Saitechinfo NEET JEE Academy

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SEMICONDUCTORS

Class 12 - Physics

Time Allowed: 1 hour and 30 minutes **Maximum Marks: 45**

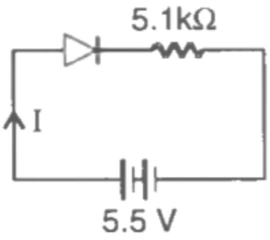
1. When we apply reverse bias to a junction diode it **[1]**

   a) lowers the potential barrier
   b) raises the potential barrier
   c) increases the minority carrier current
   d) increases the majority carrier current

2. Ge is doped with As. Due to doping, **[1]**

   a) the number of conduction electrons increases.
   b) the number of conduction electrons decreases.
   c) the number of holes increases.
   d) the structure of Ge lattice is distorted.

3. A p-n junction diode is connected to a battery of emf 5.5 V and external resistance 5.1 kΩ. The barrier potential in the diode is 0.4 V. The current in the circuit is: **[1]**



   a) 1 mA
   b) 1.08 mA
   c) 0.08 mA
   d) 1 A

4. A semiconductor is damaged by a strong current, because of **[1]**

   a) excess of electrons
   b) lack of free electrons
   c) Increase of free electrons
   d) decrease in electrons

5. Holes are charge carriers in **[1]**

   a) intrinsic and p-type semiconductors
   b) n-type semiconductor
   c) intrinsic semiconductor only
   d) p-type semiconductor only

6. Give reasons for the following: **[3]**

   i. The Zener diode is fabricated by heavily doping both the p- and n-sides of the junction.
   ii. A photodiode, when used as a detector of optical signals is operated under reverse bias.
   iii. The band gap of the semiconductor used for fabrication of visible LEDs must atleast be 1.8 eV.

7. When is a transistor said to be in active state? Draw a circuit diagram of p-n-p transistor and explain how it works as a transistor amplifier. Write clearly, why in the case of a transistor **[3]**

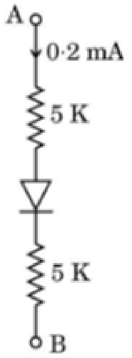
   i. the base is thin and lightly doped and
   ii. the emitter is heavily doped.

8. How is a light emitting diode fabricated? Briefly explain the basic processes involved in the emission of spontaneous radiation from it. Write two advantages of LED lamps over the incandescent low power lamps. **[3]**

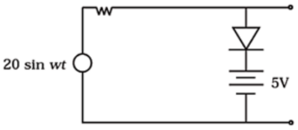
9. **[3]**
   a. Draw V-I characteristics of a p-n Junction diode.
   b. Differentiate between the threshold voltage and the breakdown voltage for a diode.
   c. Write the property of a junction diode which makes it suitable for rectification of ac voltages.

10. Using the concept of electron and hole current, derive an expression for the electrical conductivity of a semiconductor. **[3]**

11. **[5]**
   i. Draw the circuit diagram used to study I - V characteristics of a p-n junction diode in conducting mode. Mark on the graph the threshold voltage of the diode. Explain the significance of this voltage.
   ii. In the circuit shown in the figure, the forward voltage drop across the diode is 0.3 V. Find the voltage difference between A and B.



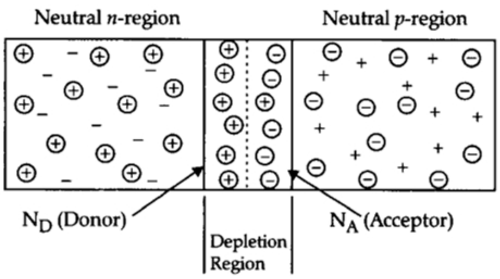
12. Assuming the ideal diode, draw the output waveform for the circuit given in the given Figure. Explain the waveform. **[5]**



13. An n-p-n transistor in a common-emitter mode is used as a simple voltage-amplifier with a collector current of 4 mA. The terminal of an 8-V battery is connected to the collector through a load-resistance R_L and to the base through a resistance R_B. The collector-emitter voltage V_{CE} = 4 V, the base-emitter voltage V_{BE} = 0.6 V and the current amplification factor β_{dc} = 100. Calculate the values of R_L and R_B. **[5]**

14. **[5]**
   i. Explain with the help of a diagram the formation of depletion region and barrier potential in a p-n junction.
   ii. Draw the circuit diagram of a half-wave rectifier and explain its working.

15. **Read the text carefully and answer the questions:** **[5]**

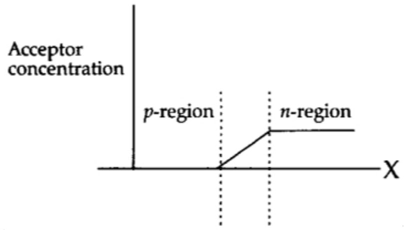


The donor concentration is high at n side and acceptor concentration is high at p-side. There is no acceptor concentration at n-side and no donor concentration at p-side.

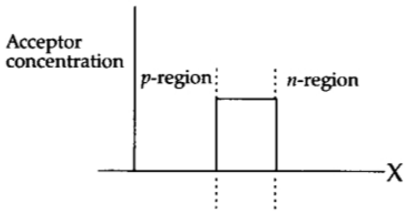
For simplicity, let us assume that there is no hole concentration in n-side and no electron concentration in p-side. After diffusion and drift of electrons and holes, depletion region is formed around the junction where there is no free charge. There are only immobile ions: +ve ions in n-side and -ve ions in p-side.

