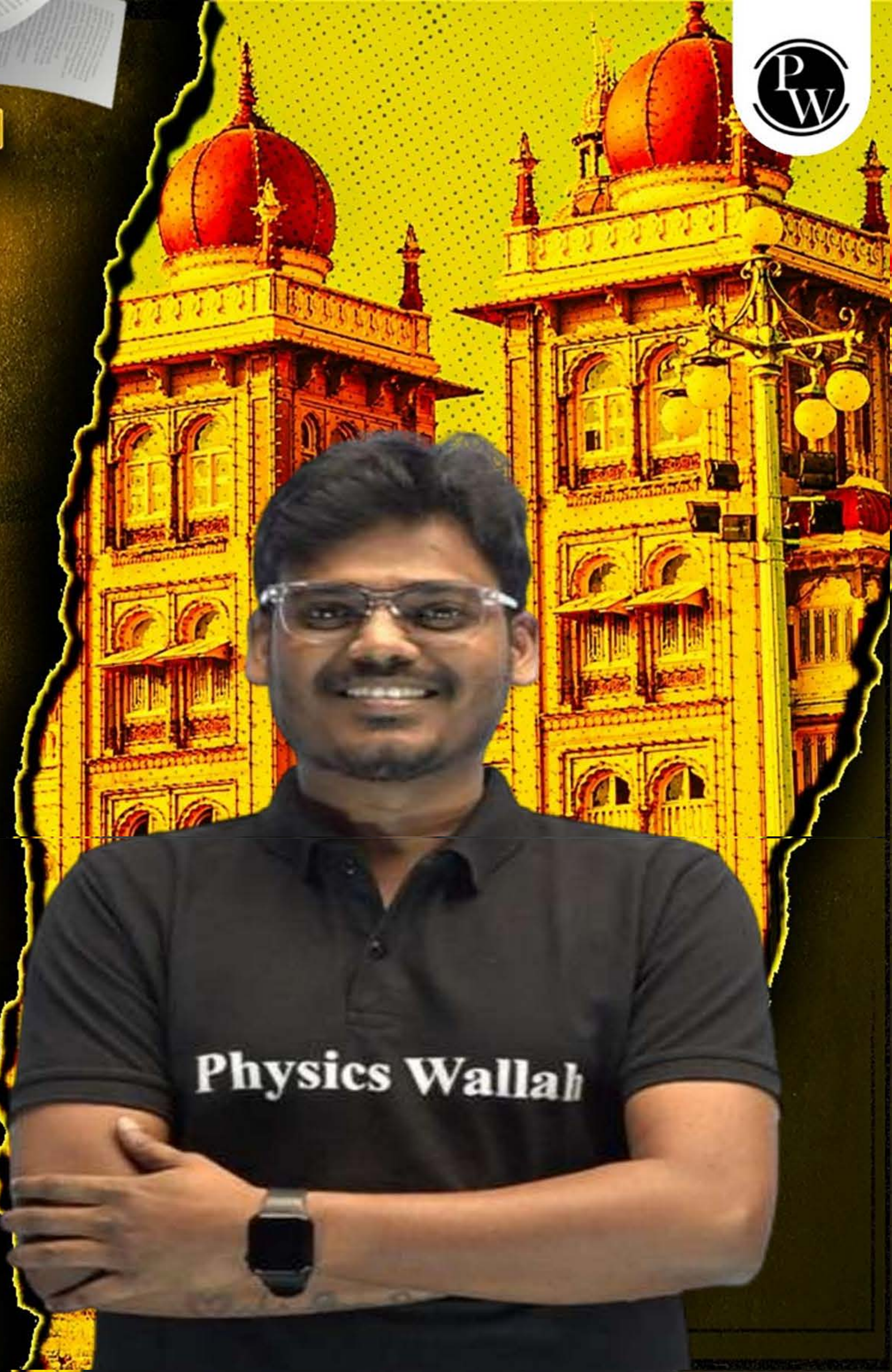
ULTIMATE KCET

CRASH COURSE 2026

PHYSICS | Lecture : 01

SEMICONDUCTOR ELECTRONICS

By – AK SIR



Recap *of previous lecture*

1. QUESTIONS ON ATOM
2. COMPOSITION OF NUCLEOUS
3. BINDING ENERGY AND B.E PER NUCLION
4. NUCLEAR FISSION AND NUCLEAR FUSION

Topics *to be covered*

1. ENERGY BAND THEORY
2. SEMICONDUCTORS AND ITS TYPES
3. PN-JUCTION DIODE AND ITS WORKING
4. RECTIFIERS AND ITS TYPES

KCET analysis of chapter - Marks weightage

Year	Topic
2025 (3Q)	Conductivity and resistivity of metal, N-type semiconductor, Current through ideal diodes
2024(4Q)	Depletion region of unbiased S.C diode, Energy levels, Zener diode and PN-Junction diode
2023(3Q)	Forward bias, Full wave rectifier and Truth Table of logic gate
2022(3Q)	Resistivity of semiconductor, Combination of logic gates and forbidden Energy gap
2021(2Q)	Logic operation, PN-Junction diode and Photodiode

KCET analysis of chapter - Marks weightage

Year	Topic
2020(3Q)	Diode and capacitor, Logic gate and Positive hole of semiconductor
2019(3Q)	Logic gate, Conductivity of semiconductor and transistor amplifier
2018 (4Q)	CE amplifier, Boolean algebra, Electron density and DC common emitter
2017(5Q)	Transistor, Energy gap, Forward bias , voltage regulator and universal gate
2016(3Q)	DC voltage, Transistor and logic gate
2015 (4Q)	Current through ideal diodes, LED, truth table and transistor

Electronic Device

- Any device whose action is based on the controlled flow of electrons through it is called an electronic device.
- The branch of physics that deals with the study of these electronic devices is called electronics. Electronic devices are the basic building blocks of all the electronic circuits.

Classification of Solids on The Basis Of Their Electrical Properties

A. **Metals:** They have very low resolution or high conductivity.

$\sigma \propto \frac{1}{\rho}$

$R = \frac{ml}{ne^2\tau A}$ $\rho = \frac{m}{ne^2\tau}$

$T\uparrow$ $\tau\downarrow$ $R\uparrow$ $\rho\uparrow$ $\sigma\downarrow$

$\rho \approx 10^{-2} - 10^{-8}\,\Omega m$

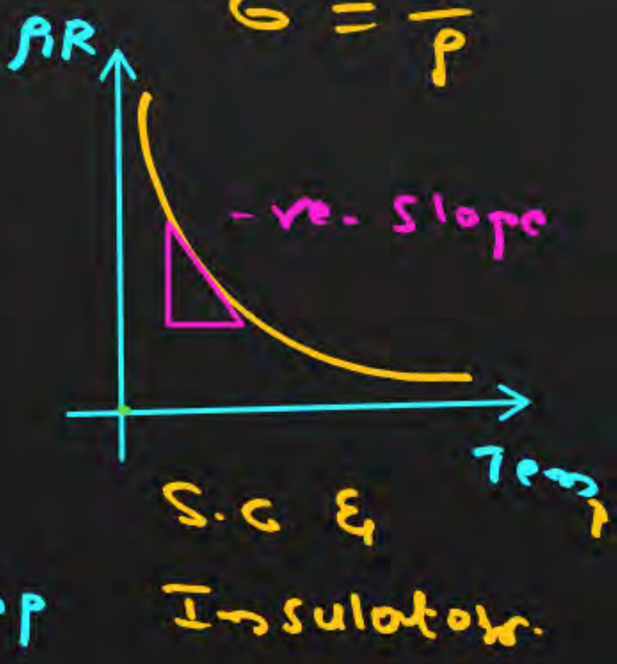
$\sigma \approx 10^{2} - 10^{8}\,Sm^{-1}$

B. **Insulators:** They have high resistivity or low conductivity.

$\rho \approx 10^{11} - 10^{19}\,\Omega m$

$\sigma \approx 10^{-11} - 10^{-19}\,Sm^{-1}$

$\sigma = \frac{1}{\rho}$



→ Acts as insulators at absolute zero

C. **Semiconductors:** They possess resistivity or conductivity intermediate to metals and insulators.

$R = \frac{ml}{ne^2\tau A}$ $T\uparrow$ $\tau\downarrow$ $n\uparrow\uparrow$

$\rho \approx 10^{-5} - 10^{6}\,\Omega m$

$\sigma \approx 10^{5} - 10^{-6}\,Sm^{-1}$

$\sigma = \frac{ne^2\tau}{m}$ $T\uparrow$ $\tau\downarrow$ $n\uparrow\uparrow$

$\sigma\uparrow$ $T\uparrow$

Question

The range of electrical conductivity σ and resistivity ρ for metals, among the following, is:

σ - High

ρ - low

(A) $\rho = 10^{-3} - 10^{-8}\ \Omega m, \sigma = 10^{2} - 10^{5}\ \Omega^{-1}m^{-1}$

(B) $\rho = 10^{-6} - 10^{3}\ \Omega m, \sigma = 10^{2} - 10^{5}\ \Omega^{-1}m^{-1}$

(C) $\rho = 10^{-6} - 10^{3}\ \Omega m, \sigma = 10^{-10} - 10^{5}\ \Omega{-1}m^{-1}$

(D) $\rho = 10^{-10} - 10^{6}\ \Omega m, \sigma = 10^{-10} - 10^{6}\ \Omega{-1}m^{-1}$

Question

The resistivity of a semiconductor at room temperature is in between

(A) 10^{-3} to 10^{6} Ω–cm

(B) 10^{6} to 10^{8} Ω–cm

(C) 10^{10} to 10^{12} Ω–cm

(D) 10^{-2} to 10^{-5} Ω–cm

Question

The conductivity of semiconductor increases with increase in temperature because

A number density of charge carriers increases

B relaxation time increases

C both number density of charge carriers and relaxation time increases

D number density of current carriers increases, relaxation time decreases but effect of decrease in relaxation time is much less than increase in number density

1. 1h = ... - ?

