PHYSICS

BOOKS - CP SINGH PHYSICS (HINGLISH)

SEMICONDUCTORS

Example

1. Pure Si at 300 K has equal electron (n_e) and hole (n_h) concentrations of $1.5 \times 10^{16} m^{-3}$

doping by indium increases n_h to $4.5 \times 10^{22} m^{-3}$. Caculate n_e in the doped Si-

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2. Determine the number of density of donor atoms which have to be added to an intrisic germanium semiconductor to produce an n-type semiconductor of conductivity $5 mho / cm$. Given that the mobility of electrons in n-type semiconductor is $3850 cm^2 / vo < - \text{sec.}$

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3. The concertration of hole-electron pairs in pire silicon at $T = 300K$ is 7×10^{15} per cubic metre. Antimoy is doped into silicon in a proportion of 1 arom in 10^7 atoms. Assuming that half of the inpurity atoms contribute electrons in the conduction band, calculate the factor electrons in the conduction band, calculate the factor by which the number of charge carriers increase due to doping. the number of silicon atoms per cubic meter is 5×10^{28}.

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4. The energy gap of pure Si is $1.1eV$ The mobilities of electrons and holes are respectively $0.135m^2V^{-1}s^{-1}$ and $0.048m^2V^{-1}s^{-1}$ and can be taken as independent of temperature. The intrinsic carrier concentration is given by $n_i = n_0e^{-Eg/2kT}$.

Where n_0 is a constant, E_g The gap width and k The Boltmann's constant whose vaue is

$1.38 \times 10^{-23} JK^{-1}$ The ratio of the electrical conductivities of Si at $600K$ and $300K$ is.

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5. Find the current produced at room temperature in a pure germanium plate of area $2 \times 10^{-4} m^2$ and of thickness $1.2 \times 10^{-3} m$ when a potential of $5V$ is applied across the faces. Concentration of carries in germanium at room temperature is 1.6×10^{6} per cubic metre. The mobilities of electrons and holes are $0.4 m^2 V^{-1} s^{-1}$ and $0.2 m^2 V^{-1} s^{-1}$ respectively. The heat energy generated in the plate in 100 second is.

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6. If resistivity of pure silicon is $3000 \Omega meter$, and the electron and hole mobilities are $0.12 m^2 V^{-1} s^{-1}$ and $0.045 m^2 V^{-1} s^{-1}$ respectively, determine the resistivity of a specimen of the material when 10^{19} atoms of phosphorous are added per m^3 are also added. Given charge on electron $= 1.6x10^{-19}C$.

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7. (a) Find the conductivity of intrinsic silon at $300K$. It is given that n_i at $300K$ in silicon is $1.5x10^{10} / cm$^(3) and the mobilities of electrons and holes in silicion are $1300cm^2 / V - \sec$ and $500cm^2 / V - \sec$ respectively.

(b) if donor type impurity is added to the extent of 1 impurity atom in 10^8 sillicon atoms, find the conductivity.

(c) if acceptor inpurity is added to the extent of 1 impurity atom in 10^8 silicon atoms,find the conductivuity.

Given: number of $a \rightarrow ms / m^3$ for $Si = 5 \times 10^{28}$

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8. A N-type silicon sample of width $4 \times 10^{-3} m$, thickness and length $6 \times 10^{-2} m$

carriers a current of $4.8mA$, when the voltage is applied across the length of the sample. The free electron density is $10^{22}m^{-3}$

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9. A potential barrier of $0.3V$ exists across a $p-n$ junction.

(a) if the depletion region is $1\mu m$ width. What is the intensity of elctric field in this region ?

(b) An electron with speed $5 \times 10^5 m/\sec$

approaches this $p-n$ junction from n-side, what will be its speed on entering the p-side?

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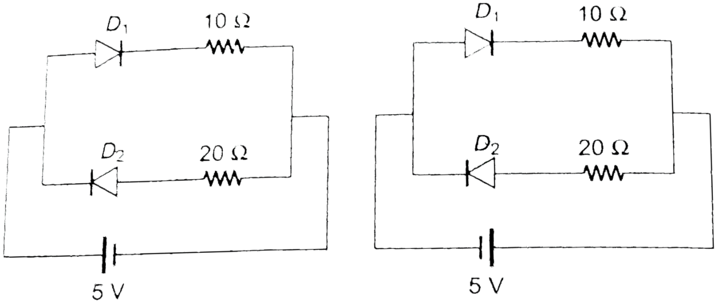
10. In the following problems, assume that the resistance of each diode is zero in forward bias and infinity in reverse bias .

(a) Find the current supplied by the battery in the following cases. (b) Find the currents through the resistance in the circuits shown in the figures.

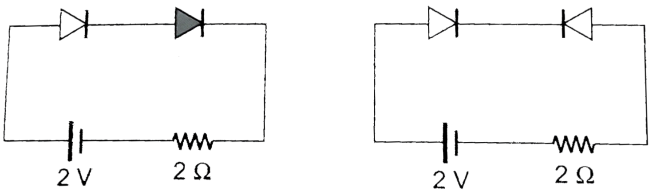
(c) Find the current through the battery in each of the circuits shown in the figures.

(d) Find the equivalent resistance of the network shown in the figure between the points A and B.

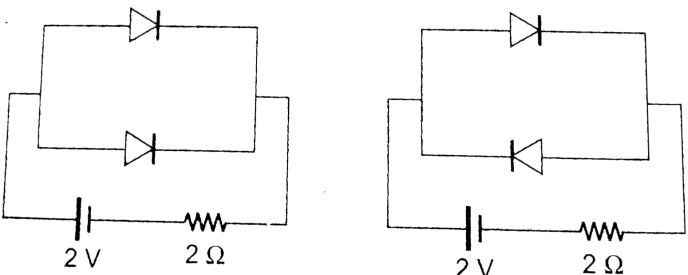


(i) (ii)

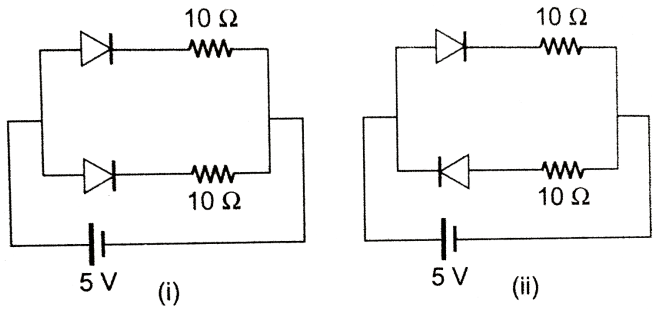
(b) Find the currents through the resistances in the circuits shown in the figures.

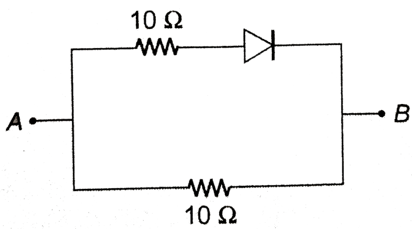


(i) (ii)



(iii) (iv)





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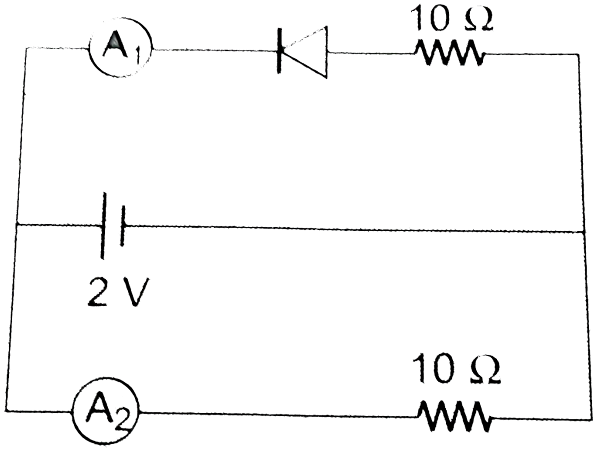
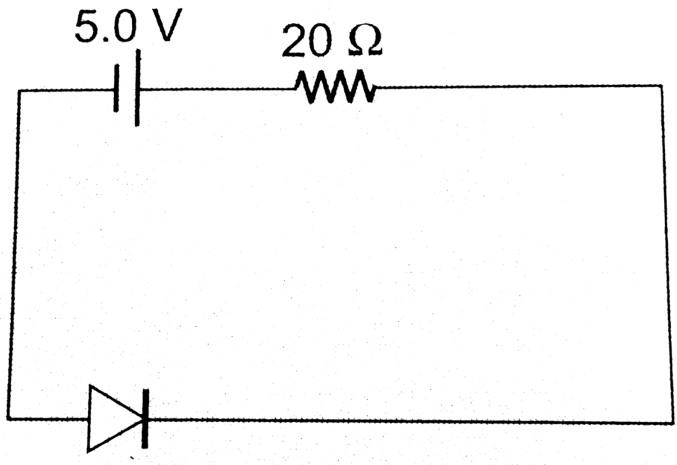
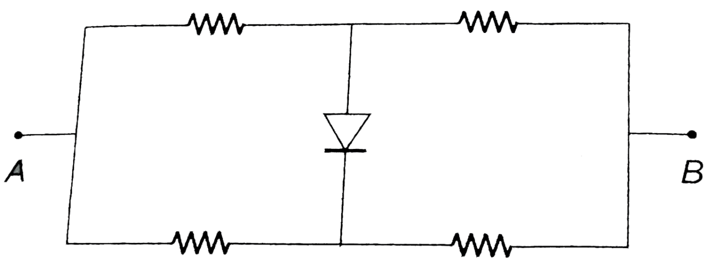
11. (a) What are the readings of the ammeters A_1 and A_2 shown in the figure.neglect the resistance of the meters.

(b) Calculate the current through the circuit and the potential difference across the diode shown in the figure. The drift current fo the diode is $20 \mu A$.

(c) Each of the resistances shown in the figure has a value of 20Ω. find the equivalent resistance between A and B. Does it depend on whether the point A or B is at higher potential?







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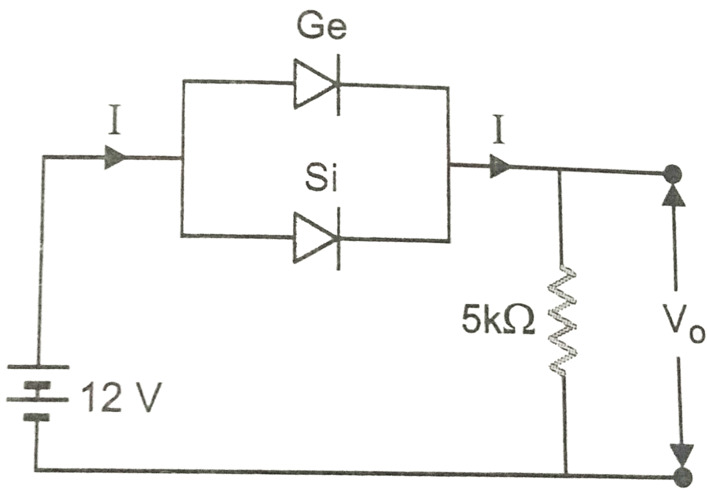
12. (i) calculate the value of output voltage V_0 and current I if silicon diode and germanium diode conduct at $0.7V$ and $0.3V$ respectively.

