Week 3 assignment

The due date for submitting the assignment has passed. As per your record you have not submitted this assignment.

1. What happens to the electrical conductivity of degenerate semiconductors when the temperature increases?
   - Options: increase, decrease, depends on the nature of doping
   - Accepted Answers: increase

2. The intrinsic carrier concentration of Si at 300 K is $10^{10}$ cm$^{-3}$. It is doped with $10^{17}$ cm$^{-3}$ boron atoms. Assume that all dopants are ionized. When $10^{17}$ cm$^{-3}$ is the Fermi level of the doped semiconductor, with respect to the intrinsic Fermi level? Give your answer in eV.
   - Options: 0.6, 0.3, 0.0
   - No, the answer is incorrect.
   - Accepted Answers: 0.3

3. Which of the following is true regarding degenerate and non-degenerate semiconductors?
   - Options: both have high conductivity compared to metals, both have lower conductivity compared to metals, degenerate semiconductors have lower doping concentration compared to non-degenerate semiconductors, degenerate semiconductors have Fermi level in the valence/conduction band, non-degenerate semiconductors have Fermi level in the valence/conduction band.
   - Accepted Answers: degenerate semiconductors have Fermi level in the valence/conduction band while in the non-degenerate region the Fermi level is non-degenerate.

4. You are given two samples. A and B. Sample A is doped with P and sample B is doped with D. Which of the above statement is true?
   - Options: sample A has been doped with P and sample B has been doped with D, sample A has been doped with B and sample B has been doped with P.
   - No, the answer is incorrect.

5. The intrinsic carrier concentration of Si at 300 K is $10^{10}$ cm$^{-3}$. It is doped with $10^{17}$ cm$^{-3}$ donor atoms and $10^{17}$ cm$^{-3}$ phosphorus donors. Assume that all dopants are ionized. Which of the following is true for the semiconductors?
   - Options: $a = 1.1 \times 10^{-3}$ cm, $b = 9 \times 10^{-3}$ cm$^{-1}$. $a = 10^{-3}$ cm, $b = 1.1 \times 10^{-3}$ cm$^{-1}$. $a = 9 \times 10^{-3}$ cm, $b = 1.1 \times 10^{-3}$ cm$^{-1}$.
   - No, the answer is incorrect.
   - Accepted Answers: $a = 10^{-3}$ cm, $b = 1.1 \times 10^{-3}$ cm$^{-1}$.

6. Adding Zn to germanium would constitute what type of doping?
   - Options: Compensation, None, p-type, n-type.
   - No, the answer is incorrect.
   - Accepted Answers: p-type.

7. The intrinsic carrier concentration of Si at 300 K is $10^{10}$ cm$^{-3}$. It is doped with $10^{17}$ cm$^{-3}$ acceptor atoms and $10^{17}$ cm$^{-3}$ phosphorus donors. Assume that all dopants are ionized. Which of the Fermi level located, with respect to the intrinsic Fermi level? Give your answer in eV.
   - Options: 0.0, 0.3, 0.5, 0.7
   - No, the answer is incorrect.
   - Accepted Answers: 0.3 eV.

8. Which dopant would constitute an n-type doping in GaAs?
   - Options: A, B, C, D.
   - No, the answer is incorrect.
   - Accepted Answers: A.

9. Which of the following statements are true when phosphorus is doped in a silicon lattice?
   - Options: As the temperature decreases from 300 K, the phosphorus atoms completely ionize, the phosphorus atoms become localized in the silicon lattice, As the temperature increases above 300 K, the semi-conductor becomes more intrinsic.
   - No, the answer is incorrect.
   - Accepted Answers: D, E.

10. Which of the following is true for a doped semiconductor? Assume that the semiconductor at 300 K and the dopants are completely ionized. Also make sure that the crystal structure does not change upon doping.
    - Options: The Fermi level position is determined by the overall dopant type and concentration, the effective mass is determined by the overall dopant type and concentration, Doping causes the semiconductor to become anisotropic.
    - No, the answer is incorrect.
    - Accepted Answers: A, B, C.

11. As the temperature increases above 300 K, the semiconductor becomes more intrinsic.
    - Options: The following statements are true when phosphorus is doped in a silicon lattice, the phosphorus atoms become localized in the silicon lattice.
    - No, the answer is incorrect.
    - Accepted Answers: D, E.

12. Which of the following is true for a doped semiconductor? Assume that the semiconductor at 300 K and the dopants are completely ionized. Also make sure that the crystal structure does not change upon doping.
    - Options: The Fermi level position is determined by the overall dopant type and concentration, the effective mass is determined by the overall dopant type and concentration, Doping causes the semiconductor to become anisotropic.
    - No, the answer is incorrect.