PHYSICS

BOOKS - MODERN PUBLICATION

Solids

Example

1. A semiconductor is known to have an electron concentration of $8 \times 10^{13} cm^{-3}$ and a hole concentration of $5 \times 10^{12} cm^{-3}$.

Is the semiconductor n type or p-type?

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2. A semiconductor has electron concentration of $8 \times 10^{-13} cm^{-3}$ and hole concentration of $4 \times 10^{-12} cm^{-3}$.Calculate conductivity of the sample if electron mobility = $24000 cm^2 V^{-1} s^{-1}$ and hole mobility = $200 cm^2 V^{-1} s^{--1}$ and $e = 1.6 \times 10^{-19} C$.

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3. Find the maximum wavelength of electromagnetic radiation,which can create a hole-electron pair in germanium.Given that forbidden energy gap in germanium is 0.72 eV.

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4. Suppose that the energy liberated in the combination of a hole-electron pair is conveted into electromagnetic radiation.If the maximum waveelngth of the radiation emitted is 630 nm,what is the width of forbbidden energy gap?

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5. A doped semiconductor has impurity levels 40 MeV (millielectron volt) below the conduction band

Is the material n-type or p-type?

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6. A doped semiconductor has impurity levels 40 MeV (millielectron volt) below the conduction band

In a thermal collision,an amount of energy k T is given ot the extra electron loosely bound to the impurity ion and this electron is just able to jump into the conduction band.Calculate the temperature T.

Given,Boltzmann's constant , $k = 8.62 \times 10^{-5} eVK^{-1}$.

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7. The mean free path of conduction electrons in copper is about $4 \times 10^{-8} m$. Find the electric field which can give 2 eV energy (on the average) to a conduction electron in a copper block.

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8. A p-type semiconductor has acceptor energy levels 57 meV(millielectron volt) above the valence band.Find the maximum wavelength of the radiation,which can create a hole?

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9. Energy of the photon of sodium light of wavelength $5,890\overset{\circ}{A}$ equals the energy gap between valence and conduction band of a semiconductor.

Find the minimum energy E required to create a hole-electron pair.

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10. Energy of the photon of sodium light of wavelength $5,890\overset{\circ}{A}$ equals the energy gap between valence and conduction band of a semiconductor.

Find the minimum energy E required to create a hole-electron pair.

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11. Why crystalline solids have a sharp melting point?

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12. Fill in the blanks:

Majority of hte solids in nature have ....internal stucture (ordered ,disordered).

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13. Fill in the blanks:

All crystals are ....(isotrpic,anisotrpic).

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14. Fill in the blanks:

If the physical properties of a solid do not depend on the direction,the solid is known as........(isotropic,anisotropic).

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15. Fill in the blanks:

The polycrystalline solids show.....properties,while the monocrystals have .... properties (isotropic ,anistropic)

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16. Fill in the blanks:

Within the liquid crystal phase, some materials show a change in ....with the change in temperature.(color, shape).

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17. Fill in the blanks:

Physical propertie of amorphous solids are identical in..............directions and therefore they are of.......nature. (all,some,isotrpoic,anisotropic).

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18. Fill in the blanks:

The liquid crystal displays (LCD) are based on the principle that they ...(emit light ,change the plane of polarisation of polarised light).

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19. Fill in the blanks:

Cermics are .... solid (polycrystalline,amorphous).

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20. Fill in the blanks:

Ceramic solids are ......insulators(generally,always).

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21. Fill in the blanks:

The structure of NaCl is ....(cubic,hexagonal).

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22. Name the seven crystal systems.

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23. What is the electron configuration in various orbits of silicon and germanium?

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24. Name the charge carrieers in the following at room temperature:

Conductor

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25. Name the charge carrieers in the following at room temperature:

intrinsic semi-conductor

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26. Name the charge carrieers in the following at room temperature:

insulator.

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27. What is valence band ?

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28. What is conduction band ?

Watch Video Solution

29. What is forbideen energy gap?

Watch Video Solution

30. What is the value of forbidden gap energy of germanium?

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31. Why germanium is preferred over silicon for making semiconductor devices?

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32. What is Fermi energy level ?

