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S.CONDUCTORS

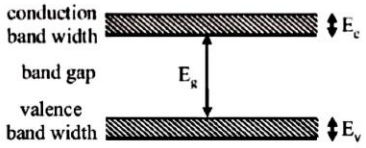
Multiple Choice Questions (MCQs)

DIRECTIONS : *This section contains multiple choice questions. Each question has four choices (a), (b), (c) and (d) out of which only one is correct.*

1. The electrical conductivity of pure germanium can be increased by
(a) increasing the temperature
(b) doping acceptor impurities
(c) doping donor impurities
(d) All of the above

2. Which of the following statements is/are true/false ?
I. Pure Si doped with trivalent impurities gives a p-type semiconductor.
II. Majority carriers in a *n*-type semiconductor are holes.
III. Minority carriers in a *p*-type semiconductor are electrons.
IV. The resistance of intrinsic semiconductor decreases with increase of temperature.
(a) T, F, F, F (b) T, F, T, T
(c) T, F, F, T (d) F, T, F, F

3. If the lattice constant of this semiconductor is decreased, then which of the following is correct?



(a) All E_c, E_g, E_v increase
(b) E_c and E_v increase, but E_g decreases
(c) E_c and E_v decrease, but E_g increases
(d) All E_c, E_g, E_v decrease

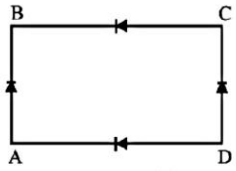
4. On doping germanium with donor atoms of density 10^{17} cm^{-3} its conductivity in mho/cm will be
[Given : $\mu_e = 3800$ cm^2/V–s and $n_i = 2.5 \times 10^{13}$ cm^{-13}]
(a) 30.4 (b) 60.8
(c) 91.2 (d) 121.6

5. These are used for doping
I. A trivalent impurity. II. A tetravalent impurity.
III. A pentavalent impurity. IV. A monovalent impurity.
Select the true/false statements from above
(a) T, T, F, F (b) F, T, F, T
(c) F, T, T, F (d) T, F, T, F

6. If the forward bias on *p-n* junction is increased from zero to 0.045 V, then no current flows in the circuit. The contact potential of junction i.e. V_B is
(a) zero (b) 0.045 V
(c) more than 0.045 V (d) less than 0.045 V

7. Rectifier converts
(a) ac into dc (b) dc into ac
(c) both (a) and (b) (d) None of the above

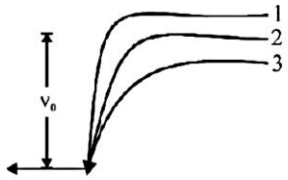
8. In fig., the input is across the terminals A and C and the output is across B and D. Then the output is



(a) zero (b) same as the input
(c) half wave rectified (d) full wave rectified

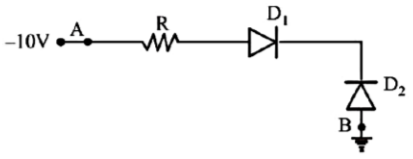
9. The conductivity of a semiconductor increases with increase in temperature because
(a) number density of free current carries increases
(b) relaxation time increases
(c) both number density of carries and relaxation time increase
(d) number density of carries increases, relaxation time decreases but effect of decrease in relaxation time is much less than increase in number density

10. In figure given below V_0 is the potential barrier across a p–n junction, when no battary is connected across the junction

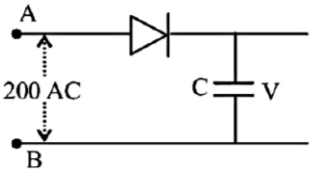


(a) 1 and 3 both correspond to forward bias of junction
(b) 3 corresponds to forward bias of junction and 1 corresponds to reverse bias of junctions
(c) 1 corresponds to forward bias and 3 corresponds to reverse bias of junction
(d) 3 and 1 both correspond to reverse bias of junction

