PHYSICS

BOOKS - U-LIKE PHYSICS (HINGLISH)

SEMICONDUCTOR ELECTRONICS : MATERIALS, DEVICES AND SIMPLE CIRCUITS

N C E R T Textbook Exercises

1. In an n-type silicon, which of the following statement is true:

A. Electrons are majority carriers and trivalent atoms are the dopants.

B. Electrons are minority carriers and pentavalent atoms are the dopants.

C. Holes are minority carriers and pentavalent atoms are the dopants.

D. Holes are majority carriers and trivalent atoms are the dopants.

Answer:

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2. Which of the statements given in Exercise 14.1 is true for p-type semiconductors?

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3. Carbon, silicon and germanium have four valence electrons each. These are characterised by valence and conduction bands separated by energy band gap respectively equal to $1(E_g)_c$, $(E_g)_{s1}$ and $(E_g)_G$; Which of the following statement is true ?

A. $(E_g)_{si} < (E_g)_{Ge} < (E_g)_C$

B. $(E_g)_C < (E_g)_{Ge} > (E_g)_{Si}$

C. $(E_g)_C > (E_g)_{Si} > (E_g)_{Ge}$

D. $(E_g)_C = (E_g)_{Si} = (E_g)_{Ge}$

Answer:

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4. In an unbiased p-n junction, holes diffuse from the p-region to n-region because

A. free electrons in the n-region attract them.

B. they move across the junction by the potential difference.

C. hole concentration in p-region is more as compared to n-region.

D. All the above.

Answer:

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5. When a forward bias is applied to a p-n junction, it

A. raises the potential barrier.

B. reduces the majority carrier current to zero.

C. lowers the potential barrier.

D. none of the above.

Answer:

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6. In half-wave rectification, what is the output frequency if the input frequency is 50 Hz. What is the output frequency of a full-wave rectifier for the same input frequency ?

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7. A p-n photodiode is fabricated from a semiconductor with a band gap of 2.8 eV. Can it detect a wavelength of 6000 run?

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Additional Exercises

1. The number of silicon atoms per m^3 is 5×10^{28}. This is doped simultaneously with 5×10^{22} atoms per m^3 of Arsenic and 5×10^{20} per m^3 atoms of Indium. Calculate the number of electrons and holes. Given that $n_i = 1.5 \times 10^{16} m^{-3}$. Is the material n-type or p-type?

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Case Based Source Based Integrated Questions

1. Read the following passage and then answer question (a) - (e) on the basis of your understanding of the following passage and the related studied concepts.

As per Bohr atom model, in an isolated atom the energy of any of its electrons depends on the orbit in which it revolves and it is characterised by a sharp energy level. However, inside a crystalline solid atoms are close to

each other and the outer orbits of electrons from neighbouring atoms would come very close or could even overlap. As a result, each electron will have a different energy level. These different energy levels with continuous energy variation form energy bands.

The energy band which includes the energy levels of the valence electrons is called the valence band. All the valence electrons reside in the valence band. The energy band above the valence band is called the conduction band. Normally the conduction band is empty.

If the lowest level in the conduction band

happens to be lower than the highest level of the valence band, electrons from the valence band may easily move into the conduction band and the solid behaves as a conductor.

If there is some gap between the conduction band and the valence band, electrons in the valence band remain confined to it and no free electrons are available in the conduction band. It makes the solid an insulator.

If some of the electrons from the valence band may gain external energy to cross the gap between the conduction band and valence band, these electrons will move into the

conduction band and simultaneously create vacant energy levels in the valence band. Therefore, there is a possibility of conduction due to electrons in conduction band as well as due to vacancies in the valence band.

How are energy bands formed in a crystalline solid ?

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Draw energy band diagram for a metal.

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What is the difference between energy band diagram of an insulator and a semiconductor?

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What are holes ? How are they formed ?

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Name two elements which behave as semiconductors.

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6. Read the following passage and then answer questions (a) - (e) on the basis of your understand- ing of the passage and the related studied concepts.