Watch Video Solution

33. What is Fermi energy level ?

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34. Fill in the blanks:

When two isolated atomes are brought close to each other such that the distance between them is ....(comparable to ,uch larger than) lattice spacing,the ....(energy bands,energy levels) of the outermost electrons is split into ....(very loarge,very small) nuber of levels,called ....(energy gap,energy bnds).

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35. Fill in the blanks:

The energy band in solids is an outcome of ....(Pauli's exclusion principle,Coulmb's law).

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36. Fill in the blanks:

The forbidden enegy gap in case of a semiconductor is .... as compared to that of an insulator(smaller,greater).

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37. Fill in the blanks:

The conduction band of an insulator is ....empty.(partially, fully).

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38. Why metallic solids are opaque?

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39. Give the ratio of the number of holes and the number of conduction electrons in an intrinsic semiconductor.

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40. Draw the energy-band diagram for an insulator.

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41. What is an intrinsic Semi-conductor ?

Watch Video Solution

42. Draw an energybnad diagram for an intrinsic semiconductor.

Watch Video Solution

43. What is the raio of number of holes and the number of conduction electrons in an n-type extrinsic semiconductor?

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44. What is doping ?

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45. Why semiconductors are doped?

Watch Video Solution

46. What type of impurity is added to obtain N-Type and P-Type semi conductors ?

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47. Which type of semiconductor is formed ,when germanium is doped with indium?

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48. Name the types of semicondcutors produced when germanium is doped separately with boron and arsenic. Which one of the better semiconductor and why?

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49. What is a p-type semicoductor?

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50. What is a hole? Which doping creates a hole?

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51. What is a hole? Which doping creates a hole?

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52. Doping of silicon with Indium leads to which type of semiconductor?

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53. Doping of silicon with Indium leads to which type of semiconductor?

Watch Video Solution

54. Dopingg of silicon with arsenic leads to which type of semiconductor?

Watch Video Solution

55. Which type of charge carries are there in n-type semiconductor?

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56. Which type of charge carries are there in p-type semiconductors?

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57. Which type of charge carries are there in p-type semiconductors?

Watch Video Solution

58. Which type of charge carries are there in n-type semiconductor?

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59. What is electron mobility?

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60. Fill in the blanks:

In an intrinsic semiconductor, the electron and hole concentrations are............(equal, unequal)

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61. Fill in the blanks:

When a block of semiconductor is connected to a battery by a metallic wire, the current flow in the wire is due to the motion of ....in the wire.(electrons, electrons and holes)

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62. Fill in the blanks:

The doping of an intrinsic semiconductor with certain type of impurity atoms causes an ....in its electric conductivity.(decrease, increase)

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63. Fill in the blanks:

When a battery is connected to a p-type semiconductor with metallic wire ,the current in the semiconductor is predominantly due to ....(electrons, holes)

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64. Fill in the blanks:

The movement of charge carriers from a region of higher concentration to a region of lower concentration is called.........(drift, diffusion)

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65. Fill in the blanks:

The drift velocity of electrons is expected to be ....(equal to, greater than holes).

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66. What is an intrinsic semiconductor? How can this material semiconductor? How can this material be converted into

p-type extrinsic semiconductor? Explain with the help of energy band diagrams?

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67. Is the ratio of number of holes and the number of conduction electrons in an n-type extrinsic semiconductor more than,less than or equal to 1 ?

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68. A semiconductor has equal electron and hole concentration $6 \times 10^8 m^{-3}$ .On doing with a certain impurity,electron concentration increases to $8 \times 10^{12} m^{-3}$.Identify the type of semicondcutor after doping.

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69. Draw the energy band diagram of N-type semiconductor.

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70. Draw the energy-band diagram of p-type semiconductor.

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71. How does the energy gap of an intrinsic semiconductor vary. When doped with a trivalent impurity?

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72. How does conductivity of a semi conductor change with the rise in temperature ?

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73. Fill in the blanks:

As the temperature rises, the resistance offered by metals ....(increses, decreases)

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74. Fill in the blanks:

The semiconductors are ....at absolute zero (conductors,insulators)

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75. The resistance of semiconductors.............with incresing temperature.(decrease,increases).

