**MCQ**

1. **Resistance of a semiconductor:-**
2. $√$ **Decreases with increase in temperature. (b) Increases with increase in temperature.**
3. **Increases for germanium and decreases for silicon (d) Is not affected by change in temperature.**
4. **Majority charge carrier in p-type materials are:-**
5. **Holes (b) Electrons (c) both electrons and holes (d) none of these.**
6. **Boron is added as an impurity to silicon, the resulting material is:-**
7. **n-type semiconductor (b)**$ √$ **p-type semiconductor (c) n-type conductor (d) p-type conductor.**
8. **In a semiconductor material, the mobility of electron and holes are** $μ\_{e}$ **and** $μ\_{h}$ **respectively which of the following is true?**
9. $√$$μ\_{e}>μ\_{h}$ **(b)** $μ\_{e}<μ\_{h}$ **(c)** $μ\_{e}=μ\_{h}$ **(d)** $μ\_{e}<0; μ\_{h}>0$

**[ Hint:- current in intrinsic or pure semiconductor I=Ae(**$n\_{h}v\_{h}+n\_{e}v\_{e}$**) where A is cross sectional area ,e is electronic charge,** $n\_{h}$**,** $n\_{e}$ **are hole and electron number density,** $v\_{h}$**,** $v\_{e}$ **are drift velocity of holes and electrons. Mobility (**$μ)$ **drift velocity(v) and electric field (E) related as :** $μ=v/E$ **also drift velocity is inversely proportional to square root of mass (**$v∝\frac{1}{\sqrt{m}}$ **).**

**We know resistance (R) is related to cross section area (A), length (l) and resistivity (**$ρ)$ **is R=**$ ρl/A$ **and electric field (E) developed across a length (l) due to potential difference (V) is E=V/l or E= V**$ρ$**/RA (since l=RA/**$ρ$ **) also V=IR or E=IR**$ρ$**/RA =I**$ ρ/A$ **implies E/**$ρ$ **=I/A**

**1/**$ρ$**=e(**$n\_{h}v\_{h}/E+n\_{e}v\_{e}/E$**) also inverse of resistivity is conductivity** $σ=1/ρ$

$σ$ **=e(**$n\_{h}v\_{h}/E+n\_{e}v\_{e}/E$**) and drift velocity per unit electric field (E) is mobility**$ μ$ **and electron mobility and hole mobility are given as :** $μ\_{e}=v\_{e}/E$ **and** $μ\_{h}=v\_{h}/E$ **respectively.**

 **Lesser mass will have more velocity so among electron and hole, electron mass is less so velocity of electron is more so as mobility. ]**

1. **The number density of electrons and holes in a sample of germanium at room temperature (300K) are equal and its value is 3x1016 m-3 . on doping it with aluminum , the hole density increased to 4.5x10-22 m-3 . Then electron density in germanium is:**

$√$ **(a)**$2×10^{10}m^{-3}$**(b)** $4.5×10^{9}m^{-3}$ **(c)** $4×10^{10}m^{-3}$ **(d)** $3×10^{9}m^{-3}$

**[ hint: intrinsic number density (**$n\_{i}$**) related to electron number density(**$n\_{e})$ **and hole number density (**$n\_{h})$ **as :** $n\_{e}n\_{h}=n\_{i}^{2}$ **which implies** $n\_{e}=n\_{i}^{2}/n\_{h}$ **=9x1032/4.5x1022=2x1010 ]**

1. **The electrical conductivity of a semiconductor increases when electromagnetic radiation of wavelength shorter than 2480nm is incident on it. The band gap (in eV) for the semiconductor is:**
2. **0.9 (b) 0.7 (c)**$ √$ **0.5 (d) 1.1**

**[Hint:- band gap(**$E\_{g}$**) is related to Plank’s constant(h), velocity of light (c) and maximum wavelength (**$λ\_{max}$**) as** $E\_{g}=\frac{h c}{λ\_{max}}$**, h=6.63**$×10^{-34}Js$**, c=3**$×10^{8}$ **and** $λ\_{max}=2480×10^{-9}m$ **. further 1eV=1.6**$×10^{-19}Joules$**.** $E\_{g}=$**6.63**$×10^{-34}×$**3**$×10^{8}$**/**$ 2480×10^{-9}$**=19.89**$×10^{-17}$**/2480 =8.02**$×10^{-20}$**Joules. In electron volt the quantity must be divided by 1.6**$×10^{-19}$ **and final result is** $E\_{g}=$**8.02**$×10^{-20}/$**1.6**$×10^{-19}$**=0.802/1.6=0.5012 eV**$≅0.5eV$**]**