A semiconductor diode is basically a p-n junction and is thus a two terminal device, when an external voltage is applied across a semiconductor diode such that p-side is connected to the positive terminal of the battery and n-side to the negative terminal, it is forward biased. The direction of the applied voltage is opposite to the built in barrier potential. As a result, the depletion layer width decreases and the barrier height is reduced. If the applied voltage is increased, it may overcome the barrier potential altogether and a large current flows across the junction.

When an external voltage (V) is applied across the diode such that n-side is positive and p-side is negative, it is said to be reverse biased. The direction of applied voltage is same as the direction of barrier potential. As a result, the barrier height increases and the depletion region widens. So current flowing across the junction decreases enormously (practically becomes zero) as compared to the diode under forward bias.

If an alternating voltage is applied across a diode, the current flows only in that part of the cycle when the diode is forward biased.

Why is a p-n junction called semiconductor diode ?

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Draw circuit arrangement of a p-n junction in forward bias and in revene bias arrangement.

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Distinguish between forward bias and reverse bias arrangements of a semiconductor diode.

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If an alternating voltage is applied across a diode, the current flows only in that part of the cycle when the diode is forward biased.

What is a rectifier ? Draw a circuit diagram of a half-wave rectifier.

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Name two main components of your mobile phone charger.

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11. Read the following passage and then answer questions (a) - (e) on the basis of your understand- ing of the passage and the related studied concepts.

India is lucky to receive solar energy for the

greater part of the year. Energy received from the sun is about 1.4 kW m^{-2} and it is estimated that during a year India receives energy equivalent to more than 5000 trillion kWh from the sun. Solar energy can be harnessed by the use of solar panels. Each solar panel consists of a number of solar cells which work on photovoltaic effect.

With continuous enhancement in technology cost of installing solar power has come down and is now comparable with thermal power stations. As a result, solar power is a fast developing industry in India. During last few

years country's installed solar capacity has grown by leaps and bounds and reached 30.1 GW as on 31-07-2019. India aims to have an installed solar power capacity of 100 GW by 2022 and 250 GW by 2030.

What a.re the three basic processes due to which the generation of emf takes place in a sol?- cell?

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Which material is ideal for solar cell fabrication and why ?

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What type of bias is employed for a solar cell and why ?

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Draw I· V characteristic of a solar cell.

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Name three important criteria for the selection of a material for solar cell fabrication.

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Multiple Choice Questions

1. The intrinsic semiconductor becomes an insulator at

A. 0° C

B. -100° C

C. 300 K

D. 0 K

Answer: D

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2. Which impurity is doped in Si to form N-type semiconductor ?

A. Al

B. B

C. P

D. None of these

Answer: C

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3. A Ge specimen is doped with Al. The concentration of acceptor atoms is $\sim 10^{21} m^{-3}$. Given that the intrinsic concentration of electron-hole pairs is $\sim 10^{19} m^{-3}$. The concentration of electrons in the specimen is

A. $10^{17} m^{-3}$

B. $10^{15} m^{-3}$

C. $10^{4} m^{-3}$

D. $10^{2} m^{-3}$

Answer: A

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4. A piece of copper and the other of germanium are cooled from the room temperature to 80 K, then which of the following would be a correct statement ?

A. Resistance of each increases.

B. Resistance of each dec.reases.

C. Resistance of copper increases while that of germanium decreases.

D. Resistance of copper decreases while that of germanium increases.

Answer: D

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5. Hole is

A. an antiparticle of electron.

B. a vacancy created when an electron leaves _a covalent bond.

C. absence of free electrons.

D. an artificially created particle.

Answer: B

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6. The reverse biasing in a p-n junction diode