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76. Give important differences between crystalline and amorphous solids.

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77. The amorphous substances do not melt at a sharp temperature ,rather they have a softening range .Explain this obsrvation.

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78. What is the shpae of tthe unit cell of a cubic and a hexagonal crystal system?

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79. What is the difference between a single crystal and polycrystal ?

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80. Distinguish between energy levels and energy bands.

Watch Video Solution

81. Draw the energy-band diagram for an insulator.

Watch Video Solution

82. Give the enregy band diagram for metls

Watch Video Solution

83. Draw the energy band diagram of N-type semiconductor.

Watch Video Solution

84. Distinguish between conductor, insulator and semiconductor on the basis of their energy bands.

Watch Video Solution

85. Draw a labelled energy band diagram for an insulator,a conductor and a semiconductro.

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86. Define doping .Write two mehtods of dping?

Watch Video Solution

87. What is meant by doping? Why is it done?

Watch Video Solution

88. What is doping? How it changes the conductivity of a semiconductor?

Watch Video Solution

89. What is meant by doping?Draw energy band diagram of a n-type semiconductor.

Watch Video Solution

90. Draw the energy band diagram of N-type semiconductor.

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91. Distinguish between intrinsic and extrinsic semiconductors.

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92. Distinguish between intrinsic and extrinsic semiconductors.

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93. Distinguish between an intrinsic semiconductor and p-type semiconductor. Give reason, why a p-type semiconductor crystal is electrically neutral, although $n_h \rangle n_e$?

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94. Why n-type and p-type semiconductors are electrically neutral?

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95. What is donor energy level?Explain.

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96. What is an "acceptor energy level"?explain.

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97. What do you mean by hole in a semiconductor? Write its three characteristics.

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98. What is the difference between hole-current and electron current?

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99. Distinguish between n-type and p-type semiconductors.

Watch Video Solution

100. Distinguish between n-type and p-type semiconductors.

Watch Video Solution

101. Draw the energy band diagram of N-type semiconductor.

Watch Video Solution

102. Draw the energy band diagram of N-type semiconductor.

Watch Video Solution

103. With fall of temperature, the forbidden energy gap of a semiconductor:

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104. What is the effect of temperature on the electrical conductivity of metallic conductors ?

Watch Video Solution

105. Why is semiconductor damaged by a strong current?

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106. Why does conductivity of a semiconductor increase with rise in temperature?

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107. The electrical conductivity of metal decreases with rise in temperature, while that of a semiconductor increases. Explain

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108. Explain the effect of temperature on the resistivity of pure semiconductors.

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109. The graph shown in Fig.1.15 represenrts a plot of current versus voltage for a given semiconductor.

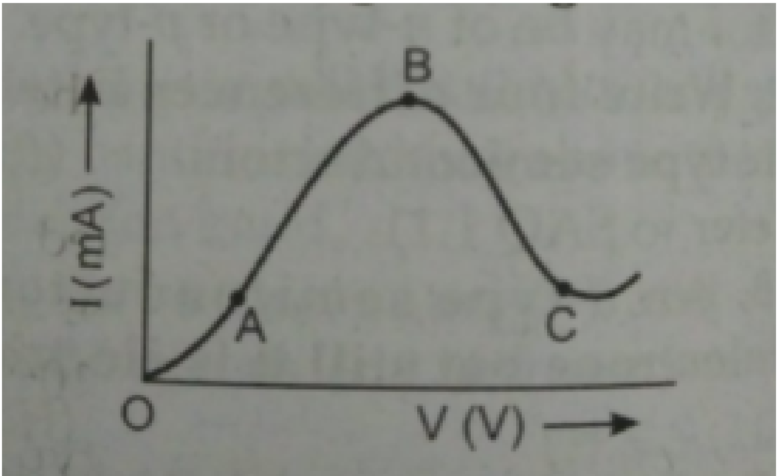

Fig. 1.15

identify the region,if any,over which the semiconductor has a negative resistance.

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Exercise

1. Explain the formation of energy bands in solids and hence define conduction band and valence band.

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2. Draw the energy band diagram of N-type semiconductor.

