**GITAM (Deemed to be University)**

**PROGRAM: B. Tech (CSE, ECE, EEE and IT branches)**

**SUBJECT CODE: 19EPH131**

**SUBJECT NAME: ENGINEERING PHYSICS**

**SEMESTER: I**

**Unit -IV: Semiconductor Physics**

***Objective Type Question (One or More than once answer)***

|  |  |  |
| --- | --- | --- |
| **1** | Intrinsic semiconductor at room temperature will have, ................ available for conduction | |
|  |  | Electrons |
|  |  | Holes |
|  |  | Both electrons and holes |
|  |  | None of the above |
| **2** | A pure semiconductor behaves like an insulator at 0 K because | |
|  |  | Energy possessed by electrons at that low temperature is almost zero |
|  |  | Free electrons are not available for current conduction |
|  |  | Drift velocity of free electrons is very small |
|  |  | There is no recombination of electrons with holes |
| **3** | A semiconductor has.... temperature co-efficient of resistance. | |
|  | A. | Zero |
|  | B. | Positive |
|  | C. | Negative |
|  | D. | All of the above |
| **4** | Which of the following doping elements would not be suitable for converting intrinsic semiconductor? | |
|  | A. | Phosphorous |
|  | B. | Indium |
|  | C. | Arsenic |
|  | D. | Antimony |
| **5** | The temperature co-efficient of an intrinsic semiconductor is....... | |
|  | A. | Zero |
|  | B. | Positive |
|  | C. | Negative |
|  | D. | All of the above |
| **6** | The temperature co-efficient of an extrinsic semiconductor is....... | |
|  | A. | Zero |
|  | B. | Positive |
|  | C. | Negative |
|  | D. | All of the above |
| **7** | Intrinsic concentration (ni) in a semiconductor varies as | |
|  | A. | T |
|  | B. | T-(1/2) |
|  | C. | T(3/2) |
|  | D. | T(-3/2) |
| **8** | The resistivity of a semiconductor lies | |
|  | A. | Below 10-6 |
|  | B. | Between 10-6 to 102 ohm-metre |
|  | C. | Between 10-6 to 104 ohm-metre |
|  | D. | Above 104 ohm-metre |
| **9** | The strength of a semiconductor crystal comes from ……. | |
|  | A. | Forces between nuclei |
|  | B. | Forces between protons |
|  | C. | Electron-pair bonds |
|  | D. | None of the above |
| **10** | Which of the following is known as Elemental semiconductors? | |
|  | A. | Germanium |
|  | B. | Nickel |
|  | C. | Platinum |
|  | D. | Carbon |
| **11** | Pure Si at 300 K has equal electron (ni) and hole concentration (p) of 1.5 X 1016 m-3. Doping by indium increases p to 4.5 X 1022 m-3. What is n in the doped silicon? | |
|  | A. | 4.5 X 109 m-3 |
|  | B. | 4.5 X 1022 m-3 |
|  | C. | 5 X 109 m-3 |
|  | D. | 5 X 1022 m-3 |
|  |  | Explanation: Here, ni = 1.5 X 1016 m-3, p = 4.5 X 1022 m-3 We know, np = ni2 n = ni2/p = 5 X 109 m-3 |
| **12** | In a semiconductor it is observed that three-quarters of the current is carried by electrons and one quarters by holes. If the drift speed is three times that of the holes, what is the ratio of electrons to holes? | |
|  | A. | 1 : 1 |
|  | B. | 1 : 2 |
|  | C. | 2 : 1 |
|  | D. | 4 : 1 |
|  | Explanation: In a semiconductor, I = Ie + Ih Here, Ie = 3⁄4 I and Ih = 1⁄4 I Now ve = 3vh Ie/Ih = nve/nvh 3 = 3n/p n = p Hence the ration is, 1 : 1 | |
| **13** | If the number of electrons (majority carrier) in a semiconductor is 5 X 1020 m-3 and μe is 0.135 mho, find the resistivity of the semiconductor. | |
|  | A. | 0.0926 Ωm |
|  | B. | 0.0945 Ωm |
|  | C. | 0.0912 Ωm |
|  | D. | 0.0978 Ωm |
|  |  | Answer: a Explanation: We know, Conductivity, σ = ene μe = 5 X 1.6 X 0.135 X 10 mho/m = 10.8 mho/m Resistivity = 1/σ = 0.0926 Ωm. |
| **14** | The intrinsic carrier density at room temperature in Ge is 2.37×1019/m3. If the electron and hole mobilities are 0.38 and 0.18 m2/Vs respectively. Calculate its resistivity. | |
|  | A. | 0.18ohm m |
|  | B. | 0.460ohm m |
|  | C. | 0.4587ohm m |
|  | D. | 0.709ohm m |
|  |  | Answer: d Explanation: Conductivity = nie(μe+μh) Conductivity = 2.12352/ohm m Resistivity = 1/Conductivity Resistivity = 0.4709ohm m |
| **15** | A uniform silver wire has a resistivity of 1.54×10-18 ohm/m at room temperature. For an electric field along the wire of 1 volt/cm. Compute the mobility, assuming that there are 5.8×1028 conduction electrons/m3. | |
|  | A. | 1.54 m2/Vs |
|  | B. | 6.9973m2/Vs |
|  | C. | 6.9973×10-3 m2/Vs |
|  | D. | 0.69973 m/s |
|  |  | Answer: c Explanation: Mobility of the electrons = 1/ƿne Mobility = 6.9973×10-3 m2/Vs. |
| **16** | Calculate the drift velocity of the free electrons with mobility of 3.5×10-3 m2/Vs in copper for an electric field strength of 0.5 V/m. | |
|  | A. | 3.5 m/s |
|  | B. | 1.75×103 m/s |
|  | C. | 11.5 m/s |
|  | D. | 1.75×10-3 m/s |
|  |  | Answer: d Explanation: Drift velocity = μE Drift velocity = 3.5×10-3×0.5 = 1.75×10-3m/s. |
| **17** | What is the level that acts as a reference which separated the vacant and filled states at 0K? | |
