



## Weekly Test 2- Semiconductor Devices

**Date:** 25.08.2012

**Time:** 30 Min

**Course:** E2Sem1\_ ECE

**Max Marks:** 10

1. Which of the following set of statements are completely true in case of formation energy bands?
  - A) Energy bands become wider as the distances between atoms become shorter
  - B) The lower the energy level, the wider is the corresponding energy band that it splits into.
  - C) The number of discrete energy levels that make up an energy band is generally equal to the number of atoms in the solid multiplied by the number of discrete energy states in an isolated atom
  - D) The higher the energy level, the wider is the corresponding energy band that it splits into.
  - a) A , B & C
  - b) A, C & D
  - c) B & C
  - d) B and D
  - e) A & B
  - f) B,C and D
  - g) all are incorrect
2. The effective momentum of an electron in the conduction band of GaAs when the electron energy measured from the band edge is 0.5 eV. Where  $m^* = .067 m_0$ 
  - a)  $9.83 \times 10^{-26} \text{ kg m s}$
  - b)  $8.83 \times 10^{-16} \text{ kg m s}^{-1}$
  - c)  $9.83 \times 10^{-25} \text{ kg m s}^{-1}$
  - d)  $3.8 \times 10^{-25} \text{ kg ms}^{-1}$
  - e)  $9.83 \times 10^{-26} \text{ kg m s}^{-2}$
  - f) none of these
3. the energy of an electron and hole in the heavy hole band of a semiconductor at a k- value of  $0.1 \text{ \AA}^{-1}$  hole heavy mass is  $0.5 m_0$ 
  - a)  $E_v - .0755 \text{ eV}, E_v + .0755 \text{ eV}.$
  - b)  $E_v + .0755 \text{ eV}, E_v - .0755 \text{ eV}.$
  - c)  $E_v + .055 \text{ eV}, E_v - .055 \text{ eV}$
  - d)  $E_v - .755 \text{ eV}, E_v + .755 \text{ eV}$
  - e)  $E_v - .0655 \text{ eV}, E_v + .0655 \text{ eV}$
  - f) None of these
4. In an intrinsic Si crystal at room temperature, which of the following can have a concentration of  $9.84 \times 10^{18} \text{ cm}^{-3}$  ( $m_h^* = .067 m_0$   $m_e^* = 1.06 m_0$ )
  - a) CB effective density
  - b) VB effective density
  - c) Valence electrons
  - d) Holes
  - e) Electrons
  - f) Intrinsic carrier concentration
  - g) Silicon atoms

5. Which of the following set of statements are incorrect in case of extrinsic semiconductors
  - A) The donor impurity atoms add electrons to the conduction band without creating holes in the valence band
  - B).The donor impurity atoms add electrons to the conduction band with creating holes in the valence band
  - C).The acceptor atom can generate holes in the valence hand without generating electrons in the conduction band.
  - D).The acceptor atom can generates holes in the valence hand with generating electrons in the conduction band.
  - a) A & C
  - b) B & D
  - c) B & C
  - d) A and D
  - e) A , B & C
  - f) B, C and D
  - g) all are correct
6. Intrinsic SC material A has an energy gap 0.36 e V while the material B has an energygap of 0.72 eV at 300 K. the ratio of the intrinsic carrier concentration is ( assume the effective masses of electrons and holes are equal to the free electron mass)
  - a) 525
  - b) 100
  - c) 700
  - d) 1015
  - e) 915
  - f) 600
  - g) 300
  - h) none of these
7. Which of the following set of statements are completely true in the case of semiconductors
  - A) The product of  $n$  and  $p$  is constant and is independent of the exact position of the fermi level
  - B) Fermi level moves towards the CB if  $n$  increases and  $p$  decreases
  - C) Fermi level moves towards the VB if  $p$  increases and  $n$  decreases
  - D) The position of the Fermi level shifts downwards to the top of the VB if effective mass of hole is greater than effective mass of electron.
  - a) A , B & C
  - b) B ,C & D
  - c) A , B & D
  - d) B and D only
  - e) D & A only
  - f) C and D only
  - g) all are incorrect.
8. The temperature at which there is a one percent of probability that a state 0.30 eV below the Fermi energy level will not contain an electron.
  - a) 715 k
  - b) 789 K
  - c) 750 k
  - d) 756k
  - e) 725 k
  - f) 770 k
  - g) none of these
9. The position of the fermi level with respect to the center of the bandgap in silicon at 450 K is
  - a) 19.2 eV below the midgap energy
  - b) 18.2 meV below the midgap energy

- c) 19.2 meV above the midgap energy
  - d) 18.2 meV above the midgap energy
  - e) 12.8 meV below the midgap energy
  - f) 12.8 meV below the midgap energy
  - g) None of these
10. The total number of density of states in GaAs between  $E_V$  and  $E_V - KT$  is
- a)  $6.29 \times 10^{18} \text{ cm}^{-3} \text{ eV}^{-1}$
  - b)  $6.29 \times 10^{17} \text{ cm}^{-3} \text{ eV}^{-1}$
  - c)  $5.29 \times 10^{16} \text{ cm}^{-3}$
  - d)  $6.29 \times 10^{16} \text{ cm}^{-3}$
  - e)  $7.29 \times 10^{19} \text{ cm}^{-3} \text{ eV}^{-1}$
  - f)  $6.29 \times 10^{16} \text{ cm}^{-3} \text{ eV}^{-1}$
  - g)  $6.29 \times 10^{18} \text{ cm}^{-3}$

**KEY:**

- 1. b
- 2. f
- 3. a
- 4. b
- 5. b
- 6. d
- 7. a
- 8. d
- 9. g
- 10. g