A. decreases the potential barrier.

B. increases the potential barrier.

C. increases the number of minority charge carriers.

D. increases the number of majority charge carriers.

Answer: B

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7. In the circuit shown in Fig.14.05, if the diode forward voltage drop is 0.3 V, the voltage

difference between A and Bis

A. 1.3 V

B. 2.3 V

C. 0

D. 0.5 V

Answer: B

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8. If a full-wave rectifier circuit is operating from 50 Hz mains, the fundamental frequency in the ripple will be

A. 50 Hz

B. 70.7 Hz

C. 100 Hz

D. 25 Hz

Answer: C

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

A. 20×10^{14} Hz

B. 10×10^{14} Hz

C. 5×10^{14} Hz

D. 1×10^{14} Hz

Answer: C

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10. A zener diode is used as

A. half-wave rectifier.

B. full-wave rectifier.

C. voltage multiplier.

D. voltage regulator.

Answer: D

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11. The majority charge carriers in p-type semiconductors are

A. electrons.

B. protons.

C. holes.

D. positrons.

Answer: C

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12. When the electrical conductivity of a semiconductor is due to breaking of its covalent bonds, the semiconductor is said to be a _____ semiconductor.

A. donor

B. acceptor

C. extrinsic

D. intrinsic

Answer: D

View Text Solution

View Text Solution

13. When a semiconductor is heated, its resistance

A. decreases.

B. increases.

C. remains unchanged.

D. first increases and then decreases.

Answer: A

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14. An-type semiconductor is

A. negatively charged

B. positively charged.

C. electrically neutral.

D. either negatively or positively charged.

Answer: C

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15. In an intrinsic se:miconductor the forbidden energy band is of the order of

A. 1 eV

B. 3 eV

C. 6 eV

D. 0.1 eV

Answer: A

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16. The energy band gap between valence band and conduction band is maximum in

A. metals.

B. super conductors.

C. semiconductors.

D. insulators.

Answer: D

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17. Which of the following statement is true for an-type semiconductor?

A. The donor level lies just below the bottom of the conduction bond.

B. The donor level lies just above the top of the valence band.

C. The acceptor level lies just above the top of the valence band.

D. The acceptor level lies just below the bottom of the conduction band.

Answer: A

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18. In a semiconducting material, the mobilities of electrons and holes are μ_e and μ_h respectively. Then

A. $\mu_e < \mu_h$

B. $\mu_e = \mu_h$

C. $\mu_e < \mu_h$

D. $\mu_e > 0$ but $\mu_h < 1$

Answer: A

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19. In the forward bias arrangement of a p-n junction diode

A. the n-end is connected to positive terminal of the battery.

B. the p-end is connected to positive terminal of the battery.

C. the p-end is connected to negative terminal of the battery.

D. the current flows in the diode from 11-end top-end.

Answer: B

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20. In the depletion region of the an unbaised p-n junction diode, there are

A. only free electrons.

B. only holes.

C. both electrons and holes.

D. only immobile charged ions.

Answer: D

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21. In a p-n junction in an unbiased condition

A. the potential is the same everywhere.

B. the p-side is at a higher potential than then-side.

C. an electric field exists at the junction directed from then-type side top-type side.

D. an electric field exists at the junction directed from the p-type side to n-type

side.

Answer: C

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22. Which of the following is forward biased?

A. 

B. 

C. 

D. 

Answer: B

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23. Which of the following shows a reverse biased p-n junction diode ?

A. 

B. 

C. 

D. 

Answer: B

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24. To make a p-n junction conducting

A. the value of forward bias should be more than the barrier potential.

B. the value of forward bias should be less than the barrier potential.

C. the value of reverse bias should be more than the barrier potential.

D. the value of reverse bias should be less than the barrier potential.

Answer: A

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25. A p-n junction diode is a

A. linear device.

B. non-linear device.

C. oscillating device.

D. amplifying device.

Answer: B

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26. If knee voltage of silicon p-n junction is 0.7 V, then find the current flowing in the circuit.

