QB365

Important Questions - Electronic Devices

12th Standard CBSE

Physics

Reg.No. :

Time : 01:00:00 Hrs

Total Marks : 50

Section-A

1) The conduction band in a solid is partially filled at 0 k.The solid sample is **1**

(a) Conductor (b) Semiconductor (c) Insulator (d) none of these

2) In good conductorsof electricity the type of bonding that exists is **1**

(a) ionic (b) vander waals (c) covalent (d) (d)metallic

3) In the middle of the depletion layer of a review biased $p-n$ junction,the **1**

(a) electric field is zero (b) potential is zero (c) electric field is maximum (d) potential is maximum

4) The electrical resistance of depletion layer is large because **1**

(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

5) In Boolean algebra $\overline{A}\ \overline{B}$ equals **1**

(a) A+B (b) $\overline{A+B}$ (c) A.B (d) $\overline{A}.B$

6) The gate for which outout is high,if atleast one input is low is **1**

(a) NAND (b) NOR (c) AND (d) OR

Section-B

7) What do you understand by logic gate? Why is it so called? State the types of gates. **2**

8) What do you understand by truth table and Boolean expression? **2**

9) Distinguish between electrons and holes. **2**

10) Why is the semiconductor damaged by a strong current? **2**

11) The energy gap of silicon is 1.14 eV. Find the maximum wavelength at which silicon starts energy absorption. **2**

12) Distinguish between intrinsic semiconductor and p-type semiconductor. Give reason, why a p-type semiconductor crystal is electrically neutral, although $n_h >> n_e$ **2**

Section-C

13) For transistor amplifier, the voltage gain. (a) remains constant for all frequencies (b) is high at high and low frequencies (c) is low at high and low frequencies and constant in the middle frequency rage (d) None of the above **3**

14) 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? **3**

15) The conductivity of a semiconductor increases with increase in temperature because (a) number density of three current carriers increases. (b) relaxation time increases. (c) both number density of carriers and relaxation time increase. (d) number density of current carriers increases, relaxation time decreases but effect of decreases in relaxation time is much less than increase in number density. **3**

16) Hole 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. **3**

Section-D

17) Suppose a 'n'-type wafer is created by doping Si crystal having 5×10^{28} atoms/m^3 with 1 ppm concentration of As.On the surface 200 ppm Boron is added to create $'p'$ region in this wafer. Considering $n_i = 1.5 \times 10^{16} m^{-3}$ (i) Calculate the densities of the charge carriers in the $n \& p$ regions.(ii)Comment which carriers would contribute largely for the reverse saturation current when diode is reverse biased. **5**

18) (i) Differentiate between three segments of a transistor on the basis of their size and level of doping **5**

(ii) How is a transistor biased to be in active state?

(iii) With the help of necessary circuit diagram, describe briefly how n-p-n transistor in CE configuration amplifies a small sinusoidal input voltage. Write the expression for the AC current gain.

19) Prakash finds his friend Rakesh connecting his new television set directly to a awitch board. Prakash advises Rakesh not to do so and to connect the television through a voltage stabilizer. **5**

(a) Identify the diode used in voltage regulator and give its symbol.

(b) What values dis, Prakash exhibit in the siuation described ?

20) How is a transistors biased to be in active state ? **5**

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Section-A

1) (a) Conductor **1**

2) (d) (d)metallic **1**

3) (a) electric field is zero **1**

4) (a) it has no charge carriers **1**

5) (b) $\overline{A} + \overline{B}$ **1**

6) (a) NAND **1**

Section-B

7) **2**

Logic gate. A digital circuit or electronic circuit which either allows a signal to pass through it or stops it, is called a gate. A gate which allows the signal to pass through it when some logical conditions are satisfied is called a logic gate. It means, for a logic gate there is a certain logical relationship between input and output voltages. The basic logic gates are of three types : 1. OR gate 2. AND gate and 3. NOT gate

8) **2**

Truth table. It is a table that shows all possible input combinations and the corresponding output combinations for a given logic gate. It is also called a table of combinations.

Boolean expression. It is an expression invented by George Boole which deals with logical combination of inputs and outputs for a given logic gate.

The Boolean expression for OR gate is A + B = y, indicates that y equals A OR B. Here symbol plus (+) is referred to as OR. The Boolean expression for AND gate is ; A.B = y, indicates that y equals A AND B. Here symbol dot $(\cdot)$ is referred to as AND.

