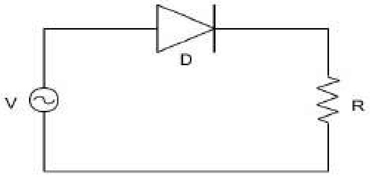
SEMICONDUCTOR ELECTRONICS: MATERIALS,DEVIES AND SIMPLE CIRCUITS

1. Semiconductor material having fewer free electrons than pure germanium or silicon is
   a) p-type b) n-type c) Both (a) and (b) d) None of these
2. A p-n junction (D) shown in the figure can act as a rectifier. An alternating current source (V) is connected in the circuit.



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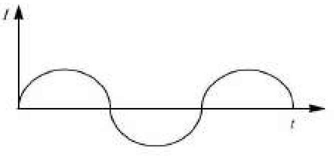

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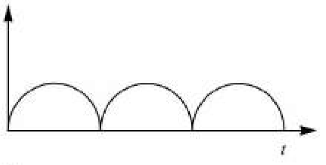

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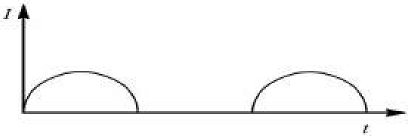

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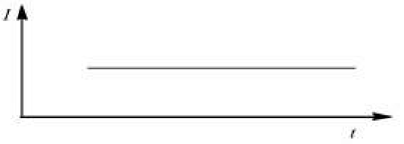
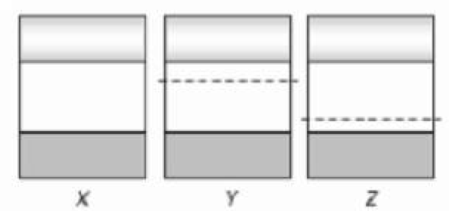


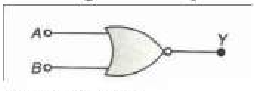
3. Due to S.C.R. in vacuum tube
   a) $I_p \rightarrow$ Decrease b) $I_p -$ Increase c) $V_p =$ Increase d) $V_g =$ Increase
4. The following logic circuit represents

   a) NAND gate with output $O = \overline{X} + \overline{Y}$ b) NOR gate with output $O = \overline{X + Y}$
   c) NAND gate with output $O = \overline{X \cdot Y}$ d) NOR gate with output $O = \overline{X} \cdot \overline{Y}$
5. In a common emitter configuration of a transistor, the voltage drop across a 500Ω resistor in the collector circuit is 0.5 V when the collector supply voltage is 0.96, the base current is
   a) $\frac{1}{20}\mu A$ b) $\frac{1}{5}\mu A$ c) $\frac{1}{20}mA$ d) $\frac{1}{24}mA$
6. The emitter-base junction of a transistor is .... biased while the collector-base junction is .... biased.
   a) Forward, forward b) Forward, reverse c) Reverse, forward d) Reverse, reverse
7. A change of 8.0 mA in the emitter current brings a change of 7.9 mA in the collector current. The values of α and β are
   a) 0.99, 90 b) 0.96, 79 c) 0.97, 99 d) 0.99, 79
8. 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 group 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 group impurity respectively

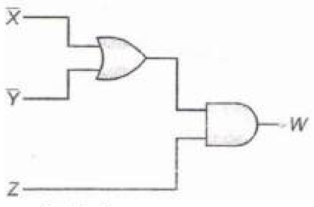
9. Which gate is represented by the symbolic diagram given here?



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

10. A zener diode is used for
a) Rectification b) Modulation c) Detection d) Voltage regulation

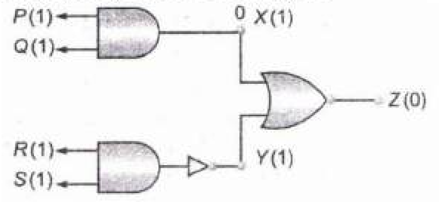
11. Output Y is given by



a) $(\overline{X}\cdot\overline{Y})\cdot Z$ b) $(X+Y)\,Z$ c) $(X+Y)\,\overline{Z}$ d) $\overline{X}\cdot\overline{Y}+\overline{Z}$

12. What is the number of code combination in a 4 bit byte?
a) 256 b) 4 c) 16 d) 32

13. The circuit diagram shows a logic combination with the states of output X, Y and Z given for inputs P, Q, R and S all at state 1. When inputs P and R change to state 0 with inputs Q and S still at 1, the states of outputs X, Y and Z change to



a) 1, 0, 0 b) 1, 1, 1 c) 0, 1, 0 d) 0, 0, 1

14. Change in temperature
a) Increases forward resistance
b) Increases reverse resistance
c) Affects $V-I$ characteristics of $p-n$ junction
d) Does not affect $V-I$ characteristic of $p-n$ junction

15. The output form of a full wave rectifier is
a) An AC voltage b) A DC voltage
c) Zero d) A pulsating unidirectional voltage

16. In a p-n junction diode acting as a half-wave rectifier, which of the following statement is not true?
a) The average output voltage over a cycle is non-zero
b) The drift current depends on biasing
c) The depletion zone decreases in forward biasing

d) The diffusion current increases due to forward biasing

17. The charge carries in a p-type semiconductor are
a) Electrons only
b) Holes only
c) Holes in larger numbers and electrons in smaller numbers
d) Holes and electrons in equal numbers

18. In a common-emitter amplifier, the load resistance of the output circuit is 1000 times the resistance of the input circuit. If $\alpha = 0.98$, then voltage gain is
a) 49×10^3 b) 2.5×10^2 c) 1.5×10^2 d) 4.9

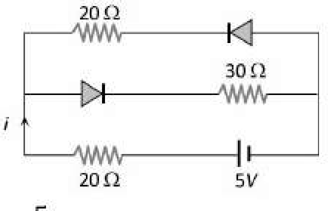
19. Avalanche breakdown in a p-n junction diode is due to
a) Sudden shift of Fermi level
b) Increase in the width of forbidden gap
c) Sudden increase of impurity concentration
d) Cumulative effect of increased electron collision and creation of added electron-hole pairs

20. If n_E and n_H represent the number of free electrons and holes respectively in a semiconducting material, then for n-type semiconducting material
a) $n_E << n_H$ b) $n_E >> n_H$ c) $n_E = n_H$ d) $n_E = n_H = 0$

21. Carbon, silicon and germanium atoms have four valence electrons each. Their valence and conduction bands are separated by energy band gaps represented by $(E_g)_C$, $(E_g)_{Si}$ and $(E_g)_{Ge}$ respectively. Which one of the following relationships is true in their case?
a) $(E_g)_C > (E_g)_{Si}$ b) $(E_g)_C = (E_g)_{Si}$ c) $(E_g)_C < (E_g)_{Ge}$ d) $(E_g)_C$ $(E_g)_{Si}$

22. Which of the following statements is true for an n-type semiconductor?
a) The donor level lies closely below the bottom of the conduction band.
b) The donor level lies closely above the top of the valence band
c) The donor level lies at the halfway mark of the forbidden energy gap
d) None of the above

23. Current in the circuit will be



a) $\frac{5}{40}A$ b) $\frac{5}{50}A$ c) $\frac{5}{10}A$ d) $\frac{5}{20}A$

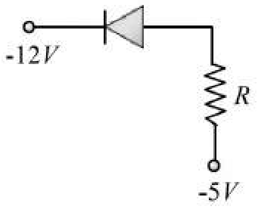
24. Which of the following is not a process involved in fabrication of IC
a) Polymerization b) Diffusion c) Photolithography d) Metallisation

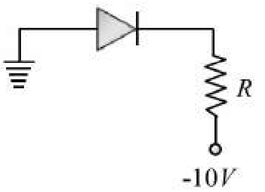
25. To a germanium sample, traces of gallium are added as an impurity. The resultant sample would behave like
a) A conductor b) A P-type semiconductor
c) An N-type semiconductor d) An insulator

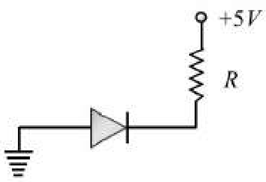
26. In a triclinic crystal system
a) $a \neq b \neq c, \alpha \neq \beta \neq \gamma$ b) $a = b = c, \alpha \neq \beta \neq \gamma$ c) $a \neq b \neq c, \alpha \neq \beta = \gamma$ d) $a = b \neq c, \alpha = \beta = \gamma$

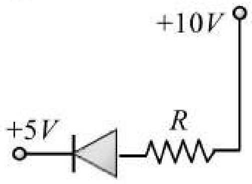
27. In presence of interspace charge, at plate voltage of 200 V, the current is 80 mA. Then the current in mA at 400 V will be
a) $160\sqrt{2}$ b) $2\sqrt{2}$ c) $80/\sqrt{2}$ d) None of these

28. Of the diodes shown in the following diagrams, which one is reverse biased

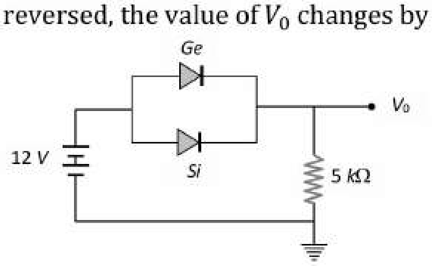
a) 

b) 

c) 

d) 

29. *Ge* and *Si* diodes conduct at 0.3 V and 0.7 V respectively. In the following figure if *Ge* diode connection is reversed, the value of V_0 changes by



a) 0.2 V b) 0.4 V c) 0.6 V d) 0.8 V

30. A solid which is not transparent to visible light and whose conductivity increases with temperature is formed by

a) Ionic binding b) Covalent binding
c) van der Waal's binding d) Metallic binding

31. When and *P* end of *P*-*N* junction is connected to the negative terminal of the battery and the *N* end to the positive terminal of the battery, then the *P*-*N* junction behaves like

a) A conductor b) An insulator c) A super-conductor d) A semi-conductor

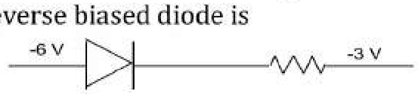
32. The energy band gap is maximum in

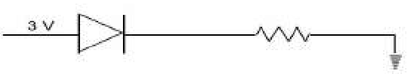
a) Metals b) Superconductors c) Insulators d) Semiconductors

33. The grid voltage of any triode valve is changed from -1 volt to -3 *volt* and the mutual conductance is 3×10^{-4} *mho*. The change in plate circuit current will be

a) 0.8 mA b) 0.6 mA c) 0.4 mA d) 1 mA

34. A reverse biased diode is

a) 

b) 

c) 

d) 

35. Which of the following is an amorphous solid

a) Glass b) Diamond c) Salt d) Sugar

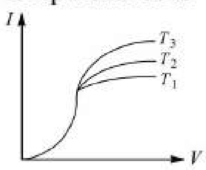
36. The minimum potential difference between the base and emitter required to switch a silicon transistor 'ON' is approximately

a) 1 V b) 3 V c) 5 V d) 4.2 V

37. In Colpitt oscillator the feedback network consists of

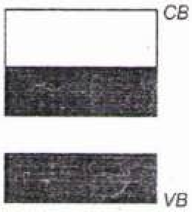
a) Two inductors and a capacitor b) Two capacitors and an inductor
c) Three pairs of RC circuit d) Three pairs of RL circuit

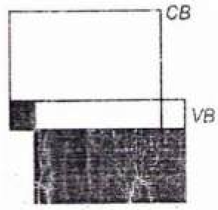
38. For the diode, the characteristics curves are given at different temperatures. The relation between the temperatures is

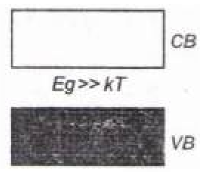


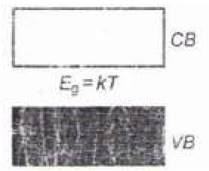
a) $T_1 = T_2 = T_3$ b) $T_1 < T_2 < T_3$ c) $T_1 \geq T_2 \geq T_3$ d) None of these