A. 8 mA

B. 22 mA

C. 15 mA

D. Zero

Answer: A

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27. Function of a rectifier is

A. to convert a.c. input into d.c. output.

B. to convert d.c. input into a.c. output.

C. to remove the ripple present in a.c. output.

D. to act as a voltage stabiliser.

Answer: A

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28. The bias applied for a solar cell is

A. forward bias

B. reverse bias

C. no bias

D. ant type of bias

Answer: C

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29. Which of the following is the correct diagram of a half-wave rectifier?

A. 

B. 

C. 

D. 

Answer: A

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30. In a zener diode

A. both p- and n-side are very lightly doped.

B. both p- and 11-side are heavily doped.

C. p-side is heavily doped but n-side is lightly doped.

D. p-side is ilightly doped but n-side is heavily doped.

Answer: B

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31. For a light emitting diode (LED) the forbidden energy gap E_g between the valence

band and conduction band should have a value

A. $E_g < 0.7\text{eV}$

B. $E_g = 1.1$ eV

C. 1.1 eV $\leq E_g \leq 1.8$ eV

D. 1.8 eV $\leq E_g \leq 3.1$ eV

Answer: D

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32. Which of the following represents the reverse bias characteristic of a zener diode correctly ?

A. 

B. 

C. 

D. 

Answer: A

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33. In a photodiode the value of current produced, when monochromatic light of suitable is incident on the junction, depends on

A. the frequency of incident light.

B. the intensity of incident light.

C. the barrier potential at the junction.

D. the voltage applied at the p-n junction.

Answer: B

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34. A light emitting diode (LED) has a voltage drop of 2 V across it and passes a current of 10 mA when it operates with a 6 V battery through a limiting resistor R. The value of R is

A. 40 $k\Omega$

B. $4k\Omega$

C. 200Ω

D. 400Ω

Answer: D

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35. The 1-V characteristic of an LED is shown as

A. 

B. 

C. 

D. 

Answer: B

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36. Two ideal diodes are connected to a battery as shown here. The current supplied by the battery is

A. 5 mA

B. 2.5 mA

C. 7.5 mA

D. zero

Answer: A

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37. A p-n photodiode is fabricated from a semiconductor with a band gap of 2.5 eV. It can detect a signal of wavelength

A. 6000 Å

B. 6000 nm

C. 4000 nm

D. 4000 Å

Answer: D

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38. Which of the following correctly represents the 1-V characteristic of a solar cell ?

A. 

B. 

C. 

D. 

Answer: B

View Text Solution

39. Ideal semiconducting materials for solar cell fabrication are those whose band gap is

A. close of 1.5 eV

B. less than 1 eV

C. greater than 2 eV

D. close to 1.1 eV

Answer: A

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40. Which of the following of these are called "optoelectronic junction devices"?

A. Solar cell

B. Photodiode

C. LED

D. All of these

Answer: D

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Fill In The Blanks

1. In a n-type semiconductor ____ .are minority carriers and ___ are majority charge carriers.

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2. ___ of an intrinsic semiconductor increases with increase in temperature but its ____ decreases with increase in temperature.

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3. In a n-type semiconductor the donor energy level is slightly _____

View Text Solution

4. In a p-type semiconductor the acceptor energy level is slightly _____

View Text Solution

5. A ____used in parallel of load in a full wave rectifier acts as a____

View Text Solution

6. Photodiode used for detecting optical signal is invariably used in ___ arrangement.

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7. The lowest unfilled energy band fonned above the valence band in a crystalline solid is called _____.

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8. Conductivity of a given intrinsic semiconducting material solely depends on its _____.

View Text Solution

9. Commonly used materials for fabricating solar cells are _____ and _____ .

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10. In a p-n junction the width of depletion region on either side of junction is _____ or even less.

View Text Solution

11. A zener diode offers _____ resistance for voltages V $< V_z$: and offers _____ resistance for voltages $V > V_z$.

View Text Solution

12. An ideal p-n junction is to be used across a battery of 3 V. A resistance of _____ should be connected in series of p-n junction so as to limit the current to 15 mA only.