11. In figure given below, assuming the diodes to be ideal
(a) D_1 is forward biased and D_2 is reverse biased and hence current flows from A to B
(b) D_2 is forward biased and D_1 is reverse biased and hence no current flows from B to A and vice–versa
(c) D_1 and D_2 are both forward biased and hence current flows from A to B
(d) D_1 and D_2 are both reverse biased and hence no current flows from A to B and vice – versa



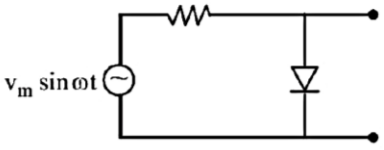
12. A 220 V AC supply is connected between points A and B (figure). What will be the potential difference V across the capacitor?



(a) 220 V (b) 110 V
(c) 0V (d) $220\sqrt{2}$V

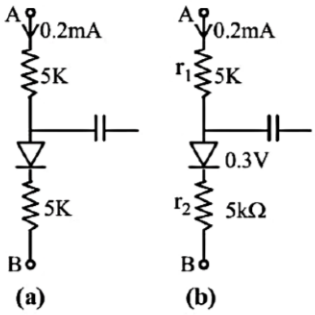
13. Hole in semiconductor is
(a) an anti – particle of electron
(b) a vacancy created when an electron leaves a covalent bond
(c) absence of free electrons
(d) an artificially created particle

14. The output of the given circuit in figure given below,



(a) would be zero at all times
(b) would be like a half wave rectifier with positive cycles in output
(c) would be like a half wave rectifier with negative cycles in output
(d) would be like that of a full wave rectifier

15. In the circuit shown in figure given below, if the diode forward voltage drop is 0.3 V, the voltage difference between A and B is



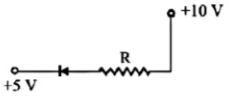
(a) 1.3 V (b) 2.3 V
(c) 0 (d) 0.5 V

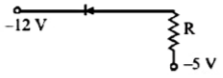
16. Electric conduction in a semiconductor takes place due to
(a) electrons only
(b) holes only
(c) both electrons and holes
(d) neither electrons nor holes

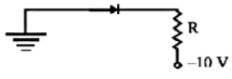
17. The depletion layer in the p-n junction region is caused by
(a) drift of holes only
(b) diffusion of charge carriers
(c) migration of impurity atoms
(d) drift of electrons only

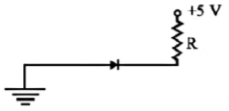
18. The forbidden energy gap for germanium crystal at 0 K is
(a) 0.071 eV (b) 0.71 eV
(c) 2.57 eV (d) 6.57 eV

19. Of the diodes shown in the following diagrams, which one is reverse biased?

(a) 

(b) 

(c) 

(d) 

20. In a semiconductor
(a) there are no free electrons at 0 K
(b) there are no free electrons at any temperature
(c) the number of free electrons increases with pressure
(d) the number of free electrons is more than that in a conductor

21. Let n_h and n_e be the number of holes and conduction electrons in an extrinsic semiconductor. Then
(a) $n_h > n_e$ (b) $n_h = n_e$
(c) $n_h < n_e$ (d) $n_h \neq n_e$

22. In semiconductors, at room temperature
(a) the conduction band is completely empty
(b) the valence band is partially empty and the conduction band is partially filled
(c) the valence band is completely filled and the conduction band is partially filled
(d) the valence band is completely filled

23. The mobility of free electrons is greater than that of free holes because
(a) they are light
(b) they carry negative charge
(c) they mutually colllide less
(d) they require low energy to continue their motion

24. In a p-type semiconductor, the acceptor valence band is
(a) close to the valence band of the host crystal
(b) close to conduction band of the host crystal
(c) below the conduction band of the host crystal
(d) above the conduction band of the host crystal

25. A piece of copper and another of germanium are cooled from room temperature to 77K, the resistance of
(a) copper increases and germanium decreases
(b) each of them decreases
(c) each of them increases
(d) copper decreases and germanium increases

26. Select the incorrect statement from the following.
(a) In conductors, the valence and conduction bands may overlap.
(b) Substances with energy gap of the order of 10 eV are insulators.
(c) The resistivity of a semiconductor increases with increase in temperature.
(d) The conductivity of a semiconductor increases with increase in temperature.