Fig.



(ii) If now germanium diode is cinnected to

$12V$ in reverse polarity, find new values of V_0 and I.

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13. A silicon diode is connected to a load resistance R_L as shown in the figure. If $V_{\in} = 15V$ and $R_L = 10k\Omega$

(a) If barrier voltage, $V_B = 0.7V$ then calculate

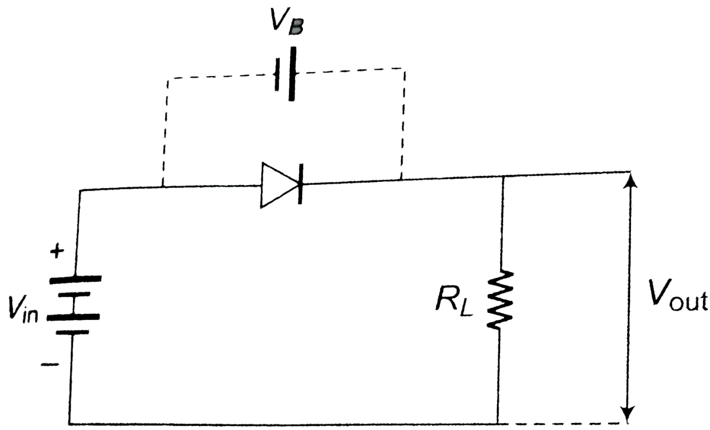
(i) output voltage across R_L

(ii) current in diode and ltbRgt (iii) forward resistance.

(b) If diode is assumed ideal, then what will be

(i) output voltage and

(ii) output current in diode?



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14. The energy of a photon of sodium light $(\lambda = 589nm)$equal the band gap of a semiconducting material.(a)Find the minimum energy E requried to create a hole-electron pair.(b)Find the value of E/kTat a temperature of 300K.

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15. A p-type semoconductor has acceptor levels $57meV$above the valence band. Find the maximum wavelength of light which can create a hole.

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16. In a $n-p-n$ transistor 10^{10} electrons enter the emitter in $10^{-6}s$. 2% of the elecrons are lost in the base. The current transfer ratio and the current amplification factor will be

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17. A change of $8.0mA$ in the emitter current brings a change of $7.9mA$ in the collector current. How much change in the base current is required to have the same change $7.9mA$ in the collector current?Find the values of (α) and (β).

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18. A$p-n-p$ transistor is used in common-emitter mode in an amplifier circuuit. A change of $40\mu A$ in the base current brings a change

of $2mA$ in collector current and $0.04V$ in base-emitter volatage. Find the

(a) input resistance r_i and

(b) the base current amplification factor (β).

(c) if a load of $6k\Omega$ is used, then also find the voltage gain of the amplifier.

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19. A transistor is used in common-emitter mode in an amplifier circuit. When a signal 20mV is added to the base-emmiter voltage,the base current changes by $20(\mu)A$ and the collector current changes by 2mA.The load resistance is $5k(\Omega)$.Calculate (a)the factor (β)(b)the input resistance R_{BE}, (c) the transconductance and (d) the voltage gain .

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20. A load resistor of $2k\Omega$is connected in the collector branch of an amplifier circuit using a transistor in common-emitter mode.The current gain$\beta - 50$.The input resistance of the transistor is $0.50 k\Omega$. If the input current is changed by $50 \mu A$,(a)by what amount soes the output voltage change by ,(b)by what amount does the input voltage change and (c) what is the power gain ?

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21. A transistor is connected in a common emitter configuration.

The collector supply is 8 V and the voltage drop across a resistor of 800Ω in the collector circuit is 0.5 V. If the current gain factor (α) is 0.96 , Find the base current.

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22. An $n-p-n$ transistor is connected in common emiter configuration in which collector supply is $8V$ and the boltage drop across the load resestance of 800Ω connected in the collector circuit is $0.8V$. If current gain factor is $(25/26)$, determine the collector -

emitter voltage and base current. if the internal resistance of the transistor is 200Ω. calculate the voltage gain and power gain.

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23. 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 positive terminal of a 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 $V_{CE} = 4V$, the base - emitter voltage $V_{BE} = 0.6V$ and the current amplification factor $\beta = 100$. Calculate the values of R_L and R_B .

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24. Write down truth tables for

(a) $X = A.\overline{B} + \overline{A}.B$

(b) $X = (A + B) + \overline{A.B}$

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25. Let $X = A\overline{BC} + B\overline{CA} + C\overline{AB}$.Evalute X

for

(a)$A = 1, B = 0, C = 1$

(b)$A = B = C = 1$

$A = B = C = 0$

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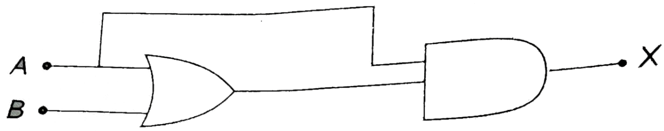
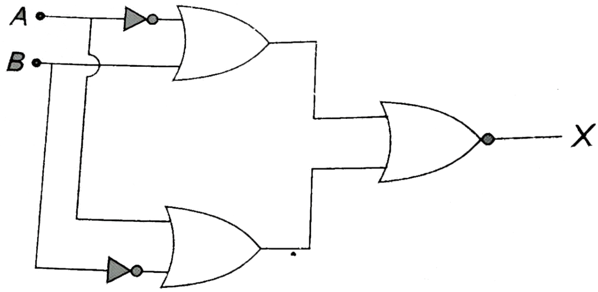
26. Construct truth table for the function X of

A and B as shown in the figure.

(a)



(b)



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Exercises

1. Which of the followin is correct regarding band theroy of solids?

A. The energy bands which are completely filled at $0K$ are called valence bands. The bands with higher energies are called conduction bands

B. The difference between the highest energy in a band and the lowest energy in the next higher band is called band gap between the two bands

C. Band gap for $Si(1.1eV)$, $Ge(0.7eV)$, for insulators (about $5eV$)

D. All option are correct

Answer: D

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2. In isulators

A. The valence band is partially filled with electrons

B. the conduction band is partially filled with electrons

C. the conduction band is filled with elctrons and the valence band is empty

D. the conduction band is empty and the valence band is filled with electrons

Answer: D

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3. In an insulator, the forbidden energy gap between the valence band and conduction band is of the order of

A. $1eV$

B. $5eV$

C. $1keV$

D. $1MeV$

Answer: A

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4. In an insulator, the forbidden energy gap between the valence band and conduction band is of the order of

A. $1 MeV$

B. $0.1 MeV$

C. $1 eV$

D. $5 eV$

Answer: D

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5. A hole in a semiconductor is

A. an excess electron

B. a missing electron

C. a missing atom

D. a donor level

Answer: B

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6. Electric conduction in a semiconductor takes place due to

A. electrons only

B. holes only

C. both

D. none

Answer: C

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7. In a semiconductor,

(i)there are no free elctrons at $0K$

(ii) there are no free elctrons at any tempreture

(iii) the number of free electrons increases with tempreture

(iv) the number of free electrons is less than that in a conductor

A. $(i), (ii)$

B. $(i), (iii), (iv)$

C. $(ii), (iii)$

D. $(ii), (iv)$

Answer: B

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8. A pure semiconductor has

A. an infinite resistance at $0^\circ C$

B. `a finite resistance which does not depend upon temperature

C. a finite resistance which decrease with temperature

D. a finite resistance which increase with temperature

Answer: C

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9. when the electrical conductivity of a semiconductor is due to the breaking of its covalent bonds, then the semiconductor is said to be

A. donor

B. acceptor

C. intrinsic

D. extrinsic

Answer: C

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10. In an intrinsic semiconductor

A. only electrons are responsible for the flow of current

B. only holes are responsible for the flow of current

C. both holes and electrons carry current and their number is the same

D. both holes and electrons carry current but electrons are the majority carriers

Answer: C

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11. Let n_p and n_e, be the numbers of holes and condution electrons in an intrinsic semiconductor

A. $n_p > n_e$

B. $n_p = n_e$

C. $n_p < n_e$

D. $n_p \neq n_e$

Answer: B

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12. If tempreture is increased, the number of electron-hole pairs increased and is proportional to a factor $(\Delta E:$ band gap$)$

A. $T^{3/2}e^{-\frac{\Delta E}{2kT}}$

B. $T^{1/2}e^{-\frac{\Delta E}{2kT}}$

C. $T^{1/2}\frac{e^{\Delta E}}{2kT}$

D. $T^{3/2}e^{-\frac{\Delta E}{kT}}$

Answer: A

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13. A strip of copper and another of germanium are cooled from room tempreature to $80K$ The resistance of

A. each of them increases

B. each of them decrease

C. Cu increases and Ge decreases

D. Cu decreases and Ge increases

Answer: D

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14. An electric field us applied to a semiconductor.Let the number of charge carriers be n and the average drift speed be v.If the temperature is increased,

A. both n and v will increase

B. n will increase but v will increased

C. v will increase but v will decrease

D. both n and v will decrease

Answer: B

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15. Solids having highest energy level partially filled with electrons are

A. swmiconductor

B. conductor

C. insulator

D. none of these

Answer: B

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16. In semiconductors at a room tempreture

A. the valence band is partially empty and the conduction band is partially filled

B. the valence band is completely filled and the conduction band is partially filled

C. `the valence band is completely filled

D. the conduction band is completely empty

Answer: A

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17. The state of the energy gained by valence electrons when the temperature is raised or when electric field is applied is called as

A. valence band

B. conduction band

C. forbidden band

D. none of these

Answer: B

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18. Energy band in solids are a consequence of

A. Ohm's Law

B. Pauli's exclusion principle

C. Bohr's theory

D. Heisenberg's uncertainty principle

Answer: B

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19. Which of the following is semi-conductor?

A. Cu

B. Zn

C. Ag

D. Si

Answer: D

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20. Carbon , silicon and germanium have four valence elcectrons 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 ture ?

A. $E_g(Si) < E_g(Ge) < E_g(C)$

B. $E_g(Ge) < E_g(Si) < E_g(C)$

C. $E_g(Si) < E_g(Ge) > E_g(C)$

D. $E_g(Si) < E_g(Ge) > E_g(C)$

Answer: B

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21. Carbon , silicon and germanium have four valence electrons each . At room temperature which one of the following statements is most appropriate ?

