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CLASS 12 PHYSICS NCERT SOLUTIONS

NCERT Solutions for Class 12 Physics Chapter 14: Semiconductor Electronics – Free PDF Download

Chapter 14 covers semiconductor electronics — energy bands in solids, intrinsic and extrinsic semiconductors, p-n junction formation, and half-wave and full-wave rectification. Several sections from older editions — special-purpose diodes (photodiode, LED, solar cell), the Zener diode as a voltage regulator, the...

Contents

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NCERT Exercise Solutions

14.1 In an n-type silicon, which of the following statements 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.
Ans: **(c) is correct.** n-type silicon is formed by doping with pentavalent atoms (e.g. phosphorus, arsenic), each of which contributes one extra (donor) electron. This makes electrons the majority carriers and holes the minority carriers — so "holes are minority carriers and pentavalent atoms are the dopants" is the true statement. (Trivalent dopants, in (a) and (d), instead produce p-type material.)

14.2 Which of the statements given in Exercise 14.1 is true for p-type semiconductors?
Ans: **(d) is correct.** p-type silicon is formed by doping with trivalent atoms (e.g. boron, aluminium), each of which creates a hole (acceptor site). This makes holes the majority carriers and electrons the minority carriers — matching "holes are majority carriers and trivalent atoms are the dopants."

14.3 Carbon, silicon and germanium have four valence electrons each. These are characterised by valence and conduction bands separated by energy band gaps respectively equal to $(E_g)_C$, $(E_g)_{Si}$ and $(E_g)_{Ge}$. Which of the following statements 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) $(E_g)_C=(E_g)_{Si}=(E_g)_{Ge}$
Ans: **(c) is correct.** Carbon (diamond form) has the widest energy band gap (≈5.4eV, behaving as an insulator), silicon has an intermediate gap (≈1.1eV), and germanium has the narrowest gap (≈0.7eV) among the three — so $(E_g)_C>(E_g)_{Si}>(E_g)_{Ge}$, which is also why carbon behaves as an insulator while silicon and germanium behave as semiconductors.

14.4 In an unbiased p-n junction, holes diffuse from the p-region to the n-region because
Ans: holes are present at a much higher concentration in the p-region than in the n-region, and **diffusion always occurs from a region of higher concentration to a region of lower concentration**. This concentration gradient across the junction — not any electric field, since none exists yet in an unbiased junction before diffusion begins — drives the initial diffusion of holes into the n-region (and, symmetrically, of electrons into the p-region), which is what creates the depletion region and the built-in potential barrier in the first place.

14.5 When a forward bias is applied to a p-n junction, it
Ans: forward bias connects the p-side to the positive terminal and the n-side to the negative terminal of the external battery, so the applied voltage opposes the junction's built-in field. This **reduces (lowers) the potential barrier** at the junction, allowing majority carriers to cross the junction much more easily — producing a large forward current that increases rapidly with increasing forward voltage.

14.6 In half-wave rectification, what is the output frequency if the input frequency is 50Hz? What is the output frequency of a full-wave rectifier for the same input frequency?
Ans: A half-wave rectifier conducts for only one half of each input cycle (once per full cycle), so its output frequency equals the input frequency: **50Hz**. A full-wave rectifier conducts during both halves of each input

cycle, producing one output pulse per half-cycle — twice per input cycle — so its output frequency is **twice the input frequency, i.e. 100Hz**.

Class 12 Physics Chapter 14 – Notes and Extra Questions

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