View Text Solution

13. A photodiode is to be designed to detect visible light radiation of all possible colours. The energy band gap for semiconducting material used to fabricate the photodiode should be

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14. A capacitor joined in parallel with the load in a full-wave rectifier serves the purpose of a _____.

View Text Solution

15. A solar cell is based on the _____ effect.

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16. A p-n junction diode has a potential difference 0.5 V across its junction which does not depend on the circuit current. A resistance of 200 Ω is connected in series with the junction and a current of 10 mA passes through it. The voltage of forward bias applied is _____.

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17. LED, photodiode and _____ are called opto electric devices.

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True Or False

1. At 0 K silicon behaves as a super conductor.

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2. In a semiconductor holes are as mobile as electrons.

View Text Solution

3. In a n-type semiconductor each pentavalent dopant atom contributes only one electron.

View Text Solution

4. An-type semiconductor is negatively charged but a p-type semiconductor is positively charged.

View Text Solution

5. Deficiency of an electron is called a hole.

View Text Solution

6. A p-n junction offers a high resistance in forward bias and a low resistance is reverse bias.

View Text Solution

7. A rectifier is a device which is used to convert a.c. voltage input into d.c. voltage

output.

View Text Solution

8. Zener diode is fabricated by heavily doping both p- and n-sides of the junction so breakdown occurs at a voltage of about 5 V in reverse bias.

View Text Solution

9. A photodiode as well as a LED are employed in forward bias arrangement.

View Text Solution

10. Si and Ga - As are preferred materials for solar cells.

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Assertion Reason Type Questions

1. Assertion (A) : The number of free electrons in a p-type semiconductor silicon is less than the number of electrons in a pure silicon semiconductor at room temperature.

Reason (R) : It is due to law of mass action.

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2. Assertion (A) : Electron has higher mobility than hole in a semiconductor.

Reason (R) : Mass of electron is less than that of hole.

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3. Assertion (A) : A p-type semiconductor has a large number of holes yet it is electrically neutral.

Reason (R) : A p-type semiconductor is obtained by doping an intrinsic semiconductor with a trivalent impurity.

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4. Assertion (A) : Silicon is prefened over germanium for making semiconductor devices.

Reason (R) : The energy gap for germanium is more than the energy gap of silicon.

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5. Assertion (A) : Zener diode works on the principle of breakdown voltage.

Reason (R) : Current increases suddenly after breakdown voltage.

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Very Short Answer Questions

1. Carbon and silicon both have four valence electrons each. How then are they distinguished ?

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2. What is a hole ?

View Text Solution

3. What is an intrinsic semiconductor ?

View Text Solution

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

View Text Solution

5. At what temperature would an intrinsic semiconductor behave like a perfect insulator?

View Text Solution

6. Name two factors on which electrical conductivity of a pure semiconductor at a given temperature depends.

View Text Solution

7. What is doping?

View Text Solution

8. What is an extrinsic semiconductor ?

View Text Solution

9. What is the difference between an -type and a p-type intrinsic semiconductor?

View Text Solution

10. Draw energy band diagram for a n-type extrinsic semiconductor.

View Text Solution

11. Why is the conductivity of n-type semiconductorgreater than that of the p-type semiconductor even when both of these have same level of doping ?

View Text Solution

12. Why can't we take one slab of p-type semiconductor and physically join it to another slab of 1-type semiconductor to get p-n junction ?

View Text Solution

13. What is depletion region in a p-n junction ?

View Text Solution

14. What happens to the width of depletion layer of a p-n junction when it is () forward biased, (i) reverse biased ?

View Text Solution

15. Name the type of biasing of a p-n junction diode so that the junction offers very high resistance.

View Text Solution

16. What is the cause of a small leakage current in reverse bias arrangement ofa p-n junction?

View Text Solution

17. In the given diagram [Fig. 14.161, is the diode D forward or reverse biased ?

View Text Solution

18. In the given diagram [Fig. 14.171, is the junction diode forward biased or reverse biased ?

View Text Solution

19. Draw the output signal in a p-n junction diode when a square input signal of 10 V as shown in the Fig. 14.18 is applied across it.

