Physicsaholics

DPP – 1

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Q 1. Silicon is a semiconductor. If a small amount of As is added to it, then its electrical conductivity
(a) Decreases (b) Increases
(c) Remains Unchanged (d) Becomes zero

Q 2. The electrical conductivity of a semiconductor increases when electromagnetic radiation of wavelength shorter than 2480nm is incident on it. The band gap in (eV) for the semiconductor is
(a) 0.9 eV (b) 0.7 eV
(c) 0.5 eV (d) 1.1 eV

Q 3. A p–n photodiode is fabricated from a semiconductor with a band gap of 2.5eV. It can detect a signal of wavelength
(a) 6000 Å (b) 4000 nm
(c) 6000 nm (d) 4000 Å

Q 4. A photodetector is made from a compound semiconductor with band gap 0.73eV. The maximum wavelength (approx.) it can detect is
(a) 12400 Å (b) 17000 Å
(c) 6200 Å (d) 1703 Å

Q 5. A N-type semiconductor is
(a) Negatively charged (b) Positively charged
(c) Neutral (d) None of these

Q 6. The forbidden energy band gap in conductors, semiconductors and insulators are EG_1, EG_2 and EG_3 respectively. The relation among them is
(a) $EG_1 = EG_2 = EG_3$ (b) $EG_1 < EG_2 < EG_3$
(b) $EG_1 > EG_2 > EG_3$ (d) $EG_1 < EG_2 > EG_3$

Q 7. A Ge specimen is doped with Al. The concentration of acceptor atoms is $\sim 10^{21}$ atoms/m^3. Given that the intrinsic concentration of electron-hole pairs is $\sim 10^{19}/m^3$, the concentration of electrons in the specimen is
(a) $10^{17}/m^3$ (b) $10^{15}/m^3$
(c) $10^4/m^3$ (d) $10^2/m^3$

Q 8. What is the conductivity of a semiconductor sample having electron concentration of $5 \times 10^{18}/m^3$ hole concentration of $5 \times 10^{19}/m^3$, electron mobility of $2\ m^2V^{-1}s^{-1}$ and hole mobility of $0.01\ m^2V^{-1}s^{-1}$?
(Take charge of electron as 1.6×10^{-19}C)
(a) $1.83\ (\Omega - m)^{-1}$ (b) $1.68\ (\Omega - m)^{-1}$
(c) $1.20\ (\Omega - m)^{-1}$ (d) $0.59\ (\Omega - m)^{-1}$

Q 9. A semiconductor has equal electron and hole concentration of $6 \times 10^4/m^3$. On doping with a certain impurity, electron concentration increases to $8 \times 10^{12}/m^3$. Identify the type of semiconductor.
(a) P- type (b) N- type
(c) cant identify with given data (d) NPN type

Q 10. Pure Si at 500 K has equal number of electron (n_e) and hole (n_h) concentrations of 1.5 x $10^{16}\ m^{-3}$. Doping by indium increases n_h to 4.5 x $10^{22}\ m^{-3}$. The doped semiconductor is of
(a) p-type having electron concentration $n_e = 5 \times 10^9\ m^{-3}$
(b) n-type having electron concentration $n_e = 5 \times 10^{22}\ m^{-3}$
(c) p-type having electron concentration $n_e = 2.5 \times 10^{10}\ m^{-3}$
(d) p-type having electron concentration $n_e = 2.5 \times 10^{23}\ m^{-3}$

Q 11. The number density of donor atoms which have to be added to an intrinsic germanium semiconductor to produce an n-type semiconductor of conductivity 5 $ohm^{-1}cm^{-1}$ is $a \times 10^{15}\ cm^{-3}$. Given that the mobility of electron in n-type Ge is 3900 $cm^2V^{-1}s^{-1}$. Neglect the contribution of holes to conductivity. Then a will be
(a) 8 (b) 2
(c) 14 (d) 0.4

Q 12. Which of the following has negative temperature coefficient of resistance
(a) Copper (b) Aluminium
(c) Iron (d) Germanium