27. Which of the following statements is incorrect?
(a) Pure Si doped with trivalent impurities gives a p-type semiconductor
(b) Majority carriers in a n-type semiconductor are holes
(c) Minority carriers in a p-type semiconductor are electrons
(d) The resistance of intrinsic semiconductor decreases with increase of temperature

28. In a n-type semiconductor, which of the following statements is correct?
(a) Electrons are minority carriers and pentavalent atoms are dopants.
(b) Holes are minority carriers and pentavalent atoms are dopants.
(c) Holes are majority carriers and trivalent atoms are dopants.
(d) Electrons are majority carriers and trivalent atoms are dopants.

29. When n-type semiconductor is heated
(a) number of electrons increases while that of holes decreases
(b) number of holes increases while that of electrons decreases
(c) number of electrons and holes remain same
(d) number of electrons and holes increases equally.

30. The difference in the variation of resistance with temeperature in a metal and a semiconductor arises essentially due to the difference in the
(a) crystal sturcture
(b) variation of the number of charge carriers with temperature
(c) type of bonding
(d) variation of scattering mechanism with temperature

31. Choose the only false statement from the following.
(a) In conductors, the valence and conduction bands may overlap.
(b) Substances with energy gap of the order of 10 eV are insulators.
(c) The resistivity of a semiconductor increases with increase in temperature.
(d) The conductivity of a semiconductor increases with increase in temperature.

32. In a semiconductor diode, the barrier potential offers opposition to
(a) holes in P-region only
(b) free electrons in N-region only
(c) majority carriers in both regions
(d) majority as well as minority carriers in both regions

33. If the ratio of the concentration of electrons 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?
(a) 5/8 (b) 4/5
(c) 5/4 (d) 4/7

34. The electrical conductivity of pure germanium can be increased by
(a) increasing the temperature
(b) doping acceptor impurities
(c) doping donor impurities
(d) All of the above

35. The resistivity of a semiconductor at room temperature is in between
(a) 10^{-2} to $10^{-5}\ \Omega$ cm (b) 10^{-3} to $10^{6}\ \Omega$ cm
(c) 10^{6} to $10^{8}\ \Omega$ cm (d) 10^{10} to $10^{12}\ \Omega$ cm

36. The relation between number of free electrons (n) in a semiconductor and temperature (T) is given by
(a) $n \propto T$ (b) $n \propto T^2$
(c) $n \propto \sqrt{T}$ (d) $n \propto T^{3/2}$

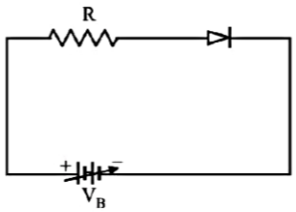
Case/Passage Based Questions

DIRECTIONS : *Study the given Case/Passage and answer the following questions.*

Case/Passage-I

P-N Junction Diode and its Characteristics

A Si diode (p-n junction) is connected to a resistor and a biasing battery of variable voltage V_B. Assume that the diode requires a minimum current of 1 mA to be above the knee point 0.7 V of its V-I characteristic curve. Also assume that the voltage V across the diode is independent of current above the knee (cut-off) point



37 If $V_B = 5V$, then the maximum value of R so that the voltage V is above the knee point voltage, should be

(a) 0.7 kΩ (b) 4.3 kΩ
(c) 5 kΩ (d) 5.7 kΩ

38. If V_B = 5V, then the value of R in order to establish a current of 5 mA in the circuit, will be

(a) 140 Ω (b) 215 Ω
(c) 430 Ω (d) 860 Ω

39. If $V_B = 6V$ and 5mA current flows through the circuit, then the power dissipated in R will be

(a) 32.6 mW (b) 26.4 mW
(c) 3.26 mW (d) 2.6 mW

40. A semiconductor device is connected in a series circuit with a battery and a resistance. A current is found to pass through the circuit. If the polarity of the battery is reversed, the current drops to almost zero. The device may be a/an