39. Which of the energy band diagrams shown in the figure corresponds to that of a semiconductor?

a) 

b) 

c) 

d) 

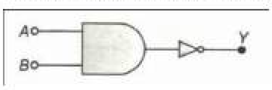
40. In a NPN transistor, 108 electrons enter the emitter in $10^{-8}s$. If 1% electrons are lost in the base, the fraction of current that enters the collector and current amplification factor are respectively

a) 0.8 and 49 b) 0.9 and 90 c) 0.7 and 50 d) 0.99 and 99

41. A working transistor with its three legs marked P, Q and R is tested using a multimeter. No conduction is found between P and Q. By connecting the common (negative) terminal of the multimeter to R and the other (positive) terminal to P or Q, some resistance is seen on the multimeter. Which of the following is true for the transistor?

a) It is an n-p-n transistor with R as base
b) It is an p-n-p transistor with R as collector
c) It is an p-n-p transistor with R as emitter
d) It is an n-p-n transistor with R as collector

42. Which is the name of the gate obtained by the combination shown in figure?



a) NAND b) NOR c) NOT d) XOR

43. In a CE, n-p-n transistor circuit, the emitter current is

a) More than the collector current
b) Less than the collector current
c) Less than the base current
d) Equal to the difference of the collector current and the base current

44. A hole in a P-type semiconductor is

a) An excess electron b) A missing electron c) A missing atom d) A donor level

45. In the middle of the depletion layer of reverse biased p-n junction, the

a) Electric field is zero b) Potential is maximum
c) Electric field is maximum d) Potential is zero

46. For a transistor amplifier, the voltage gain

a) Is high at high and low frequencies and constant in the middle frequency range
b) Is low at high and low frequencies and constant in the middle frequency range
c) Remains constant for all frequencies
d) Is high at high frequencies and low at low frequencies and constant in middle frequency range

47. Following is the relation between current and charge $I = AT^2 e^{q/V_L}$, then value of V_L will be

a) $\frac{V}{kt}$ b) $\frac{kV}{T}$ c) $\frac{kT}{V}$ d) $\frac{VT}{k}$

48. In BJT, maximum current flows in which of the following?

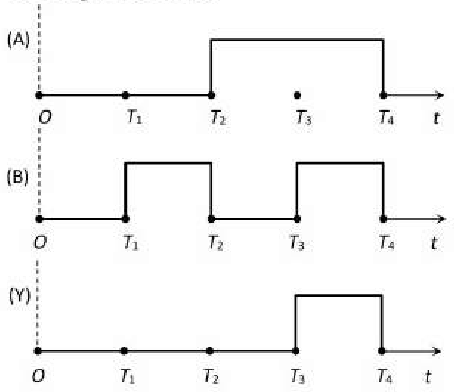
a) Emitter region b) Base region

c) Collector region d) Equal in all the regions

49. The Boolean equation of NOR gate is

a) $C = A + B$ b) $C = \overline{A + B}$ c) $C = A \cdot B$ d) $C = \overline{A \cdot B}$

50. 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

51. Electric current is due to drift of electrons in

a) Metallic conductors b) Semi-conductors c) Both (a) and (b) d) None of these

52. In order to forward bias a PN junction, the negative terminal of battery is connected to

a) P-side b) Either P-side or N-side

c) N-side d) None of these

53. On adjusting the P-N junction diode is forward biased

a) Depletion layer increases b) Resistance increases

c) Both decreases d) None of these

54. The thermionic emission of electron is due to

a) Electromagnetic field b) Electrostatic field c) High temperature d) Photoelectric effect

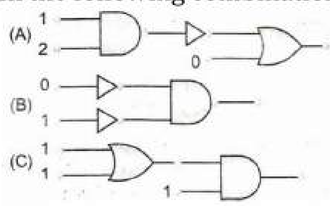
55. A gate has the following truth table

P	1	1	0	0
Q	1	0	1	0
R	1	0	0	0

The gate is

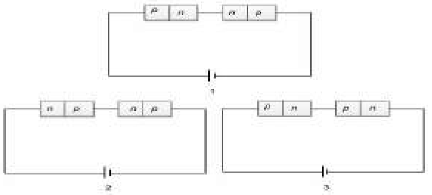
a) NOR b) OR c) NAND d) AND

56. In the following combinations of losgic gates, the outputs of A, B and C are respectively



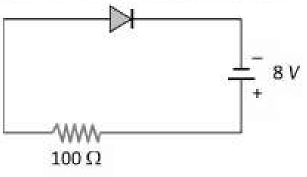
a) 0, 1, 1 b) 0, 1, 0 c) 1, 1, 0 d) 1, 0, 1

57. Two identical p-n junctions are connected in series in three different ways as shown below to a battery. The potential drop across the p-n junctions are equal in



a) Circuits 2 and 3 b) Circuits 1 and 2 c) Circuits 1 and 3 d) None of the circuit

58. A source of $8V$ drives the diode in fig. through a current-limiting resistor of 100 ohm. Then the magnitude of the slope load line on the V-I characteristics of the diode is



a) 0.01 b) 100 c) 0.08 d) 12.5

59. The output of an OR gate is connected to both the inputs of a NAND gate. The combination will serve as a

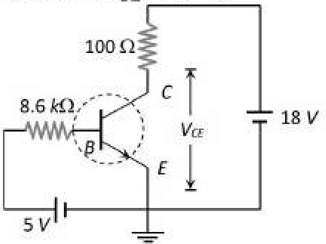
a) OR gate b) NOT gate c) NOR gate d) AND gate

60. An intrinsic semiconductor at 0 K temperature behaves like

a) Conductor b) p-type semiconductor

c) n-type semiconductor d) Insulator

61. For the transistor circuit shown below, if $\beta = 100$, voltage drop between emitter and base is 0.7 V then value of V_{CE} will be



a) 10 V b) 5 V c) 13 V d) 0 V

62. Bonds in semiconductor are

a) Trivalent b) Covalent c) Bivalent d) Monovalent

63. A solid which is not transparent to visible light and whose electrical conductivity increases with temperature is formed by

a) Ionic bonding b) Metallic bonding

c) Covalent bonding d) Van der waal bonding

64. In P-type semiconductor, there is

a) An excess of one electron b) Absence of one electron

c) A missing atom d) A donor level

65. Silicon is a semiconductor. If a small amount of As is added to it, then its electrical conductivity

a) Decreases b) Increases c) Remains unchanged d) Becomes zero

66. In extrinsic P and N-type semiconductor materials, the ratio of the impurity atoms to the pure semiconductor atoms is about

a) 1 b) 10^{-1} c) 10^{-4} d) 10^{-7}

67. A p-n photodiode is fabricated from a semiconductor with a band gap of 2.5 eV. It can detect a signal of wavelength

a) 6000 Å b) 4000 nm c) 6000 nm d) 4000 Å

68. In a transistor the collector current is always less than the emitter current because

a) Collector side is reverse biased and the emitter side is forward biased

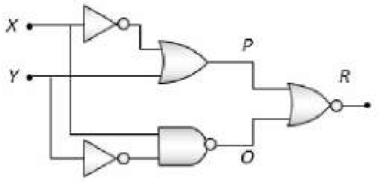
b) A few electrons are lost in the base and only remaining ones reach the collector

c) Collector being reverse biased, attracts less electrons

d) Collector side is forward biased and emitter side is reverse biased

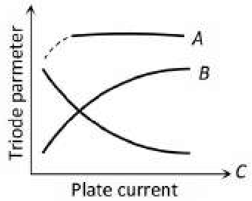
69. Why do we prefer indirectly heated cathode to the directly heated cathode?
   a) Equality of potential throughout the cathode
   b) Continuous emission of electrons
   c) Availability of filament material
   d) Due to some other persons

70. Figure gives a system of logic gates. From the study of truth table it can be found that to produce a high output (1) at R, we must have



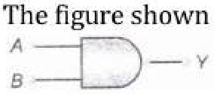
   a) $X = 0, Y = 1$ b) $X = 1, Y = 1$ c) $X = 1, Y = 0$ d) $X = 0, Y = 0$

71. The figure represents variation of triode parameter (μ or r_p or g_m) with the plate current. The correct variation of μ and r_p are given, respectively by the curves



   a) A and B b) B and C c) A and C d) None of the above

72. The figure shown the symbol of a

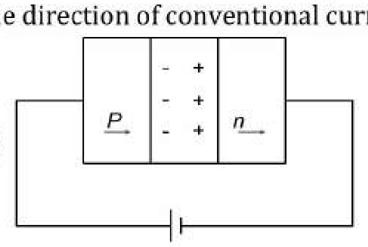


   a) AND gate   b) OR gate   c) NOT gate   d) NAND gate

73. A zener diode has a contact potential of 1 V in the absence of biasing. It undergoes Zener breakdown for an electric field of 10^6 V-m^{-1} at the depletion region of p-n junction. If the width of the depletion region is 2.5 μm, what should be the reverse biased potential for the Zener breakdown to occur?
   a) 3.5 V   b) 2.5 V   c) 1.5 V   d) 0.5 V

74. Which of the following is correct, about doping in a transistor?
   a) Emitter is lightly doped, collector is heavily doped and base is moderately doped
   b) Emitter is lightly doped, collector is moderately doped and base is heavily doped
   c) Emitter is heavily doped, collector is lightly doped and base is moderately doped
   d) Emitter is heavily doped, collector is moderately doped and base is lightly doped

75. In the case of forward biasing of a p-n junction diode, which one of the following figures correctly depicts the direction of conventional current (indicated by an arrow mark)?

a)


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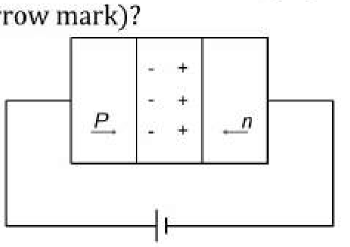

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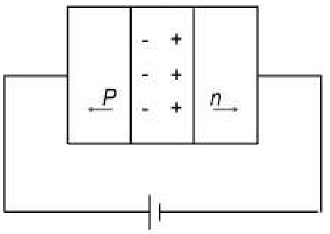
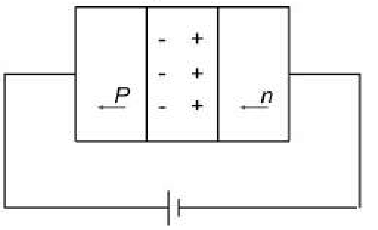


d)


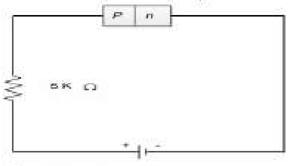
76. Which type of gate the following truth table represents?