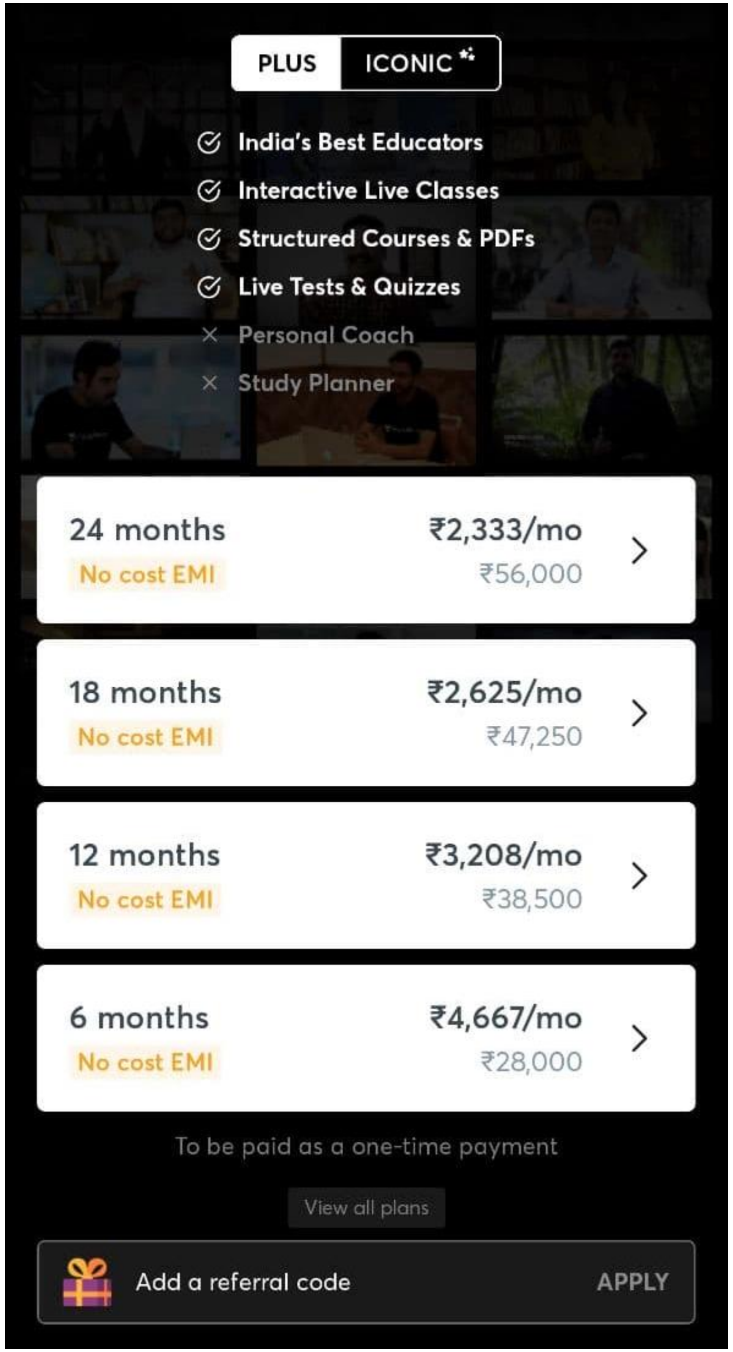
Q 13. Doping of intrinsic semiconductor is done
(a) To neutralize carriers
(b) To increase the concentration of majority charge carries
(c) To make it neutral before disposal
(d) To carry out further purification

Q 14. In a semiconducting 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) $\mu_e = \mu_h$ (d) $\mu_e < 0; \mu_h > 0$

Q 15. The major carrier of current in a p-type semiconductor will be.
(a) neutrons (b) protons
(c) electrons (d) holes

Answer Key

Q.1 b	**Q.2 c**	**Q.3 d**	**Q.4 b**	**Q.5 c**
Q.6 b	**Q.7 a**	**Q.8 b**	**Q.9 b**	**Q.10 a**
Q.11 a	**Q.12 d**	**Q.13 b**	**Q.14 a**	**Q.15 d**



