INDIAN SCHOOL AL WADI AL KABIR		
CLASS: XII	**DEPARTMENT: SCIENCE (2024-25)** **SUBJECT: PHYSICS**	**DATE: 15/11/2024**
WORKSHEET NO: 09	**TOPIC: SEMICONDUCTORS**	**NOTE: A4 FILE FORMAT**
CLASS & SEC:	**NAME OF THE STUDENT:**	**ROLL NO.**

Multiple choice questions:

1. The conduction band in a solid is partially filled at 0 K. The solid sample is
   (a) conductor (b) semiconductor (c) insulator (d) none of these
   [a]
2. In intrinsic semiconductor at room temperature, the number of electrons and holes are
   (a) equal (b) zero (c)unequal (d) infinite
   [a]
3. The forbidden energy band gap in conductors, semiconductors and insulators are E_{G1}, E_{G2} and E_{G3} respectively. The relation among them is
   (a) $E_{G1} = E_{G2} = E_{G3}$ (b) $E_{G1} > B_{G2} > E_{G3}$
   (c) $E_{G1} < E_{G2} < E_{G3}$ (d) $E_{GI} < E_{G2} > E_{G3}$
   [c]

4. n-type semiconductor is obtained when
   (a) germanium is doped with arsenic
   (b) germanium is doped with indium
   (c) germanium is doped with aluminium
   (d) silicon is doped with indium
   [a]
5. A p-type semiconductor is obtained by doping silicon with
   (a) germanium (b) gallium (c) bismuth (d) phosphorus
   [b]
6. Which type of semiconductor is obtained by mixing arsenic with silicon?
   (a) n-type (b) p-type (c) Both (d) None.
   [a]
7. The dominant mechanisms for motion of charge carriers in forward and reverse biased silicon p-n junction are
   (a) drift in forward biased, diffusion in reverse bias
   (b) diffusion in forward biased, drift in reverse bias
   (c) diffusion in both forward and reverse bias
   (d) drift in both forward and reverse bias
   [b]
8. The electrical resistance of depletion layer is large because
   (a) it has no charge carriers (b) it has few holes as charge carriers
   (c) it contains few electrons as charge carriers (d) it contains few ions as charge carriers
   [a]

9. What is the current in the circuit shown in Fig

(a) 10^{-2} A (b) 10 A (c) 1A (d) zero
[d]

2 marks questions

10. What is doping?

Ans. Doping is a process of deliberate addition of a desirable impurity in a pure semiconductor to modify its properties in a controlled manner.

11. Why doping is done in semiconductor?

Ans. To increase the number of mobile electrons/holes and hence to increase the conductivity.

12. The forbidden energy gap of germanium is 0.72 eV. What do you understand by it?

Ans. It states that if an energy of 0.72 eV is given to an electron in the valence band of germanium it will jump to the conduction band, crossing an energy gap of 0.72 eV.

13. Why do Ge and Si are semiconductors?

Ans. In the energy band diagram of Ge and Si. The energy gap is 0.72 eV and 1.1 eV respectively between conduction band and valence band. As a result of it, they behave as semiconductor.

14. Is Ohm's law obeyed in semiconductors or not?

Ans. In semiconductors, Ohms law is obeyed only for low electric field (less than 10^6 Vm).

15. Out of electron and hole, which one has higher mobility and why?

Ans. Electron has higher mobility than the hole because electron needs less energy to move in a semiconductor.

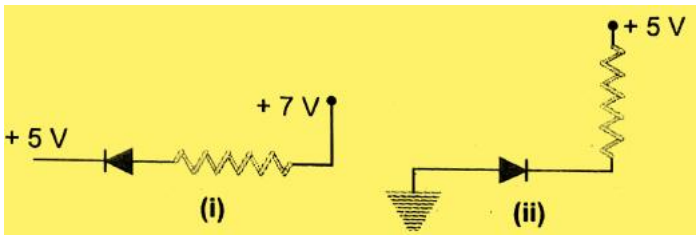
16. How does the forbidden energy gap of an intrinsic semiconductor vary with the increase in temperature

Ans. The energy gap of an intrinsic semiconductor does not change with the increase in temperature.

17. What happens when a forward bias is applied to a p-n junction?

Ans. The size of the depletion layer decreases. The resistance becomes low. The movement of the majority carriers takes place across the junction, resulting current, known as forward current which increases rapidly with increase in forward voltage.