Inputs		Output
A	*B*	*Q*
0	0	1
0	1	1
1	0	1
1	1	0

a) NOT
b) AND
c) OR
d) NAND

77. Function of rectifier is
a) To convert *ac* into *dc* b) To convert *dc* into *ac* c) Both (a) and (b) d) None of these

78. A *p-n* junction in series with a resistance of 5 kΩ is connected across a 50 V DC source. If the forward bias resistance of the junction is 50 Ω, the forward bias current is



a) 8.8 mA b) 1 mA c) 2 mA d) 9.9 mA

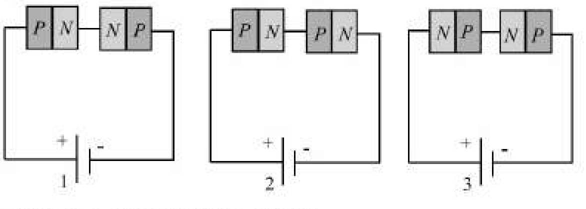
79. The ratio of slopes of anode characteristics and mutual characteristic curves is said to be
a) Mutual conductance b) Anode resistance c) Amplification factor d) Voltage gain

80. The current gain α of a transistor is 0.9. The transistor is connected to common base configuration. What would be the change in collector current when base current changes by 4 mA?
a) 1.2 mA b) 12 mA c) 24 mA d) 36 mA

81. The process of adding impurities to the pure semiconductor is called
a) Drouping b) Dropping c) Doping d) None of these

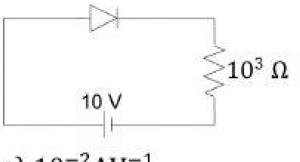
82. Digital circuit can be made by repetitive use of this gate
a) AND b) OR c) NOT d) NAND

83. Two *PN*-junctions can be connected in series by three different methods as shown in the figure. If the potential difference in the junctions in the same, then the correct connections will be



a) In the circuit (1) and (2)
b) In the circuit (2) and (3)
c) In the circuit (1) and (3)
d) Only in the circuit (1)

84. A junction diode is connected to a 10 V source and $10^3 \Omega$ rheostate figure. The slope of load line on the characteristic curve of diode will be



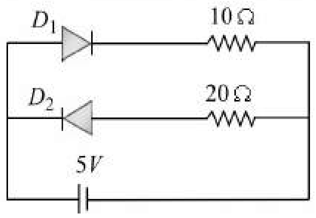
a) $10^{-2} AV^{-1}$ b) $10^{-3} AV^{-1}$ c) $10^{-4} AV^{-1}$ d) $10^{-5} AV^{-1}$

85. In a junction diode, the direction of diffusion current is
a) From n-region to p-region
b) From p-region to n-region
c) From n-region to p-region if the junction is forward baised and *vice versa* if it is reverse baised
d) From p-region to n-region if the junction is forward baised and *vice versa* if it is reversed baised

86. A solid reflects incident light and its electrical conductivity decreases with temperature. The binding in this solid is
a) Ionic b) Covalent c) Metallic d) Molecular

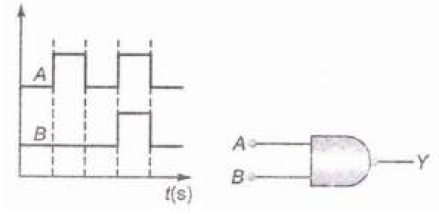
87. Would there be any advantage to adding n-type or p-type impurities to copper
a) Yes b) No
c) May be d) Information is insufficient

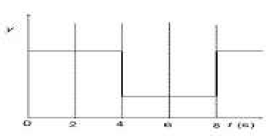
88. Two ideal diodes are connected to a battery as shown in the circuit. The current supplied by the battery is

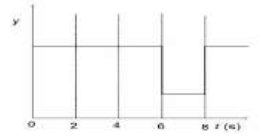


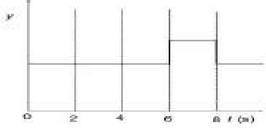
a) 0.75 A b) Zero c) 0.25 A d) 0.5 A

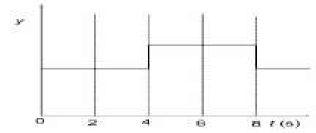
89. The real time variation of input signals A and B are as shown below. If the inputs are fed into NAND gate, then select the output signal from the following



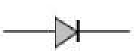
a) 

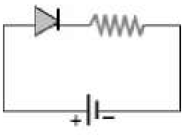
b) 

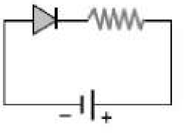
c) 

d) 

90. Which one is in forward bias

a) 

b) 

c) 

d) None of these

91. In a triode valve the amplification factor is 20 and mutual conductance is 10^{-3} *mho*. The plate resistance is
a) $2 \times 10^3\ \Omega$ b) $4 \times 10^3\ \Omega$ c) $2 \times 10^4\ \Omega$ d) $2 \times 10^5\ \Omega$

92. The distance between the body centred atom and a corner atom in sodium ($a = 4.225$ Å) is
a) 3.66 Å b) 3.17 Å c) 2.99 Å d) 2.54 Å

93. In good conductors of electricity, the type of bonding the exists is
a) Ionic b) Vander Waals c) Covalent d) Metallic

94. The difference in the variation of resistance with temperature in a metal and a semiconductor arises essentially due to the difference in the
a) Crystal structure
b) Variation of the number of charge carries with temperature

c) Type of bonding
d) Variation of scattering mechanism with temperature

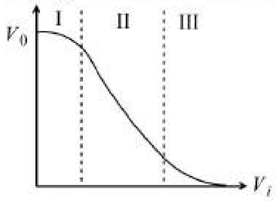
95. Doping of intrinsic semiconductor is done
a) To neutralize charge carriers
b) To increase the concentration of majority charge carriers
c) To make it neutral before disposal
d) To carry out further purification

96. The resonance frequency of the tank circuit of an oscillator when $L = \frac{10}{\pi^2} mH$ and $C = 0.04 \mu F$ are connected in parallel is
a) 250 kHz b) 25 kHz c) 2.5 kHz d) 25 MHz

97. In a common base amplifier, the phase difference between the input signal voltage and output voltage is
a) $\frac{\pi}{4}$ b) π c) Zero d) $\frac{\pi}{2}$

98. The most commonly used material for making transistor is
a) Copper b) Silicon c) Ebonite d) Silver

99. Transfer characteristics [output voltage (V_0) vs input voltage (V_i)] for a base biased transistor in CE configuration is as shown in the figure. For using transistor as a switch, it is used



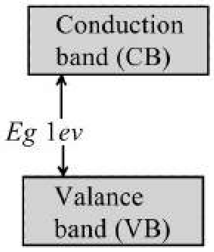
a) In region III
b) Both in region (I) and (III)
c) In region II
d) In region I

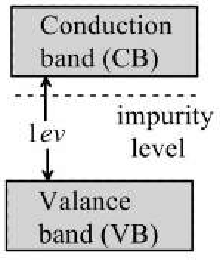
100. The average value of output direct current in a half wave rectifier is
a) I_0/π b) $I_0/2$ c) $\pi I_0/2$ d) $2I_0/\pi$

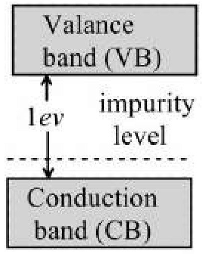
101. In which of the following ionic bond is present
a) $NaCl$ b) Ar c) Si d) Ge

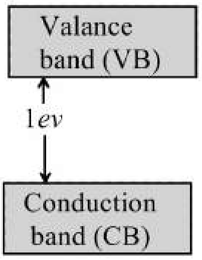
102. The transistors provide good power amplification when they are used in
a) Common collector configuration
b) Common emitter configuration
c) Common base configuration
d) None of these

103. Which of the following energy band diagram shows the N-type semiconductor

a) 

b) 

c) 

d) 

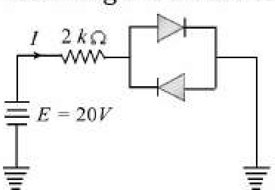
104. The triode constant is out of the following
a) Plate resistance b) Amplification factor c) Mutual conductance d) All the above

105. The device that can act as a complete electronic circuit is
a) Zener diode b) Junction diode c) Integrated circuit d) Junction transistor

106. A semiconductor is cooled from $T_1 K$ to $T_2 K$. Its resistance
a) Will decrease b) Will increase
c) Will first decrease and then increase d) Will not change

107. The width of forbidden gap in silicon crystal is 1.1 eV. When the crystal is converted in to a N-type semiconductor the distance of Fermi level from conduction band is
a) Greater than 0.55 eV b) Equal to 0.55 eV c) Lesser than 0.55 eV d) Equal to 1.1 eV

108. Assuming the diodes to be of silicon with forward resistance zero, the current I in the following circuit is



a) 0 b) 9.65 mA c) 10 mA d) 10.36 mA

109. The temperature coefficient of resistance of a semiconductor
a) Is always positive b) Is always negative
c) Is zero d) May be positive or negative or zero

110. An amplifier has a voltage gain $A_V = 1000$. The voltage gain in dB is
a) 30 dB b) 60 dB c) 3 dB d) 20 dB

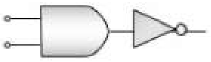
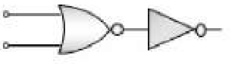
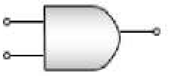
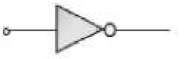
111. A logic gate and its truth table are shown below

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	1

The gate is
a) NOR b) AND c) OR d) NOT

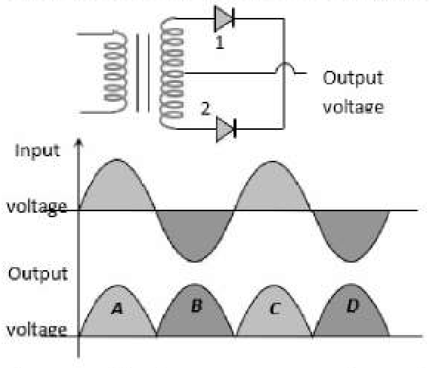
112. In N-type semiconductors, majority charge carriers are
a) Holes b) Protons c) Neutrons d) Electrons

113. Which represents NAND gate

a)  b)  c)  d) 

114. An electron-hole pair is formed when light of maximum wavelength 6000 Å is incident on the semiconductor. What is the band gap energy of the semiconductor?
($h = 6.62 \times 10^{-34}$ J-s)
a) 3.31×10^{-19} J b) 3.07×10^{-19} J c) 2.07×10^{-19} J d) 2.07 J

115. A full wave rectifier circuit along with the input and output voltages is shown in the figure



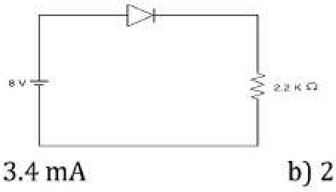
The contribution to output voltage from diode −2 is
a) A, C b) B, D c) B, C d) A, D

116. Within depletion region of p-n junction diode
a) p-side is positive and n-side is negative
b) p-side is negative and n-side is positive
c) Both sides are positive or both negative
d) Both side are neutral

117. Suppose an unregulated d.c. input voltage V_I is applied to a Zener diode having breakdown voltage (V_z). Then the breakdown condition for the diode to work as voltage regulator is
a) $V_I < V_z$ b) $V_I = V_z$ c) $V_I > V_z$ d) $V_I < \sqrt{V_z}$

118. In an unbiased $p - n$ junction, holes diffuse from p-region to n-region, because
a) Free electrons in the n-region attract them
b) They move across the junction by the potential difference
c) Hole concentration in p-region is more as compared to n-region
d) All of the above

119. In the circuit, if the forward voltage drop for the diode is 0.5 V, the current will be



a) 3.4 mA b) 2 mA c) 2.5 mA d) 3 mA

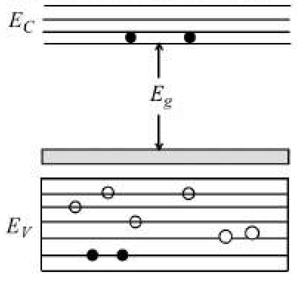
120. Consider an NPN transistor amplifier in common-emitter configuration. The current gain of the transistor is 100. If the collector current changes by 1 mA, what will be the change in emitter current
a) 1.1 mA b) 1.01 mA c) 0.01 mA d) 10 mA

121. In a junction diode, the holes are due to
a) Protons b) Neutrons c) Extra electrons d) Missing of electrons

122. What is the name of the level formed due to impurity atom in p-type in the forbidden gap?
a) Donor level b) Acceptor level c) Conduction level d) Forbidden level

123. in P-type semiconductor the majority and minority charge carriers are respectively
a) Protons and electrons b) Electrons and protons
c) Electrons and holes d) Holes and electrons

124. 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) A p-type semiconductor b) An insulator
c) A metal d) An n-type semiconductor