(a) intrinsic semiconductor
(b) p-type semiconductor
(c) n-type semiconductor
(d) p-n junction diode

41 The drift current in a p-n junction is

(a) from the n-side to the p-side
(b) from the p-side to the n-side
(c) from the n-side to the p-side if the junction is forward-biased and in the opposite direction if it is reverse biased
(d) from the p-side to the n-side if the junction is forward-biased and in the opposite direction if it is reverse-biased

Case/Passage-II

Rectifier is a device which converts ac to dc.

Junction diode allows current to pass through only if it is forward biased, hence a pulsating voltage will appear across the load only during positive half cycles when diode is F.B. Here, reverse breakdown voltage of diode must be higher than peak a.c. voltage at the secondary of the transformer to prevent breakdown of diode.

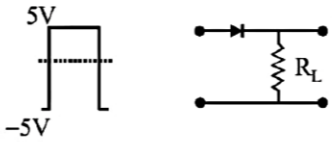
42. The average value of output direct current in a half wave rectifier is

(a) I_0/π (b) $I_0/2$ (c) $\pi I_0/2$ (d) $2I_0/\pi$

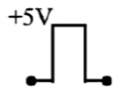
43. The average value of output direct current in a full wave rectifier is

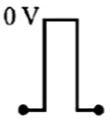
(a) I_0/π (b) $I_0/2$ (c) $\pi I_0/2$ (d) $2I_0/\pi$

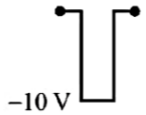
44. If in a p-n junction diode, a square input signal of 10 V is applied as shown

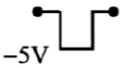


Then the output signal across R_L will be

(a) 

(b) 

(c) 

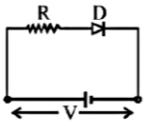
(d) 

45. In the half wave rectifier circuit operating from 50 Hz mains frequency, the fundamental frequency in the ripple would be

(a) 25 Hz (b) 50 Hz (c) 70.7 Hz (d) 100 Hz

46. A d.c. battery of V volt is connected to a series combination of a resistor R and an ideal diode D as shown in the figure below. The potential difference across R will be

(a) 2V when diode is forward biased
(b) zero when diode is forward biased
(c) V when diode is reverse biased
(d) V when diode is forward biased



Case/Passage-III

The electric conductivity of an intrinsic semiconductor increases when the electromagnetic waves of wavelength equal or shorter than 2475 nm is incident on it. The charge carrier concentration of this semiconductor at room temperature is $1.6 \times 10^{16}\ m^{-3}$ and the mobilities of electrons and holes at the same temperature are $0.4\ m^2\ V^{-1}\ S^{-1}$ and $0.2\ m^2\ V^{-1}S^{-1}$ respectively.

47. The forbidden energy gap of the semiconductor is

(a) 0.2 eV (b) 0.5 eV (c) 1.0 eV (d) 1.5 eV

48. Conductivity of the semiconductor is

(a) $1.54 \times 10^{-2}\ Sm^{-1}$ (b) $1.54 \times 10^{-3}\ Sm^{-1}$

(c) $1.54 \times 10^{-4}\ Sm^{-1}$ (d) $1.54 \times 10^{-5}\ Sm^{-1}$

49. If a battery of 5V is connected across a plate of the semiconductor of area $2 \times 10^{-4}\ m^2$ and thickness 1.2×10^{-3} m, then the current flowing through the plate is

(a) 0.32 mA (b) 0.64 mA

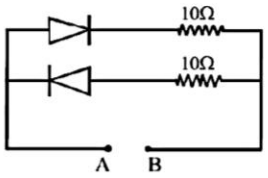
(c) 1.28 mA (d) 2.56 mA

50. When the forward bias voltage of a diode is changed from 0.6 V to 0.7 V, the current changes from 5 mA to 15 mA. Then its forward bias resistance is