1. **Which of the following statements is not true:-**
2. **The resistance of intrinsic semiconductor decreases with increase of temperature.**
3. **Doping of pure Si with trivalent impurities gives p-type semiconductors.**
4. $√$**The majority carriers in n-type semiconductors are holes.**
5. **A p-n junction can act as a semiconductor diode.**
6. **The impurity atoms, with which pure silicon should be doped to make a n-type semiconductor, are :- (a) boron (b) aluminium (c)**$ √$ **phosphorus (d) both (a) and (b)**
7. **The energy band gap is maximum in:-**
8. **Non-metal (b) metal (c) insulator (d) semiconductors.**
9. **At absolute zero (**$0^{°}K)$**, Si acts as:-**
10. **metal (b) non-metal (c)**$ √$ **insulator (d) none of these.**
11. **A piece of copper and another of germanium are cooled from room temperature (300K) to 77K. The resistance of:- (a) each of these decreases (b) copper strip increase and that of germanium decreases. (c)**$ √$ **copper strip decrease and that of germanium increases. (d) each of these increases.**
12. **Carbon, silicon and germanium have four valance electrons each. At room temperature which one of the following statement is most appropriate?**
13. $√$**The number of free electrons for conduction is significant only in Si and Ge but small in C.**
14. **The number of free electrons for conduction is significant only in C but small in Si and Ge.**
15. **The number of free electrons for conduction is negligibly small in all the three.**
16. **The number of free electrons for conduction is significant in all the three.**
17. **If the ratio of the concentration of electron to that of holes in a semiconductor is 7/5 and the ratio of currents is 7/4, then what is the ratio of their drift velocities?**
18. **5/8 (b) 4/5 (c)**$ √$ **5/4 (d) 4/7.**

 **[ Hint: current (I),electron or hole number density (n) and drift velocity(vd) for a cross section(A) of a conductor/semiconductor related as : I=enAvd and current due to electrons(Ie)and holes(Ih) related to electron/hole number densities ne /nh and respective drift velocities as** $I\_{e}=en\_{e}Av\_{e}$ **and** $I\_{h}=en\_{h}Av\_{h}$**, where**$v\_{e}$ **and** $v\_{h}$ **are drift velocitie of electron and hole. Given** $\frac{I\_{e}}{I\_{h}}$ **= 7/4 ,and** $\frac{n\_{e}}{n\_{h}}=$**7/5 so** $\frac{I\_{e}}{I\_{h}}=\frac{n\_{e}v\_{e}}{n\_{h}v\_{h}}$ **and** $\frac{v\_{e}}{v\_{h}}=\frac{I\_{e}/I\_{h}}{n\_{e}/n\_{h}}$**=**$\frac{7/4}{7/5}$**=**$\frac{5}{4}$ **]**

1. **In the middle of the depletion layer of reverse biased p-n junction, the:-**
2. $√$ **Electric field is nearly zero. (b) potential is zero (c) potential is maximum (d) electric field is maximum. [ Hint: electric field (E) , barrier potential Vb and width of depletion layar (Wd) are related as: E=**$V\_{b}$**/**$W\_{d}$ **so at reverse biased condition width of depletion layer increases** $W\_{d}\rightarrow \infty $ **and E**$≅0$ **]**

**(15) When p-n junction diode is forward biased then:-**

**(a) the depletion region is reduced and barrier height is increased.**

**(b) the depletion region is widened and barrier height is reduced.**

**(c)**$ √$ **both depletion region and barrier height are reduced.**

**(d) both depletion region and barrier height are increased.**

**(16) The valance band and conduction band of a solid overlap at low temperature, the solid may be:-**

**(a)**$ √$ **a metal (b) a semiconductor (c) an insulator (d) none of these.**

**(17) In semiconductors at room temperature:-**

**(a)**$ √$ **the valance band is partially empty and the conduction band is partially filled.**

**(b) the valance band is completely filled and the conduction band is partially filled.**

**(c) the valance band is completely filled.**

**(d) the conduction band is completely empty.**

**(18) The energy gap between conduction band and valance band is of the order 0.07eV. It is a/an:-**

**(a) insulator (b)**$ √$ **conductor (c) semiconductor (d) alloy.**

**(19) In n-type semiconductors, majority charge carriers are:-**

**(a) holes (b)protons (c)**$ √$ **electrons (d) neutrons**

**(20) n-type semiconductor is:-**

**(a) positively charged (b) negatively charged (c)**$ √$ **neutral (d) positive or negative depending upon doping material.**

**(21) To a germanium crystal equal number of aluminium and indium atoms is added. Then :-**

**(a) it remains an intrinsic semiconductor. (b) it becomes an n-type semiconductor.**

**(c)** $√$**it becomes a p-type semiconductor. (d) it becomes an insulator.**

**(22) In insulators:- (a) valance band is partially filled with electrons. (b) Conduction band is partially filled with electrons. (c) Conduction band is filled with electrons and valance band is empty.**

**(d)** $√$ **Conduction band is empty and valance band is completely filled with electrons.**$√$

**(23) If forward voltage in a diode is increased, the width of the depletion region:-**

**(a) increases (b)**$ √$ **decreases (c) fluctuates(maximum to minimum and vice versa) (d) no change**

**(24) If no external voltage is applied across p-n junction, there would be:-**

**(a) no electric field across the junction. (b)**$ √$ **an electric field pointing from n-side to p-side across the junction. (c) an electric field pointing from p-side to n-side across the junction.**

**(d) a temporary electric field during formation of p-n junction that would subsequently disappear.**

**(25) Choose the only false statement from the following:-**

**(a) substances with energy gap of the order of 10eV are insulators.**

**(b)the conductivity of a semiconductor increases with increase in temperature.**

**(c) in conductors the valance band and conduction bands may overlap.**

**(d)**$ √$ **the resistivity of a semiconductor increases with increase in temperature.**