(a) Which of the following figure properly depicts the acceptor concentration?

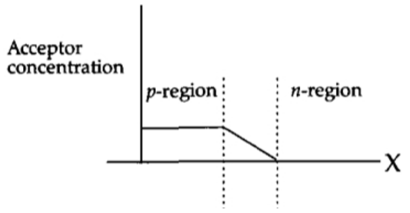
a)



b)



c)



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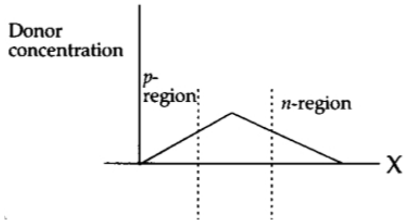
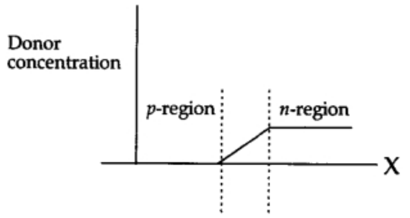


(b) Which of the following figure properly depicts the donor concentration?

a)



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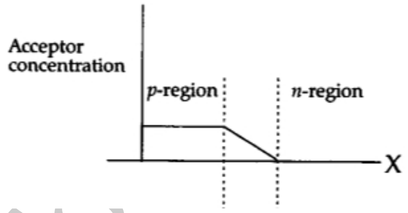

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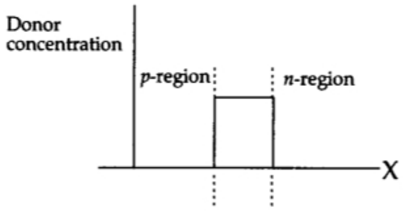

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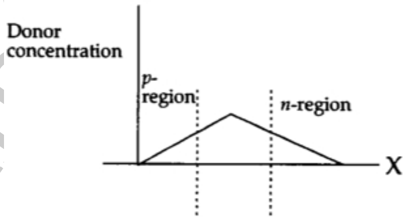
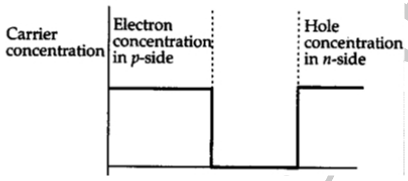
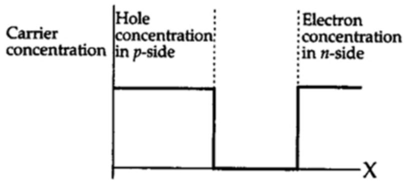


(c) Which following figure properly depicts the carrier concentration?

a)



b)



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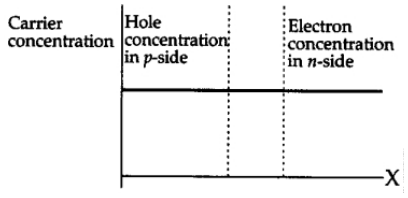

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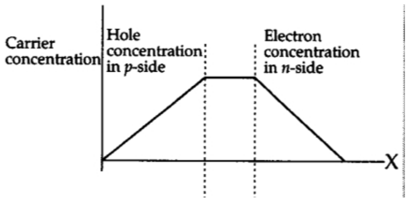
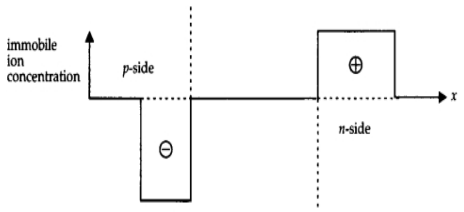
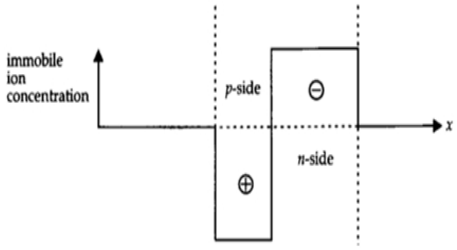


(d) Which following figure properly depicts the immobile charge concentration in depletion region?

a)

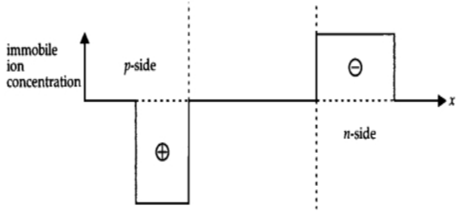


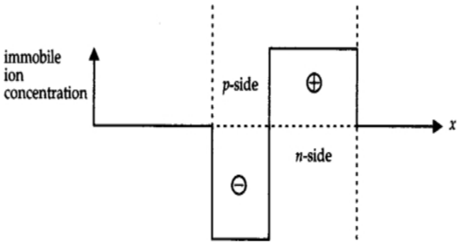
b)



c)

d)





(e) The depletion region

a) Will never change for any type of bias

b) Will reduce when the p-n junction is reverse biased

c) Will increase when the p-n junction is forward biased

d) Both Will reduce when the p-n junction is reverse biased and Will increase when the p-n junction is forward biased.