125. The depletion layer in a silicon diode is 1 μm wide and its knee potential is 0.6 V, then the electric field in the depletion layer will be

a) 0.6 Vm^{-1} b) 6×10^4 Vm^{-1} c) 6×10^5 Vm^{-1} d) Zero

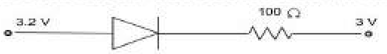
126. A crystal diode is a

a) Non-linear device b) Amplifying device c) Linear device d) Fluctuating device

127. The introduction of a grid in a triode valve affects plate current by

a) Making the thermionic emission easier at low temperature
b) Releasing more electrons from the plate
c) Increasing plate voltage
d) Neutralizing space charge

128. The current in the circuit shown in the figure, considering ideal diode is



a) 20 A b) 2×10^{-3} A c) 200 A d) 2×10^{-4} A

129. Which of the following is an amorphous substance?

a) Gold b) Silver c) Copper d) Glass

130. In a properly biased transistor

a) Both depletion layers are equally large
b) Both depletion layers are equally small
c) Emitter-base depletion layer is large but base-collector depletion layer is small
d) Emitter-base depletion layer is small but base-collector depletion layer is large

131. If in a triode valve amplification factor is 20 and plate resistance is 10 kΩ, then its mutual conductance is

a) 2 milli mho b) 20 milli mho c) (1/2) milli mho d) 200 milli mho

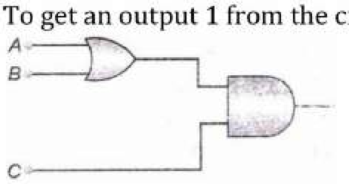
132. On increasing the reverse bias to a large value in a p-n junction, diode current

a) Increases slowly b) Remains fixed c) Suddenly increases d) Decreases slowly

133. If $R_P = 7k\Omega, g_m = 2.5\ millimho$, then on increasing plate voltage by $50V$, how much the grid voltage is changed so that plate current remains the same

a) $-2.86\ V$ b) $-4\ V$ c) $+4\ V$ d) $+2\ V$

134. To get an output 1 from the circuit shown in the figure, the input must be



a) $A = 0, B = 1, C = 0$ b) $A = 1, B = 0, C = 0$ c) $A = 1, B = 0, C = 1$ d) $A = 1, B = 1, C = 0$

135. Boolean algebra is essentially based on

a) Truth b) Logic c) Symbol d) Numbers

136. Choose the correct statement

a) When we heat a semiconductor its resistance increases
b) When we heat a semiconductor its resistance decreases

c) When we cool a semiconductor to 0 K then it becomes super conductor

d) Resistance of a semiconductor is independent of temperature

137. Sodium has body-centred packing. Distance between two nearest atoms is 3.7 Å. The lattice parameter is

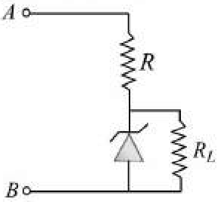
a) 4.8 Å b) 4.3 Å c) 3.9 Å d) 3.3 Å

138. When *n-p-n* 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

139. If the voltage between the terminals A and B is 17 V and Zener breakdown voltage is 9 V, then the potential across R is



a) 6 V b) 8 V c) 9 V d) 17 V

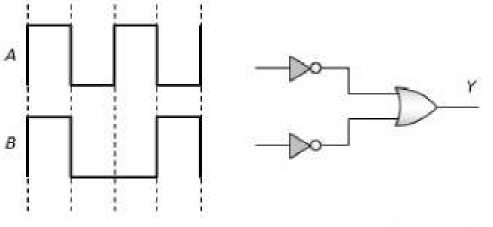
140. The energy gap between conduction band and the valence band is of the order of 0.7 eV. Then it is

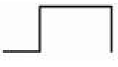
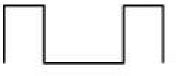
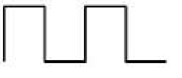
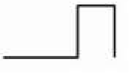
a) An insulator b) A conductor c) A semiconductor d) An alloy

141. In order to rectify an alternating current one uses a

a) Thermocouple b) Diode c) Triode d) Transistor

142. In a given circuit as shown the two input waveforms A and B are applied simultaneously. The resultant waveform Y is

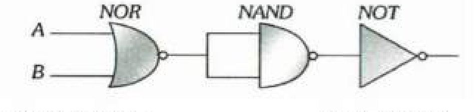


a)  b)  c)  d) 

143. The value of current in a triode valve is given by $I_p = 0.004(V_p + 10V_g)^{3/2}$ mA . When plate potential and grid potential are 120 V and −2V respectively, then the value of mutual conductance will be

a) 600 mho b) 60 mho c) 6 mho d) 6×10^{-4} mho

144. The circuit is equivalent to



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

145. For a triode

a) $\mu = r_p \times g_m$ b) $g_m = \mu \times r_p$ c) $r_p = \mu \times g_m$ d) $\mu = \frac{r_p}{(r_p + g_m)}$

146. *p*-type semiconductor are

a) Positively charged

b) Produced when boron is added as an impurity

c) Produced when phosphorus is added as an impurity to silicon

d) Produced when carbon is added as an impurity to germanium.

147. If n_e and v_d be the number of electrons and drift velocity in a semiconductor. When the temperature is increased

a) n_e increases and v_d decreases b) n_e decreases and v_d increases

c) Both n_e and v_d increases d) Both n_e and v_d decreases

148. If α and β are the current gain in the CB and CE configurations respectively of the transistor circuit, then $\frac{\beta-\alpha}{\alpha\beta}$ is equal

a) Infinite　　b) 1　　c) 2　　d) 0.5

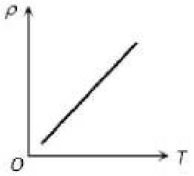
149. The electrical circuit used to get smooth DC output from a rectifier circuit is called

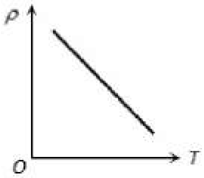
a) Filter　　b) Oscillator　　c) Logic gates　　d) Amplifier

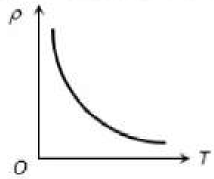
150. The amplification factor of a triode valve is 15. If the grid voltage is changed by 0.3 *volt* the change in plate voltage in order to keep the plate current constant (in volt) is

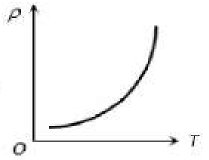
a) 0.02　　b) 0.002　　c) 4.5　　d) 5.0

151. The temperature (T) dependence on resistivity (ρ) of a semiconductor is represented by

a) 

b) 

c) 

d) 

152. Zener breakdown takes place if

a) Doped impurity is low　　b) Doped impurity is high

c) Less impurity in N-part　　d) Less impurity in P-type

153. Identify the logic gate from the following truth table.

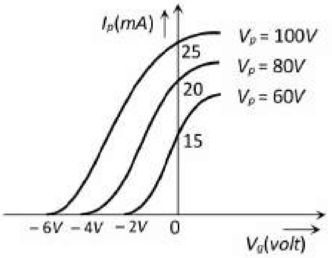
Inputs		Output
A	***B***	***Y***
0	0	1
0	1	0
1	0	0
1	1	0

a) NOR gate　　b) NOT gate　　c) AND gate　　d) NAND gate

154. For a transistor amplifier in common emitter configuration for load impedance of 1 kΩ ($h_{fe} = 50$ and $h_{oe} = 25\ \mu\ \text{AV}^{-1}$), the current gain is

a) −5.2　　b) −15.7　　c) −24.8　　d) −48.78

155. The variation of anode current in a triode corresponding to a change in grid potential at three different values of the plate potential is shown in the diagram. The mutual conductance of the triode is



a) 2.5 *m mho*　　b) 5.0 *m mho*　　c) 7.5 *m mho*　　d) 10.0 *m mho*

156. Avalanche breakdown is due to

a) Collision of minority charge carrier　　b) Increase in depletion layer thickness

c) Decrease in depletion layer thickness　　d) None of these

157. The depletion layer of a p-n junction

a) Is of constant width irrespective of the bias

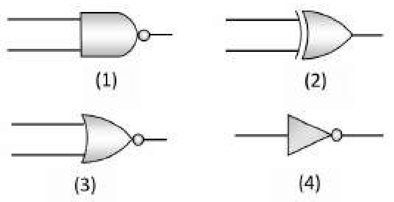
b) Acts like an insulating zone under reverse bias

c) Has a width that increases with an increase in forward bias

d) Is depleted of ions

158. Given below are symbols for some logic gates

The XOR gate and NOR gate respectively are



a) 1 and 2   b) 2 and 3   c) 3 and 4   d) 1 and 4

159. The electrical resistance of depletion layer is large because
a) It has no charge carriers
b) It has a large number of charge carriers
c) It contains electrons as charge carriers
d) It has holes as charge carriers

160. A piece of semiconductor is connected in series in an electric circuit. On increasing the temperature, the current in the circuit will
a) Decrease   b) Remain unchanged   c) Increase   d) Stop flowing

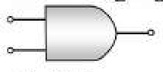
161. In forward bias, the width of potential barrier in a P-N junction diode
a) Increases
b) Decreases
c) Remains constant
d) First increases then decreases

162. Serious draw back of the semiconductor device is
a) They cannot be used with high voltage
b) They pollute the environment
c) They are costly
d) They do not last for long time

163. A Si and a Ge diode has identical physical dimensions. The band gap in Si is larger than that in Ge. An identical reverse bias is applied across the diodes
a) The reverse current in Ge is larger than that in Si
b) The reverse current in Si is larger than that in Ge
c) The reverse current is identical in the two diodes
d) The relative magnitude of the reverse currents cannot be determined from the given data only

164. In the grid circuit of a triode a signal $E = 2\sqrt{2}\cos\omega t$ is applied. If $\mu = 14$ and $r_p = 10\ k\Omega$ then root mean square current flowing through $R_L = 12\ k\Omega$ will be
a) 1.27 mA b) 10 mA c) 1.5 mA d) 12.4 mA

165. Which logic gate is represented by following diagram



a) AND   b) OR   c) NOR   d) XOR

166. In the CB mode of a transistor, when the collector voltage is changed by 0.5 $volt$. The collector current changes by 0.05 mA. The output resistance will be
a) 10 $k\Omega$ b) 20 $k\Omega$ c) 5 $k\Omega$ d) 2.5 $k\Omega$

167. 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) $l_3 > l_1 > l_2$

168. In a n-p-n transistor, the collector current is 10mA. If 90% of the electrons emitted reach the collector, then the emitter current will be
a) 9 mA   b) 11 mA   c) 1 mA   d) 0.1 mA

169. Sum of the two binary numbers $(100010)_2$ and $(11011)_2$ is
a) $(111111)_2$ b) $(101111)_2$ c) $(111001)_2$ d) $(111101)_2$

170. Solids having highest energy level partially filled with electrons are
a) Semiconductor   b) Conductor   c) Insulator   d) None of these

171. The typical ionisation energy of a donor in silicon is
a) $10.0eV$ b) $1.0eV$ c) $0.1eV$ d) $0.001eV$

172. The length of germanium rod is 0.928 cm and its area of cross-section is 1 mm^2. If for germanium $n_i = 2.5 \times 10^{19}\ m^{-3}$, $\mu_h = 0.19\ m^2V^{-1}s^{-1}$, $\mu_e = 0.39\ m^2V^{-1}s^{-1}$
a) 2.5 kΩ   b) 4.0 kΩ   c) 5.0 kΩ   d) 10.0 kΩ

173. When a p-n junction diode is connected in forward bias its barrier potential
a) Decreases and less current flows in the circuit

b) Decreases and more current flows in the circuit
c) Increases and more current flows in the circuit
d) Decreases and no current flows in the circuit