(a) 0.01 Ω (b) 0.1 Ω

(c) 10 Ω (d) 100 Ω

51. A 2-V battery is connected across the points A and B as shown in the figure given below. Assuming that the resistance of each diode is zero in forward bias, and infinity in reverse bias, the current supplied by the battery when its positive terminal is connected to A, is



(a) 0.2 A (b) 0.4 A (c) 0.3A (d) 0.1 A

Assertion & Reason

DIRECTIONS : *Each of these questions contains an assertion followed by reason. Read them carefully and answer the question on the basis of following options. You have to select the one that best describes the two statements.*

(a) If both **Assertion** and **Reason** are **correct** and the Reason is the **correct explanation** of the Assertion.

(b) If both **Assertion** and **Reason** are correct but Reason is **not the correct explanation** of the Assertion.

(c) If the **Assertion** is **correct** but **Reason** is **incorrect.**

(d) If the **Assertion** is **incorrect** but the **Reason** is **correct.**

52. **Assertion :** In semiconductors, thermal collisions are responsible for taking a valence electron to the conduction band.

Reason : The number of conduction electrons go on increasing with time as thermal collisions continuously take place.

53. **Assertion :** In an energy band, the highest energy level occupied by electron at 0K is called fermi level and its energy is called fermi-energy.

Reason : The band seperating the valence band and conduction band is callled forbidden energy gap.

Match the Following

DIRECTIONS : *Each question contains statements given in two columns which have to be matched. Statements (A, B, C, D) in column-I have to be matched with statements (1, 2, 3, 4) in column-II.*

54. Match the column I and Column II

Column I	Column II (Range of resistivity, ρ)
(A) Metals	(1) $10^{11} - 10^{19}\ \Omega$ m
(B) Semiconductors	(2) $10^{-5} - 10^{6}\ \Omega$ m
(C) Insulators	(3) $10^{-2} - 10^{-8}\ \Omega$ m

(a) (A) → (3); (B) → (2); (C) → (1)

(b) (A) → (1); (B) → (2); (C) → (3)

(c) (A) → (1); (B) → (2); (C) → (3)

(d) (A) → (1); (B) → (2); (C) → (3)

Fill in the Blanks

DIRECTIONS : *Complete the following statements with an appropriate word / term to be filled in the blank space(s).*

55. In N-type semiconductor, _____ are majority and _____ are minority charge carriers.

56. In _____ semiconductor, the fermi level lies in the energy gap, very close to conduction band.

57. A p-n photodiode is made of a material with a band gap of 2.0eV. The minimum frequency of the radiation that can be absorbed by the material is nearly _____.

58. In general maximum rectification efficiency for a half wave recifier is _____.

59. Temperature coefficient of resistance of semiconductor is _____.

60. At absolute zero, Si acts as _____.

True / False

DIRECTIONS : *Read the following statements and write your answer as true or false.*