A. The number of free conduction electrons is significant in C but small in Si and Ge

B. The number of free conduction electron is negligibly small in all the three

C. The number of free electrons for conduction is significant in all the three

D. The number of free electrons for conduction is significant only in Si and Ge but small in C

Answer: D

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22. C and Si both have same lattice structure, having 4 bonding electrons in each. However, C is insulator whereas Si is intrinsic semiconductor. This is because

A. In case of C the valence band is not completely filled at absolute zero temperature

B. in case of C the conduction band is partly filled even at absolute zero temperature

C. the four bonding electrones in the case of C lie in the second orbit, whereas in the case of Si they lie in the third

D. the four bonding electrons in the case of C lie in the third orbit, whereas for Si they lie in the fourth orbit

Answer: C

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23. The difference in the variation of resistance with temperature in a metal and a semiconductor arises essentially due to the difference in the

A. variation of scattering mechanism with tempreture

B. crystel structure

C. variation of the number of chrge carries with tempreature

D. type of bond

Answer: C

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24. The probbility of electrons to be found in the conduction band of an intrinsit semiconductor at a finile temperature

A. decrease exponentially with increasing band gap

B. increases exponentially with increasing band gap

C. decrease with increasing tempreture

D. is independent of the tempreture and the band gap

Answer: A

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25. 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. $\mu_e < 0, \mu_h > 0$

Answer: A

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26. The electrical conductivity of pure germanium can be increased by

A. $(i), (ii)$

B. (i),(iii),(iv)`

C. $(ii), (iii)$

D. all

Answer: D

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27. A semiconductor is doped with a donor impurity

A. (i),(ii)`

B. $(i), (iii)$

C. $(i), (iv)$

D. $(ii), (iv)$

Answer: C

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28. If N_P and N_e be the numbers of holes and conduction electrons in an extrinsic semiconductor, then

A. $n_p > n_e$

B. $n_p = n_{)}$€

C. $n_p < n_e$

D. $n_p \neq n_e$

Answer: D

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29. The impurity atoms with which pure silicon should be doped to make a p - type semiconductor are those of

A. (i),(ii),(iii)`

B. $(i), (iii)$

C. $(ii), (iii)$

D. all

Answer: A

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30. The impurity atoms with which pure silicon may be droped to make it a $n-type$ semiconductor are those of

(i) gallium

(ii) boron

(iii) indium

(iv) aluminium

A. (i),(ii)`

B. $(i), (iii)$

C. $(ii), (iii)$

D. all

Answer: D

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31. Choose the correct option

A. $\mu = v_d / E, \mu:$ mobility $\left(m^2 / Vs\right). v_d:$ drift speed, $E:$ Electric field

B. Conductivity of conductors, $\sigma = n_e \mu_e e$

C. Conductivity of semiconductors, $\sigma = n_e \mu_e e + n_h \mu_h e,$

D. All option are correct

Answer: D

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32. Majority carriers in a semiconductor are

A. Holes in n-type and electrons in p-type

B. holes in both n-type and p-type

C. electrons in $n$type and holes in p-type

D. electrons in both n-type and p-type

Answer: C

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33. Intrinsic semiconductor is electrically neutral. Extrinsic semiconductor having large number of current carriers would be

A. positively charged

B. negatively charged

C. posititvely charged or negatively charged depending upon the type of impurity that has been added

D. elctrically neutral

Answer: D

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34. Which of the following statements is not true?

A. the resistance of intrisic semiconductors decrease with increase of temperature

B. doping pure Si with trivalent impurities gives p-type semiconductors

C. the majority carriers in N-type semiconductors are holes

D. A PN-junction can act as a semiconductors diode

Answer: C

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35. Which statement is correct?

A. N-type germaniim is negatively charged and P-type germanium is positively charged

B. Both N-type and p-type germanium are neutral

C. N-type germanium is kpositively charged, P-type germanuim is negatively charged

D. Both N-type and P-type germanium are negatively chrged

Answer: B

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36. The valance of the impurity atom that is to be added to germanium crystal so as to make it a N-type semiconductor, is

A. 6

B. 5

C. 4

D. 3

Answer: B

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37. When N-type of semiconductor is heated

A. number of electrons increases while that of holes decrease

B. number of holes increase while that of electrons decrease

C. number of electrons and holes remains same

D. number of electrons and holes increase equally

Answer: D

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38. A N-type silicon sample of width $4 \times 10^{-3}m$, thickness and length $6 \times 10^{-2}m$ carriers a current of $4.8mA$, when the voltage is applied across the length of the sample. The free electron density is $10^{22}m^{-3}$

A. The current density is $20A/m^2$

B. The drift speed is $1.25cm/\sec$

C. The time taken by electrons to travels the full length of the sample is 4.8sec

D. All option are correct

Answer: D

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39. A semiconductor has an electron concentration of 8×10^{13} per cm^3 and a hole concentration of 5×10^{12} per cm^3. The electron mobilityis $25, 000cm^2V^{-1}\sec^{-1}$ and the hole mobility is $100 cm^2 V^{-1} \sec^{-1}$ and

the hole mobility is $100 cm^2 V^{-1} \sec^{-1}$

(i) The semiconductor is n-type

(ii) the semiconductor is p-type

(iii) the conductivity is $320 mmhocm^{-1}$

(iv) the conductivity is $80 mmhocm^{-1}$

A. $(i)(iii)$

B. $(ii), (iii)$

C. $(i), (iv)$

D. (ii),(iv)`

Answer: A

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40. A Ge specimen is dopped with Al. The concentration of acceptor atoms is ~$10^{21} atoms/m^3$. Given that the intrinsic concentration of electron hole pairs is ~$10^{19}/m^3$, the concentration of electron in the speciman is

A. $10^{17}/m^3$

B. $10^{15}/m^3$

C. $10^4/m^3$

D. $10^2 / m^3$

Answer: A

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41. Pure Si at $500K$ has equal number of electron (n_e) and hole (n_h) concentration of $1.5 \times 10^{16} m^{-3}$. Dopping by indium. Increases n_h to $4.5 \times 10^{22} m^{-3}$. The doped semiconductor is of

A. n-typpe with electron concentration

$$n_e = 2.5 \times 10^{23} m^{-3}$$

B. p-type having electron concentration

$$n_e = 5 \times 10^{9} m^{-3}$$

C. n-type with electron concentration

$$n_e = 5 \times 10^{22m^{-3}}$$

D. p-type with electron concentration

$$n_e = 2.5 \times 10^{10} m^{-3}$$

Answer: B

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42. A silicon specimen is made into a P-type semiconductor by dopping, on an average, one helium atoms per 5×10^{7} silicon atoms. If the number density of atoms in the silicon specimen is $5 \times 10^{28} atom/m^{3}$ then the number of acceptor atoms in silicon per cubic centimeter will be

A. $2.5 \times 10^{30} a \rightarrow ms/cm^{3}$

B. $1.0 \times 10^{13} a \rightarrow ms/cm^{3}$

C. $1.0 \times 10^{15} a \rightarrow ms/cm^{3}$

D. $2.5 \times 10^{36} a \rightarrow ms / cm^3$

Answer: C

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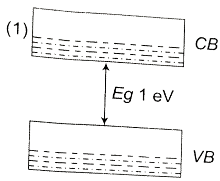
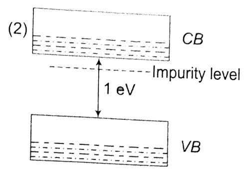
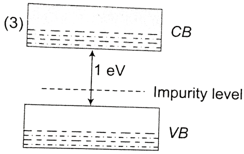
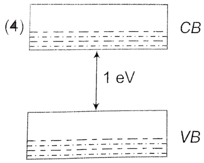
43. Which of the following energy band diagrams shows the N-type semiconductor?

A. 

B. 

C. 

D. 

Answer: B

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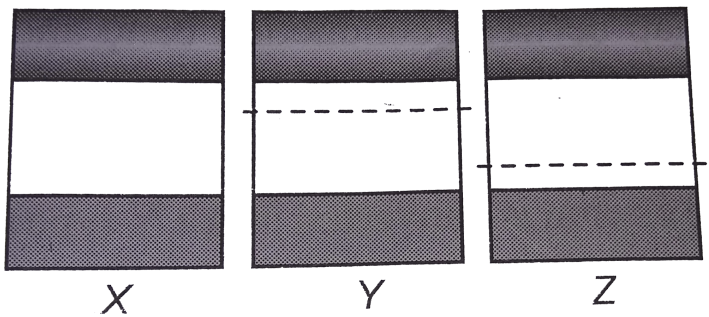
44. The energy band diagrams for three semiconductor samples of silicon are as shown. We can then assert that



A. Sample X is undoped while samples Y and Z have been doped with a third group and a fifth group impurity respectively

B. sample X is undoped while both samples Y and Z have been doped with a fifth grop impurity

C. sample X has been doped with equal amounts of third and fifth group impurities while samples Y and Z are undoped

D. sample X is undoped while samples Y and Z have been doped with a fifth group and a third impurity respectively

Answer: D

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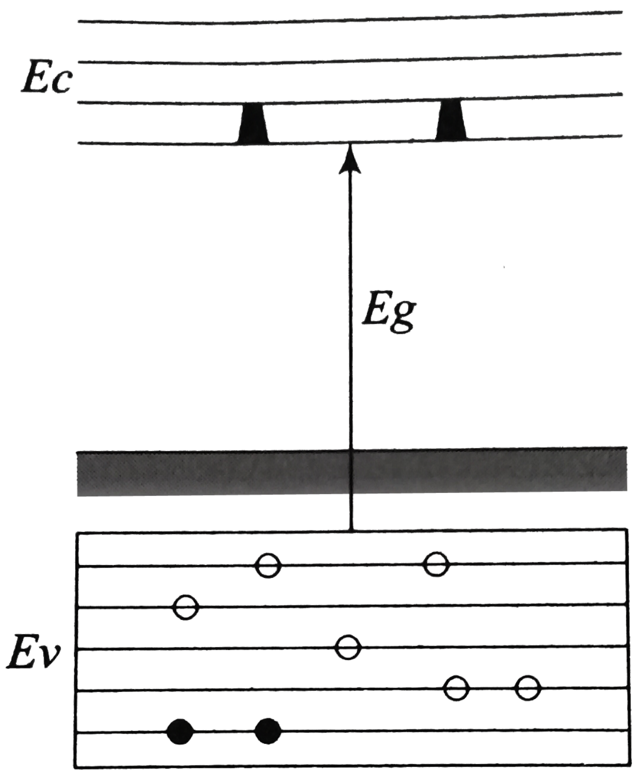
45. In the energy band diagram of a material shown below, the open circles and filled circles denote holes and electrons respectively. The material is a/an



A. a p-type semiconductor

B. an insulator

C. a metal

D. an n-type semiconductor

Answer: A

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46. The dominant mechanisms for motion of charge carriers in forward and reverse biased silicon $P-N$ junction are

A. drift in forward bias, diffusion in reverse bias

B. diffusion in forward bias, drifft in reverse bias

C. diffusion in both forward and reverse bias

D. drift in both forward and reverse bias

Answer: B

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47. A hole diffuses from the p-side to the n-side in a p-n junction.This means that