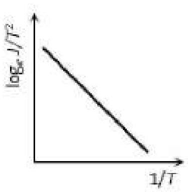
174. The dominant mechanism for motion of charge carriers in forward and reverse biased silicon *P*-*N* junctions are
a) Drift in forward bias, diffusion in reverse bias
b) Diffusion in forward bias, drift in reverse bias
c) Diffusion in both forward and reverse bias
d) Drift in both forward and reverse bias

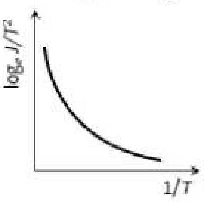
175. In a *PN*-junction
a) *P* and *N* both are at same potential
b) High potential at *N* side and low potential at *P* side
c) High potential at *P* side and low potential at *N* side
d) Low potential at *N* side and zero potential at *P* side

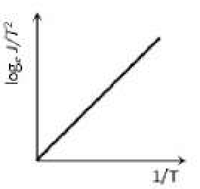
176. Correct relation for triode is
a) $\mu = g_m \times r_p$ b) $\mu = \frac{g_m}{r_p}$ c) $\mu = 2g_m \times r_p$ d) None of these

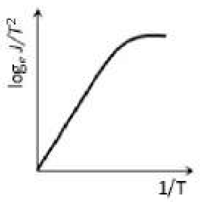
177. A donor impurity result in the
a) Production of n-semiconductor
b) Production of p-semiconductor
c) Increase of resistance of the semiconductor
d) Energy bands just above the filled valency band

178. For a thermionic emitter (metallic) if J represents the current density and T is its absolute temperature then the correct curve between $\log_e \frac{J}{T^2}$ and $\frac{1}{T}$ is

a) 

b) 

c) 

d) 

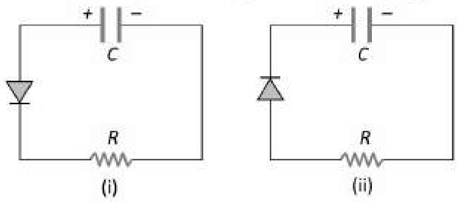
179. The correct relation between the two current gains α and β in a transistor is
a) $\beta = \frac{\alpha}{1+\alpha}$ b) $\alpha = \frac{\beta}{1-\beta}$ c) $\alpha = \frac{\beta}{1+\beta}$ d) $\alpha = \frac{1+\beta}{\beta}$

180. In a diode, when there is a saturation current, the plate resistance will be
a) Data insufficient b) Zero c) Some finite quantity d) Infinite quantity

181. No bias is applied to a *P*-*N* junction, then the current
a) Is zero because the number of charge carriers flowing on both sides is same
b) Is zero because the charge carriers do not move
c) Is non-zero
d) None of these

182. In the case of constants α and β of a transistor
a) $\alpha = \beta$ b) $\beta < 1, \alpha > 1$ c) $\alpha\beta = 1$ d) $\beta > 1, \alpha < 1$

183. Two identical capacitors *A* and *B* are charged to the same potential *V* and are connected in two circuits at $t = 0$, as shown in figure. The charge on the capacitors at time $t = CR$ are respectively



a) VC, VC b) $\frac{VC}{e}, VC$ c) $VC, \frac{VC}{e}$ d) $\frac{VC}{e}, \frac{VC}{e}$

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

a) $1\ MeV$ b) $0.1\ MeV$ c) $1 eV$ d) $5 eV$

185. As n-type and a p-type silicon semiconductor can be obtained by doing pure silicon with

a) Sodium and magnesium
b) Phosphorus and boron respectively
c) Boron and phosphorus respectively
d) Indium and sodium respectively

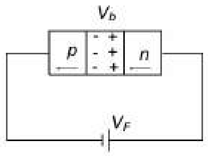
186. At absolute zero, Si acts as

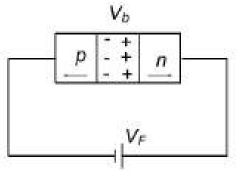
a) Non-metal b) Metal c) Insulator d) None of these

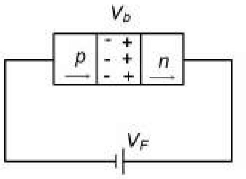
187. For an insulator the forbidden energy gap is

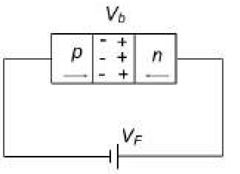
a) Zero b) 1 eV c) 5 eV d) 2 eV

188. In the case of forward biasing of $p-n$ junction, which one of the following figures correctly depicts the direction of flow of carriers?

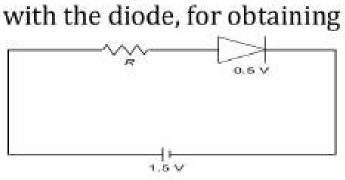
a) 

b) 

c) 

d) 

189. The diode used in the circuit shown in the figure has a constant voltage drop of 0.5 V at all currents and a maximum power rating of 100 milli-watt. What should be the value of the resistance R, connected in series with the diode, for obtaining maximum current?



a) $1.5\ \Omega$ b) $5\ \Omega$ c) $6.67\ \Omega$ d) $200\ \Omega$

190. In a triode amplifier, $\mu = 25, r_p = 40$ kilo ohm and load resistance $R_L = 10$ kilo ohm. If the input signal voltage is 0.5 volt, then output signal voltage will be

a) $1.25\ volt$ b) $5\ volt$ c) $2.5\ volt$ d) $10\ volt$

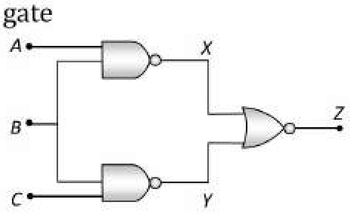
191. The typical ionisation energy of a donar in silicon is

a) 10.0 eV b) 1.0 eV c) 0.1 eV d) 0.001 eV

192. The correct relation between α and β in a transistor is

a) $\beta = \frac{\alpha}{1-\alpha}$ b) $\beta = \frac{\alpha}{1+\alpha}$ c) $\beta = \frac{1+\alpha}{\alpha}$ d) $\beta = 1-\alpha$

193. The figure shows two NAND gates followed by a NOR gate. The system is equivalent to the following logic gate



a) OR b) AND c) NAND d) None of these

194. The forbidden energy band gap in conductors, semiconductors and insulators are EG_1, EG_2 and EG_3 respectively. The relation them is

a) $EG_1 = EG_2 = EG_3$ b) $EG_1 < EG_2 < EG_3$ c) $EG_1 > EG_2 > EG_3$ d) $EG_1 < EG_2 > EG_3$

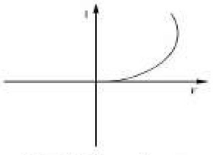
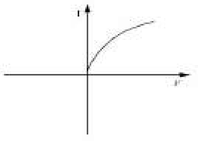
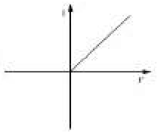
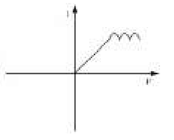
195. The main cause of zener breakdown is

a) The base semiconductor being germanium
b) Production of electron-hole pairs due to thermal excitation

c) Low doping
d) High doping

196. A transistor oscillator is
(i) An amplifier with positive feedback
(ii) An amplifier with reduced gain
(iii) The one in which DC supply energy is converted into AC output energy. Then
a) All (i), (ii) and (iii) are correct
b) (i) and (ii) are correct
c) (i) and (iii) are correct
d) (ii) and (iii) are correct

197. Different voltages are applied across a *p-n* junction and the currents are measured from each value. Which of the following graphs is obtained between voltage and current?

a) 
b) 
c) 
d) 

198. The depletion layer of a *p-n* junction
a) Is of constant width irrespective of the bias
b) Acts like an insulating zone under reverse bias
c) Has a width that increases with an increase in forward bias
d) Is depleted of ions

199. To write the decimal number 37 in binary, how many binary digits are required
a) 5
b) 6
c) 7
d) 4

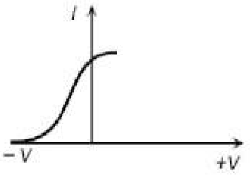
200. A pure semiconductor behaves slightly as a conductor at
a) Room temperature
b) Low temperature
c) High temperature
d) Both (b) and (c)

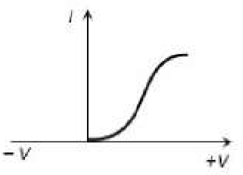
201. In *P-N* junction, avalanche current flows in circuit when biasing is
a) Forward
b) Reverse
c) Zero
d) Excess

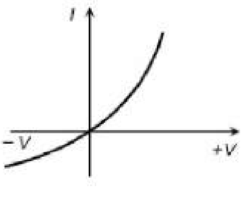
202. The nearest distance between two atoms in case of a bcc lattice is equal to
a) $\frac{a\sqrt{2}}{3}$
b) $\frac{a\sqrt{3}}{2}$
c) $a\sqrt{3}$
d) $\frac{a}{\sqrt{2}}$

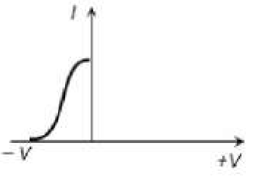
203. Doping of a semiconductor (with small traces of impurity atoms) generally changes the resistivity as follows
a) Does not alter
b) Increases
c) Decreases
d) May increase or decrease depending on the dopant

204. Different voltages are applied across a *P-N* junction and the currents are measured for each value. Which of the following graphs is obtained between voltage and current

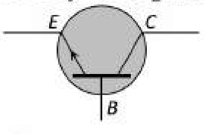
a) 

b) 

c) 

d) 

205. The symbol given in figure represents

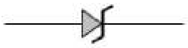
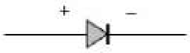
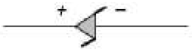
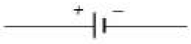


a) *NPN* transistor
b) *PNP* transistor
c) Forward biased *PN* junction diode
d) Reverse biased *NP* junction diode

206. While using triode as an amplifier, we avoid making the grid positive because,
a) The mutual characteristics is not straight
b) It affects the amplification factor

c) It decreases the plate current
d) Of some different reason

207. In an unbiased p-n junction
a) Potential at p is more than that at n
b) Potential at p is less than that at n
c) Potential at p is equal to that at n
d) Potential at p is +ve and that at n is −ve

208. The correct symbol for zener diode is
a) 
b) 
c) 
d) 

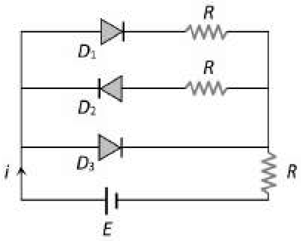
209. The coordination number of Cu is
a) 1
b) 6
c) 8
d) 12

210. Wires P and Q have the same resistance at ordinary (room) temperature. When heated, resistance of P increases and that of Q decreases. We conclude that
a) P and Q are conductors of different materials
b) P is N-type semiconductor and Q is P-type semiconductor
c) P is semiconductor and Q is conductor
d) P is conductor and Q is semiconductor

211. 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 forward 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 semiconductor used

212. In n-p-n transistor, in CE configuration
(1) The emitter is heavily doped than the collector.
(2) Emitter and collector can be interchanged.
(3) The base region is very thin but is heavily doped.
(4) The conventional current flows from base to emitter.
a) (1) and (2) are correct
b) (1) and (3) are correct
c) (1) and (4) are correct
d) (2) and (3) are correct

213. In the following circuit of PN junction diodes D_1, D_2 and D_3 are ideal then i is



a) E/R
b) $E/2R$
c) $2E/3R$
d) Zero

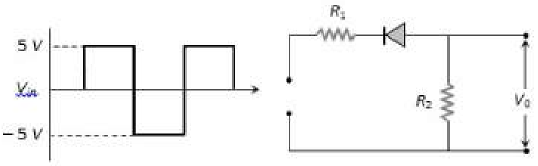
214. The resistivity of a semiconductor at room temperature is in between
a) 10^{-2} to 10^{-5} Ω cm
b) 10^{2} to 10^{6} Ω cm
c) 10^{6} to 10^{8} Ω cm
d) 10^{10} to 10^{12} Ω cm