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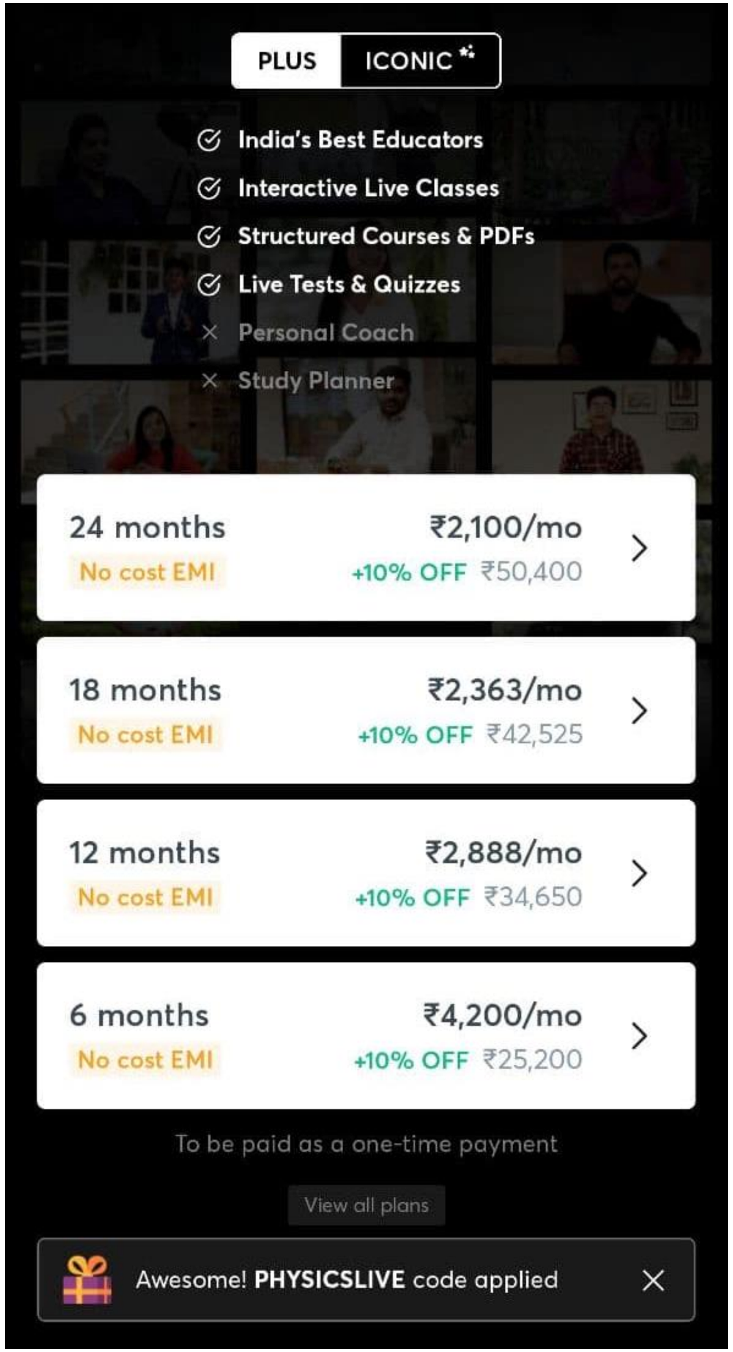

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NEET & JEE Main
Written Solution

DPP-1 Semi Conductors: Semi Conductors, Doping and P & N type Semiconductors

By Physicsaholics Team

Solution: 1

Impurity increases the conductivity of semiconductors. Hence, if a small amount of As is added to Silicon then its electrical conductivity increases.

Ans. b

Solution: 2

for $\lambda < 2480$ nm

conductivity increases.

means; $\lambda = 2480$ nm is maximum wavelength

which can given sufficient energy to the electron

so that it can cross Band gap :

so; $\Delta E_g = \frac{hc}{\lambda} = \frac{1240 (eV\text{-}nm)}{2480 (nm)} = \frac{1}{2} eV$

so; $\boxed{\Delta E_g = 0.5 \text{ eV}}$ Ans.

Ans. c

Solution: 3

It can detect energy $E \geq 2.5\,eV$

$\Rightarrow \dfrac{hc}{\lambda} > 2.5\,eV$

$\dfrac{12400}{\lambda\,(\text{in } Å)} > 2.5 \Rightarrow \dfrac{\lambda\,(\text{in } Å)}{12400} < \dfrac{1}{2.5}$

$\lambda\,(\text{in } Å) < \dfrac{12400}{2.5} = \dfrac{124000 \times 2}{5} = 2480 \times 2$

$\lambda\,(\text{in } Å) < 4960$

So, $\boxed{\lambda < 4960\ Å}$

or

$\boxed{\lambda < 496\ nm}$ Ans.