A. a bond is broken on the n-side and the electron freed from the bond jumps to the conduction band

B. a conduction electron on the p-side jumps to a broken bond to complete it

C. a bond is broken on the n-side and the electron freed from the bond jumps to a broken bond on the p-side to complete it

D. a bond is broken on the p-side and the electron freed from the bond jumps on the p-side and the electron freed from the bond jumps to a broken bond on the n-side to complete it

Answer: C

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48. In a $p-n$ junction

(i) new holes and conduction electrons are produced continously throught the material

(ii) new holes and conduction electrins are produced continuously throughout the material

(iii) Holes and condution electrons recombine continuously throughout the material

(iv) holes and conduction electrons recombine continuously throught the material exept in the depletion region

A. $(i), (ii)$

B. $(i), (iv)$

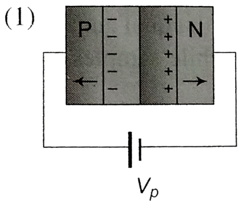
C. $(ii), (iii)$

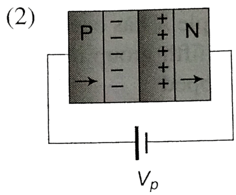
D. $(ii), (iv)$

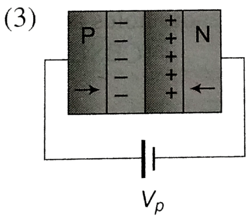
Answer: B

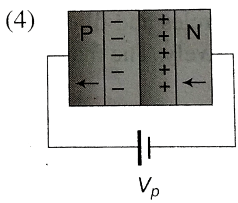
View Text Solution

49. In the case of forward biasing of PN-junction, which one of the following figures correctly depicts the direction of flow of carriers?

A. 

B. 

C. 

D. 

Answer: C

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50. To make a PN junction conducting

A. the value of forward bias should be more than the barrier potential

B. the value of forward bias should be less than the barrier potential

C. the value of reverse bias should be more than the barrier potential

D. the value of reverse bias should be less than barrier potential

Answer: A

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51. A potential barrier of $0.50V$ exists across a $P-N$ junction. If the depletion region is

$5.0 \times 10^{-7} m,$ wide the intensity of the electric field in this region is

A. $1.0 \times 10^{6} V / m$

B. $1.0 \times 10^{5} V / m$

C. $2.0 \times 10^{5} V / m$

D. $2.0 \times 10^{6} V / m$

Answer: A

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52. The reverse biasing in a PN junction diode

A. decrease the potential barrier

B. increases the potential barrier

C. increases the number of minority charge carriers

D. increase the number of majority charge carriers

Answer: B

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53. The cause of the potential barrier in a P_N diode is

A. depletion of positive charge near the the junction

B. concentration of positive charges near the junction

C. depletion of negarive charges near the junction

D. concentration of positive and negative charges near the junction

Answer: D

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54. The potential barrier, in the depletion layer, is due to

A. ions

B. holes

C. electrons

D. both (2) and (3)

Answer: A

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55. Barrier potential of a $p-n$ junction diode does not depend on

A. tempreture

B. forward bias

C. doping density

D. diode design

Answer: D

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56. The depletion layer in $P - N$ junction region is caused by

A. drift of holes

B. diffusion of charge carriers

C. migration of impurity ions

D. drift of electrons

Answer: B

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57. In a p- n junction diode not connected to any circuit,

A. the potential is the same everywhere

B. the p-type is a higer potential than the N-type side

C. there is an electric field at the junction directed from the N-type side to the P-type side

D. there is an electric field at the junction directed from the P-type side to the N-type side

Answer: C

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58. If the two ends of a p-n junction are joined by a wire ,

A. there will not be a steady current in the circuit

B. there will be a steady current from N side to P side

C. there will be a steady current from P side to N side

D. there may not be a current depending upon the resistance of the connecting wire

Answer: A

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59. A semiconducting device is connected in a series circuit with a battery and a resistance.A current is found to pass through the circuit .If the polarity of the battery is reversed, the current drops to almost zero.The device may be

A. P-type semiconductor

B. a N-type semiconductor

C. a PN-junction

D. an intrinsic semiconductor

Answer: C

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60. The PN junction diode is used as

A. an amplifier

B. a rectifier

C. an oscillator

D. a modulator

Answer: B

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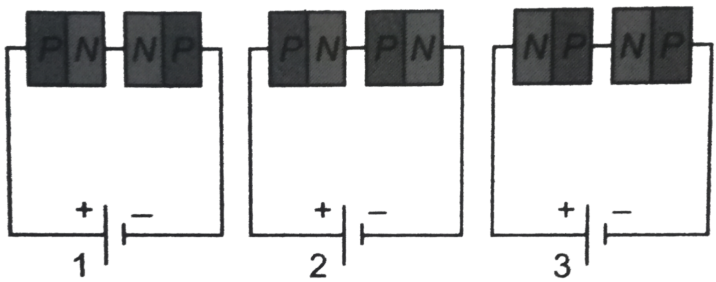
61. Two PN-junction can be connected in series by three different methods as shown in the figure. If the potential difference in the junction is the same, then the correct connection will be



A. in then circuit (1) and (2)

B. in the circuit (2) and (3)

C. in the circuit (1) and (2)

D. only in the circuit (1)

Answer: B

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62. In a $p-n$ junction photo cell, the value of the of the photo electromotive force produced by monochromatic light is proportional to

A. the voltage applied at the PN junction

B. the barrier voltage at the PN junciton

C. the intensity of the light falling on the cell

D. the frequency of the light falling on the cell

Answer: C

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63. On increases the reverse biase to a large value of in a PN- junction diode, current.

A. increase slowly

B. remains fixed

C. suddenly increases

D. decrease slowly

Answer: C

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64. In $P - N$ junction, avalanche current flows in circuit when biassing is

A. forward

B. reverse

C. zero

D. execess

Answer: D

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65. Avalanche breakdown in a PN junction diode is to

A. sudden shift to fermi level

B. increase in the width of forbidden gap

C. dudden increase of impurity concentration

D. cumulative effect of increased electron collsion and creation of added electron hole pairs

Answer: D

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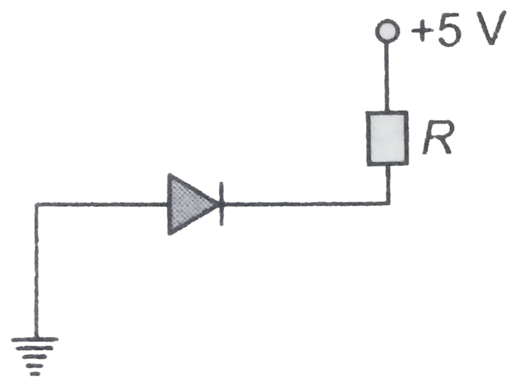
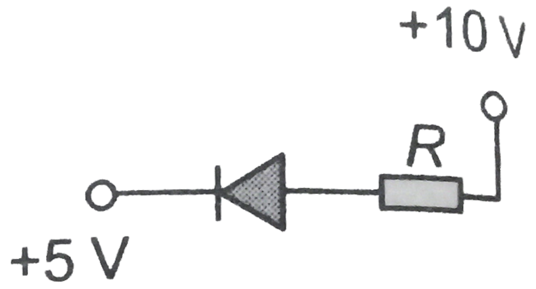
66. In the given figure, which of the diodes are forward biased?

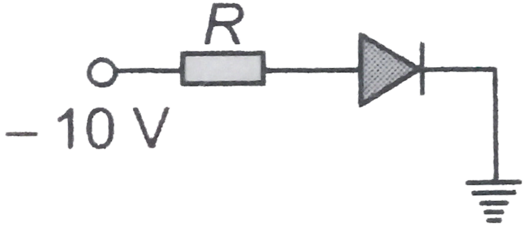
1.



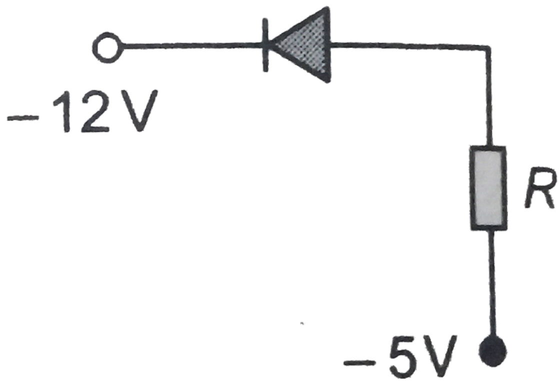
2.



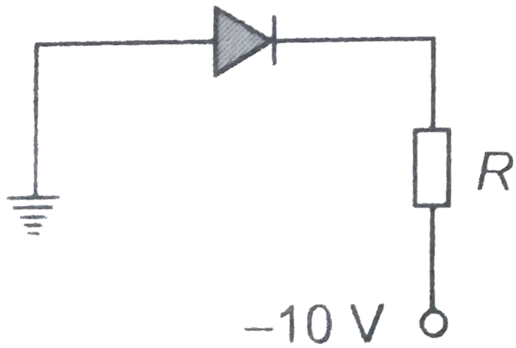
3.



4.



5.



A. A, B, C

B. B, D, E

C. A, C, D

D. B, C, D

Answer: B

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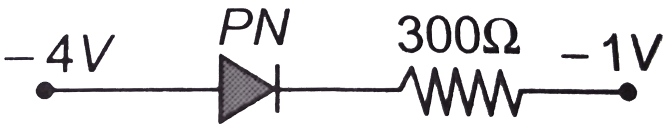
67. What is the current in the circuit shown below?



A. $0A$

B. $10^{-2}A$

C. $1A$

D. $.10A$

Answer: A

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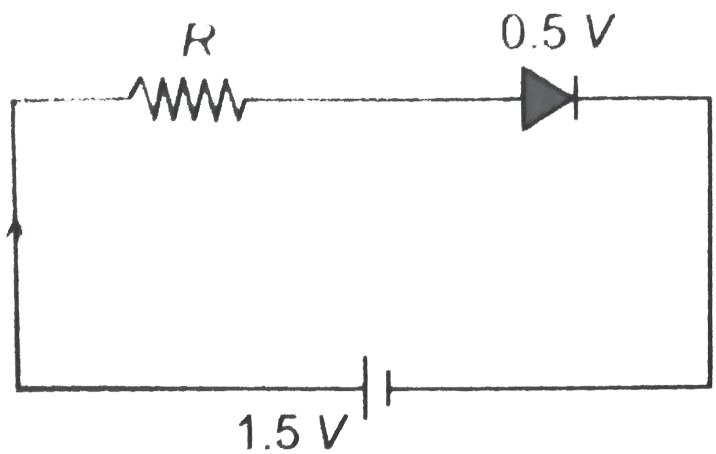
68. The diode used in the circuit shown in the figure has a constant voltage drop of $0.5V$ at all currents and a maximum power rating fo 100 milliwatts. What should be the value of the resistor R, connected in series with the diode for obtaining maximum current?