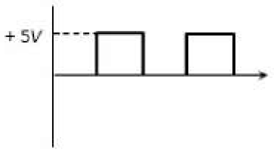
215. Least doped region in a transistor
a) Either emitter or collector
b) Base
c) Emitter
d) Collector

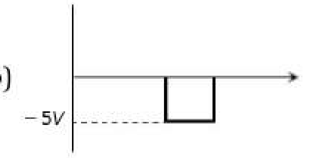
216. When a silicon PN junction is in forward biased condition with series resistance, it has knee voltage of 0.6 V. Current flow in it is 5 mA, when PN junction is connected with 2.6V battery, the value of series resistance is
a) 100 Ω
b) 200 Ω
c) 400 Ω
d) 500 Ω

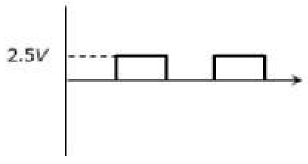
217. The laptop PC's modern electronic watches and calculators use the following for display
a) Single crystal
b) Poly crystal
c) Liquid crystal
d) Semiconductors

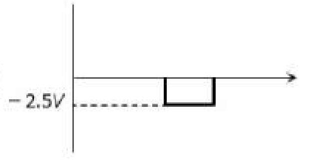
218. A waveform shown when applied to the following circuit will produce which of the following output waveform? Assuming ideal diode configuration and $R_1 = R_2$



a) 

b) 

c) 

d) 

219. In NPN transistor, 10^{10} electrons enter in emitter region in $10^{-6}s$. If 2% electrons are lost in base region then collector current and current amplification factor (β) respectively are

a) 1.57 mA, 49 b) 1.92 mA, 70 c) 2 mA, 25 d) 2.25 mA, 100

220. A strip of copper and another of germanium are cooled from room temperature to 80 K. the resistance of

a) Each of these decreases
b) Copper strip increases and that of germanium decreases
c) Copper strip decreases and that of germanium increases
d) Each of the above increases

221. Let i_e, i_c and i_b represent emitter current, collector current and the base current of a transistor, then

a) $i_c > i_e$ b) $i_b > i_c$ c) $i_b > i_c$ d) $i_e > i_c$

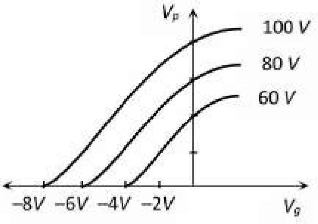
222. In a full wave rectifiers, input ac current has a frequency 'v'. The output frequency of current is

a) $v/2$ b) v c) $2v$ d) None of these

223. Zener diode is used as

a) Half wave rectifier b) Full wave rectifier c) Ac voltage stabilizer d) Dc voltage stabilizer

224. The value of amplification factor from the following graph will be

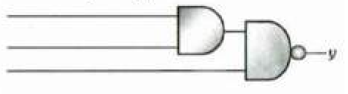


a) 10 b) 50 c) 25 d) 40

225. Boolean expression for OR gate is

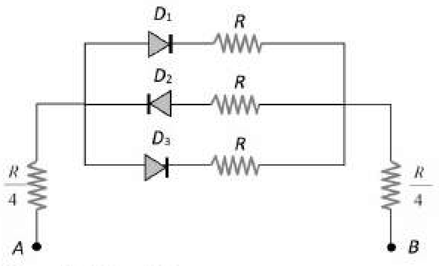
a) $Y = A.B$ b) $Y = \bar{A} + \bar{B}$ c) $Y = A + B$ d) $Y = \bar{A}$

226. The output y, when all three inputs are first high and then low, will respectively be



a) 1, 0 b) 1, 1 c) 0, 0 d) 0, 1

227. In the following circuits PN-junction diodes D_1, D_2 and D_3 are ideal for the following potentials of A and B. The correct increasing order of resistance between A and B will be



(i) $-10\,V, -5V$

(ii) $-5V, -10\,V$

(ii) $-4V, -12V$

a) (i) < (ii) < (iii) b) (iii) < (ii) < (i) c) (ii) = (iii) < (i) d) (i) = (iii) < (ii)

228. The reverse bias in a junction diode is changed from 8 V to 13 V then the value of the current charges from 40 μA to 60 μA. The resistance of junction diode will be

a) $2 \times 10^5 \Omega$ b) $2.5 \times 10^5 \Omega$ c) $3 \times 10^5 \Omega$ d) $4 \times 10^5 \Omega$

229. Pure sodium (Na) is a good conductor of electricity because the 3s and 3p atomic bands overlap to form a partially filled conduction band. By contrast the ionic sodium chloride ($NaCl$) crystal is

a) Insulator b) Conductor c) Semiconductor d) None of these

230. A silicon diode has a threshold voltage of 7 V. If an input voltage given by 2 sin ($\pi\ t$) is supplied to a half-wave rectifier circuit using this diode, the rectified output has a peak value of

a) 2 V b) 1.4 V c) 1.3 V d) 0.7 V

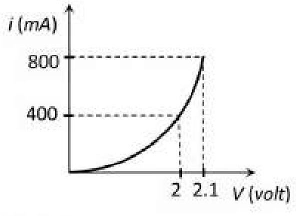
231. If the forward voltage in a semiconductor diode is doubled, the width of the depletion layer will

a) Become half b) Become one-fourth c) Remain unchanged d) Become double

232. Which of the following logic gate is an universal gate

a) OR b) NOT c) AND d) NOR

233. The i-V characteristic of a P-N junction diode is shown below. The approximate dynamic resistance of the P-N junction when a forward bias of 2$volt$ is applied\

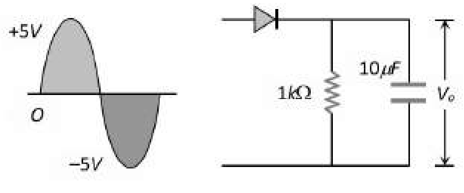


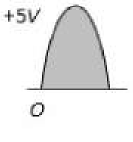
a) 1 Ω b) 0.25 Ω c) 0.5 Ω d) 5 Ω

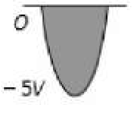
234. In a reverse biased diode when the applied voltage changes by 1 V, the current is found to change by 0.5 μA. The reverse bias resistance of the diode is

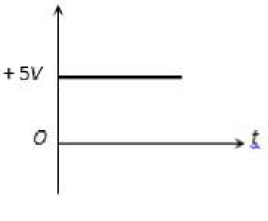
a) $2 \times 10^5\ \Omega$ b) $2 \times 10^6\ \Omega$ c) 200 Ω d) 2 Ω

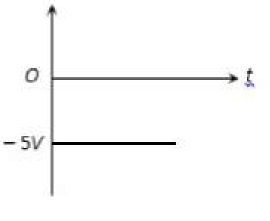
235. The output in the circuit of figure is taken across a capacitor. It is as shown in figure



a) 

b) 

c) 

d) 

236. The valence of an impurity added to germanium crystal in order to convert it into a P-type semi conductor is

a) 6 b) 5 c) 4 d) 3

237. What makes the crystalline solids have a sharp melting point?

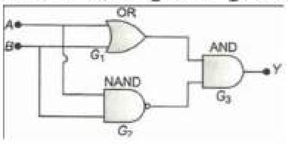
a) Anisotropic nature

b) Long range order of the constituent atoms/ ions/molecules

c) Equal strength of all the interatomic bonds

d) None of the above

238. The following configuration of gate is equivalent to figure.



a) NAND b) XOR c) OR d) None of these

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

a) 0, 0 b) 0, 1 c) 1, 0 d) 1, 1

240. Energy bands in solids are a consequence of

a) Ohm's law b) Pauli's exclusion principle

c) Bohr's theory d) Heisenberg's uncertainty principle

241. When the two inputs of a NAND gate are shorted, the resulting gate is

a) NOR b) OR c) NOT d) AND

242. Coating of strontium oxide on tungsten cathode in a valve is good for thermionic emission because

a) Work function decreases

b) Work function increases

c) Conductivity of cathode increases

d) Cathode can be heated to high temperature

243. Diode is not considered as linear device because

a) The value of plate current is not directly proportional to the plate voltage

b) When plate voltage is zero, plate current also becomes zero

c) Plate and cathode are not in a straight line

d) None of the above

244. In case of a semiconductor, which of the following statement is wrong

a) Doping increases conductivity

b) Temperature coefficient of resistance is negative

c) Resistivity is in between that of a conductor and insulator

d) At absolute zero temperature, it behaves like a conductor

245. Diode is used as a/an

a) Oscillator b) Amplifier c) Rectifier d) Modulator

246. In a triode valve

a) If the grid voltage is zero then plate current will be zero

b) If the temperature of filament is doubled, then the thermionic current will also be doubled

c) If the temperature of filament is doubled, then the thermionic current will nearly be four times

d) At a definite grid voltage the plate current varies with plate voltage according to Ohm's law

247. In a P-type semi-conductor, germanium is dopped with

a) Gallium b) Boron c) Aluminium d) All of these

248. The current gain of a common base transistor circuit is 0.96. On changing the emitter current by 10.0 mA, the change in the base current will be

a) 9.6 mA b) 0.4 mA c) 19.6 mA d) 24 mA

249. An n-p-n transistor power amplifier in CE configuration gives

a) Voltage amplification only

b) Currents amplification only
c) Both current and voltage amplifications
d) Only power gain of unity

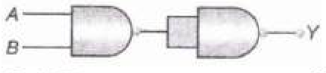
250. Why is there sudden increase in current in zener diode?
a) Due to rupture of bonds
b) Resistance of depletion layer becomes less
c) Due to high doping
d) None of the above

251. The energy gap of silicon is 1.14 eV. At what wavelength the silicon will stop to absorb the photon?
a) 10877 Å b) 9888 Å c) 1087.7 Å d) 1000 Å

252. LED is a p-n junction diode which is
a) Forward biased
b) Either forward biased or reverse biased
c) Reverse biased
d) Neither forward biased nor reverse biased

253. The slope of plate characteristic of a vacuum diode is $2 \times 10^{-2} mA/V$. The plate resistance of diode will be
a) 50 Ω b) 50 $k\Omega$ c) 500 Ω d) 500 $k\Omega$

254. The combination of the following gates produces



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

255. The impurity atom added to germanium to make it N-type semiconductor is
a) Arsenic b) Iridium c) Aluminium d) Iodine

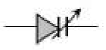
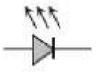
256. A PN-junction has a thickness of the order of
a) 1cm b) 1mm c) $10^{-6}m$ d) $10^{-12}cm$

257. In a common-emitter configuration of a transistor, the base current $I_b = 2\mu$A, $\beta = 0.9$ then $I_c = ?$
a) 3.0 μA b) 2.25 μA c) 4.9 μA d) 1.8 μA

258. Plate current in a diode depends
a) Only on plate potential
b) Only on area of plate
c) Only on temperature of cathode
d) On plate potential and temperature of cathode

259. The temperature coefficient of resistance of a conductor is
a) Positive always b) Negative always c) Zero d) Infinite

260. The value of ripple factor for full wave rectifier is
a) 40.6% b) 48.2% c) 81.2% d) 121%

261. Symbolic representation of photodiode is
a)  b)  c)  d) 

262. A $n-p-n$ transistor having a.c. current gain of 50 is to be used to make an amplifier of power gain of 300. What will be the voltage gain of the amplifier
a) 8.5 b) 6 c) 4 d) 3

263. In a P-type semiconductor
a) Current is mainly carried by holes
b) Current is mainly carried by electrons
c) The material is always positively charged
d) Doping is done by pentavalent material