61. A p-n junction with forward bias can be used as a photo-diode to measure light intensity.

62. In a reverse bias condition the current is small but is more sensitive to changes in incident light intensity.

63. Silicon is preferred over germanium for making semiconductor devices.

64. Electron has higher mobility than hole in a semiconductor.

ANSWER KEY & SOLUTIONS

1. **(d)** Electrical conductivity of pure germanium can be increased by increasing acceptor or donor impurities. Also by increasing temperature.
2. **(b)** Majority carriers in an *n*-type semiconductor are electrons.
3. **(c)** A crystal structure is composed of a unit cell, a set of atoms arranged in a particular way; which is periodically repeated in three dimensions on a lattice. The spacing between unit cells in various directions is called its lattice parameters or constants. Increasing these lattice constants will increase or widen the band-gap (E_g), which means more energy would be required by electrons to reach the conduction band from the valence band. Automatically E_c and E_v decreases.
4. **(b)** Conductivity $\sigma = n_i e \mu_e$
   $= 10^{17} \times (1.6 \times 10^{-19}) \times 3800$
   $- 60.8$ mho/cm
5. **(d)** The process of addition of impurity is called doping. The impurties are pentavalent and trivalent.
6. **(c)** When no current flows at the junction plane, then contact potential of junction plane is equal to the forward voltage applied = 0.045 V
7. **(a)** Rectifier is a device which converts ac into dc.
8. **(d)** It is the circuit of full wave rectifier.
9. **(c)**
10. **(b)** The depletion layer in the p-n junction region is caused by diffusion of charge carriers.
11. **(b)** **12. (d)**
13. **(b)** Atom of semiconductor are bounded by covalent bonds between the atoms of same or different type. The concept of hole describes the lack of an electron at a position where one could exist in an atom or atomic lattice. If an electron is excited into a higher state, it leaves a hole in its old state. So, hole can be defined as a vacancy created when an electron leaves a covalent bond.
14. **(c)** When the diode will be in forward biased during positive half cycle of input AC voltage, the resistance of p–n junction is low. The current in the circuit is maximum. So, a maximum potential difference will appear across resistance connected in series of circuit. So, potential across PN junction will be zero. When the diode will be in reverse biase during negative half cycle of AC voltage, the resistance of p–n juntion becomes high which will be more than resistance in series. So, there will be voltage across p–n junction with negative cycle in output.
15. **(b)** Let the potential difference between A and B is V, Given here $r_1 = 5\ k\Omega$ and $r_2 = 5\ k\Omega$ are resistance in series connection.
    So,
    $V_{AB} - 0.3 = [(r_1 + r_2)\ 10^3] \times (0.2 \times 10^{-3})]$
    $[\because V = ir]$
    $(V_{AB} - 0.3) = 10 \times 10^3 \times 0.2 \times 10^{-3} = 2$
    So, $V_{AB} = 2 + 0.3 = 2.3$ V
16. **(d)** In semiconductor the density of change carriers (electron hole) are very small, so its resistance is high when the conductivity of a semiconductor increases with increase in temperature, because the number density of current carries increases then the speed of free electron increase and relaxation time decreases but effect of decrease in relaxation is much less than increase in number density.
17. **(b)** When p–n junction is forward biased then the depleton layer is compresses or decrease so it opposes the potential junction resulting decrease in potential barrier junction when p n junction is reverese biased, it supports the potential barrier junction, resulting increase in potential across the junction.
18. **(b)** **19. (d)**
20. **(a)** In a semiconductor, no free electrons at 0 k.
21. **(d)** In extrinsic semi conductor the number of holes are not equal to number of electrons i.e., $n_h \neq n_e$
    In p - type $n_h > n_e$
    In n - type $n_e > n_h$
22. **(c)** **23. (a)**
24. **(a)** The acceptor valence band is close to the valence band of host crystal
25. **(d)** Copper is a conductor, so its resistance decreases on decreasing temperature as thermal agitation decreases,; whereas germanium is semiconductor therefore on decreasing temperature resistance increases
26. **(c)**
27. **(b)** Majority carriers in an n-type semiconductor are electrons.
28. **(b)** In a n-type semiconductor holes are minority carriers and pentavalent atoms are dopants.
29. **(d)** Due to heating, when a free electron is produced then simultaneously a hole is also produced.
30. **(b)** When the temperature increases, certain bounded electrons become free which tend to promote conductivity. Simultaneously, number of collisions between electrons and positive kernels increases
31. **(c)** **32. (c)**
33. **(c)** $\frac{I_e}{I_h} = \frac{n_e e A v_e}{n_h e A v_h} \Rightarrow \frac{7}{4} = \frac{7}{5} \times \frac{v_e}{v_h} \Rightarrow \frac{v_e}{v_h} = \frac{5}{4}$

34. (d)

35. (b) Resistivity of a semiconductor at room temp. is in between $10^{-5}\,\Omega$m to $10^{4}\,\Omega$m i.e. 10^{-3} to $10^{6}\,\Omega$cm