Ans. d

Solution: 4

$\Delta E_g = 0.73\ eV$

$\frac{hc}{\lambda_{max}} = 0.73\ eV$

$\frac{12400}{\lambda_{max}(\text{in } A^\circ)} = 0.73\ eV$

$\lambda_{max} = \frac{12400}{0.73}$

$\lambda_{max} = 16986\ A^\circ$

$\boxed{\lambda_{max} \simeq 17000\ A^\circ}$ Ans.

Ans. b

Solution: 5

N-type semiconductors are neutral because neutral atoms are added during doping.

Ans. c

Solution: 6

In insulators, the forbidden energy gap is very large, in case of semiconductor it is moderate and in conductors the energy gap is zero.

Ans. b

Solution: 7

acceptor atoms are Al

so; $N_{Al} = 10^{21}/m^3 = n_{hole}$

$\Rightarrow n_h = 10^{21}/m^3$

$n_e = ?$

and given that

$n_i = 10^{19}/m^3$

$n_i^2 = n_e \times n_h$

$(10^{19})^2 = n_e \times 10^{21}$

$n_e = 10^{38-21}$

$$\boxed{n_e = 10^{17}/m^3}$$ Ans

Ans. a

Solution: 8

$n_e = 5 \times 10^{18} /m^3$, $n_h = 5 \times 10^{19} /m^3$

$\mu_e = 2\ m^2/V\text{-}s$, $\mu_h = 0.01\ m^2/V\text{-}s$

conductivity : $\sigma = e(\mu_e n_e + \mu_h n_h)$

$= 1.6 \times 10^{-19} [2 \times 5 \times 10^{18} + 0.01 \times 5 \times 10^{19}]$

$= 1.6 \times 10^{-19} [10^{19} + 0.05 \times 10^{19}]$

$= 1.6 \times 10^{-19} \times [1.05 \times 10^{19}]$

$= 1.6 \times 1.05$

$\sigma = 1.68\ (\Omega\text{-}m)^{-1}$ Ans.

Ans. b

Solution: 9

initially; $n_e = n_h = 6 \times 10^4 /m^3 = n_i$

after dopping; $n_e = 8 \times 10^{12} /m^3$

n_h is still; $n_h = 6 \times 10^4 /m^3$

$\Rightarrow n_e > n_h$

so; resulting semiconductor is n-type

Ans. b

Solution: 10

$n_e = n_h = n_i = 1.5 \times 10^{16}\ m^{-3}$

Now $n_h = 4.5 \times 10^{22}$

$n_e \times n_h = n_i^2$

$n_e \times 4.5 \times 10^{22} = (1.5 \times 10^{16})^2$

$n_e = \frac{2.25 \times 10^{32}}{4.5 \times 10^{22}} = \frac{1}{2} \times 10^{10}$

$\boxed{n_e = 5 \times 10^{9}\ /m^3}$ Ans.

As dopping is done by 'In' acceptor impurity so; it will be p-type semiconductor.

Ans. a

Solution: 11

$\sigma = 5 \ ohm^{-1} cm^{-1}$

$\mu_e = 3900 \ cm^2 V^{-1} s^{-1}$

$\sigma = e n_e \mu_e$

$5 = 1.6 \times 10^{-19} \times n_e \times 3900$

$n_e = \dfrac{5}{1.6 \times 10^{-19} \times 3900} \ /cm^3$

$n_e = 0.801 \times 10^{16}$

$n_e = 8 \times 10^{15} \ /cm^3$

soj $a = 8$ Ans.

Ans. a

Solution: 12

Temperature co-efficient of semiconductor is negative. Copper, Aluminum, Iron are conductors, while Ge is semiconductor.

Ans. d

Solution: 13

Doping is the process of adding impurities to intrinsic semiconductors to alter their properties. Doping of intrinsic semiconductor is done to increase the concentration of majority charge carrier so that it can be use as p-type or n-type semiconductor in diode.

Ans. b

Solution: 14

$\mu_e > \mu_h$ because electron is lighter than hole. So, electrons needed less energy to move.

Ans. a

Solution: 15

Holes are the major carriers of current in a p-type semiconductor.

Ans. d

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Chalo Niklo