View Text Solution

20. What is a Zener diode?

View Text Solution

21. Draw the voltage-current characteristic of a Zener diode.

View Text Solution

22. Shows the 1-V characteristics of a given device. Name the device and write where it is used.

View Text Solution

23. Name the device D which is used as a voltage regulator in the given circuit and give its symbol.

View Text Solution

24. Name the type of diode whose -V characteristics are shown in What does the points P and Q in graph repre sent ?

View Text Solution

25. State the reason, why are GaAs and Si preferred materials for fabrication in solar cells.

View Text Solution

26. Which semiconducting material can be used for constructing LED if it is to emit light in the visible range?

View Text Solution

27. State the relation between the frequency v of radiation emitted by a LED and the band gap energy E_g of the semiconductor used to fabricate it.

View Text Solution

28. Draw symbolic representation of () photodiode, (i) light emitting diode.

View Text Solution

29. Identify the semiconductor diode whose V-I characteristics are as shown.

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30. What are the tiny lights in traffic signals called and how do these operate?

View Text Solution

31. What is the function of a photodiode?

View Text Solution

32. Why should a photodiode be operated at a reverse bias ?

View Text Solution

33. Can the potential barrier across a p-n junction be measured by simply connecting a voltmeter across the junction ?

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Short Answer Questions

1. What is meant by the term doping of an intrinsic semiconductor ? How does it affect the conductivity of a semiconductor ?

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2. Distinguish between 'intrinsic' and 'extrinsic semiconductors.

View Text Solution

3. Distinguish between n-type and p-type semiconductors on the basis of energy band diagram.

View Text Solution

4. Distinguish between an intrinsic semiconductor and p-type semiconductor. Give reason, whya p-type semiconductor is electrically neutral, although $n_h >> n_e$.

View Text Solution

5. Explain with the help of a diagram the formation of depletion layer and potential barrier in a p-n junction.

View Text Solution

6. Draw the graph showing the variation of current with voltage for a p-n junction diode in forward bias as well as revese bias arrangements.

View Text Solution

7. Define the terms 'depletion layer and barrier potential' for a p-n junction. How does (i) an increase in the doping concentration, and (ii) biasing across the junction, affect the width of the depletion layer ?

View Text Solution

8. How is forward biasing different from reverse biasing in a p-n junction diode ?

View Text Solution

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

(i) Identify the new semiconductorobtained after doping.

(ii) Calculate the new hole concentration.

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10. Assuming that two diodes D_1 and D_2 used in the electric circuit shown are ideal, find out the value the current flowing through 2 Ω resistor .

View Text Solution

11. Two semiconductor materials X and Y, shown in the given, are made by doping germanium crystal with indium and arsenic respectively. The two are joined end to end

and connected to a battery as shown.

(i) Will the junction be forward biased or reverse biased ?

(i) Sketch a V-I graph for this arrangement.

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12. Write which of the diodes are forward biased and which are reverse biased.

View Text Solution

13. Write which of the diodes are forward biased and which are reverse biased.

View Text Solution

14. Write which of the diodes are forward biased and which are reverse biased.

View Text Solution

15. Write which of the diodes are forward biased and which are reverse biased.

View Text Solution

16. Explain with the help of a circuit diagram, the working of a p-n junction diode as a half-wave rectifier.

View Text Solution

17. Draw and explain the output waveform across the load resistor R, if the input waveform is as shown in the given.

View Text Solution

18. How is it that the reverse current in Zener diode starts increasing suddenly at a relatively low breakdown voltage of 5 volt or so ?

View Text Solution

19. Name the semiconductor device that can be used to regulate an unregulated d.c. power supply. With the help of I-V characteristics of this device, explain its working principle.

View Text Solution

20. Give reason to explain why n and p regions of a Zener diode are heavily doped. Find the current through the Zener diode in the circuit given below (Zener breakdown voltage is 15 V).