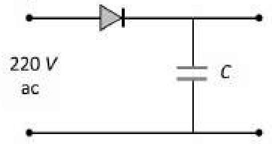
264. The Fermi level of an intrinsic semiconductor is pinned at the centre of the band gap. The probability of occupation of the highest electron state in valence band at room temperature, will be

a) Zero	b) Between zero half	c) Half	d) One

265. Mutual conductance of triode is 2 $m\Omega^{-1}$ and the amplification factor is 50. Its anode is connected with a source of 250 V and a resistance of 25 kΩ. The voltage gain of this amplifier is

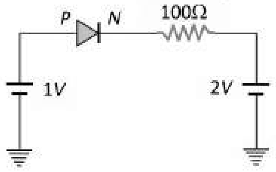
a) 12.5	b) 10	c) 25	d) 50

266. A diode is connected to 220 V $(rms)ac$ in series with a capacitor as shown in figure. The voltage across the capacitor is



a) 220 V	b) 110 V	c) 311.1 V	d) $\frac{220}{\sqrt{2}}V$

267. The current through an ideal PN-junction shown in the following circuit diagram will be



a) Zero	b) 1 mA	c) 10 mA	d) 30 mA

268. Donor type impurity is found in

a) Trivalent elements	b) Pentavalent elements	c) In both the above	d) None of these

269. The maximum efficiency of full wave rectifier is

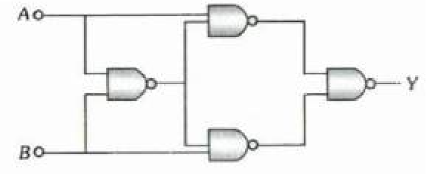
a) 100 %	b) 25.20 %	c) 40.6 %	d) 81.2 %

270. In an experiment, the saturation in the plate current in a diode is observed at 240V. But a student still wants to increase the plate current. It can be done, if

a) The plate voltage is increased further	b) The plate voltage is decreased

c) The filament current is decreased	d) The filament current is increased

271. Truth table for system of four NAND gates as shown in figure is



a)

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	0

b)

A	B	C
0	0	0
0	1	0
1	0	1
1	1	1

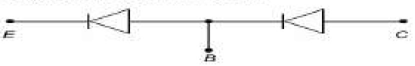
c)

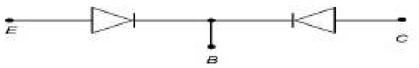
A	B	Y
0	0	1
0	1	1
1	0	0
1	1	0

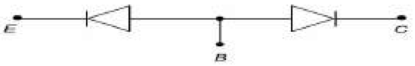
d)

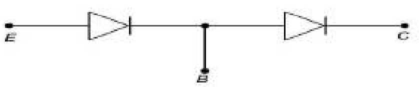
A	B	Y
0	0	1
0	1	0
1	0	0
1	1	1

272. An n-p-n transistor can be considered to be equivalent to two diodes, connected. Which of the following figures is the correct one?

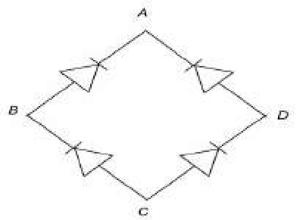
a) 

b) 

c) 

d) 

273. For the given circuit shown below, to act as full wave rectifier, the AC input should be connected across ………… and ……….. and the DC. output would appear across ……….. and ………… .

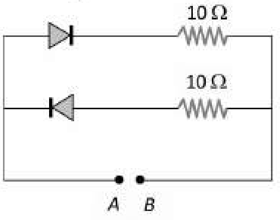


a) B and D and A and C b) B and A and C and D c) C and A and B and D d) C and D and B and A

274. In the depletion region of an unbiased P-N junction diode there are
a) Only electrons
b) Only holes
c) Both electrons and holes
d) Only fixed ions

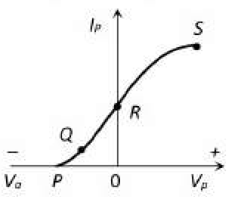
275. The addition of antimony atoms to a sample of intrinsic germanium transforms it to a material which is
a) Superconductor
b) An insulator
c) N-type semiconductor
d) P-type semiconductor

276. A $2V$ battery is connected across the points A and B as shown in the figure given below. Assuming that the resistance of each diode is zero in forward bias and infinity in reverse bias, the current supplied by the battery when its positive terminal is connected to A is



a) 0.2 A b) 0.4 A c) Zero d) 0.1 A

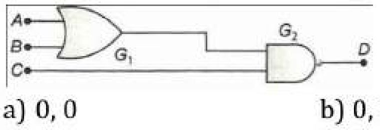
277. The point representing the cut off grid voltage on the mutual characteristic of triode is



a) S b) R c) O d) P

278. According to Bravis, the number of possible space lattice is
a) 18 b) 16 c) 14 d) 10

279. For the given combination of gates, if the logic states of inputs A, B, C are as follows $A = B = C = 0$ and $A = B = 1, C = 0$, then the logic states of output D are



a) 0, 0 b) 0, 1 c) 1, 0 d) 1, 1

280. Which one of the following statement is FALSE
a) The resistance of intrinisic semiconductor decreases with increase of temperature
b) Pure SI doped with trivalent impurities gives a p-type semiconductor
c) Majority carriers in a n-type semiconductor are holes
d) Minority carriers in a p-type semiconductor are electrons

281. The given truth table is of

A	X
0	1
1	0

a) OR gate b) AND gate c) NOT gate d) None of above

282. 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) $N_P = N_e$
c) $N_P < N_e$
d) $N_P > N_e$ or $N_P < N_e$ depending on the nature of impurity

283. If lattice parameter for a crystalline structure is 3.6 Å, then atomic radius is fcc crystal in Å is
a) 7.20 b) 1.80 c) 1.27 d) 2.90

284. The team liquid crystal refers to a state that is intermediate between
a) Crystalline solid and amorphous liquid
b) Crystalline solid and vapour
c) Amorphous liquid and its vapour
d) A crystal immersed in a liquid

285. Number of secondary electrons emitted per number of primary electrons depends on
a) Material of target
b) Frequency of primary electrons
c) Intensity
d) None of the above

286. A common emitter amplifier is designed with NPN transistor ($\alpha = 0.99$). The input impedance is 1 $K\Omega$ and load is 10 $K\Omega$. The voltage gain will be
a) 9.9 b) 99 c) 990 d) 9900

287. Identify the incorrect statement regarding a superconducting wire
a) Transport current flows through its surface
b) Transport current flows through the entire area of cross-section of the wire
c) It exhibits zero electrical resistivity and expels applied magnetic field
d) It is used to produce large magnetic field

288. In a diode valve, the state of saturation can be obtained easily by
a) High plate voltage and high filament current
b) Low filament current and high plate voltage
c) Low plate voltage and high cathode temperature
d) High filament current and high plate voltage

289. In a $p-n$ junction diode
a) The current in the reverse biased condition is generally very small
b) The current in the reverse biased condition is small but the forward biased current is independent of the bias voltage
c) The reverse biased current is strongly dependent on the applied bias voltage
d) The forward biased current is very small in comparison to reverse biased current

290. The concentration of impurities in a transistor are
a) Equal for the emitter, base and collector regions
b) Least for the emitter region
c) Largest for the emitter region
d) Largest for the base region

291. A material has N atom in its crystal structure which is a hexagonal close packed. Then the number of electronic states in a band is
a) N b) 2 N c) 4 N d) 6 N

292. In a pure silicon ($n_i = 10^{16}/m^3$) crystal at 300 K, 10^{21} atoms of phosphorus are added per cubic meter. The new hole concentration will be
a) 10^{21} per m^3 b) 10^{19} per m^3 c) 10^{11} per m^3 d) 10^5 per m^3

293. The transfer ratio of a transistor is 50. The input resistance of the transistor when used in the common emitter configuration is 1 $K\Omega$. The peak value for an A.C input voltage of 0.01 V of collector current is
a) 100 μA b) 0.01 mA c) 0.05 mA d) 500 μA

294. A potential barrier of 0.50 V exists across a P-N junction. If the depletion region is 5.0×10^{-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) $2.0 \times 10^6 V/m$

295. The probability of electrons to be found in the conduction band of an intrinsic semiconductor at a finite temperature
a) Decreases exponentially with increasing band gap

b) Increases exponentially with increasing band gap
c) Decreases with increasing temperature
d) Is independent of the temperature and the band gap

296. In a triode, $g_m = 2 \times 10^{-3}$ ohm^{-1}; $\mu = 42$, resistance load, $R = 50$ kΩ. The voltage amplification obtained from this triode will be
a) 30.42 b) 29.57 c) 28.18 d) 27.15

297. Which of the following statements is not true
a) The resistance of intrinsic semiconductors decrease with increase of temperature
b) Doping pure *Si* with trivalent gives *P*-types semiconductors
c) The majority carriers in *N*-type semiconductors are holes
d) A *PN*-junction can act as a semiconductor diode

298. In a triode valve, the plate resistance is 10000 Ω and the anode load resistance is 30000 Ω. If the amplification factor is 36, then the voltage gain is
a) 9 b) 27 c) 36 d) 108

299. Identify the property which is not characteristic for a semiconductor?
a) At a very low temperature, it behaves like an insulator
b) At high temperature two types of charge carriers will cause conductivity
c) The charge carriers are electrons and holes in the valence band at higher temperatures
d) The semiconductor is electrically neutral

300. When A is the internal stage gain of an amplifier and β is the feedback ratio, then the amplifier becomes as oscillator if
a) β is negative and magnitude of $\beta = A/2$
b) β is negative and magnitude of $\beta = 1/A$
c) β is negative and magnitude of $\beta = A$
d) β is positive and magnitude of $\beta = 1/A$

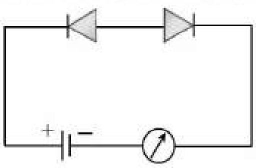
301. The grid in a triode valve is used
a) To increases the thermionic emission
b) To control the plate to cathode current
c) To reduce the inter-electrode capacity
d) To keep cathode at constant potential

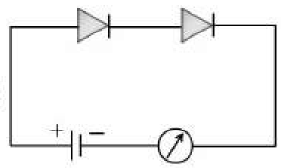
302. A transistor has $\beta = 40$. A charge in base current of 100 μA, produces change in collector current
a) 40×100 μA b) $(100 - 40)$μA c) $100 + 40$ μA d) $100 \times/40$ μA

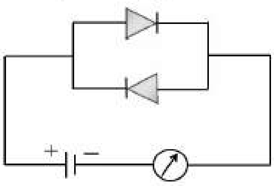
303. In a fcc lattice structure, what is the effective number of atoms?
a) 4 b) 3 c) 2 d) 1

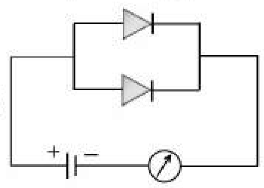
304. The band gap in germanium and silicon in eV respectively is
a) 0.7, 1.1 b) 1.1, 0.7 c) 1.1, 0 d) 0, 1.1

305. Which circuit will not show current in ammeter

a)


b)


c)


d)


306. The value of current in the following diagram will be

a) Zero b) 10^{-2} A c) 10 A d) 0.025 A

307. Radiowaves of constant amplitude can be generated with

a) FET b) Filter c) Rectifier d) Oscillator

308. The plate current in a triode is given by

$I_p = 0.004\,(V_p + 10V_g)^{3/2} mA$

Where I_p, V_p and V_g are the values of plate current, plate voltage and grid voltage, respectively. What are the triode parameters μ, r_p and g_m for the operating point at $V_p = 120\ volt$ and $V_g = -2\ volt$

a) $10, 16.7\ k\Omega, 0.6\ m\ mho$ b) $15, 16.7\ k\Omega, 0.06\ m\ mho$
c) $20, 6\ k\Omega, 16.7\ m\ mho$ d) None of these

309. In $p-n$ junction, the barrier potential offers resistance to

a) Free electrons in n-region and holes in –region
b) Free electrons in p-region and holes in n-region
c) Only free electrons in n-region
d) Only holes in p-region