~~(A)~~ 60min ✓

(B) 3600s

(C) 2 X 30min

(D) All of them.

1h = 60min

= 60 x 1min

= 60 x 60 s

1h = 3600s

Question

The solids which have the negative temperature coefficient of resistance are:

A. Insulators only

B. Semiconductors only

C. Insulators and semiconductors

D. Metals

Question

A piece of copper and other of germanium are cooled from the room temperature to 80 K, then

↳ $R \propto T$ ↳ $R \propto \frac{1}{T}$ $\sigma = \frac{1}{\rho}$

↳ $\rho \propto T$ ↳ $\rho \propto \frac{1}{T}$

(A) Resistance of each will increase ✗

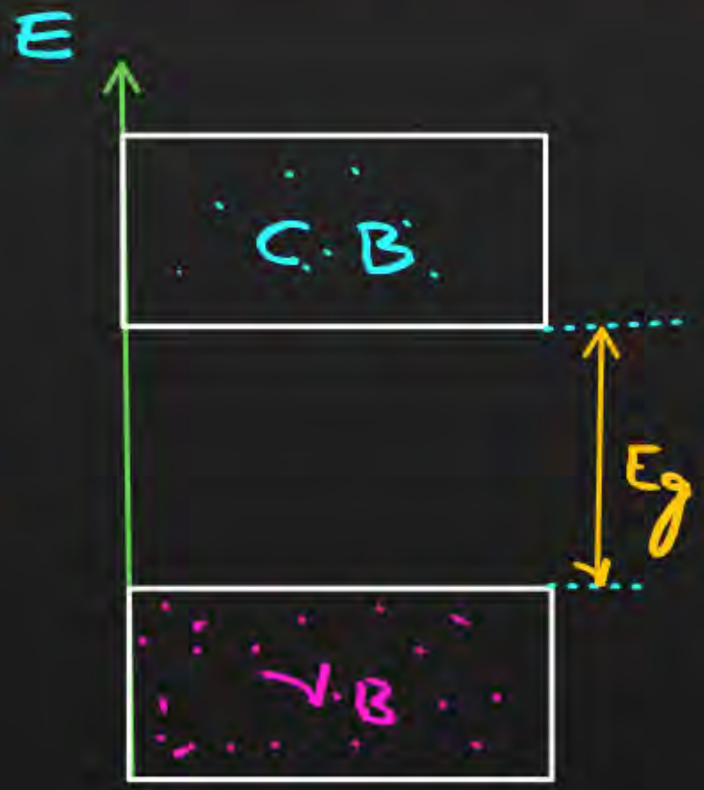
(B) Resistance of copper will decrease ✗

(C) The resistance of copper will increase while that of germanium will decrease

(D) The resistance of copper will decrease while that of germanium will increase

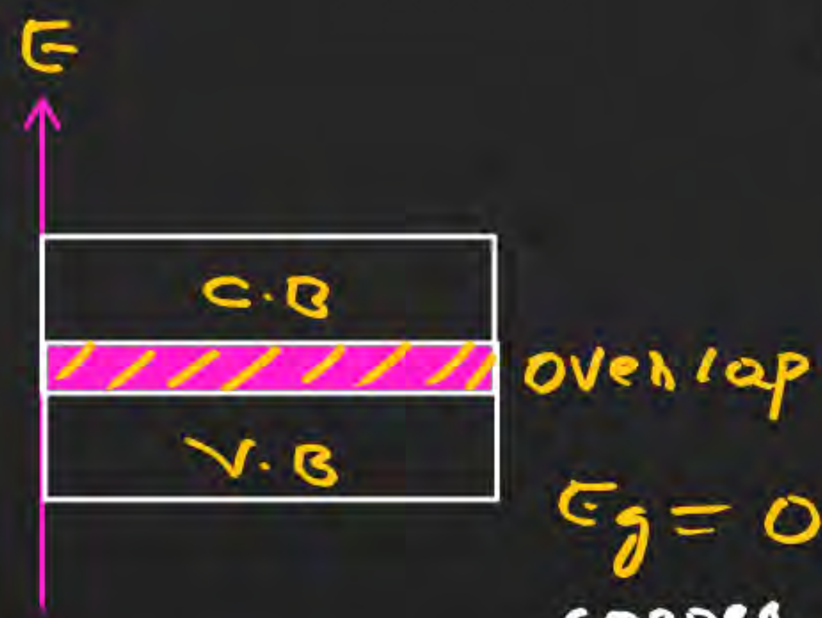
Energy Band Theory

FEG



$$E_n = -\frac{13.6}{n^2} z^2$$

Conductors

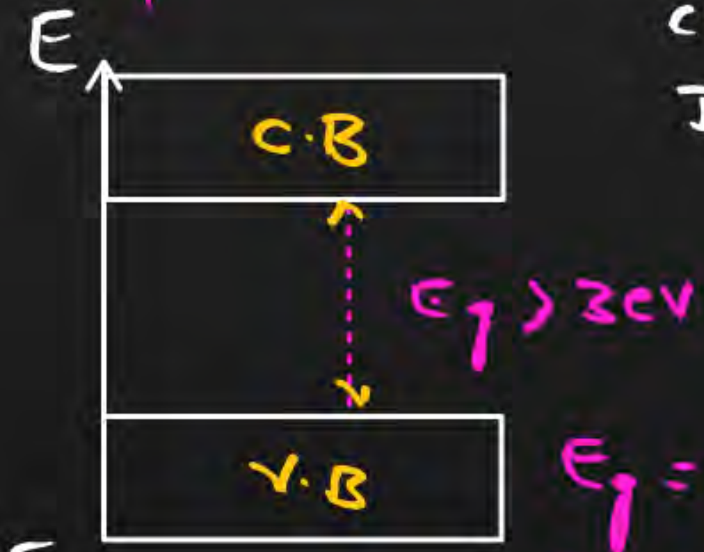


$E_g = 0$

copper

Iron.

Insulators



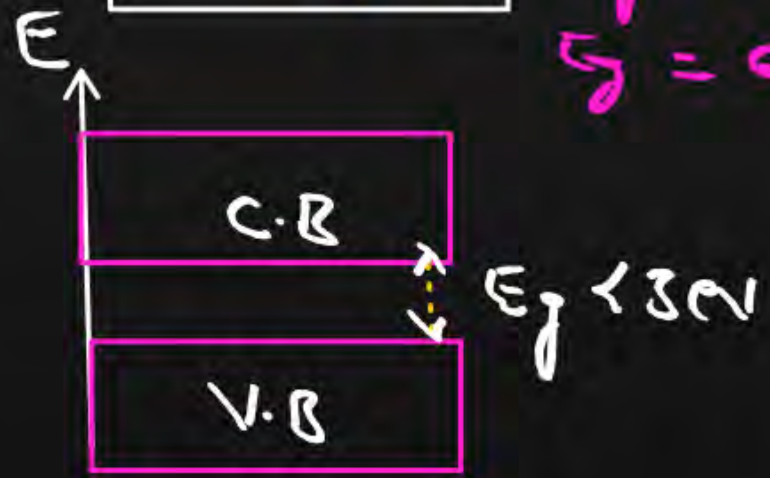
$E_g = 5.96^{eV}$ – Carbon

$E_g = 6 - 7ev$ – Diamond

Semiconductors

Ge, $E_g = 0.74$ ev

Si, $E_g = 1.17$ ev



Question

The upper level of valence band and lower level of conduction band overlap in the case of

↳ conductors

(A) silicon

(B) carbon

(C) copper

(D) germanium

Question

Carbon, silicon and germanium atoms have four valence electrons each. Their valence and conduction bands are separated by energy band gaps represented by $(E_g)_C$, $(E_g)_{Si}$ and $(E_g)_{Ge}$ respectively. Which one of the following relationships is true in their case?

A. $(E_g)_C > (E_g)_{Si}$

B. $(E_g)_C = (E_g)_{Si}$ ✗

C. $(E_g)_C < (E_g)_{Ge}$ ✗

D. $(E_g)_C < (E_g)_{Si}$ ✗

$(E_g)_c > (E_g)_{Si} > (E_g)_{Ge}$

$(E_g)_c = 5.96\,eV$

$(E_g)_{Si} = 1.17\,eV$

$(E_g)_c = 0.74\,eV$

Question

K = 273 + °C   C = -273°C

The forbidden energy gap for Ge crystal at OK is

(A) 0.71 eV

(B) 2.57 eV

(C) 6.57 eV

(D) 0.071 eV

Question

The energy gap in case of which of the following is less than 3 eV?

↳ S.C

A. Germanium

B. Iron

C. Copper

D. Aluminium

Question

Choose the only false statement from the following.

