

CLASS 12

PHYSICS

EXTRA QUESTIONS

Class 12 Physics Chapter 14 Semiconductor Electronics – Extra Questions with Answers

These extra practice questions for Class 12 Physics Chapter 14 – Semiconductor Electronics go beyond the NCERT textbook exercises to reinforce energy bands, intrinsic and extrinsic semiconductors, p-n junction formation, and rectification — the topics that remain in the current 2026-27 syllabus. Useful for board...

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Very Short Answer Type Questions (1 Mark)

Q1. Define energy band gap.

Ans: The energy band gap (E_g) is the energy difference between the top of the valence band and the bottom of the conduction band in a solid — the range of energies an electron cannot have. Its size determines whether a material behaves as a conductor, semiconductor, or insulator.

Q2. Distinguish between an intrinsic and an extrinsic semiconductor in one line each.

Ans: An **intrinsic semiconductor** is a pure semiconductor (like pure silicon or germanium) with equal numbers of electrons and holes, generated only by thermal excitation. An **extrinsic semiconductor** is one deliberately doped with impurity atoms to increase either its electron (n-type) or hole (p-type) concentration.

Q3. What is a depletion region in a p-n junction?

Ans: The depletion region is the narrow zone around the junction, on both the p- and n-sides, that becomes depleted of free mobile charge carriers once diffusion creates immobile ionised donor and acceptor atoms there — it is this region's internal field that produces the junction's built-in potential barrier.

Q4. Name the two types of extrinsic semiconductors and state their majority charge carriers.

Ans: **n-type** (majority carriers: electrons, from pentavalent dopants) and **p-type** (majority carriers: holes, from trivalent dopants).

Short Answer Type Questions (2–3 Marks)

Q5. Explain, in terms of energy bands, why conductors, semiconductors, and insulators differ in their electrical behaviour.

Ans: In a **conductor**, the valence and conduction bands overlap (or the conduction band is partially filled), so electrons are freely available to conduct even without any energy input. In an **insulator**, the energy band gap is very large (several eV), so essentially no electrons can be thermally excited across it at room temperature. In a **semiconductor**, the band gap is small enough (around 1 eV or less) that a modest number of electrons are thermally excited into the conduction band at room temperature, giving it conductivity between that of a conductor and an insulator — and one that increases sharply with temperature, unlike a metal.

Q6. Explain how the potential barrier forms at an unbiased p-n junction.

Ans: When a p-region and an n-region are joined, holes near the junction diffuse into the n-region and electrons diffuse into the p-region, driven by the concentration gradient across the junction. This diffusion leaves behind fixed, ionised donor atoms (positive) on the n-side and ionised acceptor atoms (negative) on the p-side near the junction, creating an internal electric field directed from the n-side to the p-side. This field opposes further diffusion, and equilibrium is reached once the field is strong enough to balance it — the resulting potential difference across the depletion region is the **potential barrier**.

Q7. Compare a half-wave rectifier and a full-wave rectifier in terms of the number of diodes used and their output ripple frequency for a 50Hz input.

Ans: A half-wave rectifier uses **one diode** and conducts for only one half of each input cycle, giving an output (ripple) frequency equal to the input frequency, **50Hz**. A full-wave rectifier uses **two diodes** (in a centre-tap arrangement) or four diodes (in a bridge arrangement) and conducts during both halves of every

cycle, giving an output ripple frequency of **100Hz** — twice the input frequency, which is also easier to smooth into steady DC.

Higher Order Thinking Skills (HOTS)

Q8. Explain why the electrical conductivity of a pure semiconductor increases with rising temperature, while the conductivity of a metal conductor decreases with rising temperature.

Ans: In a **semiconductor**, raising the temperature thermally excites more electrons across the (relatively small) energy band gap into the conduction band, creating more electron-hole pairs and increasing the number of available charge carriers faster than any increase in scattering — so conductivity rises with temperature. In a **metal**, the number of free electrons is already essentially fixed (they don't need to be thermally excited across a gap, since the conduction band is already populated); raising the temperature instead increases the thermal vibration of the lattice ions, which scatters the free electrons more frequently and reduces their mobility — so a metal's conductivity falls as temperature rises.

Q9. A student builds a rectifier circuit intended to be full-wave, but wires it incorrectly so that it behaves as a half-wave rectifier instead, using the same 50Hz AC mains supply. Explain two practical differences this mistake would cause in the rectified output.

Ans: (1) **Ripple frequency**: the intended full-wave circuit should have produced an output ripple at 100Hz (two pulses per input cycle), but the miswired half-wave version produces only one pulse per cycle, giving a ripple frequency of just 50Hz. (2) **Smoothness and efficiency**: because the half-wave output is zero for one entire half of every cycle rather than continuously receiving pulses, it is far harder to smooth into steady DC with a given filter capacitor (requiring a much larger capacitor for the same ripple, or accepting greater ripple), and delivers a lower average DC output for the same input — a difference that would show up clearly as a much rougher, lower-voltage output on an oscilloscope or multimeter than the intended full-wave design.

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