A. 1.5Ω

B. 5Ω

C. 6.67Ω

D. 200Ω

Answer: B

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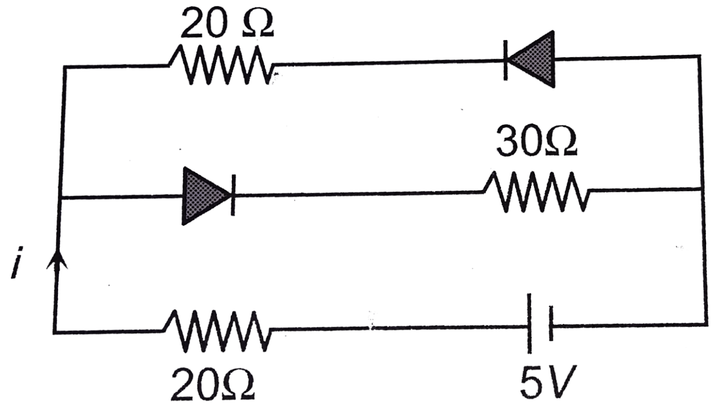
69. Current in the circuit will be



A. $\frac{5}{40} A$

B. $\frac{5}{50} A$

C. $\frac{5}{10} A$

D. $\frac{5}{20} A$

Answer: B

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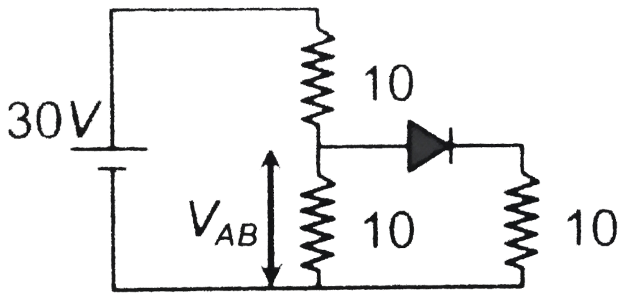
70. Find V_{AB}



A. $10V$

B. $20V$

C. $30V$

D. none of these

Answer: A

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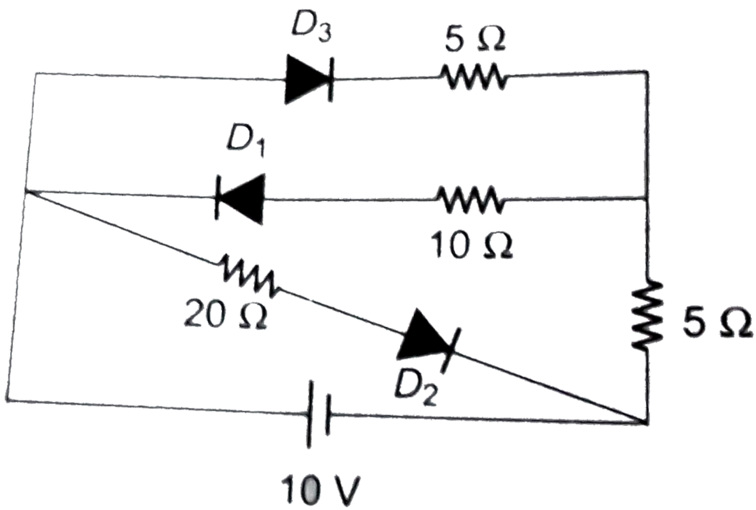
71. In the given circuit

The current through the battery is



A. $0.5A$

B. $1A$

C. $1.5A$

D. $2A$

Answer: C

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72. In a reverse biased diode, when the applied voltage changes by $1V$, the current is found to change by $0.5\mu A$. The reversebiase resistance of the diode is

A. $2 \times 10^5 \Omega$

B. $2 \times 10^6 \Omega$

C. 200Ω

D. 2Ω

Answer: B

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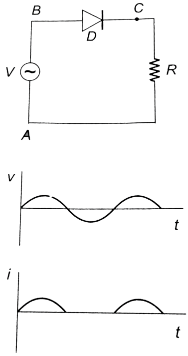
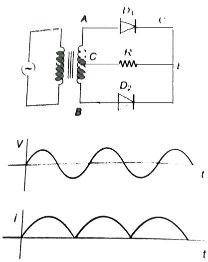
73. Which of the following is correct regarding recitficaton?

A. A rectifier is a device which converts an ac into dc. A $p-n$ junction can be used as a rectifier because it permits current in one direction only

B. Half-wave rectification can be obtain by one $p-n$ junction diode



C. Full-wave rectification can be obtained by wo diodes



D. All option are correct

Answer: D

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74. An alternating current can be converted into direct current by a

A. dynamo

B. motor

C. transformer

D. rectifier

Answer: D

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75. The peak voltage in the output of a half-wave diode rectifier fed with a sinusiodal signal without filter is $10V$. The dc component of the output voltage is

A. $10/\sqrt{2V}$

B. $10/\pi V$

C. $10V$

D. $20/\pi V$

Answer: B

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76. If a full wave reactifier circuit is operating from $50Hz$ mains, the fundamental frequency in the ripple will be

A. $50Hz$

B. $70.7Hz$

C. $100Hz$

D. $25Hz$

Answer: C

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77. The maximum effeciency of full wave rectifier is

A. 100%

B. 25.20%

C. 40.2%

D. 81.2%

Answer: D

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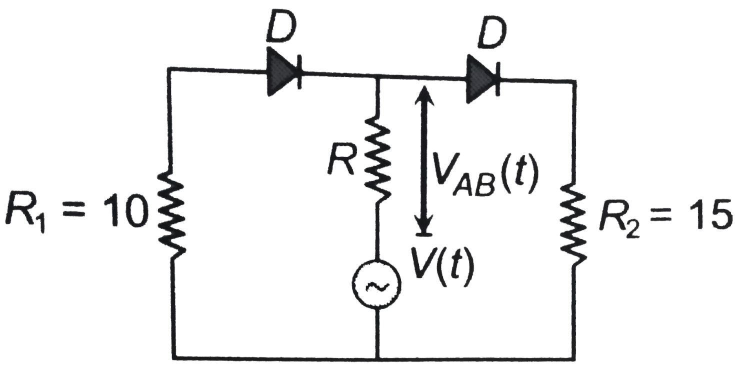
78. In the circuit given below, $V(t)$ is the sinusiodal voltage source, voltage drop $V_{AB}(t)$ across the resistance R is



A. Is half wave rectified

B. is full wave rectified

C. has the same peak value in the positive and negative half cycles

D. has different peak values during positive and negative half cycle

Answer: D

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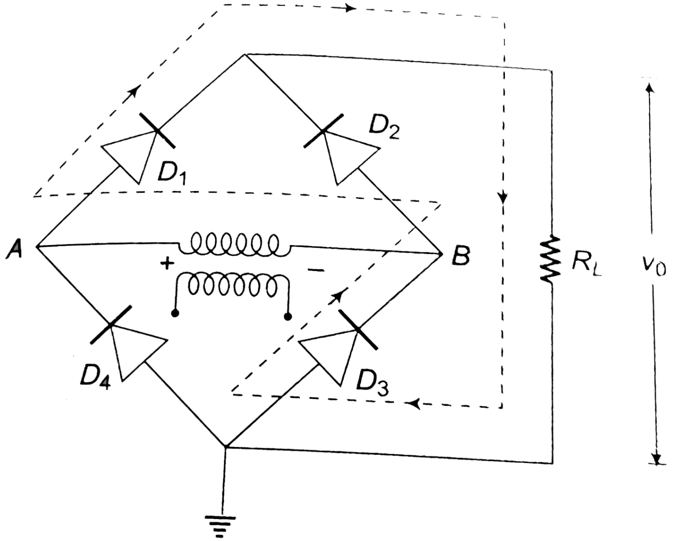
79. Which of the following is correct regarding bridge recifier?



A. when A is positive, B is negative, diodes D_1 and D_3 conducts, the conduction path is shown by dotted lines

B. During next half-cycle, diodes D_2 and D_4 conducts

C. Bioth (1) and (2)

D. None

Answer: C

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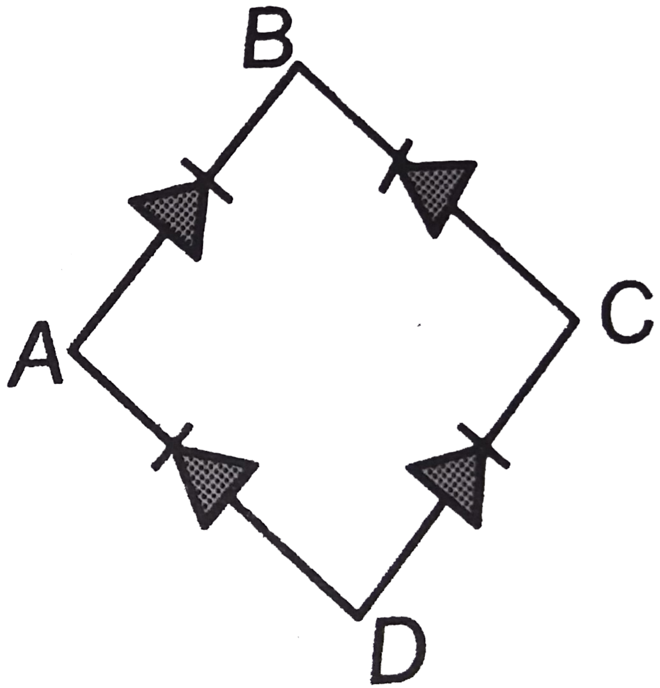
80. In the diagram, the input is across the terminals A and C and the output is across the terminals B and D, then the outputs is



A. zero

B. same as input

C. full wave rectifier

D. half wave rectifier

Answer: C

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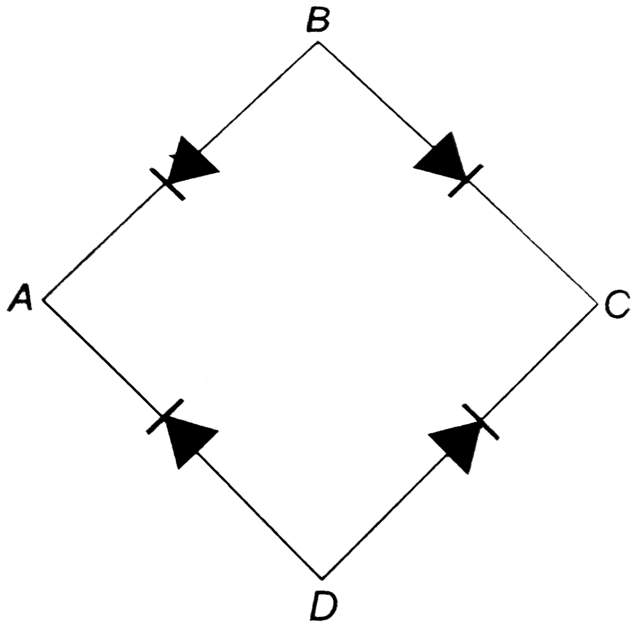
81. A bridge rectifier is shown in figure. Alternating input is given across A and C. If output is taken across BD, then it is



A. zero

B. same as input

C. half wave rectified

D. full wave rectified

Answer: A

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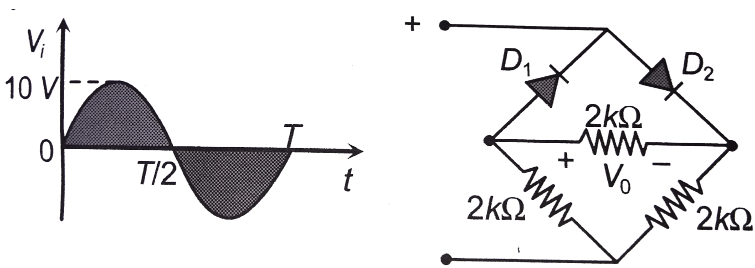
82. In the circuit shown in figure the maximum output voltage V_0 is



A. $0V$

B. $5V$

C. $10V$

D. $5\sqrt{2V}$

Answer: B

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83. Which one of the following statement is not correct in the case of light emitting diodes?