S.C $R \propto \frac{1}{T}$

$\rho \propto \frac{1}{T}$ $\quad \sigma = \frac{1}{\rho} \propto T$

$T\uparrow \; \rho\downarrow$

(A) In conductors, the valence and conduction bands overlap ✓

(B) Substances with energy gap of the order of 10 eV are insulators ✓ $> 3\,eV$

(C) The resistivity of a semiconductor increases with increase in temperature ✗

(D) The conductivity of a semiconductor increases with increase in temperature ✓

Question

At absolute zero, Si acts as

(A) Non-metal

(B) Metal

(C) Insulator

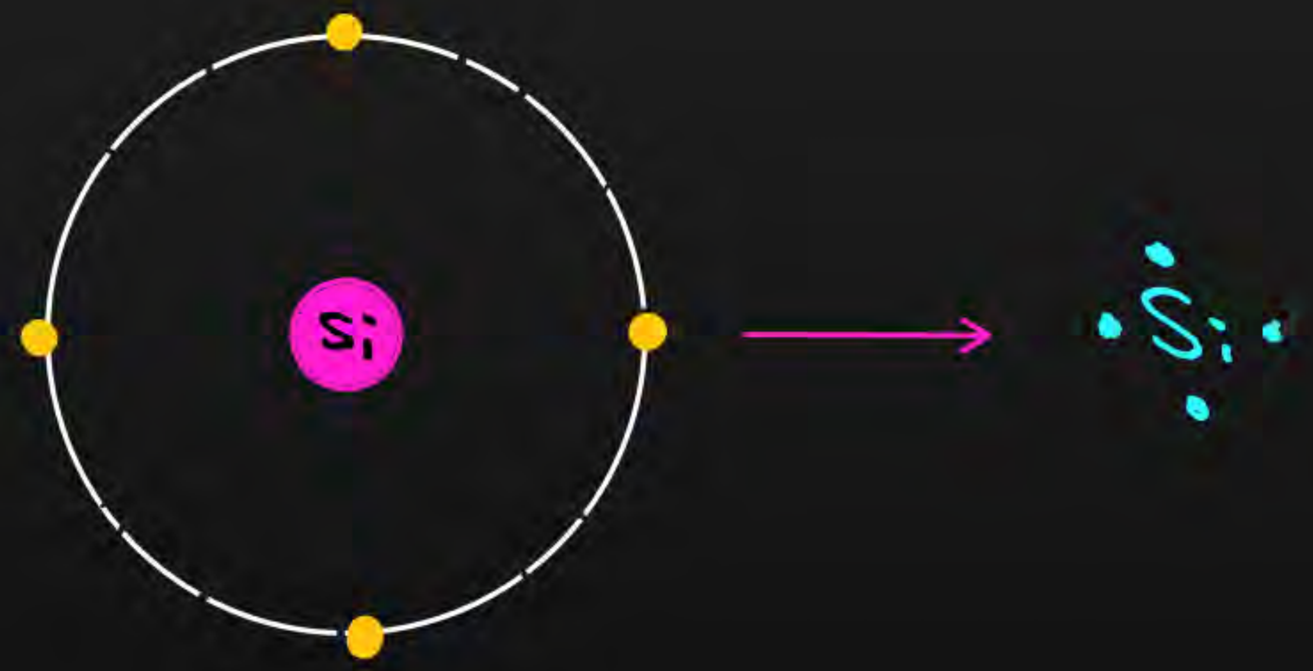
(D) None of these

Semiconductors

Semiconductors are group-14 elements having 4 valence electrons.

Ex : Germenium (Ge) . $E_g = 0.71\,eV$ Silicon (Si) , $E_g = 1.17\,eV$

Lewise structure:



Types of Semiconductors

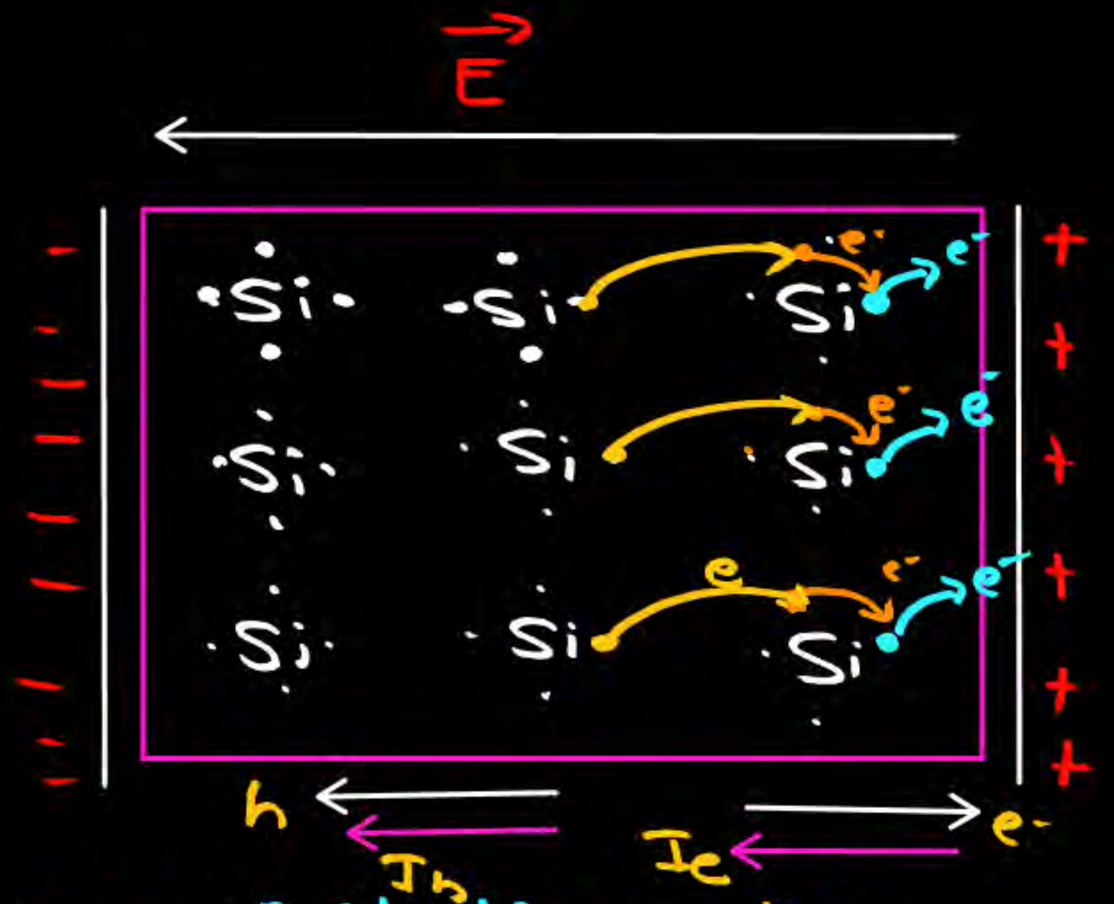
SEMICONDUCTORS

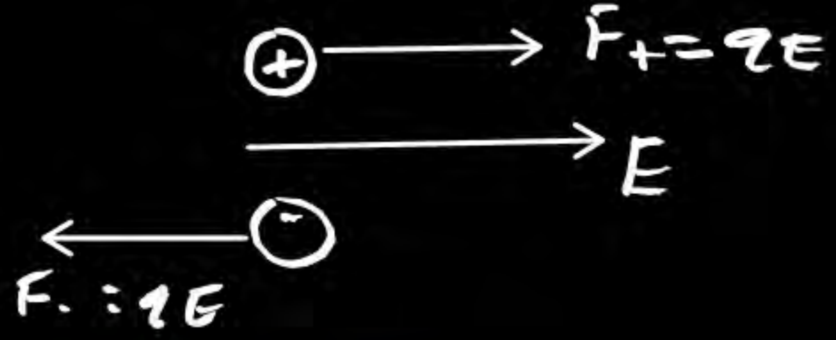
- **INTRINSIC SEMICONDUCTORS**
  - ↳ pure S.C
  - Ex: Si, Ge
- **EXTRINSIC SEMICONDUCTORS**
  - P-Type
  - N-Type.

Intrinsic S.C

$\sigma \propto T$

$\sigma \uparrow$ Doping





$m_e < m_h$

$\mu_e > \mu_h$

$I_e > I_h$

$I = I_h + I_e$

→ Empty space of electrons – Holes

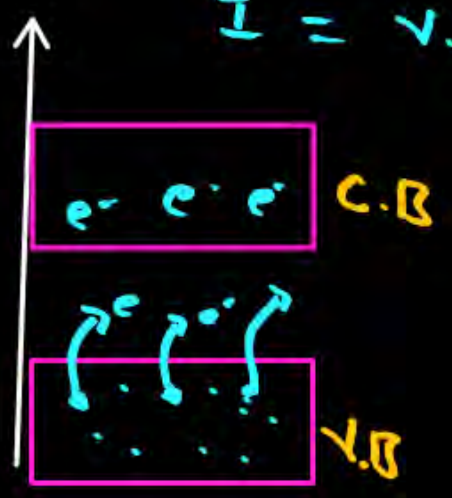
↳ Acts as +ve charge.

$I = I_h + I_e$

$\mu = \frac{v_d}{E} = \frac{eE\tau}{mE} = \frac{e\tau}{m}$

$\mu \propto \frac{1}{m}$

I = V.B C.B



$n_h = n_e$

σ = small

Extrinsic S.C

To increase the conductivity → Doping.

(i) P-Type SC

pure S.C + Doping

→ Si + Trivalent atoms → Group-13 elements
↳ 3 valence electrons.

↳ $n_e = n_h$ → Intrinsic

$n_i^2 = n_e n_h$ → Extrinsic

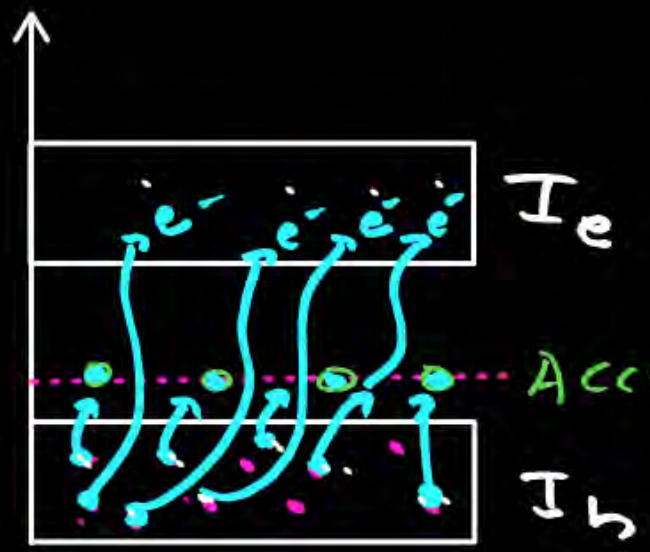
→ Trivalent atoms → Trick : B In Al.
B - Boron, In - Indium, Al - Aluminium, Gallium.

(·X· · → electrons, · ↳ Hole)

→ ·Si· + ·X·

4 - e^-

8 - h



$$I = I_h + I_e$$

→ ·X· ⇒ Developes

1 hole extra

⇓

Ready to accept

electrons

⇓

Acceptor atom.

