



LifeX Merchant Navy

IMU CET Coaching & Merchant Navy Sponsorship Training

CLASS 12 PHYSICS · NCERT CHAPTER 14 · IMU CET PRACTICE

Semiconductor Electronics

Call/WhatsApp: +91 91401 91138

Web: www.lifexmerchantnavy.com

Questions: 45 MCQs

Each question has exactly one correct option. Attempt all questions first, then check the Answer Key and Solutions at the end.

1 In insulators, the energy gap between valence and conduction bands is typically

- (A) negative
- (B) zero
- (C) greater than 3 eV
- (D) about 1 eV

2 In conductors (metals), the valence and conduction bands

- (A) are separated by about 1 eV
- (B) overlap or the conduction band is partially filled
- (C) are separated by a large gap
- (D) do not exist

3 The band gap of silicon is about

- (A) 3 eV
- (B) 0.7 eV
- (C) 5.4 eV
- (D) 1.1 eV

4 At absolute zero, a pure semiconductor behaves like

- (A) a metal
- (B) a superconductor
- (C) a conductor
- (D) an insulator

5 In an intrinsic semiconductor,

- (A) $n_h > n_e$
- (B) $n_e = 0$
- (C) $n_e = n_h = n_i$
- (D) $n_e > n_h$

6 An n-type semiconductor is obtained by doping silicon with

- (A) a trivalent impurity (e.g., boron)
- (B) a divalent impurity
- (C) a pentavalent impurity (e.g., phosphorus)
- (D) a tetravalent impurity

7 A p-type semiconductor is obtained by doping silicon with

- (A) a trivalent impurity (e.g., boron, aluminium)
- (B) carbon
- (C) a pentavalent impurity
- (D) germanium



- 8 In an n-type semiconductor, the majority charge carriers are
(A) protons (B) positive ions
(C) holes (D) electrons
- 9 In a p-type semiconductor, the majority charge carriers are
(A) negative ions (B) neutrons
(C) electrons (D) holes
- 10 An n-type semiconductor is
(A) positively charged (B) electrically neutral
(C) charged depending on temperature (D) negatively charged
- 11 In a semiconductor, $n_e \times n_h$ equals
(A) n_i^2 (B) zero
(C) n_i (D) $2n_i$
- 12 A silicon sample has $n_i = 1.5 \times 10^{16} \text{ m}^{-3}$ and is doped so that $n_e = 4.5 \times 10^{22} \text{ m}^{-3}$. The hole concentration is
(A) $5 \times 10^9 \text{ m}^{-3}$ (B) $4.5 \times 10^{22} \text{ m}^{-3}$
(C) $1.5 \times 10^{16} \text{ m}^{-3}$ (D) $3 \times 10^6 \text{ m}^{-3}$
- 13 The resistance of a semiconductor ___ with increase in temperature.
(A) becomes infinite (B) decreases
(C) increases (D) remains constant
- 14 The depletion region in a p-n junction contains
(A) both free electrons and holes in large numbers
(B) immobile ions only
(C) free holes only
(D) free electrons only
- 15 The barrier potential of a silicon p-n junction is about
(A) 5 V (B) 0.3 V
(C) 1.1 V (D) 0.7 V
- 16 In forward bias of a p-n junction,
(A) p-side is connected to positive terminal and depletion layer narrows
(B) p-side is connected to negative terminal
(C) no current flows
(D) depletion layer widens
- 17 In reverse bias of a p-n junction,
(A) the barrier potential decreases
(B) the depletion layer narrows
(C) the depletion layer widens and only a small current flows
(D) a large current flows