View Text Solution

21. With the help of a diagram, show the biasing of a light emitting diode (LED). Give its two advantages over conventional incandescent lamps.

View Text Solution

22. Mention the important considerations required while fabricating a p-n junction diode

to be used as a Light Emitting Diode (LED). What should be the order of band gap of an LED if it is required to emit light in the visible range ?

View Text Solution

23. Explain the working principle of a photodiode.

Or

Explain briefly how a photodiode operates.

View Text Solution

24. Explain with the help of a circuit diagram, the working of a photodiode. Write briefly how it is used to detect the optical signals.

View Text Solution

25. The current in the forward bias is known to be more (~ mA) than the current in the reverse bias $(\sim \mu A)$. What is the reason, then to operate the photndiode in reverse bias ?

View Text Solution

26. The semiconducting material used to fabricate a photodiode has an energy gap of 1.2 eV. Using calculations show whether it can detect light of wavelength 400 nm.

View Text Solution

27. Draw a circuit diagram to show biasing of a solar cell. Draw its characteristic curve and explain it

View Text Solution

28. Give any two differences between a half-wave rectifier and a full-wave rectifier.

View Text Solution

Long Answer Questions I

1. What is an intrinsic semiconductor ? How can this material be converted into (i) p-type,

(ii) n-type extrinsic semiconductor? Explain with the help of energy band diagrams.

View Text Solution

2. Write the two processes that take place in the formation of a p-njunction. Explain with the help of a diagram, the formation of depletion region and barrier potential in ap-n junction.

View Text Solution

3. Write any two distinguishing features between conductors, semiconductors and insulators on the basis of energy band diagrams.

View Text Solution

4. Show, on a plot, variation of resistivity of (i) a conductor, and (i) a typical semiconductor as a function of temperature.

Using the expression for the resistivity in terms of number density and relaxation time

between the collisions, explain how resistivity in thc casce of a conductor increases while it decrcases in a semiconductor, with the rise of temperature.

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5. Explain briefly, with the help of circuit diagram , how V-I characteristics of a p-n junction diode are obtained in (i) forward bias, and (ii) reverse bias. Draw the shapes of the characteristic curves obtained.

Or

Explain briefly, with the help of necessary diagrams, the forward and the reverse biasing of a p-n junction diode. Also draw their characteristic curves in the two cases.

View Text Solution

6. Drawa labelled diagram of a full-wave rectifier circuit and briefly explain its working, Show the input-output waveforms.

Or

A student wants to use two p-n junction diodes to convert a.c. into d.c. Draw the labelled circuit diagram she would use and explain how it works.

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7. Draw V-I characteristicsof a p-n junction diode. Answer the following questions, giving reasons:

(i) Why is the current under reverse bias almost independent of the applied potential

upto a critical voltage ?

(ii) Why does the reverse current show a sudden increase at the critical voltage ? Name any semiconductor device which operates under the reverse bias in the breakdown region.

View Text Solution

8. What is a filter ? With the help of a circuit diagram describe the role of a capacitor in

filtering. Draw input and output waveforms too.

View Text Solution

9. With the help of a labelled circuit diagram, explain how a junction diode is used as a full-wave rectifier. Draw its input and output wave formns. How do you obtain steady d.c. output from the pulsating voltage ?

View Text Solution

10. A zener diode is fabricated by heavily doping both p- and -sides of the junction. Explain why ? Breifly explain the use of zener diode as a d.c. voltage regulator with the help of a circuit diagram.

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11. The shows the V-I characteristic of a semiconductor diode designed to operate under reverse bias.

(a) Identity the semiconductor diode used.

(b) Draw the circuit diagram to obtain the given characteristics of this device .

(c) Briefly explain one use of this device.

View Text Solution

12. With what considerations in view, a photodiode is fabricated ? State its working with the helpP of a suitable diagram.