→ P-Type S.C

↳ Majority charge carriers – Holes

↳ Minority " " – Electrons.

↳ This S.C is Electrically Neutral

→ **N-Type S.C** → pure S.C + Doping

→ Si + pentavalent ⇒ Group-15 elements

↳ 5-Valence electrons

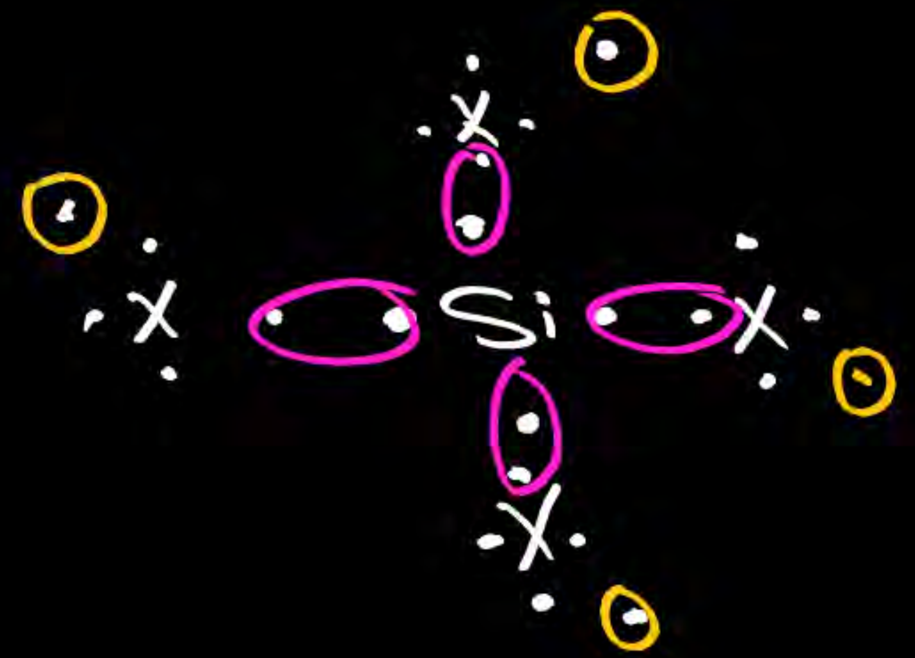
↳ pentavalent atoms

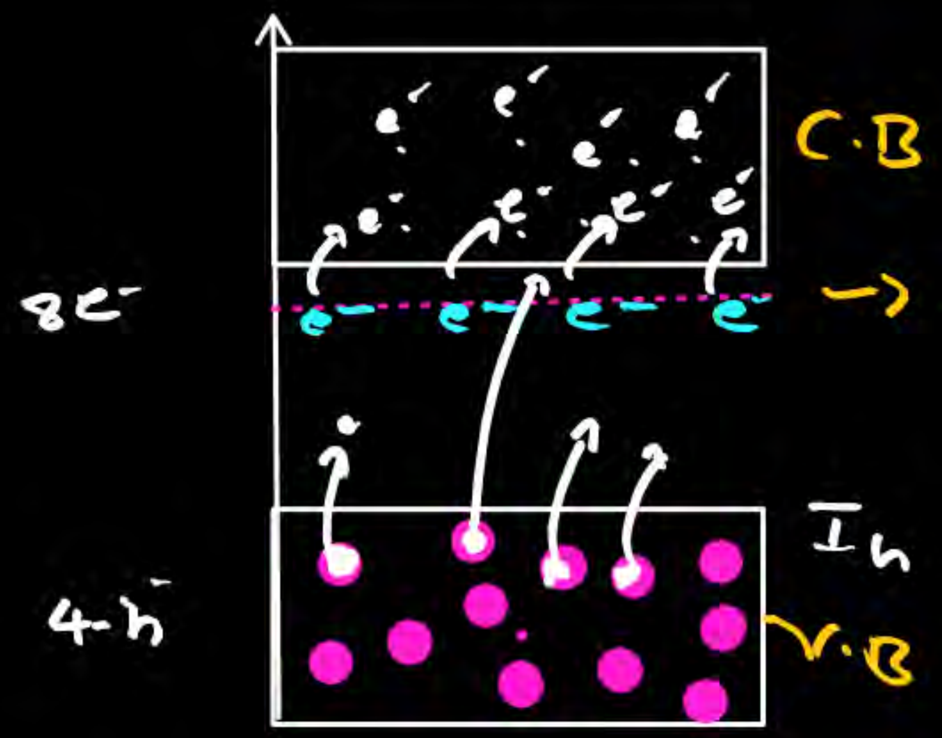
Trick : P As Sb

phosphorous, Arsenic Antimony

Bismuth.

↳ $\cdot\dot{X}\cdot$ + $\cdot\dot{Si}\cdot$





$I = I_h + I_e$

→ ·X· ⇒ Developes 1 extra electron

⇓

Donor atom.

→ N-Type S.C

↳ majority charge carriers - Electrons

↳ minority " " - Holes

↳ Electrically Neutral.

Question

The intrinsic semiconductor becomes an insulator at:

(A) 0°

(B) –100°C

(C) 300 K

(D) 0 K

Question

The electron concentration in an n-type semiconductor is the same as hole concentration in a p-type semiconductor. An external field (electric) is applied across each of them. Compare the currents in them.

$n_i = n_h \Rightarrow I_e > I_h$

$\mu_e > \mu_h$

A. Current in n-type = current in p-type.

B. Current in p-type > current in n-type.

C. Current in n-type > current in p-type.

D. No current will flow in p-type, current will only flow in n-type.

Question

A *p*-type extrinsic semiconductor is obtained when Germanium is doped with:

(A) Antimony

(B) Phosphorous

(C) Arsenic

(D) Boron

Question

$R \propto \frac{1}{T}$

What happens to resistance of an intrinsic semiconductor when heated?

$T \uparrow \quad R \downarrow$

(A) Increases

(B) Remains Constant

(C) Decreases

(D) Decreases Linearly

Question

A semiconductor has an electron concentration of 6×10^{22} per m^3 and hole concentration of 8.5×10^{9} per m^3. Then it is :

(A) n-type semiconductor

(B) p-type semiconductor

(C) Intrinsic semiconductor

(D) Conductor

Intrinsic $\Rightarrow n_e = n_h$

P-Type $\Rightarrow n_h > n_e$

N-Type $\Rightarrow n_e > n_h$

Question

In an n – type semiconductor, which of the following statements is true?

(A) Electrons are majority carries and trivalent atoms are the dopants.

(B) Electrons are minority carries and pentavalent atoms are the dopants.

(C) Holes are minority carries and pentavalent atoms are the dopants.

(D) Holes are majority carries and trivalent atoms are the dopants.

Question

Majority charge carries in p-type materials are:

A. Holes

B. Electrons

C. Both holes and electrons

D. None of these

Question

An n-type semiconductor is :

(A) Neutral

(B) Positively charged

(C) Negatively charged

(D) None of these

Question

In a semiconductor material, the mobilities of electrons and holes are μ_e and μ_h respectively. Which of the following is true?

(A) $\mu e > \mu h$

(B) $\mu e < \mu h$

(C) $e = \mu h$

(D) $\mu e < 0; \mu h > 0$

Question

Which of the following statements is correct for an n-type semiconductor?

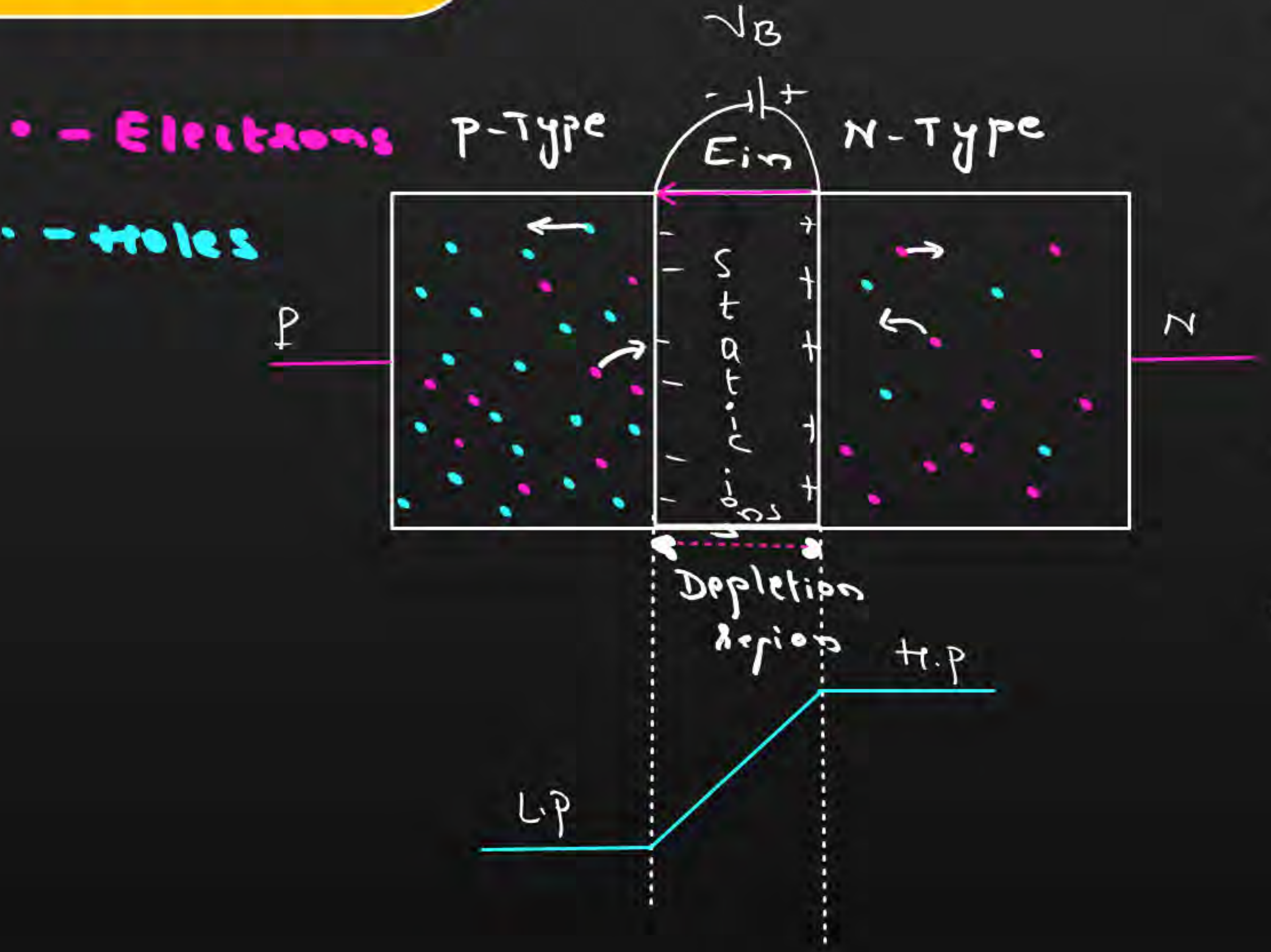
(A) The donor energy level does not exist.