- 18 The reverse saturation current in a p-n junction is due to
(A) majority charge carriers (B) acceptor ions
(C) donor ions (D) minority charge carriers
- 19 The I-V characteristic of a p-n junction diode is
(A) non-linear (B) linear
(C) horizontal (D) a straight line through origin
- 20 A diode is used as a rectifier because it
(A) produces light (B) stores charge
(C) amplifies current (D) conducts in one direction only
- 21 In a half-wave rectifier, the output frequency for 50 Hz input is
(A) 50 Hz (B) 100 Hz
(C) 0 Hz (D) 25 Hz
- 22 In a full-wave rectifier, the output ripple frequency for 50 Hz input is
(A) 50 Hz (B) 200 Hz
(C) 100 Hz (D) 25 Hz
- 23 A capacitor filter connected across the load in a rectifier
(A) blocks DC output (B) increases ripples
(C) reduces ripples (D) converts DC to AC
- 24 A Zener diode is used as a
(A) voltage regulator (B) rectifier for high power
(C) oscillator (D) amplifier
- 25 A Zener diode is operated in
(A) reverse breakdown region (B) saturation region
(C) forward bias only (D) zero bias
- 26 A light-emitting diode (LED) works in
(A) zero bias (B) forward bias
(C) reverse bias (D) breakdown
- 27 The colour of light emitted by an LED depends on
(A) the reverse voltage (B) the size of the LED
(C) the forward current (D) the band gap of the semiconductor
- 28 A photodiode is operated in
(A) zero bias only (B) reverse bias
(C) breakdown always (D) forward bias
- 29 A solar cell works on the principle of
(A) Zener breakdown (B) photovoltaic effect
(C) electromagnetic induction (D) thermionic emission



- 30** The minimum energy of a photon to create an electron-hole pair in a semiconductor of band gap 2 eV corresponds to a wavelength of about
- (A) 2000 nm (B) 1240 nm
(C) 310 nm (D) 620 nm
- 31** Which of the following is a direct band-gap semiconductor commonly used for LEDs?
- (A) Si (B) Diamond
(C) Ge (D) GaAs
- 32** When a pure semiconductor is heated, its
- (A) conductivity decreases (B) conductivity increases
(C) resistance increases (D) band gap becomes zero
- 33** Holes in a semiconductor behave as
- (A) photons (B) positive charge carriers
(C) negative charge carriers (D) neutral particles
- 34** The width of the depletion layer of a p-n junction
- (A) decreases with forward bias and increases with reverse bias
(B) is independent of bias
(C) decreases with reverse bias
(D) increases with forward bias
- 35** In a p-n junction diode, the current in forward bias is mainly due to
- (A) drift of minority carriers (B) ions in the depletion layer
(C) drift of majority carriers (D) diffusion of majority carriers
- 36** The electric field in the depletion region of an unbiased p-n junction is directed
- (A) from p-side to n-side (B) zero
(C) from n-side to p-side (D) along the junction plane
- 37** The dynamic resistance of a diode is defined as
- (A) $\Delta V/\Delta I$ (B) $\Delta I/\Delta V$
(C) V/I (D) VI
- 38** For an ideal diode, the resistance in forward bias and reverse bias respectively is
- (A) zero and zero (B) zero and infinite
(C) infinite and zero (D) infinite and infinite
- 39** The number of diodes used in a bridge full-wave rectifier is
- (A) 1 (B) 6
(C) 4 (D) 2
- 40** A centre-tap full-wave rectifier uses
- (A) 2 diodes (B) 1 diode
(C) 4 diodes (D) 3 diodes

- 41** Doping a semiconductor increases its
(A) density significantly (B) band gap
(C) conductivity (D) resistivity
-
- 42** In a semiconductor, the donor energy level lies
(A) just above the valence band (B) just below the conduction band
(C) in the middle of the band gap (D) inside the valence band
-
- 43** In a semiconductor, the acceptor energy level lies
(A) at the centre of the gap (B) in the conduction band
(C) just above the valence band (D) just below the conduction band
-
- 44** Germanium and silicon are
(A) metals (B) trivalent elements
(C) tetravalent elements (D) pentavalent elements
-
- 45** Which of the following is an elemental semiconductor?
(A) Silicon (B) Gallium arsenide
(C) Copper (D) Cadmium sulphide
-

Answer Key

1	2	3	4	5	6	7	8	9	10
C	B	D	D	C	C	A	D	D	B
11	12	13	14	15	16	17	18	19	20
A	A	B	B	D	A	C	D	A	D
21	22	23	24	25	26	27	28	29	30
A	C	C	A	A	B	D	B	B	D
31	32	33	34	35	36	37	38	39	40
D	B	B	A	D	C	A	B	C	A
41	42	43	44	45					
C	B	C	C	A					