36. (d) For semiconductor, $n = AT^{3/2}e^{-\frac{E_g}{2KT}}$;

so $n \propto T^{3/2}$

37. (b) $V_B = I(R_D + R)$ $(1\times4 = 4\text{ marks})$

$$\Rightarrow 5 = 1\times10^{-3}\left(\frac{0.7}{10^{-3}} + R\right)$$

$$\Rightarrow R = 4.3\,\text{k}\Omega$$

38. (d) $V_B = I(R_D + R)$

$$\Rightarrow 5 = 5\times10^{-3}\left(\frac{0.7}{5\text{mA}} + R\right)$$

$$\Rightarrow 1\,\text{k}\Omega = 180\Omega + R$$

$$\Rightarrow R = 860\Omega$$

39. (b) $\text{Power} = VI = (6-0.7)\times5\times10^{-3}\,\text{W} = 26.4\,\text{mW}$

40. (d) **41.** (a)

42. (a) The average value of output direct current in a half wave rectifier is = (average value of current over a cycle) $2 = (2\,I_0/\pi)/2 = I_0/\pi$

43. (d) The average value of output direct current in a full wave rectifier = average value of current over a cycle $= 2\,I_0/\pi$

44. (a) The current will flow through R_L when the diode is forward biased.

45. (b) In half wave rectifier, we get the output only in one half cycle of input a.c. therefore, the frequency of the ripple of the output is same as that of input a.c. *i.e.*, 50 Hz.

46. (c)

47. (b) Forbidden energy gap $= \dfrac{12400\,(\text{eV}-\text{Å})}{\lambda\,(\text{Å})}$

$$= \frac{12400}{24750}\text{eV} = 0.5\text{ eV}$$

48. (b) $\sigma = ne(\mu_e + \mu_h) = 1.6\times10^{16}\times1.6\times10^{-19}(0.4+0.2)$

$= 1.54\times10^{-3}\,\text{Sm}^{-1}$

49. (c) $\rho = \dfrac{1}{\sigma} = \dfrac{1}{1.54\times10^{-3}}$

$$I = \frac{V}{R} = \frac{V}{\frac{\rho L}{A}} = \frac{5}{\frac{1}{1.54\times10^{-3}}}\times\frac{2\times10^{-4}}{1.2\times10^{-3}} = 1.28\,\text{mA}$$

50. (c) Forward bias resistance $= \dfrac{\Delta V}{\Delta I}$

$$= \frac{(0.7-0.6)\text{V}}{(15-5)\,\text{mA}} = \frac{0.1}{10\times10^{-3}} = 10\Omega.$$

51. (a) As one of the diodes (the lower one) will be in reverse bias, no current will pass through it, so the effective resistance of the circuit $= 10\,\Omega$.

$$\therefore \quad \text{Current in the circuit} = \frac{2\text{ V}}{10\,\Omega} = 0.2\text{ A}$$

52. (c) Sometimes, thermal collisions do not provide sufficient energy to the electron to jump. Also, energy is last in the form of heat because of the collision of the carriers with other charge carriers and atoms. Because of all these losses only few electrons are left with sufficient energy to jump from VB to CB. So the population of electron in the CB does not keep on increasing with time.

53. (b)

54. (a) (A) → (3); (B) → (2); (C) → (1)

55. (Electrons, holes)

56. (*n*-type semiconductor)

57. (5×10^{14} Hz)

58. (40.6%) $\eta = \dfrac{0.406}{1-\dfrac{R_f}{R_L}}$

$$\%\,\eta_{max} = 40.6\% \quad \left(\text{if}\ \frac{R_f}{R_L} \ll 1\right)$$

59. (Negative) The temperature coefficient of resistance of a semiconductor is negative. It means that resistance decrease with increase of temperature.

60. (Insulator) Semiconductors are insulators at low temperature

61. (False) When photo-diode is used in reverse barrier are proportional to the amount of light incident on the diode.

62. (True) A current is generated in a depletion region due to the absorbed light. This amount of current is proportional to the light inensity.

63. (True) The energy gap for germanium is less than the energy gap of Si. The structure of Germanium crystals will be distroyed at higher temperature.

64. (True)