(B) The donor energy level lies just below the bottom of the conduction band.

(C) The donor energy level lies closely above the top of the valence band.

(D) The donor energy level lies at the halfway mark of the forbidden energy gap

P-N Junction



→ Holes from p-side & Electrons from n-side diffused towards the Junction

⇒ I_{Diff} = Majority charge carriers

⇒ After some time $I_D \downarrow$

→ minority charge carriers

I_{drift} = Minority charge carriers

→ When $I_{Diff} = I_{Drift}$, no change will be present in depletion region.

PN-Junction ⇒ I - Unidirection
Diode

Biasing ⇒ Connecting battery

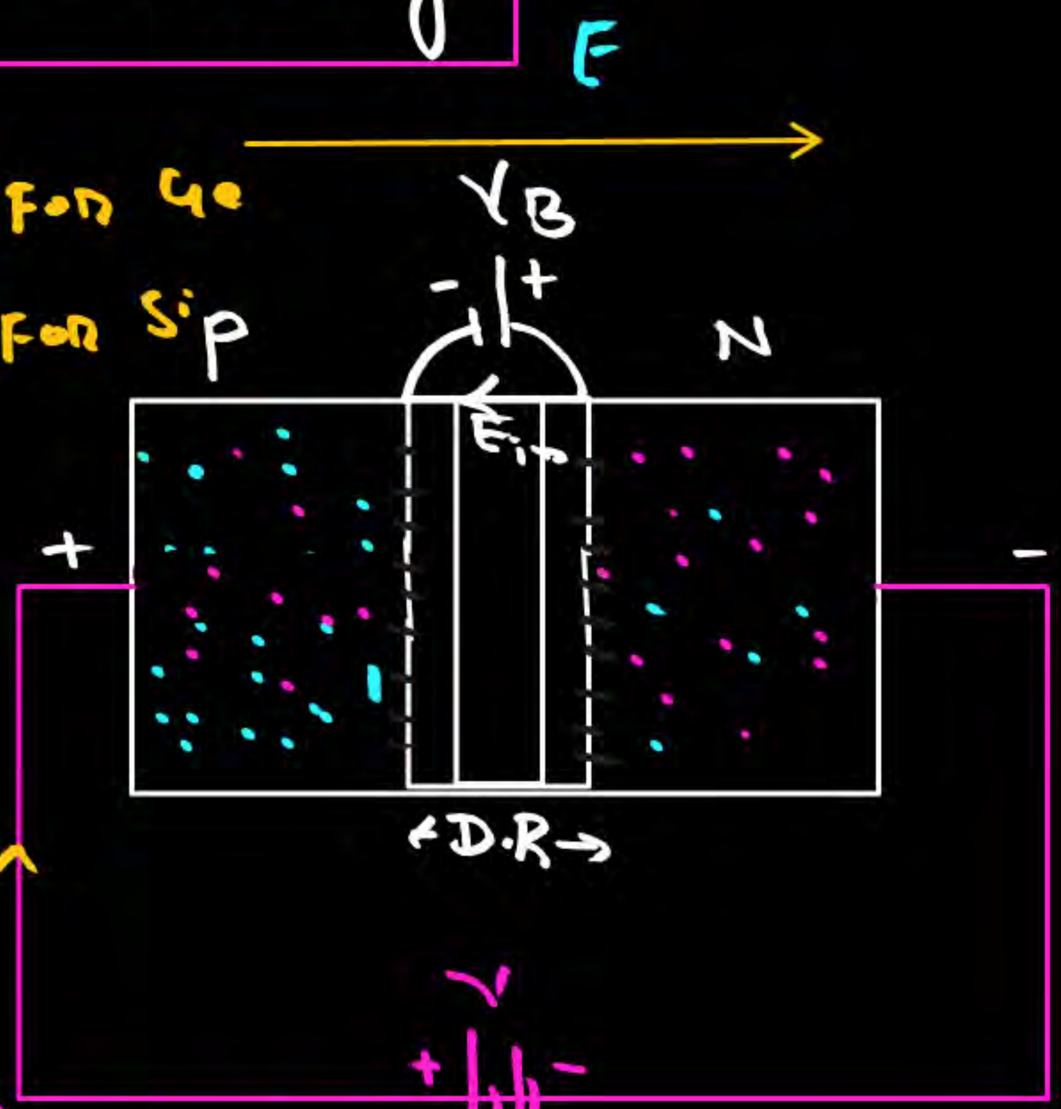
F·B

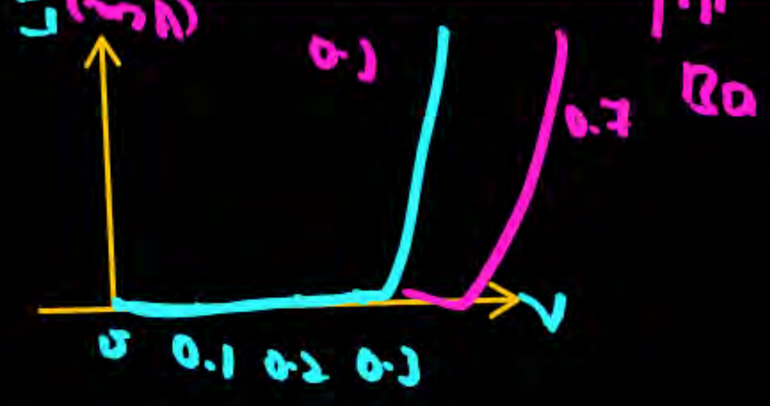
R·B

Forward Biasing

$V_B = 0.3V$ for Ge

$V_B = 0.7V$ for Si





- → F.B → connecting +ve terminal to p-side, -ve to N-side.
- → Now Barrier potential decrea-ses i.e $(V_B - V)$
- → Once it crosses barrier potential, I will flow due to majority charge carriers.
- → Holes from p side electrons from N-side flow towards junction.
- → Depletion region decreases
- → E_{in} is also decreases.

P-N Junction

The barrier potential V_B depends on

(i) the nature of the semiconductor,
(ii) temperature, and
(iii) the amount of doping.
(iv) The value of barrier potential is 0. 7 V for Si and 0. 3 V for Ge semiconductors.

Working of P-N Junction : Forward Bais

Forward biasing: If the positive terminal of a battery is connected to the p-side and the negative terminal to the n-side, then the p-n junction is said to be forward biased.

I ✓

$I = \frac{\Delta V}{R}$ ⇒ majority charge carriers (mA)

- The effective barrier potential decreases to $(V_B - V)$ and hence the energy barrier across the junction decreases,
- The majority charge carries i.e., holes from p-side and electrons from n-side begin to flow towards the junction,
- The diffusion of electrons and holes into the depletion layer decreases its width, and
- The effective resistance across the $p - n$ junction decreases.

Working of P-N Junction : Reverse Bais

F.B, I ✓

R.B, I ✗

Reverse biasing: If the positive terminal of a battery is connected to the n-side and negative terminal to the p-side, then the p-n junction is said to be reverse biased.

$I = \frac{\Delta V}{R} \Rightarrow I\ (\mu A) \Rightarrow$ minority charge carriers.

- The barrier potential increases to $(V_B + V)$ and hence the energy barrier across the junction increases,
- The majority charge carriers move away from the junction, increasing the width of the depletion layer,
- The resistance of the $p - n$ junction becomes very large, and
- No current flows across the junction due to majority charge carriers.