A. It is a heavily doped $p-n$ junction

B. It emits light only when it is forwatd biased

C. It emits light only when it is reverse biased

D. the energy of the light emitted is less than the energy gap of the semicooductor used

Answer: C

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84. A $p-n$ photodiode is fabricate from a semiconductor with a band gap of $2.5eV$. It can detect a singal of wavelength

A. 6000 Å

B. 4000nm

C. $6000nm$

D. 4000Å

Answer: D

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85. A light emitting diode (LED) has a voltage drop of $2V$ across it and passes a current of $10mA$. When it operates with a $6V$ battery through a limiting resistor R. The value of R is

A. $40k\Omega$

B. $4k\Omega$

C. 200Ω

D. 400Ω

Answer: D

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86. GaAs (with a band gap $=1.5eV$) as an LED can emit

A. blue light

B. infrared rays

C. ultraviolet rays

D. X-rays

Answer: B

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87. Zener breakdown in a semi-conductor diode occurs when

A. forward current exceeds certain value

B. reverse bias exceeds certain value

C. forward bias exceeds certain value

D. potential barrier is reduced to zero

Answer: B

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88. Zener breakdown takes place if

A. doped imputy is low

B. doped impurity is high

C. less impurity in N-part

D. less impurity in P-type

Answer: B

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89. Zener diode is used as

A. half wave rectifier

B. full wave rectifier

C. ac voltage stabilizer

D. dc voltage stabilizer

Answer: C

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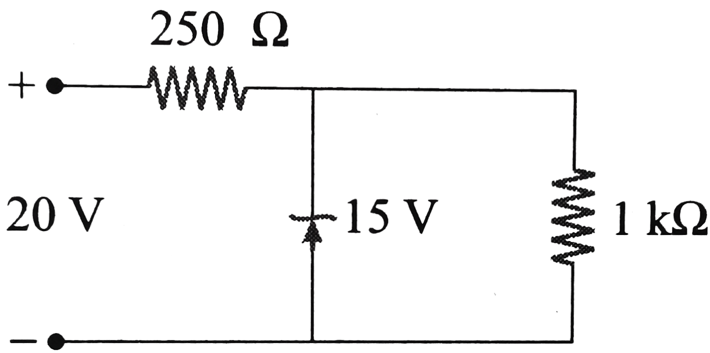
90. A zener diode, having breakdown voltage equal to $15V$ is used in a voltage regulator circuit shown in the figure. The current through the diode is



A. $20mA$

B. $5mA$

C. $10mA$

D. $15mA$

Answer: B

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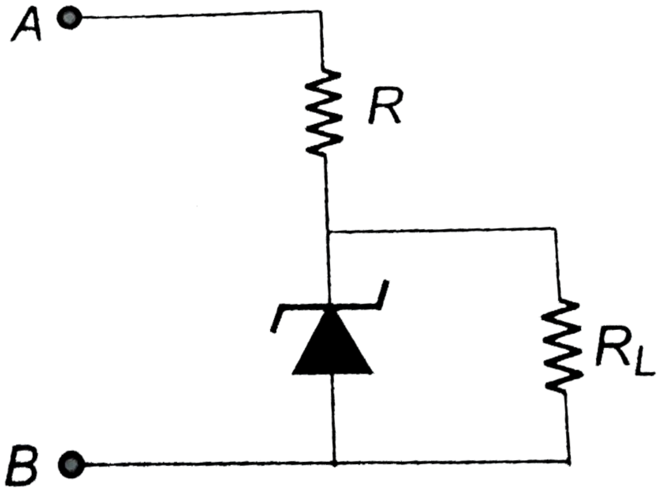
91. If the voltage between the terminals A and B is $17V$ and zener breakdown voltage is $9V$, then the potential across R is



A. $6V$

B. $8V$

C. $9V$

D. $17V$

Answer: B

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92. Least doped region in a transistor

A. either emitter or collector

B. base

C. emmiter

D. collector

Answer: B

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93. The part of a transistor which is most heavily doped to produce large number of majority carriers is

A. base

B. emitter

C. collector

D. none of these

Answer: B

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94. If l_1, l_2, l_3 are the lengths of the emitter, base and collector of a transistor then

A. $l_1 = L(2) = L_3$

B. $L_3 < L_2 < L_1$

C. $L_3 < L_1 < L_2$

D. $L_3 > L_1 > L_2$

Answer: D

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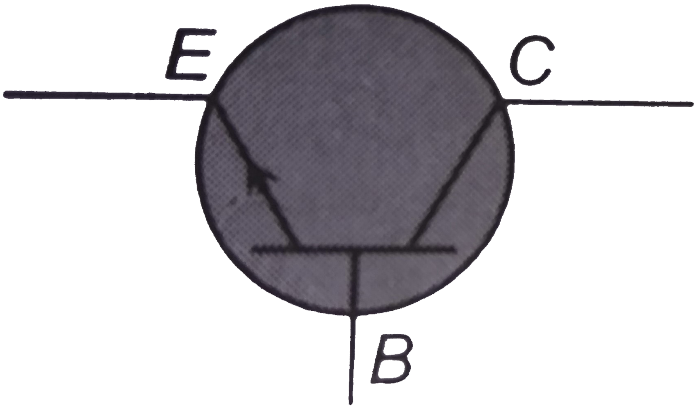
95. The symbol given in figure represents



A. NPN transistor

B. PNP transistor

C. forward biased PN junction diode

D. reverse biased NP junction diode

Answer: A

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96. In a transistor base is made thin and doped with little impurity atoms. Why?

A. most of the charge carriers cross over to the collectoer

B. a very small number of charge crriers may cross over to the collector

C. none of the above

D.

Answer: A

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97. In a normal operation of a transistor,

(i) base-emitter junction is forward-biased

(ii) base-collector junction is forward-biased

(iii) base-emitter junction is reverse-baised

(iv) base-collector junction is reverse-biased

A. (i), (ii)

B. (i), (iv)

C. $(ii), (iii)$

D. $(ii), (iv)$

Answer: B

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98. Let I_E, I_C and I_B represent the emitter current, the collector current and the base current respectively in a transistor.then

(i)I_C is slightly smaller than I_E

(ii) I_C is slightly greater than I_E

(iii) I_B is much smaller than I_E

(iv) I_B is much greater than I_E

A. $(i), (ii)$

B. (i),(iii)`

C. $(ii), (iii)$

D. $(ii), (iv)$

Answer: B

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99. In NPN transistor the collector current is $10mA$. If 90% of electrons emitted reach the collector, the

A. emitter current will be $9mA$

B. emitter current will be $11.1mA$

C. base current will be $0.1mA$

D. base current will be $0.01mA$

Answer: B

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100. In the study of transistors as an amplifier, if $\alpha = I_c / I_c$ and $\beta = I_c / I_b$, where I_c, I_b and I_e are the collector, base and emitter currents, then

A. $\beta = \dfrac{1-\alpha}{\alpha}$

B. $\beta = \dfrac{\alpha}{1-\alpha}$

C. $\beta = \dfrac{\alpha}{1+\alpha}$

D. $\beta = \dfrac{1+\alpha}{\alpha}$

Answer: B

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101. In a transistor, a change of $8.0 mA$ in the emitter current produced a charge of $7.9 mA$ in the collector current. The base current changes by

A. $1 \mu A$

B. $10 \mu A$

C. $100 \mu A$

D. $1000 \mu A$

Answer: C

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102. The current gain of a transistor in a common base arrangement in 0.98 . Find the change in collector current corresponding to a change of 5.0 mA in emitter current . What would be the change in base current?

A. $0.196mA$

B. $2.45mA$

C. $4.9mA$

D. $5.1mA$

Answer: C

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103. In a $n-p-n$ transistor 10^{10} electrons enter the emitter in $10^{-6}s$. 2% of the elecrons are lost in the base. The current transfer ratio and the current amplification factor will be

A. $0.98, 49$

B. $98, 0.49$

C. $0.49, 98$

D. $49, 0.49$

Answer: A

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104. A transistor is operetaed in common-emitter configuration at $V_c = 2V$ such that a change in the base current from $100mA$ to $200mA$ produces a change in the collector current from $5mA$ to $10mA$. The current gain is

A. 75

B. 100

C. 150

D. 50

Answer: D

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105. The transfer ration of a transistor is 50. The input resistance of the transistor when used in the common -emitter configuration is $1k\Omega$. The peak value for an $A.C.$ input voltage of $0.01V$ peak is

A. $100\mu A$

B. $0.01mA$

C. $0.25mA$

D. $500\mu A$

Answer: D

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106. For a common base configuration of PNP transistor $\frac{l_C}{l_E} = 0.98$, then maximum current gain in common emitter configuration will be

A. 12

B. 24

C. 6

D. 5

Answer: B

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107. Which of the following is true?

