

Semiconductor Electronics — CBSE Pattern Test 1

Class 12 Physics · 90 minutes · 40 marks · Sections A–D with answer key · Narayan Gurukul Academy

Test 1 — CBSE Pattern (90 minutes, 40 marks)

Class 12 Physics · Semiconductor Electronics · Narayan Gurukul Academy (ClassApna)

General Instructions: (1) This paper has four sections — Section A (1×10), Section B (2×4), Section C (3×4) and Section D (5×2) — total 40 marks. Time allowed: 90 minutes.
(2) All questions are compulsory. No overall choice is given; internal choice, where allowed, is clearly marked.
(3) For MCQ questions choose the single correct option; for VSA answers write a single line.
(4) Take $g = 10 \text{ m/s}^2$. All symbols carry their usual meaning. Use of a calculator is not permitted.

Section A — MCQ & VSA ($10 \times 1 = 10$ marks)

- The energy gap of a semiconductor is of the order of
 - 1 eV
 - 10 eV
 - 0 eV
 - 100 eV
- An n-type semiconductor is obtained by doping with a
 - pentavalent impurity
 - trivalent impurity
 - monovalent impurity
 - tetravalent impurity
- In a p-type semiconductor, the majority charge carriers are
 - holes
 - electrons
 - protons
 - neutrons
- In forward bias, the p-n junction diode
 - conducts
 - does not conduct
 - acts as an insulator
 - emits light only
- The barrier potential of a silicon p-n junction diode is about
 - 0.7 V
 - 0.3 V
 - 1.1 V
 - 5 V
- A full-wave bridge rectifier uses
 - four diodes
 - one diode
 - two diodes
 - three diodes
- A transistor has
 - three terminals

- (B) two terminals
 - (C) four terminals
 - (D) one terminal
8. The output of an OR gate is high when
- (A) any input is high
 - (B) all inputs are high
 - (C) all inputs are low
 - (D) inputs are equal
9. What is meant by doping?
10. In which bias is a photodiode operated?

Section B — Short Answer I ($4 \times 2 = 8$ marks)

11. In a common-emitter amplifier, the base current is $100 \mu\text{A}$ and the collector current is 10 mA . Find the current gain.
12. A silicon diode has a forward voltage drop of 0.7 V and is connected in series with a $1 \text{ k}\Omega$ resistor and a 5 V battery. Find the current.
13. Draw the output waveform of a half-wave rectifier for a sinusoidal input.
14. Write the truth table of a two-input NAND gate.

Section C — Short Answer II ($4 \times 3 = 12$ marks)

15. Distinguish between intrinsic and extrinsic semiconductors and explain the formation of n-type and p-type semiconductors.
16. Explain the working of a p-n junction diode in forward and reverse bias and draw its I-V characteristics.
17. Explain the working of a full-wave bridge rectifier and draw the input and output waveforms.
18. Draw the logic symbols and truth tables of the basic gates and explain how NAND and NOR gates are used as universal gates.

Section D — Long Answers ($2 \times 5 = 10$ marks)

19. Explain the formation of a p-n junction, the depletion region and the potential barrier. Describe the working of the diode in forward and reverse bias with its I-V characteristics.
20. Draw the circuit of a common-emitter transistor amplifier and explain how it amplifies a signal. Define its current gain and voltage gain, and state the phase relationship between the input and output signals.

Answer Key (Marking Scheme)

- Q1 — (A) 1 eV . Q2 — (A) pentavalent impurity. Q3 — (A) holes. Q4 — (A) conducts.
- Q5 — (A) 0.7 V . Q6 — (A) four diodes. Q7 — (A) three terminals. Q8 — (A) any input is high.
- Q9 — The deliberate addition of a controlled amount of impurity to a semiconductor to change its conductivity.
- Q10 — Reverse bias.
- Q11 — $\beta = I_C/I_B = 10 \text{ mA} / 100 \mu\text{A} = 100$.
- Q12 — $I = (5 - 0.7)/1000 = 4.3 \text{ mA}$.
- Q13 — Positive half cycles appear across the load; negative halves are blocked.
- Q14 — Output is 0 only when both inputs are 1; otherwise 1.

Q15 — Intrinsic: pure, equal carriers; extrinsic: doped, majority carriers set by impurity; pentavalent → n-type, trivalent → p-type.

Q16 — Forward bias reduces the barrier and current flows; reverse bias widens the depletion region and only a small leakage current flows.

Q17 — Four diodes in a bridge conduct in pairs, rectifying both half cycles.

Q18 — NAND and NOR can each be combined to realise AND, OR and NOT, hence universal.

Q19 — Diffusion forms the depletion layer and barrier; forward bias lowers the barrier, reverse bias raises it; I-V curve as in notes.

Q20 — Emitter-base forward biased, collector-base reverse biased; $\beta = I_C/I_B$; output is 180° out of phase with input.