I ✗

Checking of Forward Bias

1. Forward Bias

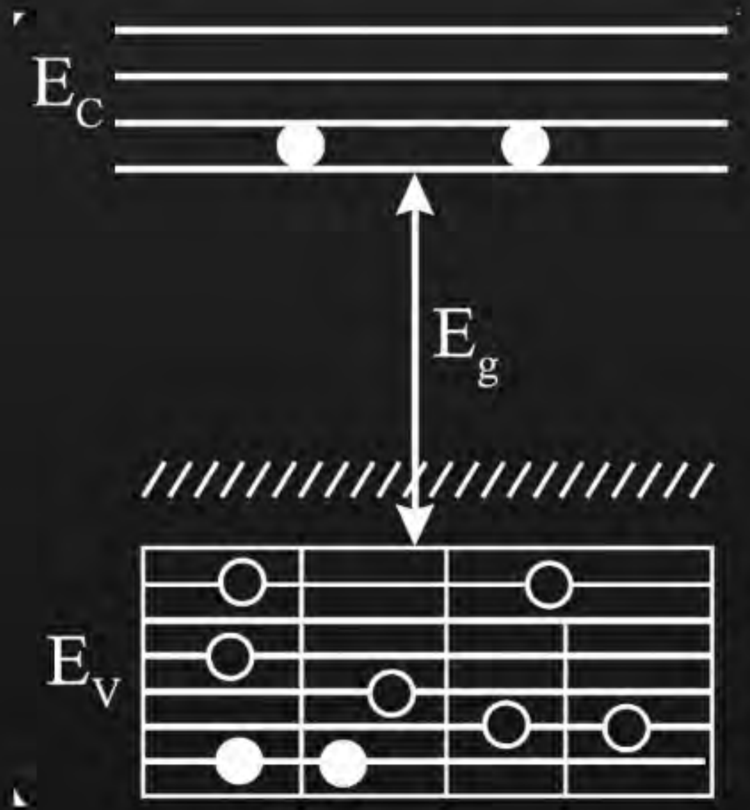
$V_P - V_N > 0$, I ✓

2. Reverse Bias

$V_P - V_N < 0$, I ✗

Question

In the energy band diagram of a material shown below, the open circles and filled circles denote holes and electrons respectively. The material is:



(A) An insulator

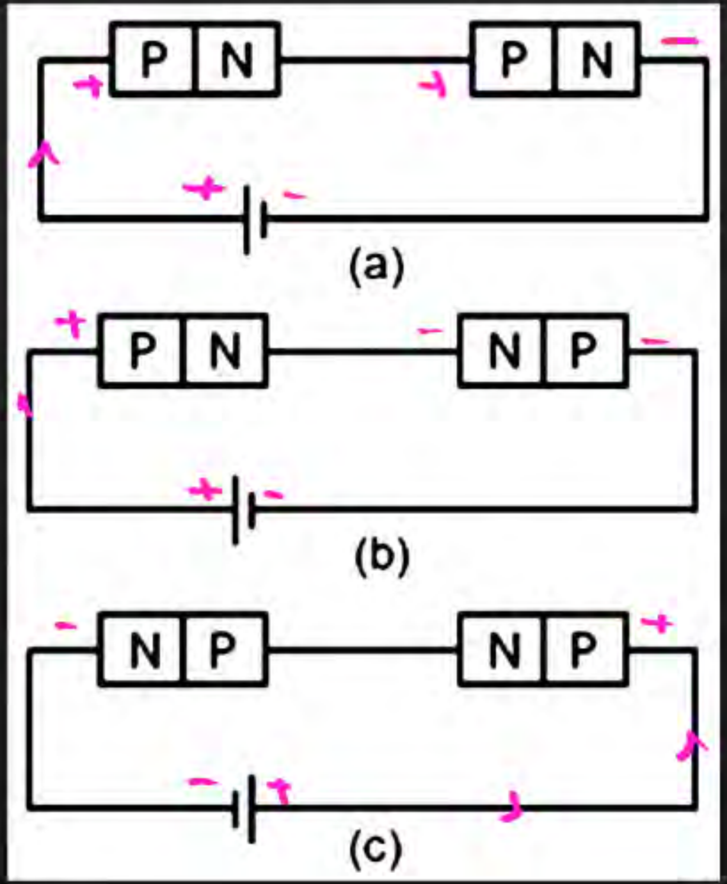
(B) A metal

(C) An *n*-type semiconductor

(D) A *p*-type semiconductor

Question

In the given circuits (a), (b) and (c), the potential drop across the two p-n junctions are equal in:



A. Both circuits (a) and (c)

B. Circuit (a) only

C. Circuit (b) only

D. Circuit (c) only

Question

A $p-n$ junction diode is connected to a battery of e.m.f. $5.5V$ and external resistance $5.1k\Omega$. The barrier potential in the diode is $0.4V$. The current in the circuit is:

(A) 1 A

(B) 1 mA

(C) 2 mA

(D) 0.08 mA

$$I = \frac{\Delta V}{R} = \frac{V - V_B}{R}$$

$$I = \frac{5.5 - 0.4}{5.1 \times 10^3} = \frac{5.1}{5.1 \times 10^3}$$

$$I = 1 \times 10^{-3} A$$

$$I = 1 mA$$

Question

A p-n junction diode is connected to a battery of emf 5.7 V in series with a resistance 5 KΩ such that it is forward biased. If the barrier potential of the diode is 0.7 V, neglecting the diode resistance, the current in the circuit is

(A) 1.14 mA

(B) 1 mA

(C) 1 A

(D) 1.14 A

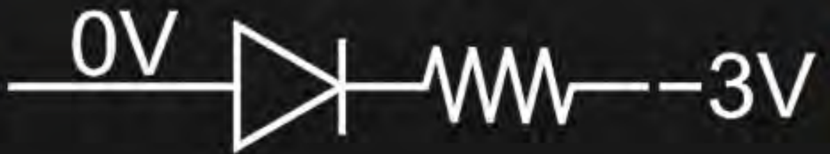
Question

Out of the following, which one is a forward biased diode?

$V_P - V_N > 0$

(A) 

(B) 

(C) 

(D) 

$2 - 5 = -3V < 0$

$-2 - 2 = -4V < 0$

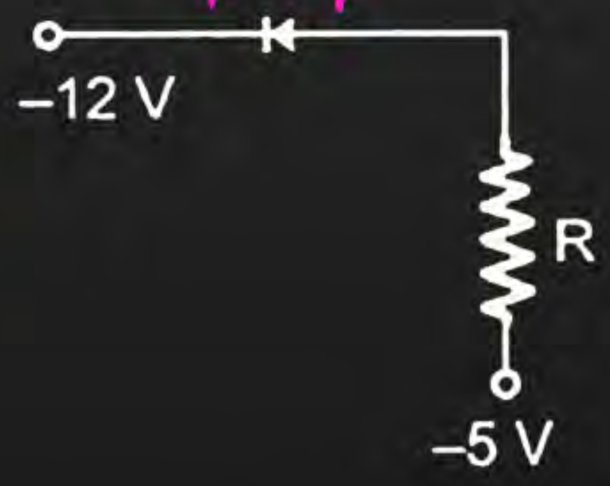
$0 - (-3) = +3 > 0$ ✓

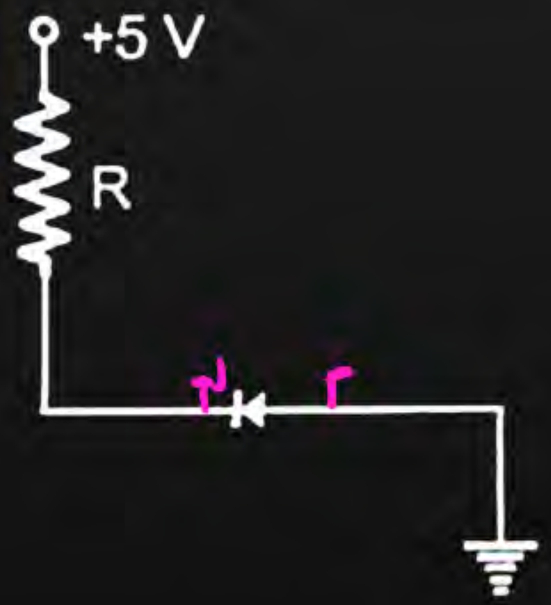
$-4 - (-2) = -2 < 0$

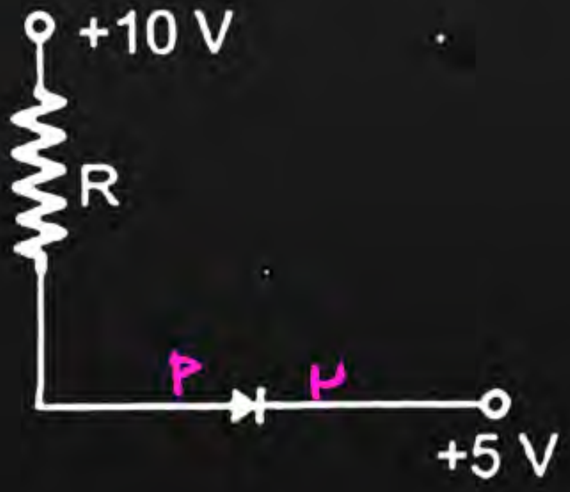
Question

Which of the following diodes is reverse biased?

A


B


C


D


Question

The current in the circuit will be:

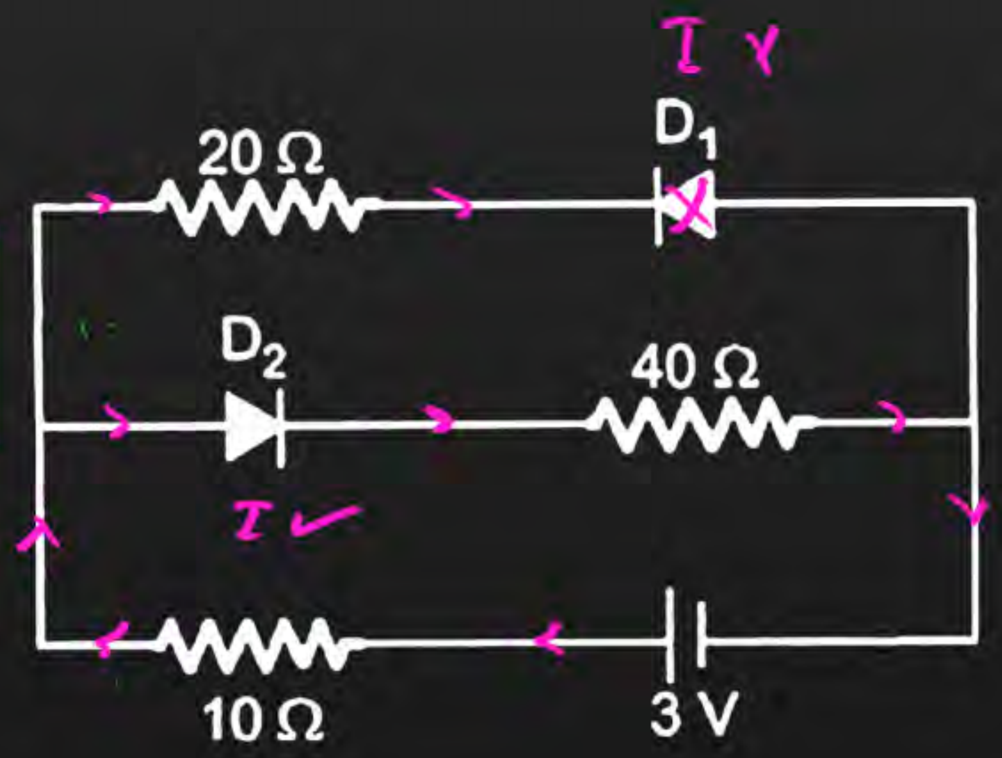
(A) $\frac{3}{40} A$

(B) $\frac{1}{10} A$

(C) $\frac{3}{50} A$

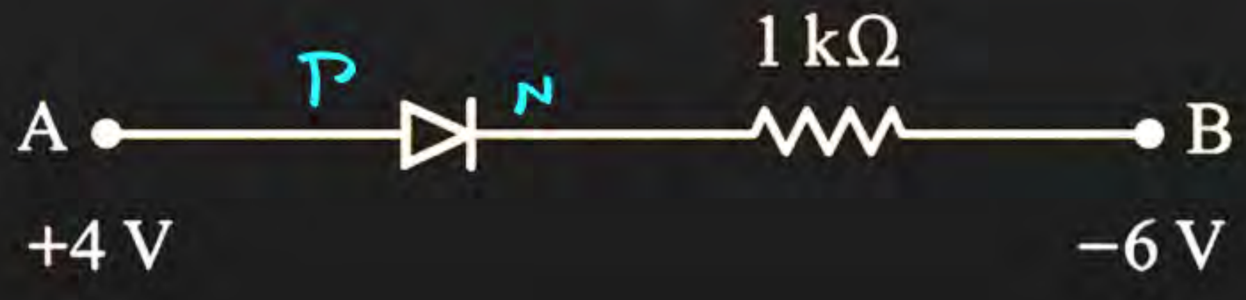
(D) $\frac{3}{10} A$

$$I = \frac{\Delta V}{R} = \frac{3-0}{10+40} = \frac{3}{50} A$$



Question

Consider the junction diode as ideal. The value of current flowing through AB is:



(A) 0 A

(B) 10^{-2} A

(C) 10^{-1} A

(D) 10^{-3} A

$$I = \frac{\Delta V}{R} = \frac{V_P - V_N}{R}$$

$$I = \frac{4-(-6)}{1\times10^{3}}$$

$$I = 10\times10^{-3}\text{ A}$$

$$I = 10^{-2}\text{ A}$$

Question

The number densities of electrons and holes in a piece germanium at room temperature are equal and its value is $3 \times 10^{16} \mathrm{m}^{-3}$. On doping with aluminum, the hole density increases to $4.5 \times 10^{22} \mathrm{m}^{-3}$. Then electron density in doped germanium is:

(A) $2 \times 10^{10} \mathrm{m}^{-3}$

(B) $4 \times 10^{10} \mathrm{m}^{-3}$

(C) $3 \times 10^{9} \mathrm{m}^{-3}$

(D) $4.5 \times 10^{9} \mathrm{m}^{-3}$

$$n_i^2 = n_e n_h$$

$$(3 \times 10^{16})^2 = n_e \times 4.5 \times 10^{22}$$

$$9 \times 10^{32} = n_e \times 4.5 \times 10^{22}$$

$$n_e = 2 \times 10^{10}$$

Question

The dominant mechanism for motion of charge carriers in forward and reverse biased silicon p-n junctions are:

(A) diffusion in both forward and reverse bias

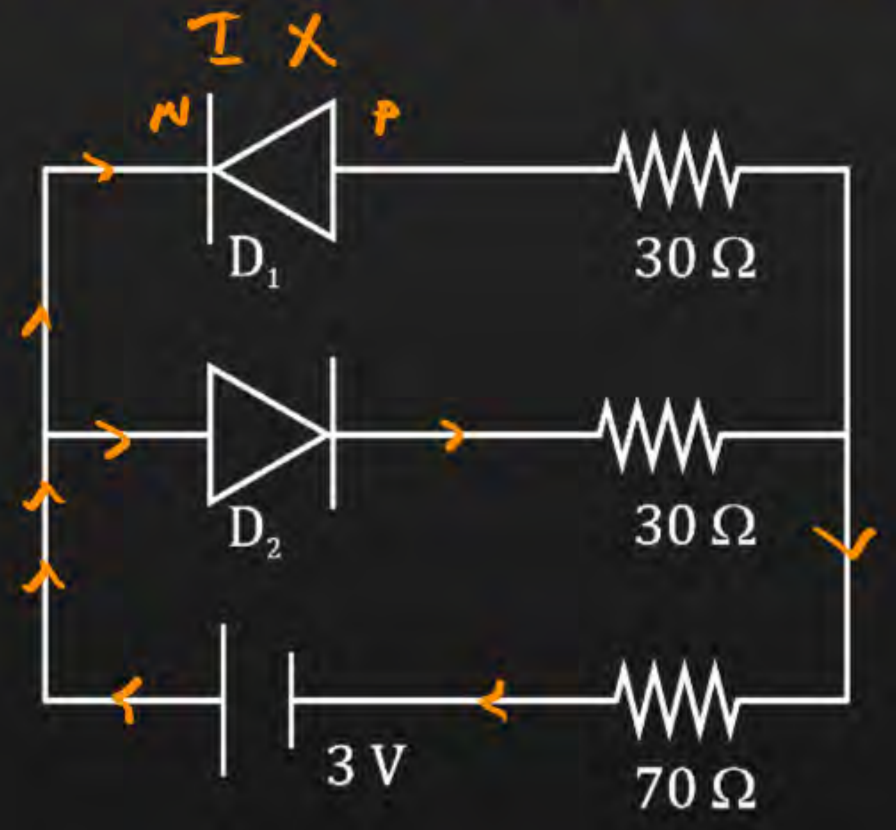
(B) drift in both forward and reverse bias

(C) diffusion in forward bias, drift in reverse bias

(D) drift in forward bias, diffusion in reverse bias

Question

The circuit shown in the figure contains two ideal diodes D_1 and D_2. If a cell of emf 3V and negligible internal resistance is connected as shown, then the current through 70Ω resistance (in amperes) is:



$$I = \frac{\Delta V}{R_T} = \frac{3-0}{30+70} = \frac{3}{100}$$

$$I = 0.03\,A$$

(A) 0.03 A

(B) 0.06 A

(C) 0.01 A

(D) 0.02 A

Question

Depletion region in an unbiased semiconductor diode is a region consisting of

(A) both free electrons and holes

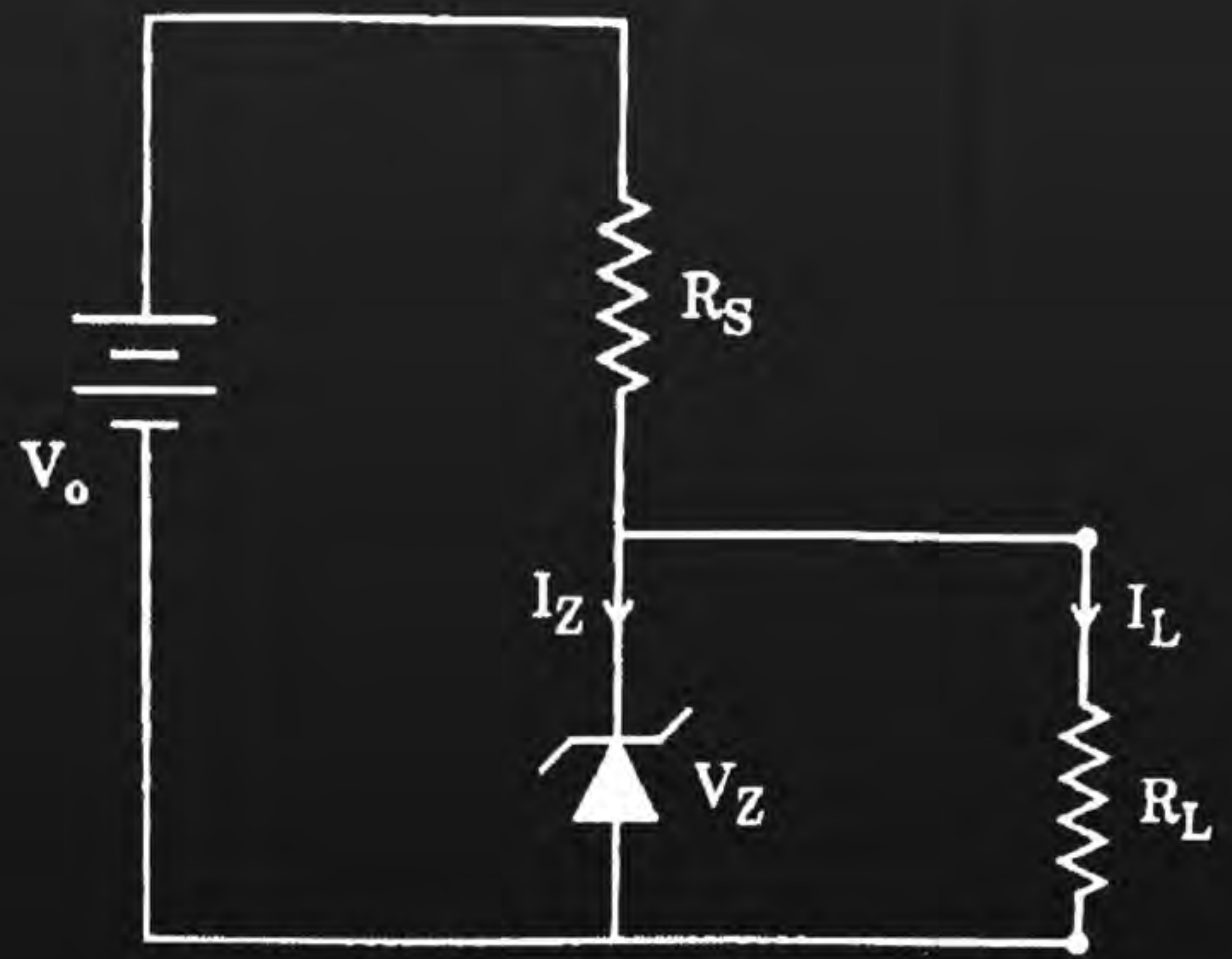
(B) neither free electrons nor holes

(C) only free electrons

(D) only holes

Question

In the diagram shown, the Zener diode has a reverse breakdown voltage of V_Z. The current through the load resistance R_L is I_L. The current through the Zener diode is



(A) $\dfrac{V_0 - V_Z}{R_S}$

(B) $\dfrac{V_0 - V_Z}{R_L}$

(C) $\dfrac{V_Z}{R_L}$

(D) $\left(\dfrac{V_0 - V_Z}{R_S}\right) - I_L$

$I = \dfrac{\Delta V}{R} = \dfrac{V_0 - V_Z}{R_S}$

$I = I_Z + I_L$

$I_Z = I - I_L$

$I_Z = \dfrac{V_0 - V_Z}{R_S} - I_L$

Question

When a *p*-*n* junction diode is in forward bias, which type of charge carriers flows in the connecting wire?