A. Commen base transistor is commonly used beacause current gain is maximum

B. Common emitter is commonly used because current gain is maximum

C. ommon collector is commonly used because current gain is maximum

D. Common emitter is the least used transistor

Answer: B

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108. In a common base ampifier , the phase difference between the input signal and output voltage is

A. 0

B. $\pi / 4$

C. $\pi / 2$

D. π

Answer: A

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109. In the CB mode of a transistor, when the collector voltage is changed by 0.5 volt. The collector current changes by $0.05mA$. The output resistance will be

A. $10k\Omega$

B. $20k\Omega$

C. $5k\Omega$

D. $2.5k\Omega$

Answer: A

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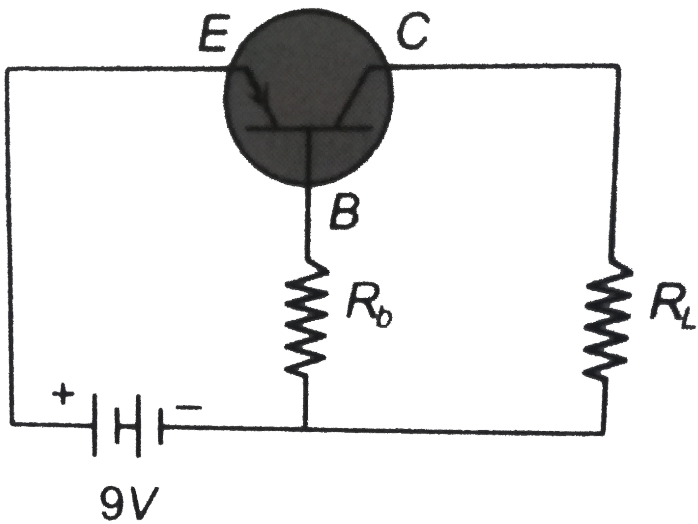
110. In a transistor circuit shown here the base current is $35\mu A$. The value of the resistor R_b is



A. $123.5k\Omega$

B. $257k\Omega$

C. $5k\Omega$

D. $2.5k\Omega$

Answer: B

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111. The transistors provide good power amplification when they are used in

A. Common collector configuration

B. common emitter configuration

C. common base configuration

D. none of these

Answer: B

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112. When npn transistor is used as an amplifier

A. electrons move from base to collector

B. holes move from emitter to base

C. electrons move from collector to base

D. holes move from base to emitter

Answer: A

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113. A common emitter amplifier has a voltage gain of 50, an input impedence of 100Ω and an output impedence of 200Ω. The power gain of the of the amplifier is

A. 500

B. 1000

C. 1250

D. 100

Answer: C

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114. In a CE transistor amplifier, the audio signal voltage across the collector resistance of $2k\Omega$ is $2V$. If the base resistance is $1k\Omega$ and the current amplification of the transistor is 100, the input signal voltage is

A. $0.1V$

B. $1.0V$

C. $1mV$

D. $10mV$

Answer: D

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115. The input resistance of a common emitter transistor amplifer, if the output resistance is $500 K\Omega$, the current gain $\alpha = 0.98$ and power gain is 6.0625×10^6, is

A. 198Ω

B. 300Ω

C. 100Ω

D. 400Ω

Answer: A

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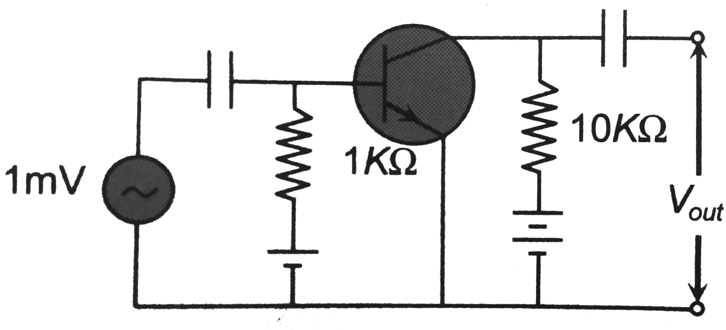
116. In the following common emitter configuration an NPN transistor with current gain $\beta = 100$ is used. The output voltage of the amlifier will be



A. $10mV$

B. $0.1V$

C. $1.0V$

D. $10V$

Answer: C

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117. A transistor is connected in common emmitter (CE) configuration. The collector supply is $8V$ and the voltage deop across a resistor of 800Ω in the collector circuit is $0.8V$

. If the current gain factor (α) is 0.96, then the

change in base current is

A. $\frac{1}{24}mA$

B. $\frac{1}{12}mA$

C. $\frac{1}{6}mA$

D. $\frac{1}{3}mA$

Answer: A

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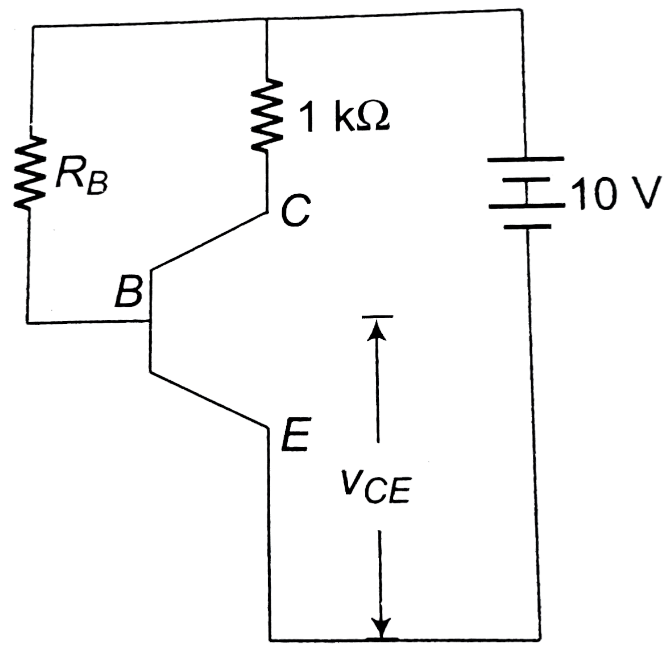
118. In the cuircuit shown here the transistor used has a current gain $\beta = 100$. What should be the bias resistor R_{BE} so that $V_{CE} = 5V$ (neglect V_{BE})



A. $2 \times 10^{3}\Omega$

B. $200 \times 10^{30\,\Omega}$

C. $1 \times 100^{6}\Omega$

D. 500Ω

Answer: B

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119. Which of the following is correct regarding oscillator?

A. The function of an oscillator circuit is to produce an alternating voltage of desired frequency when only DC batteries are available

B. The basic parts of an oscillator is an amplifier and an LC network

C. The amplifier section is just a taransistor used in CE mode. The LC network consists of an inductor and a capacitance. This network resonates at a frequency

$$v_0 = \frac{1}{2\pi}\sqrt{\frac{1}{LC}}$$

D. All option are correct

Answer: D

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120. The resonce frequency of the tank cuircuit of an oscillator when $L = \frac{1}{\pi^2} mH$ and $C = 0.04 \mu F$ are connected in parellel is

A. $250kHz$

B. $25kHz$

C. $2.5kHz$

D. $25MHz$

Answer: B

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121. An oscillator is nothing but an amplifier with

A. positive feed back

B. large gain

C. no feedback

D. negative feedback

Answer: A

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122. The voltage gain of an amplifier with 9% negative feedback is 10. The voltage gain without feedback will be

A. 1.25

B. 100

C. 90

D. 10

Answer: B

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123. What will be the input of A and B for the Boolean expression $\overline{(A+B)}.\overline{(A.B)}=1$?

A. 0, 0

B. 0, 1

C. 1, 0

D. 1, 1

Answer: A

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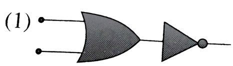
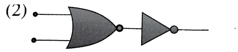
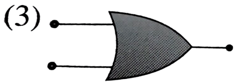
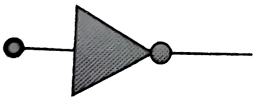
124. Which of these represents $NAND$ gate?

A. 

B. 

C. 

D. 

Answer: A

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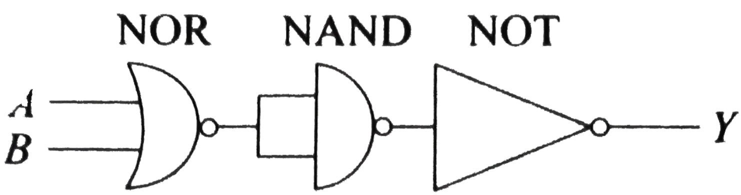
125. The circuit is equivalent to



A. NOR gate

B. OR gate

C. AND gate

D. $NAND$ gate

Answer: A

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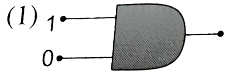
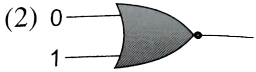
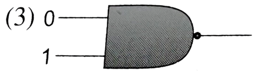
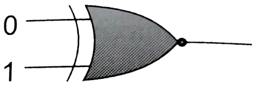
126. Which of the following gates will have an output of 1?

A. 

B. 

C. 

D. 

Answer: C

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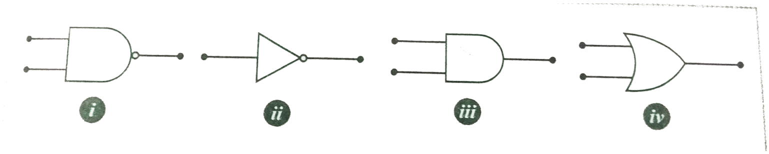
127. The symbolic representation of four logic gates are given in Fig.The logic symbol for OR, NOT and NAND gates are respectively



A. $(iii), (iv), (ii)$

B. $(iv), (i), (iii)$

C. $(iv), (ii), (i)$

D. $(i), (iii), (iv)$

Answer: C

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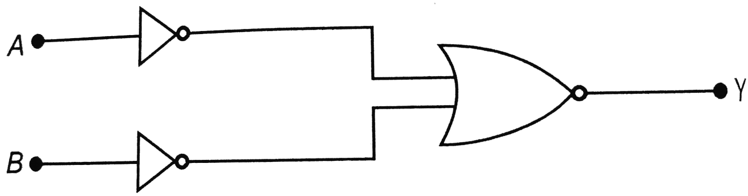
128. Which logic gate is represented by the following combination of logic gates ?



A. OR

B. $NAND$

C. AND

D. NOR

Answer: C

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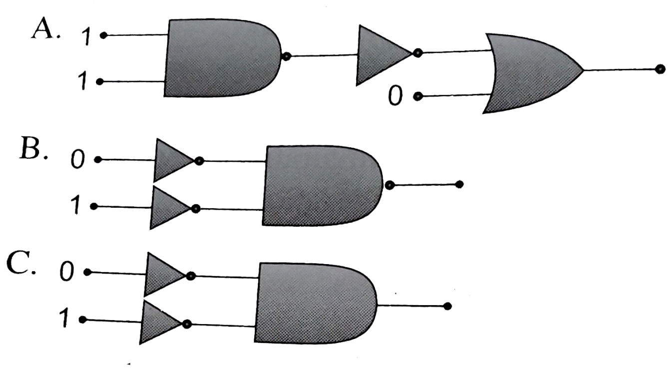
129. In the following combination of logic gates, the outputs of A, B and C are respectively

(i) 

A. 0, 1, 1

B. 0, 1, 0

C. 1, 1, 0

D. $1, 0, 1$

Answer: C

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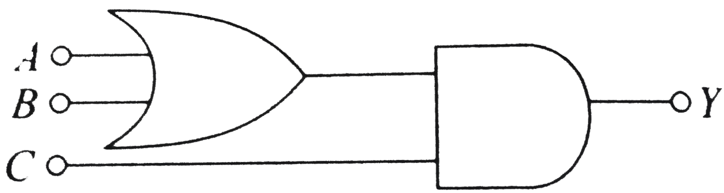
130. To get output 1for the following circuit, the correct choice for the input is :