18. In the following circuits, Fig. which one of the two diodes is forward biased and which is reverse biased?

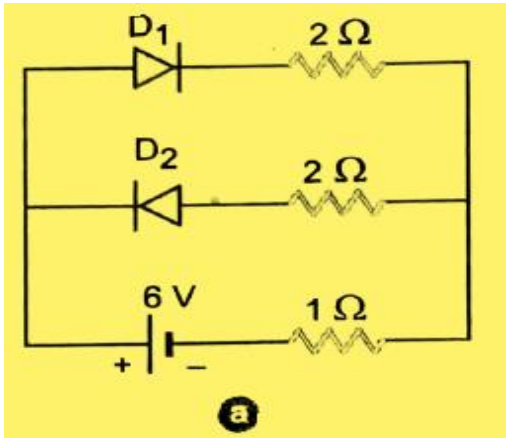


Ans. (i) p-n junction is forward biased
(ii) p-n junction is reverse biased

19. What is an ideal junction diode?

Ans. An ideal junction diode is one which acts as a perfect conductor when forward biased and perfect insulator when reverse biased.

20. For the circuit shown in Fig, find the current flowing through the 1Ω resistor. Assume that the two diode are ideal diodes.



Ans- Here, diode D_2, is reverse biased, it offers infinite resistance.

$I = \frac{6}{(2+1)} = 2$ A.

3 marks questions

21. State the principle of working of P-N diode as a rectifier. Explain, with the help of a circuit diagram, the use of a PN diode as a full wave rectifier. Draw a sketch of the input and output waveforms

22. Explain with the help of a circuit diagram, the use of a diode as a half wave rectifier.
23. [i] With the help of a diagram, distinguish between forward and reverse biasing of a diode[ii] Draw V-I characteristics of a pn junction diode in [a] forward [b] reverse biased
24. Explain the formation of depletion layer and barrier potential in pn junction diode and define knee voltage, potential barrier

Assertion Reason type questions

1. Assertion: The resistivity of a semiconductor increases with temperature.
   Reason: The atoms of a semiconductor vibrate with larger amplitude at higher temperature thereby increasing its resistivity,
   Ans. If both A and R are false.
2. Assertion: The number of electrons in a p-type silicon semiconductor is less than the number of electrons in a pure silicon semiconductor at room temperature.
   Reason: It is due to the law of mass action.

Ans. If both A and R are true and R is the correct explanation of A

Case Study question

Read the Case Study given below and answer the questions that follow:

Consider a thin p-type silicon (p-Si) semiconductor wafer. By adding precisely, a small quantity of pentavalent impurity, part of the p-Si wafer can be converted into n-Si. There are several processes by which a semiconductor can be formed. The wafer now contains p-region and n-region and a metallurgical junction between p-, and n- region. Two important processes occur during the formation of a p-n junction: diffusion and drift. We know that in an n-type semiconductor, the concentration of electrons (number of electrons per

unit volume) is more compared to the concentration of holes. Similarly, in a p-type semiconductor, the concentration of holes is more than the concentration of electrons. During the formation of p-n junction, and due to the concentration gradient across p-, and n- sides, holes diffuse from p-side to n-side (p → n) and electrons diffuse from n-side to p-side (n → p). This motion of charge carries gives rise to diffusion current across the junction.

I. How can a p-type semiconductor be converted into n- type semiconductor?
a) adding pentavalent impurity
b) adding trivalent impurity
c) not possible
d) heavy doping
Ans : a

II. Which of the following is true about n type semiconductor?
a) concentration of electrons is less than that of holes.
b) concentration of electrons is more than that of holes.
c) concentration of electrons equal to that of holes.
d) None of these
Ans:b

III. Which of the following is true about p type semiconductor?
a) concentration of electrons is less than that of holes.
b) concentration of electrons is more than that of holes.
c) concentration of electrons equal to that of holes.
d) None of these
Ans:a

lV. Which of the following is the reason about diffusion current?
a) diffusion of holes from p to n
b) diffusion of electronss from n to p
c) both (a) and (b)
d) None of these
Ans. c
OR
What are the processes that occur during formation of a p-n junction?
a) drift
b) diffusion
c) both (a) and (b)
d) None of these
Ans: c

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