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3. Draw the energy-band diagram of p-type semiconductor.

Watch Video Solution

4. Give the enregy band diagram for

metls

Watch Video Solution

5. Draw the energy band diagram of N-type semiconductor.

Watch Video Solution

6. Draw the energy-band diagram of p-type semiconductor.

Watch Video Solution

7. Draw the energy-band diagram for an insulator.

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8. Explain the behaviour of semiconductors and insulators on the basis of energy bands in solids.

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9. Explain various energy bands in an atom.

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10. On the basis of the energy band diagrams distinguish between metals, insulators and semiconductors.

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11. Draw a labelled energy band diagram for an insulator,a conductor and a semiconductro.

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12. Draw a labelled energy band diagram for an insulator,a conductor and a semiconductro.

Watch Video Solution

13. Draw the energy-band diagram for an insulator.

Watch Video Solution

14. On the basis of the energy band diagrams distinguish between metals, insulators and semiconductors.

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15. What are ‘holes’? Write their characteristics.

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16. What is doping ? Write three necessary conditions for it and two methods of doping.

Watch Video Solution

17. What is doping ? Write three necessary conditions for it and two methods of doping.

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18. What is doping? What are the necessary conditions for it? State any method of doping.

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19. A n-type semiconductor is:

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20. What is an intrinsic Semi-conductor ?

Watch Video Solution

21. What is an intrinsic Semi-conductor ?

Watch Video Solution

22. What are intrinsic and extrinsic semiconductors? Discuss the formation and working of P-type semiconductor.

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23. What is extrinsic semiconductor? Describe N-type semiconductor.

Watch Video Solution

24. hat are extrinsic semi-conductors ? Explain donor type semi-conductor.

Watch Video Solution

25. What are extrinsic semiconductor ? Explain acceptor-type semi-conductors.

Watch Video Solution

26. What are extrinsic semiconductors? Describe p-type semiconductor?

Watch Video Solution

27. Why n-type and p-type semiconductors are electrically neutral?

Watch Video Solution

28. How can intrinsic semiconductor material be converted into n-type extrinsic semiconductor? Explain with the help of energy band diagrams?

Watch Video Solution

29. What is an intrinsic semiconductor? How can this material semiconductor? How can this material be converted into p-type extrinsic semiconductor? Explain with the help of energy band diagrams?

Watch Video Solution

30. What is meant by doping? Why is it done?

Watch Video Solution

31. What is doping? How it changes the conductivity of a semiconductor?

Watch Video Solution

32. What is an Extrinsic Semi-conductor ?

Watch Video Solution

33. Distinguish between intrinsic and extrinsic semiconductors.

Watch Video Solution

34. Derive an expressin for electrical conductiity of semiconductors.

Watch Video Solution

35. Explain the band theory of solids.

Watch Video Solution

36. Explain the formation of energy bands in solids and hence define conduction band and valence band.

Watch Video Solution

37. On the basis of the energy band diagrams distinguish between metals, insulators and semiconductors.

Watch Video Solution

38. Distinguish between conductor and semiconductor on the basis of their energy bands.

Watch Video Solution

39. Explain the formation of energy bands in solids and hence define conduction band and valence band.

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40. On the basis of the energy band diagrams distinguish between metals, insulators and semiconductors.

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44. What is an intrinsic semiconductor? How can this material semiconductor? How can this material be converted into

p-type extrinsic semiconductor? Explain with

the help of energy band diagrams?

Watch Video Solution

45. What is doping? What are the necessary

conditions for it? State any method of doping.

Watch Video Solution

46. What are extrinsic semiconductors ? Explain how p-type and n-type semiconductors are formed ?

Watch Video Solution

47. Derive an expressin for electrical conductiity of semiconductors.

Watch Video Solution

48. Using the concept of free electrons in a conductor, derive the expression for the conductivity of a wire in terms of number density and relaxation time. Hence obtain the relation between current density and the applied electric field E.

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49. Energy band gap of gallium arsenide phosphate is 1.98 eV.Calculate the wavelength of electromagnetic radiation emitted,when electrons and holes combine in this alloy semiconductor directly.