(A) Free electrons

(B) ions

(C) Protons

(D) Holes

Question

A positive hole in a semiconductor is

A. an anti-particle of electron

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

C. absence of free electrons

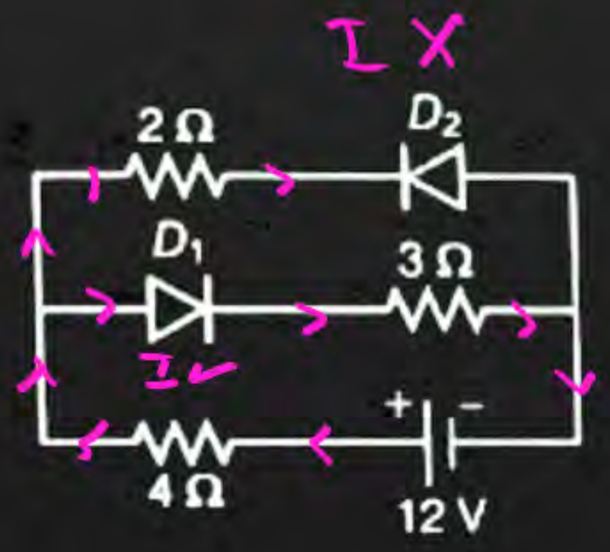
D. an artificially created particle

Question

The circuit has two oppositely connected ideal diodes in parallel. What is the current flowing in the circuit?

$$I = \frac{\Delta V}{R_T} = \frac{12-0}{4+3} = \frac{12}{7}$$

$I = 1.71\,A$



(A) 2.31 A

(B) 1.71 A

(C) 1.33 A

(D) 2.0 A

Question

In n-type semiconductor, electrons are majority charge carriers but it does not show any negative charge. The reason is

(A) electrons are stationary

(B) electrons neutralize with holes

(C) mobility of electrons is extremely small

(D) atom is electrically neutral

Question

In which of the following statements, the obtained impure semiconductor is of p-type?

(A) Germanium is doped with bismuth

(B) Silicon is doped with antimony

(C) Germanium is doped with gallium

(D) Silicon is doped with phosphorus

Question

The width of the depletion region in a p-n junction diode is

(A) increased by reverse bias ✓

(B) increased by forward bias ✗

(C) decreased by reverse bias ✗

(D) independent of the bias voltage ✗

V_B, E, D.R

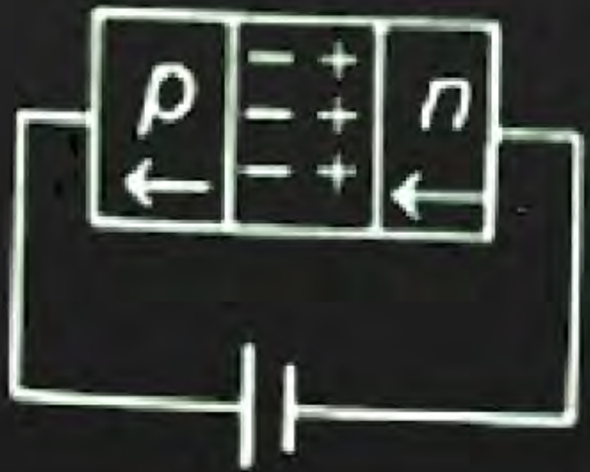
F.B → Decreas

R.B → Incresare

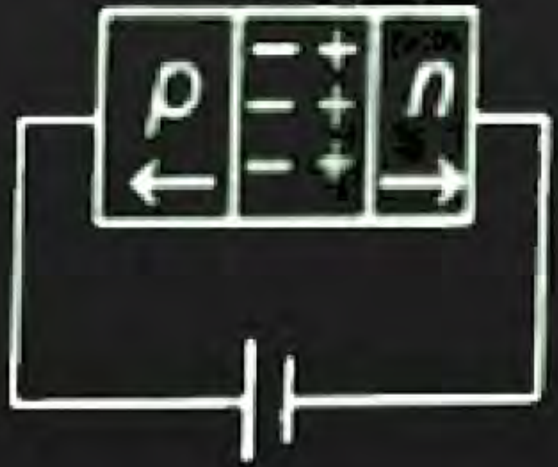
Question

In the case of forward biasing of a p-n junction diode, which one of the following figures correctly depicts the direction of conventional current (indicated by an arrow mark)?

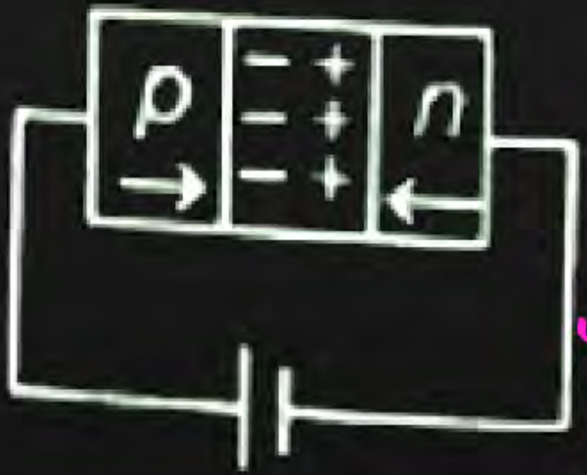
A



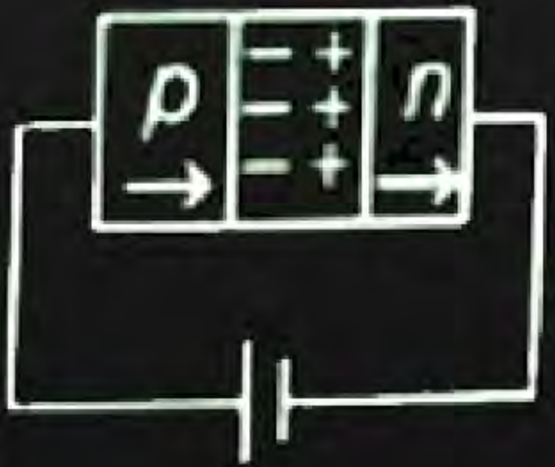
B



C



D



Question

In a p-n junction diode not connected to any circuit

(A) the potential is the same everywhere

(B) the p-type side has a higher potential than the n-type side

(C) there is an electric field at the junction directed from the n-type side to p-type side

(D) there is an electric field at the junction directed from the p-type side to n-type side

Question

In an unbiased p-n junction

(A) Potential at p is more than that at n

(B) Potential at p is less than that at n

(C) Potential at p is equal to that at n

(D) Potential at p is +ve and that at in is –ve

Question

Minority carriers in a p-type semiconductor are

A. free electrons

B. holes

C. neither holes nor free electrons

D. both holes and free electrons

Question

In a reverse biased diode when the applied voltage changes by 1 V, the current is found to change by 0.5 μA. The reverse bias resistance of the diode is

(A) $2 \times 10^5\ \Omega$

(B) $2 \times 10^6\ \Omega$

(C) $200\ \Omega$

(D) $2\ \Omega$

$$I = \frac{\Delta V}{R}$$

$$R = \frac{\Delta V}{I} = \frac{1}{0.5 \times 10^{-6}} = 2 \times 10^6$$

$$R = 2 \times 10^6\ \Omega$$

Question

To a germanium crystal equal number of aluminium and indium atoms are added. Then

(A) it remains an intrinsic semiconductor

(B) it becomes a *n*-type semiconductor

(C) it becomes a *p*-type semiconductor

(D) it becomes an insulator

Question

Application of a forward bias to a *p*-*n* junction

A. Widens the depletion zone

B. Increases the potential difference across the depletion zone

C. Increases the number of donors on the n side

D. Decreases the electric field in the depletion zone

Question

Reverse bias applied to a junction diode

A. Lowers the potential barrier

B. Raises the potential barrier

C. Increase the majority carrier current

D. Increase the minority carrier current

Question

Barrier potential of a *p-n* junction diode does not depend on

(A) Diode design

(B) Temperature

(C) Forward bias

(D) Doping density

Question

Depletion layer has (for an unbiased PN junction)

(A) Electrons

(B) Holes

(C) Static Ions

(D) Neutral Atoms

Question

The barrier potential of a *p*-*n* junction depends on

A. Type of semiconductor material

B. Amount of doping

C. Temperature, Which one of the following is correct?

(A) A and B only

(B) B only

(C) B and C only

(D) A, B and C

Question

In forward biasing of the *p*-*n* junction:

(A) The positive terminal of the battery is connected to *p*-side and the depletion region becomes thick.

(B) The positive terminal of the battery is connected to *n*-side and the depletion region becomes thin.

(C) The positive terminal of the battery is connected to *n*-side and the depletion region becomes thick.

(D) The positive terminal of the battery is connected to *p*-side and the depletion region becomes thin.

Thank You