Hints & Solutions

- (C)** Large band gap (e.g., diamond ≈ 5.4 eV) prevents electrons from reaching the conduction band.
- (B)** Electrons are freely available for conduction.
- (D)** Si ≈ 1.1 eV; Ge ≈ 0.7 eV.
- (D)** No electrons are thermally excited into the conduction band at 0 K.
- (C)** Every electron excited leaves behind a hole.
- (C)** The fifth valence electron of P becomes a free electron (donor).
- (A)** Trivalent atoms create holes (acceptors).
- (D)** Donor atoms supply extra electrons.
- (D)** Acceptor atoms create holes.
- (B)** Donor atoms are neutral; each free electron is balanced by a positive donor ion.
- (A)** Mass action law: $n_e n_h = n_i^2$ at thermal equilibrium.
- (A)** $n_h = n_i^2 / n_e = 2.25 \times 10^{32} / 4.5 \times 10^{22} = 5 \times 10^9 \text{ m}^{-3}$.
- (B)** More carriers are generated, increasing conductivity (negative temperature coefficient).
- (B)** Diffusion and recombination leave uncovered donor and acceptor ions.
- (D)** Si ≈ 0.7 V; Ge ≈ 0.3 V.
- (A)** Forward bias reduces the barrier, allowing large current.
- (C)** Reverse bias increases the barrier; only minority carriers give a tiny current.
- (D)** Thermally generated minority carriers drift across the junction.
- (A)** Current increases exponentially beyond the knee voltage in forward bias.
- (D)** Unidirectional conduction converts AC to DC.
- (A)** Only one half-cycle passes per input cycle, so ripple frequency = 50 Hz.
- (C)** Both half-cycles produce output pulses $\rightarrow 2f$.
- (C)** The capacitor charges at peaks and discharges slowly, smoothing the output.



24. (A) In reverse breakdown, the voltage across a Zener stays nearly constant.
25. (A) Voltage regulation uses the sharp reverse breakdown.
26. (B) Recombination of electrons and holes in forward bias emits photons.
27. (D) $h\nu \approx E_g$; e.g., GaAsP for red/yellow.
28. (B) In reverse bias, photogenerated carriers change the reverse current noticeably.
29. (B) Light generates electron-hole pairs that are separated by the junction field, producing emf.
30. (D) $\lambda = 1240/2 = 620 \text{ nm}$.
31. (D) GaAs and GaAsP have direct gaps, enabling efficient light emission.
32. (B) More electron-hole pairs are thermally generated.
33. (B) A hole is a vacancy that acts like a positive charge $+e$.
34. (A) Forward bias pushes carriers into the junction; reverse bias pulls them away.
35. (D) Lowered barrier lets majority carriers diffuse across.
36. (C) Positive donor ions on the n-side and negative acceptor ions on the p-side give a field from n to p.
37. (A) $r_a = \Delta V/\Delta I$ at a point on the characteristic.
38. (B) An ideal diode is a perfect conductor in forward bias and a perfect insulator in reverse.
39. (C) Four diodes in a bridge rectify both half-cycles without a centre-tapped transformer.
40. (A) Two diodes conduct alternately with a centre-tapped transformer.
41. (C) Impurity atoms add a large number of majority carriers.
42. (B) Donor electrons need only $\sim 0.01\text{--}0.05 \text{ eV}$ to enter the conduction band.
43. (C) Valence electrons easily jump to acceptor levels, creating holes.
44. (C) Both have four valence electrons forming covalent bonds in a diamond lattice.
45. (A) Si and Ge are elemental; GaAs and CdS are compound semiconductors.

Preparing for IMU CET & Merchant Navy Sponsorship?

Join LifeX Merchant Navy — IPP (offline), AIM (online), Interview Intensive, PSP/ASP sponsorship guidance & Test Series.

Call/WhatsApp: +91 91401 91138 | www.lifexmerchantnavy.com