



**Question 14.1:**

In an n-type silicon, which of the following statement is true:

- (a)** Electrons are majority carriers and trivalent atoms are the dopants.
- (b)** Electrons are minority carriers and pentavalent atoms are the dopants.
- (c)** Holes are minority carriers and pentavalent atoms are the dopants.
- (d)** Holes are majority carriers and trivalent atoms are the dopants.

Answer

The correct statement is **(c)**.

In an n-type silicon, the electrons are the majority carriers, while the holes are the minority carriers. An n-type semiconductor is obtained when pentavalent atoms, such as phosphorus, are doped in silicon atoms.

**Question 14.2:**

Which of the statements given in Exercise 14.1 is true for p-type semiconductors.

Answer

The correct statement is **(d)**.

In a p-type semiconductor, the holes are the majority carriers, while the electrons are the minority carriers. A p-type semiconductor is obtained when trivalent atoms, such as aluminium, are doped in silicon atoms.

**Question 14.3:**

Carbon, silicon and germanium have four valence electrons each. These are characterised by valence and conduction bands separated by energy band gap respectively equal to  $(E_g)_C$ ,  $(E_g)_{Si}$  and  $(E_g)_{Ge}$ . Which of the following statements is true?

- (a)**  $(E_g)_{Si} < (E_g)_{Ge} < (E_g)_C$
- (b)**  $(E_g)_C < (E_g)_{Ge} > (E_g)_{Si}$
- (c)**  $(E_g)_C > (E_g)_{Si} > (E_g)_{Ge}$
- (d)**  $(E_g)_C = (E_g)_{Si} = (E_g)_{Ge}$

Answer

The correct statement is **(c)**.

Of the three given elements, the energy band gap of carbon is the maximum and that of germanium is the least.

The energy band gap of these elements are related as:  $(E_g)_C > (E_g)_{Si} > (E_g)_{Ge}$

**Question 14.4:**

In an unbiased p-n junction, holes diffuse from the p-region to n-region because

- (a) free electrons in the n-region attract them.
- (b) they move across the junction by the potential difference.
- (c) hole concentration in p-region is more as compared to n-region.
- (d) All the above.

Answer

The correct statement is (c).

The diffusion of charge carriers across a junction takes place from the region of higher concentration to the region of lower concentration. In this case, the p-region has greater concentration of holes than the n-region. Hence, in an unbiased p-n junction, holes diffuse from the p-region to the n-region.

**Question 14.5:**

When a forward bias is applied to a p-n junction, it

- (a) raises the potential barrier.
- (b) reduces the majority carrier current to zero.
- (c) lowers the potential barrier.
- (d) None of the above.

Answer

The correct statement is (c).

When a forward bias is applied to a p-n junction, it lowers the value of potential barrier. In the case of a forward bias, the potential barrier opposes the applied voltage. Hence, the potential barrier across the junction gets reduced.

**Question 14.6:**

For transistor action, which of the following statements are correct:

- (a) Base, emitter and collector regions should have similar size and doping concentrations.
- (b) The base region must be very thin and lightly doped.
- (c) The emitter junction is forward biased and collector junction is reverse biased.
- (d) Both the emitter junction as well as the collector junction are forward biased.

Answer

The correct statement is (b), (c).

For a transistor action, the junction must be lightly doped so that the base region is very thin. Also, the emitter junction must be forward-biased and collector junction should be reverse-biased.

**Question 14.7:**

For a transistor amplifier, the voltage gain

- (a) remains constant for all frequencies.
- (b) is high at high and low frequencies and constant in the middle frequency range.
- (c) is low at high and low frequencies and constant at mid frequencies.
- (d) None of the above.

Answer

The correct statement is (c).

The voltage gain of a transistor amplifier is constant at mid frequency range only. It is low at high and low frequencies.

**Question 14.8:**

In half-wave rectification, what is the output frequency if the input frequency is 50 Hz.

What is the output frequency of a full-wave rectifier for the same input frequency.

Answer

Input frequency = 50 Hz

For a half-wave rectifier, the output frequency is equal to the input frequency.

∴ Output frequency = 50 Hz

For a full-wave rectifier, the output frequency is twice the input frequency.

∴ Output frequency =  $2 \times 50 = 100$  Hz

**Question 14.9:**

For a CE-transistor amplifier, the audio signal voltage across the collector resistance of  $2\text{ k}\Omega$  is  $2\text{ V}$ . Suppose the current amplification factor of the transistor is  $100$ , find the input signal voltage and base current, if the base resistance is  $1\text{ k}\Omega$ .

Answer

Collector resistance,  $R_C = 2\text{ k}\Omega = 2000\ \Omega$

Audio signal voltage across the collector resistance,  $V = 2\text{ V}$

Current amplification factor of the transistor,  $\beta = 100$

Base resistance,  $R_B = 1\text{ k}\Omega = 1000\ \Omega$

Input signal voltage =  $V_i$

Base current =  $I_B$

We have the amplification relation as:

$$\text{Voltage amplification} = \frac{V}{V_i} = \beta \frac{R_C}{R_B}$$

$$V_i = \frac{V}{\beta} \frac{R_B}{R_C}$$

$$= \frac{2 \times 1000}{100 \times 2000} = 0.01\text{ V}$$

Therefore, the input signal voltage of the amplifier is  $0.01\text{ V}$ .

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