A. $A = 0, B = 1, C = 0$

B. $A = 1, B = 0, C = 0$

C. $A = 1, B = 0C = 1$

D. $A = 1B = 1, C = 0$

Answer: C

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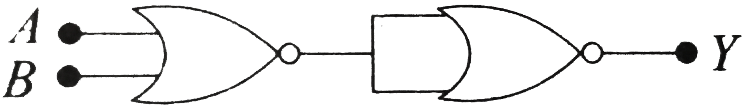
131. In the following circuit, the output Y for all possible inputs A and B is expressed by the truth table:



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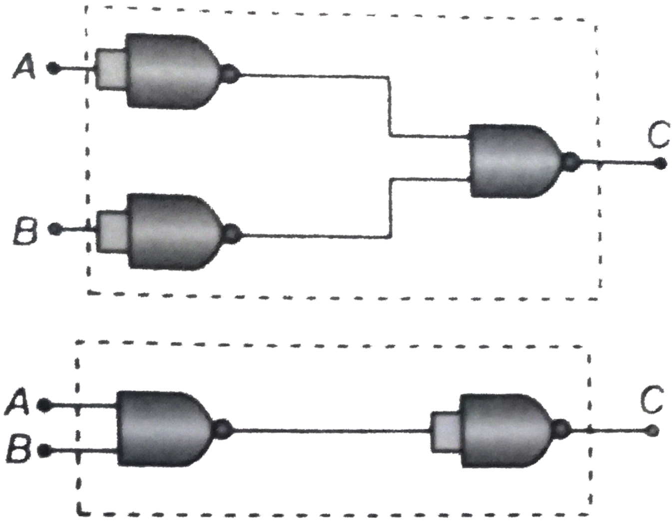
132. The combination of $'NAND'$ gates shown here under (figure) are equivalent to



A. an OR gate and an AND gate respectively

B. an AND gate and a NOT gate respectively

C. an AND gate and an OR gate respectively

D. an OR gate and a NOT gate respectively

Answer: A

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133. An AND gate can be prepared by repetitive use of

A. $(i), (ii)$

B. $(i), (iii)$

C. $(ii), (iii)$

D. (iii),(iv)`

Answer: D

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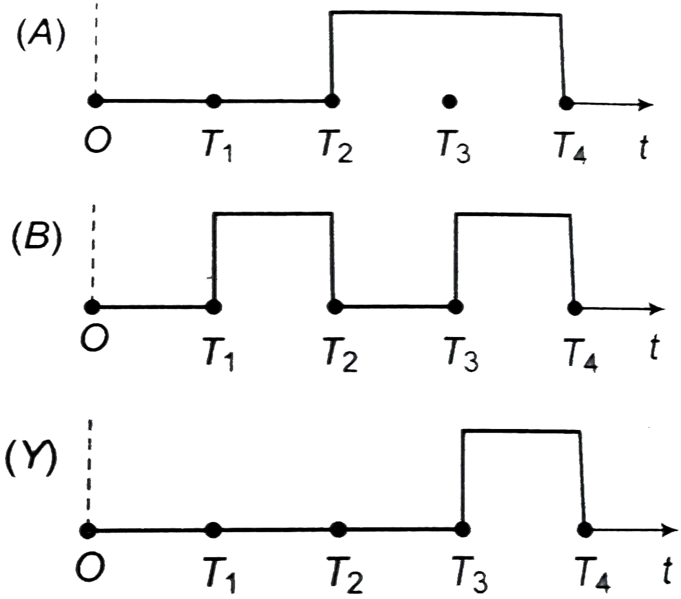
134. The given figure shows the wave forms for two inputs A and B and that for the output Y

of a logic circuit.the logic circuit is



A. an AND gate

B. an OR gate

C. a $NAND$ gate

D. an NOT gate

Answer: A

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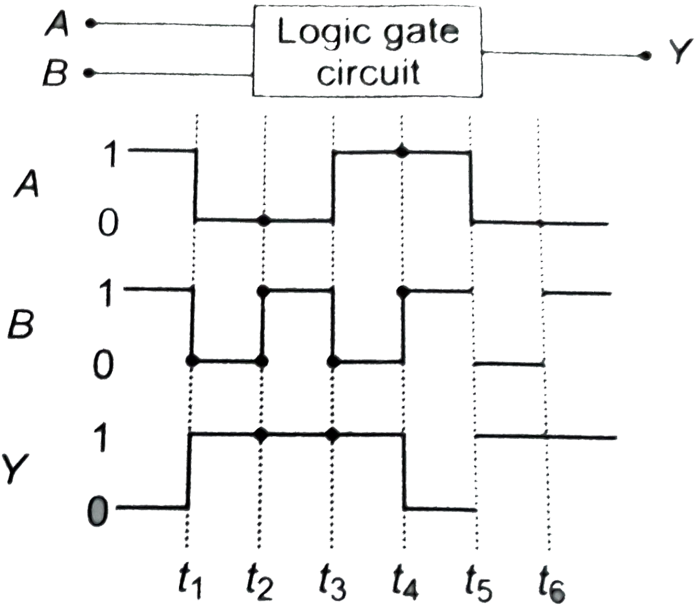
135. The following figure shows a logic gate circuit with two inputs A and B and the output Y. The voltage waveforms of A, B and the output Y are as given



A. NOR gate

B. OR gate

C. AND gate

D. $NAND$ gate

Answer: D

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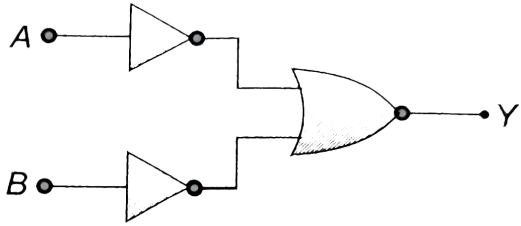
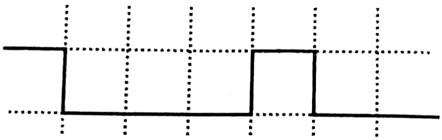
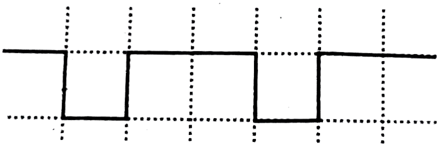
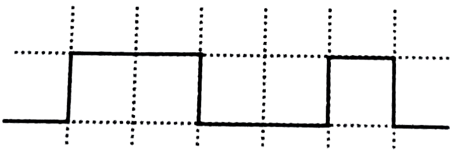
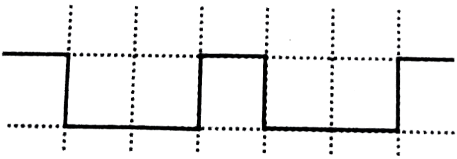
136. The logic circuit shown belows has the input waveforms $'A'$ and $'B'$ as shown. Pick out the correct output waveform



(1)


(2)


(3)


(4)


A. 

B. 

C. 

D.

Answer: A

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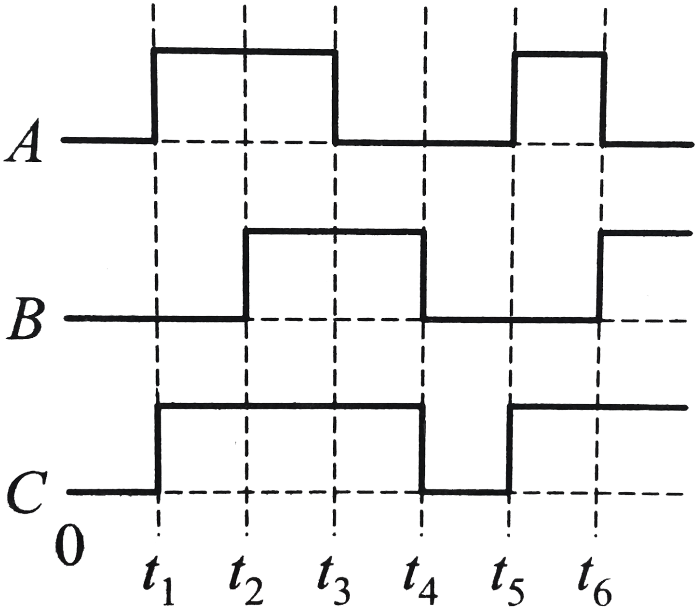
137. The figure shows a logic circuit with two inputs A and B and the output C. The voltage wave forms across A, B and C are as given.

The logic circuit gate is



A. OR gate

B. NOT gate

C. AND gate

D. $NAND$ gate

Answer: A

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138. The barrier potential of a $p-n$-junction depends on

(i) Type of semiconductor material

(ii) Amount of doping

(iii) Temperature

which of the following is correct?

A. b only

B. b and c only

C. a, b and c

D. a and b only

Answer: D

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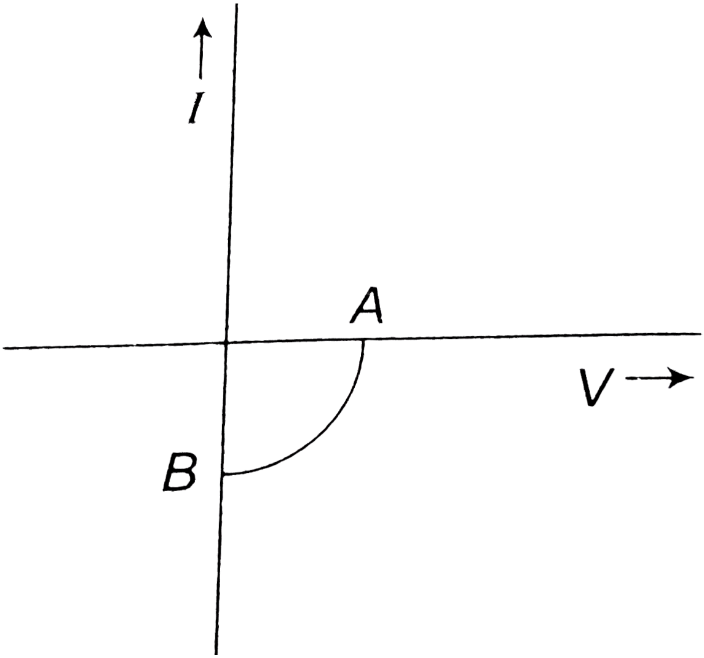
139. The given graph represents $V - I$ characteristic for a semiconductor device.

which of the following statement is correct?



A. It is for a solar cell and points A and B represent open circuit voltage and current

B. It is for a photodiode and points A and B represent open circuit voltage and current, respectively

C. It is for a LED and points A and B represent open circuit voltage and short circuit current respectively

D. It is $v-I$ characteristic for solar cell where point A represents open circuit voltage and point B short circuit current

Answer: D

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140. A truth table is given below. Which of the following has this types fo truth table?

$$\begin{vmatrix} A & 0 & 1 & 0 & 1 \\ B & 0 & 0 & 1 & 1 \\ Y & 1 & 0 & 0 & 0 \end{vmatrix}$$

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