
- Carrier diffusivity

No, the answer is incorrect.
Score: 0
Accepted Answers:
Carrier diffusivity

11) Absorber layer in solar cell is *p*-type and is heavily doped, free from any traps and is exposed to 1 Sun irradiation such that $\Delta n << p_o$. Carrier lifetime will be dependent on which of the following processes? *1 point*

- Radiative and SRH recombination
- Radiative recombination only
- Auger recombination and radiative recombination
- SRH, auger and radiative recombination

No, the answer is incorrect.
Score: 0
Accepted Answers:
Auger recombination and radiative recombination

12) Si is doped with Nitrogen such that majority charge carrier concentration becomes 10^{15} cm^3. It is irradiated with light such that excess minority charge concentration is 10^{8} cm^3. Minority charge carrier concentration (cm^3) is: *1 point*

- 10^{7}
- 10^{8}
- 10^{9}
- 10^{7}

No, the answer is incorrect.
Score: 0
Accepted Answers:
10^{7}

13) For a semiconductor with non-uniform grading, say highest at the surface to lowest at the bottom, which is likely to happen when a band diagram is drawn? *1 point*

- Fermi level will vary as a function of depth
- Conduction band edge will vary as a function of depth
- Valence band edge will vary as a function of depth
- Intrinsic Fermi level will vary as a function of depth.

No, the answer is incorrect.
Score: 0
Accepted Answers:
Conduction band edge will vary as a function of depth
Valence band edge will vary as a function of depth
Intrinsic Fermi level will vary as a function of depth.

14) Electron drift current in a semiconductor is due: *1 point*

- Carrier concentration gradient
- Electric field
- Both concentration and electric field
- Defects

No, the answer is incorrect.
Score: 0
Accepted Answers:
Electric field

15) Which of the following are direct bandgap semiconductors: *1 point*

- Si
- GaAs
- CdTe
- Ge

No, the answer is incorrect.
Score: 0
Accepted Answers:
GaAs
CdTe