Even though the current in the forward bias is known to be more than in the reverse bias, yet

the photodiode works in reverse bias. What is the reason ?

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13. (a) In the given 'S' is a semiconductor. Would you increase or decrease the value of R to keep the reading of the ammeter A constant when S is heated ? Give reason for your answer.

(b) Draw the circuit diagram of a photodiode

and explain its working. Draw its 1-V characteristics.

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14. Three photo diodes $D_1 D_2$ and D_3 are made of semiconductors having band gaps of 2.5 eV, 2 eV and 3 eV respectively. Which of them will not be able to detect light of wavelength 600 nm ?

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15. Why photodiodes are required to operate in reverse bias ? Explain.

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16. Explain, with the help of a schematic diagram, the principle and working of a Light Emiting Diode. What criterion is kept in mind while choosing the semiconductor material for such a device ? Write any two advantages of light emiting diode over conventional incandescent lamps.

View Text Solution

17. Describe briefly with the help of a necessary circuit diagram, the working principle of a solar cell.

View Text Solution

18. Why are Si and GaAs preferred materials for solar cells ? Explain.

View Text Solution

19. In the given , which bulb out of B_1 and B_2 will glow and why ?

View Text Solution

20. Draw a diagram of an illuminated p-n junction solar cell.

View Text Solution

21. Give reasons for the Sunlight is not always required for the working of a solar cell.

View Text Solution

22. Give reasons for the The electric field, of the junction of a zener diode, is very high even for a small reverse bias voltage of about 5 V.

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Long Answer Questions Ii

1. Explain the formation of depletion layer and potential barier in a p-n junction.

View Text Solution

2. In the input waveform is converted into the output waveform by a device 'X. Name the device and draw its circuit diagram.

View Text Solution

3. Describe briefly, with the help ofa diagram, the role of the two important processes involved in the formation of a p-n junction.

View Text Solution

4. Name the device which is used as a voltage regulator. Draw the necessary circuit diagram and explain its working .

View Text Solution

5. Using the necessary circuit diagrams, show how the V-I characteristics of a p-n junction are obtained in

(i) Forward baising

(ii) Reverse biasing.

View Text Solution

6. An a.c. signal is fed intu two cireuits X and Y and the corresponding output in the two cases have the waveforms as shown.

(a) Identify the circuits X and Y. Draw their

labelled circuit diagrams.

(b) Briefly explain the working of Y.

(c) How does the output waveform from circuit Y get modified when a capacitor is connected across the output terminals parallel to the load resistor?

View Text Solution

7. Write the important considerations which are to be taken into account while fabricating

a p-n junction diode to be used as a Light Emitting Diode (LED). What should be the order of band gap of an LED, if it is required to emit light in the visible range ? Draw a circuit diagram and explain its action.

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8. Draw the V-I characteristics of an LED. State two advantages of LED lamps over conventional incandescent lamps.

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Self Assessment Test Multipe Choice Questions Section A

1. The temperature coefficient of resistivity of a semiconductor is

A. always postive.

B. always negative.

C. zero.

D. either zero or positive.

Answer: B

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2. A potential barrier of 0.5 V exists across a p-n junction. If the depletion region is 0.5 um wide, the strength of the electric field in the region is

A. $1.0 \times 10^6 Vm^{-1}$

B. $1.0 \times 10^{-5} Vm^{-1}$

C. $2.0 \times 10^5 Vm^{-1}$

D. $2.0 \times 10^6 Vm^{-1}$

Answer: A

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3. Which one of the following statement is not correct?

A. A p-n junction does not obey Ohm's law.

B. A p-n junction diode symbol shows an arrow identifying the direction of

current (forward) flow.

C. An ideal p-n junction is an open switch.

D. An ideal p-n junction is an ideal one way conductor.

Answer: C

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Section B

1. Three photo diodes D_1, D_2 and D_3 are made of semiconductors having band gaps of 2.5 eV, 2eV and 3eV respectively. Which of them will not be able to detect light of wavelength 600 nm?

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