The Boolean expression for NOT gate is $\bar{A} = y$, indicates that y equals NOT A or A negated. Here symbol bar over A means we change A to the alternative digit i.e. $\bar{1} = 0$ and $\bar{0} = 1$

9) **2**

(i) Electron is a negatively charged particle having charge $= 1.6 \times 10^{-19} C$. Hole is a seat having positive charge which is produced when an electron breaks away from a covalent bond in a semiconductor. Hole is having the same charge as that of electron. (ii) Energy of a hole is high as compared to that of electron. (iii) The mobility of a hole is smaller than that of electron.

10) **2**

When a strong current is passed through a semiconductor, it heats up the semiconductor. Due to it, the large number of covalent bonds breakup in semiconductor, resulting large number of charge carriers. As a result of it, the material starts behaving as a conductor. At this stage, the semiconductor losses the property of low conduction, hence it is said to be damaged.

11) Here,$E = 1.14 \quad eV = 1.14 \times 1.6 \times 10^{-19} \quad J$ **2**

$\lambda = \frac{hc}{E} = \frac{6.62 \times 10^{-34} \times 3 \times 10^{8}}{1.6 \times 10^{-19} \times 1.14} = 10,888 A^{\circ}$

12) **2**

In a pure semiconductors (Ge or Si) called intrinsic semiconductor the electrically conductivity is related by the electrons thermally excited from the valence band to the conduction band. There are equal number densities of free electrons and holes in conduction band and valence band of intrinsic semiconductor.

When a pure semiconductor of Ge or Si is doped with impurity atoms of valence three (like B or A1), some additional energy levels are created just above the upper energy level of valence band. Due to it, band gap of p-type semiconductor becomes smaller than intrinsic semiconductor. Also in p-type semiconductor, the number density of holes is more than that of electrons.

A p-type semiconductor is obtained when a trivalent atoms (Bor A1) are doped in pure semiconductor of Ge or Si. Here each doped trivalent atom shares its three valence electrons with the three atoms of Ge or Si and form bonds. While the fourth bond remains unbounded. Due to it, a hole is created. Since the impurity atoms and atoms of semiconductor are electrically neutral, hence p-type semiconductor is also neutral.

Section-C

13) (c) **3**

14) **3**

Give input frequency =50 Hz Output frequency For Half wave rectifier=50 Hz For full wave rectifier=50x2 =100 Hz

15) (d) n increases, τ decreases but decrease in τ is much less than increase in n . **3**

16) (b) (Knowledge based question) **3**

Section-D

17) **5**

(i)When As is implanted in Si-crystal,n-type wafer is created.The no of majority carrier electrons due to doping of As is

$$n_e = N_D = \frac{1}{10^6} * 5 * 10^{28} = 5 * 10^{22}/m^{-3}$$

No of minority carriers (holes) in $n-$type wafer is

$$n_h = \frac{n_1^2}{n_e} = \frac{(1.5*10^{16})^2}{5*10^{22}} = 0.45 * 10^{10}/m^3$$

when B is implanted in Si-crystal p-type wafer is created with no of holes

$$n_h = N_A = \frac{200}{10^6} * (5 * 10^{28}) = 1 * 10^{25}/m^3$$

Minority carriers (electrons) created in p-type wafer is

$$n_e = \frac{n_1^2}{n_h} = \frac{(1.5*10^{16})^2}{1*10^{25}} = 2.25 * 10^{10}/m^3$$

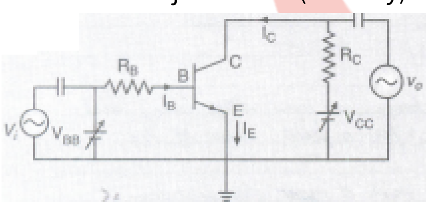
When $p-n$junction is reverse biased,the minority carrier holes of $n-$region wafer $(n_h = 0.45 * 10^{10}/m^3)$ would contributte more to the reverse saturation current than minority carrier than minority carrier electrons $(n_e = 2.25 * 10^7/m^3)$

18) **5**

(a) Emitter: It is of moderate size and heavily doped

Base: It is very thin and lightly doped Collector : It is moderately doped and larger in size.

(b) Transistor is said to be in active state when its emitter-base junction is (suitably) forward biased and base-collector junction is (suitably) reverse biased.



(c)When a small sinusoidal voltage is superposed on the dc base biased, the base current will have sinusoidal variation superimposed on the value of I_E .As a consequence, the collector current also will have sinusoidal variations, superimposed on the

Value of I_C, producing corresponding (amplified) changes in the value of V_0.

ac current gain,$\beta_{ac} = \left(\frac{\Delta I_C}{\Delta I_B}\right)_{V_{CB}}$

19) (a) Zener diode. **5**

(b) Helpful and concerned, practical application of theoretical knowledge.

20) **5**

Transistor is said to be in active active state when its emitter-base junction is forward biased and base-collector junction is reverse biased.