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50. The enrgy gap of silicon is 1.14 eV.Find the maximum wavelength ,at which silicon starts energy absorption.Give that $1eV = 1.610^{-19}J$ and $h = 6.62 \times 10^{-34} Js$.

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51. The energy liberated in the combination of a hole-electron pair is converted into electromagnetic radiation.What is tha band gap,if the maximum wawveelngth fo th radiation emitted is 820 nm?Gien that $1eV = 1.6 \times 10^{-19} J$ and $h = 6.62 \times 10^{-34} Js$.

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52. The energy liberated in the ecombination of hole-electron pair is converted into electromagnetic radiation. If the maximum wave length emitted is 400 nm, find the value of forbidden energy gap.

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53. A p-type semiconductor has acceptor energy levels 57 meV(millielectron volt) above the valence band.Find the maximum wavelength of the radiation,which can create a hole?

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54. A semiconductor has accpetor level 1.57 eV above the valence band.What is the maximum wavelength of light required to create a hole? Given that $1eV = 1.6 \times 10^{-19} J$ and $h = 6.62 \times 10^{-34} Js.$

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55. A semiconductor has equal electron and hole concentration of $4.2 \times 10^{8} m^{-3}$.On doping with a certain impurity,electron concentration increases to $6 \times 10^{12} m^{-3}$.

identify the new seiconductor obtained after doping.

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56. A semiconductor has equal electron and hole concentration of $4.2 \times 10^{8} m^{-3}$.On doping with a certain impurity,electron concentration increases to $6 \times 10^{12} m^{-3}$.

identify the new seiconductor obtained after doping.

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57. A semiconductor has equal electron and hole concentration $6 \times 10^8 m^{-3}$ .On doing with a certain impurity,electron concentration increases to $8 \times 10^{12} m^{-3}$.Identify the type of semicondcutor after doping.

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58. A semiconductor has equal electron and hole concentration of $6 \times 10^8 m^{-3}$. On doping with a certain impurity electron concentration increases to $9 \times 10^{12} m^{-3}$

Calculate the new hole concentration.

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59. A semiconductor has equal electron and hole concentration of $6 \times 10^{4} m^{-3}$. On doping with a certain impurity electron concentration increases to $8 \times 10^{12} m^{-3}$. Identify the type of semiconductor?

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60. A semiconductor has equal electron and hole concentration of $2 \times 10^8 m^{-3}$.On doping with a certain impurity,electron concentration increases to $4 \times 10^{10} m^{-3}$.

What type of semiconductor is obtained on doping?

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61. A semiconductor has equal electron and hole concentration of $6 \times 10^8 m^{-3}$. On doping with a certain impurity electron concentration increases to $9 \times 10^{12} m^{-3}$

Calculate the new hole concentration.

Watch Video Solution

62. A semiconductor has equal electron and hole concentration of $4.2 \times 10^{8} m^{-3}$.On doping with a certain impurity,electron concentration increases to $6 \times 10^{12} m^{-3}$. identify the new seiconductor obtained after doping.

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63. A semiconductor has electron concentration of $8 \times 10^{8} m^{-3}$. and hole concentration $4 \times 10^{10} m^{-3}$.Is this semiconductor p-type or n-type?

Watch Video Solution

64. A semiconductor has the electration $0.45 \times 10^{20} m^{-3}$ and hole concentration $5 \times 10^{20} m^{-3}$.Find its

conductivity.Given,electron mobility = $0.135 m^2 V^{-1} s^{-1}$, hole mobility = $0.048 m^2 V^{-1} s^{-1}$, $e = 1.6x10^{-19} C$.

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65. Estimate the fraction of electrons,which are excited from the energy gap of 1.1 eV at a temperature of 300 K. Given Boltzmann's constant,$k = 1.38 \times 10^{-23} J$.

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66. In an intrinsic semiconductor the energy gap E_g is 1.2eV . Its hole mobility is much smaller than electron mobility and independent of temperature. What is the ratio between conductivity at 600K and that at 300K? Assume that the temperature dependence of intrinsic carrier concentration ni is given by $n_i = n_0 \exp\left(\frac{E_g}{2k_BT}\right)$ where n_0 is constant.

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