|  | A. | Excited level |
|  | B. | Ground level |
|  | C. | Valance orbit |
|  | D. | Fermi energy level |
|  |  | Answer: d Explanation: Fermi energy level is the maximum energy level up to which the electrons can be filled at 0K. Thus it acts as reference level which separated the vacant and filled states at 0K. |
| **18** | Which of the following would have highest wavelength? | |
|  | A. | A |
|  | B. | B |
|  | C. | C |
|  | D. | D |
|  |  | Answer: a Explanation: In the I-V characteristic of an LED, as the frequency increases, the voltage required to achieve the same current increases. Hence A would have the highest wavelength. |
| **19** | Materials characterized by atoms that consists of only one Valence electron and this electron is bound to atom is called | |
|  | A. | single element material |
|  | B. | double element material |
|  | C. | triple element material |
|  | D. | no element material |
| **20** | Which of the following is most unstable at high temperature? | |
|  | A. | silicon |
|  | B. | germanium |
|  | C. | carbon |
|  | D. | gallium arsenide |
| **21** | In n=AT2e[-EG/kT], EG is energy gap at temperature of | |
|  | A. | 0K |
|  | B. | 273.15K |
|  | C. | 300K |
|  | D. | -273.15K |
| **22** | Which one of the following statement(s) is/are true? | |
|  | A. | A substitution impurity in donor and acceptor atoms does not cause any disturbances in the crystal lattice of semiconducting material. |
|  | B. | Mobility of charge carriers equals its average speed v divided by the applied electric field E. |
|  | C. | Each donor atom contributes two free electrons to semiconducting crystal lattice. |
|  | D. | In an n-type semiconductor, the free electrons concentration approximately equals the density of donor atoms |
| **23** | Good conductors does not have hole current because they are | |
|  | A. | Full of electrons |
|  | B. | Have large forbidden energy gap |
|  | C. | Have no valence band |
|  | D. | Have overlapping valence band and conduction band |
| **24** | A p-type semiconductor has an acceptor density of 1020 atoms/m3 and intrinsic concentration of 2.5×1019 m-1 at 300K. The electron concentration in this p-type semiconductor is | |
|  | A. | 6.23×1018 |
|  | B. | 6.25×1019 |
|  | C. | 62.5×1019 |
|  | D. | 62.5×1018 |
|  |  | NANA is nearly equal to npnp where NANA is acceptor impurity and npnp is hole concentration. nenp=n2inenp=ni2 ne=n2inp=6.25×1018electrons per m3ne=ni2np=6.25×1018electrons per m3 Hence (a) is the correct answer |
| **25** | Mobility of electrons and holes in a sample of intrinsic semiconductors at room temperature are 0.36 m2/Vs and 0.17 m2/Vs respectively. If both electrons and hole densities in semiconductor equals 2.5×1019m3 then conductivity of semiconducting material is | |
|  | A. | 212 S/m |
|  | B. | 21.2 S/m |
|  | C. | 2.12 S/m |
|  | D. | .212 S/m |
|  |  | For intrinsic semiconductors σ=en(μe+μn)=1.6×10−19×2.5×1019(0.36+0.17)=2.12S/mσ=en(μe+μn)=1.6×10−19×2.5×1019(0.36+0.17)=2.12S/m Hence (c) is the correct answer |
| **26** | Which one of the following statement(s) is true? | |
|  | A. | Resistivity of conductors increases with increase in temperature. |
|  | B. | Resistivity of semiconductors increases with increase in temperature |
|  | C. | Resistivity of semiconductors decreases with increase n temperature. |
|  | D. | Resistivity of insulators decreases with decrease in temperature |
| **27** | Current flow in a semiconductor depends on the phenomenon of | |
|  | A. | drift |
|  | B. | diffusion |
|  | C. | recombination |
|  | D. | all of the above |
| **28** | In a non-degenerate germanium sample maintained under equilibrium conditions near room temperature, it is known that intrinsic concentration ni= 1013 cm3, n= 2p and NA = 0. What are the values of n (electron concentration) and ND (Donor concentration) ? | |
|  |  | n ND |
|  | A. | 7.07×1012 per cm3 1.414×1012 per cm3 |
|  | B. | 1.414×1013 per cm3 0.707×1013 per cm3 |
|  | C. | 2.828×1013 per cm3 0.707×1013 per cm3 |
|  | D. | 1.414×1013 per cm3 1.414×1013 per cm3 |
|  |  | Hint mass action law, charge neutrality equation |
| **29** | The energy gap is much more in silicon than in germanium because | |
|  | A. | It has less number of electrons |
|  | B. | It has high atomic mass number |
|  | C. | Its crystal has much stronger bonds called ionic bonds |
|  | D. | Its valence electrons are more tightly bound to their parent nucli |
| **30** | Consider the following statements: pure germanium and pure silicon are examples of:  1. Direct band-gap semiconductors  2. Indirect band-gap semiconductors  3. Degenerate semiconductors  Of these statements: | |
|  | A. | 1 alone is correct |
|  | B. | 2 alone is correct |
|  | C. | 3 alone is correct |
|  | D. | None of the above |