310. When the plate voltage of a triode is 150V, its cut-off voltage is -5 V. On increasing the plate voltage to 200 V, the cut-off voltage can be

a) -4.5 V b) -5.0 V c) -2.3 V d) -6.66 V

311. Resistivity of a semiconductor depends on

a) Shape of semiconductor
b) Atomic nature of semiconductor
c) Length of semiconductor
d) Shape and atomic nature of semiconductor

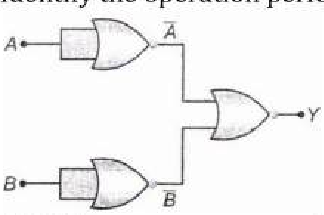
312. The valency of the impurity atom that is to be added to germanium crystal so as to make it a N-type semiconductor, is

a) 6 b) 5 c) 4 d) 3

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

a) n –type 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 $n_e = 5 \times 10^{22} m^{-3}$
d) p –type with electron concentration $n_e = 2.5 \times 10^{10} m^{-3}$

314. Identify the operation performed by the circuit given in the figure.



a) NOT b) AND c) OR d) NAND

315. For germanium crystal, the forbidden energy gap in joules is

a) 1.12×10^{-19} b) 1.76×10^{-19} c) 1.6×10^{-19} d) Zero

316. Absorption of X-Rays is maximum in which of the following material sheet of same thickness

a) Cu b) Au c) Be d) Pb

317. Current gain β_{AC} common emitter mode of transistor is

a) $\beta_{AC} = \left(\frac{\Delta I_C}{\Delta I_B}\right), V_C =$ constant b) $\beta_{AC} = \left(\frac{\Delta I_B}{\Delta I_C}\right), V_C =$ constant
c) $\beta_{AC} = \left(\frac{\Delta I_C}{\Delta I_E}\right), V_C =$ constant d) $\beta_{AC} = \left(\frac{\Delta I_E}{\Delta I_C}\right), V_C =$ constant

318. When boron is added as an impurity to silicon, the resulting material is

a) n-type semiconductor b) n-type conductor
c) p-type conductor d) p-type semiconductor

319. Reverse bias applied to a p-n junction diode

a) Lowers the potential barrier
b) Decreases the majority charge carries
c) Raises the potential barrier
d) Change the mass of p-n junction diode

320. The peak voltage in the output of a half-wave diode rectifier fed with a sinusoidal signal without filter is $10\ V$. The dc compound of the output voltage is

a) $10/\sqrt{2}\ V$ b) $10/\pi\ V$ c) $10\ V$ d) $20/\pi\ V$

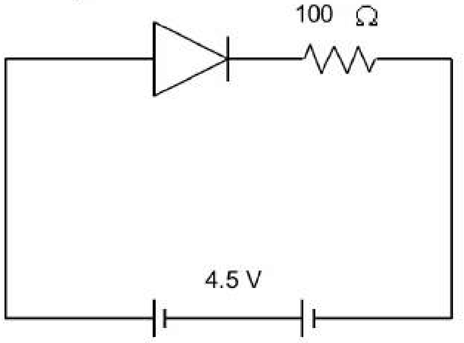
321. Which of the following is not equal to 1 in Boolean algebra?

a) $\overline{A \cdot \overline{A}}$ b) $A \cdot \overline{A}$ c) $A + \overline{A}$ d) $A + 1$

322. The electrical conductivity of an intrinsic semiconductor at 0 K is

a) Less than that of an insulator b) Is equal to zero
c) Is equal to infinity d) More than that of an insulator

323. Figure shows a diode connected to an external resistance and an emf. Assuming that the barrier potential developed in diode is 0.5 V, obtain the value of current in the circuit in milli ampere.



a) 40 mA b) 60 mA c) 80 mA d) 100 mA

324. Based on the energy band description, a solid can be classified as a semiconductor if the energy gap between the valence band and conduction band is

a) $3eV < E_g < 6\ eV$ b) $E_g > 6\ eV$ c) $E_g < 3\ eV$ d) $E_g = 0eV$

325. If the ends p and n of $p - n$ diode 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 will not be a current depending upon the resistance of the connecting wire

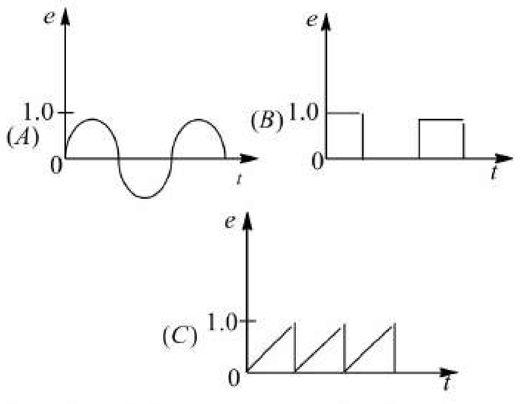
326. Which of the following materials in non crystalline

a) Copper b) Sodium chloride c) Wood d) Diamond

327. The correct relation between n_e and n_h in an intrinsic semiconductor at ordinary temperature is

a) $n_e > n_h$ b) $n_e < n_h$ c) $n_e = n_h$ d) $n_e = n_h = 0$

328. The time variations of signals are given as in A, B and C. Point out the true statement from the following.

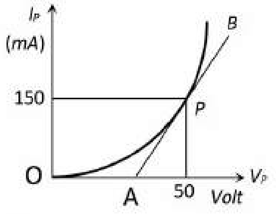


a) A, B and C are analogue signals

b) A and B are analogue, but C is digital signal
c) A and C digital, but B is analogue signal
d) A and C are analogue but B is digital signal

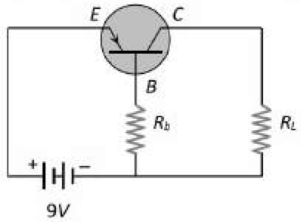
329. The reverse biasing in a PN junction diode
a) Decreases the potential barrier
b) Increases the potential barrier
c) Increases the number of minority charge carriers
d) Increases the number of majority charge carriers

330. The plate characteristic curve of a diode in space charge limited region is as shown in the figure. The slope of curve at point P is 5.0 mA/V. The static plate resistance of diode will be



a) 111.1Ω b) 222.2Ω c) 333.3Ω d) 444.4Ω

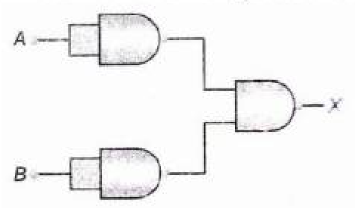
331. In a transistor circuit shown here the base current is 35 μA. The value of the resistor R_b is



a) 123.5 $k\Omega$ b) 257 $k\Omega$ c) 380.05 $k\Omega$ d) None of these

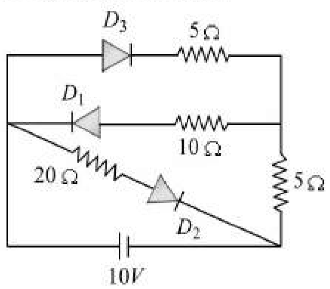
332. When forward bias is applied to a P-N junction, then what happens to the potential barrier V_B, and the width of charge depleted region x
a) V_B increases, x decreases
b) V_B decreases, x increases
c) V_B increases, x increases
d) V_B decreases, x decreases

333. The combination of gates shown below yields



a) OR gate b) NOT gate c) XOR gate d) NAND gate

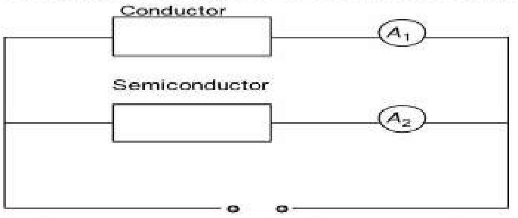
334. In the given circuit



The current through the battery is
a) 0.5 A b) 1 A c) 1.5 A d) 2 A

335. To obtain electrons as majority charge carriers in a semiconductor, the impurity mixed is
a) Monovalent b) Divalent c) Trivalent d) Pentavalent

336. A conductor and a semiconductor are connected in parallel as shown in the figure. At a certain voltage both ammeters register the same current. If the voltage of the DC source is increased then the

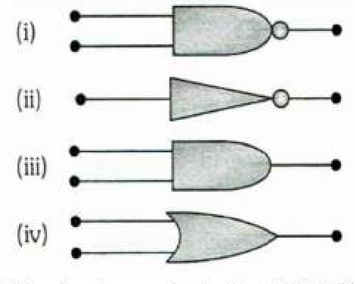


a) Ammeter connected to the semiconductor will register higher current than the ammeter connected to the conductor
b) Ammeter connected to the conductor will register higher current than the ammeter connected to the semiconductor
c) Ammeters connected to both semiconductor and conductor will register the same current
d) Ammeters connected to both semiconductor and conductor will register no change in the current

337. Platinum and silicon are heated upto 250°C and after that cooled. In the process of cooling
a) Resistance of platinum will increase and that of silicon will decrease
b) Resistance of silicon will increase and that of platinum will decrease
c) Resistance of both will increase
d) Resistance of both will decrease

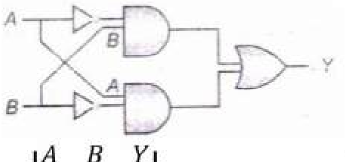
338. Consider the following statements A and B and identify the correct choice of the given answers
A. The width of the depletion layer in a P-N junction diode increases in forward bias
B. In an intrinsic semiconductor the fermi energy level is exactly in the middle of the forbidden gap
a) A is true and B is false
b) Both A and B are false
c) A is false and B is true
d) Both A and B are true

339. The symbolic representation of four logic gates are given below



The logic symbols for OR, NOT and NAND gates are respectively
a) (iii), (iv), (ii)
b) (iv), (i), (iii)
c) (iv), (ii), (i)
d) (i), (iii), (iv)

340. The truth table for the following logic circuit is



a)

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	0

b)

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	1

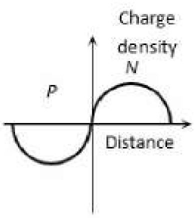
c)

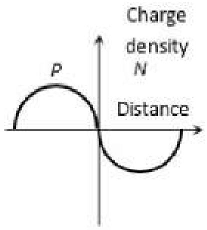
A	B	Y
0	0	1
0	1	0
1	0	1
1	1	0

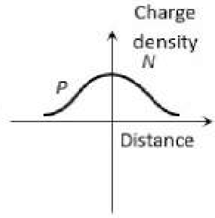
d)

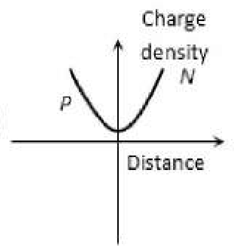
A	B	Y
0	0	1
0	1	1
1	0	0
1	1	1

341. The curve between charge density and distance near P-N junction will be

a) 

b) 

c) 

d) 

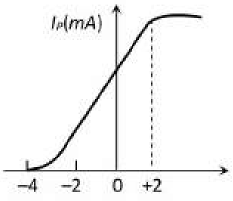
342. The crystal structure can be studied by using

a) *UV* raus b) *X*-rays c) *IR* radiation d) Microwaves

343. The plate resistance of a triode is $2.5 \times 10^4 \Omega$ and mutual conductance is 2×10^{-3} *mho*. What will be the value of amplification factor

a) 50 b) 1.25×10^7 c) 75 d) 2.25×10^7

344. The mutual characteristic curves of a triode are as shown in figure. The cut off voltage for the triode is



a) 0 V b) 2 V c) −4 V d) 6 V

345. 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

346. Although carbon, silicon and germanium have same lattice structure and four valence electrons each, their band structure leads to the energy gaps as

a) $E_g(Si) < E_g(Ge) < E_g(C)$ b) $E_g(Si) > E_g(Ge) < E_g(C)$

c) $E_g(Si) < E_g(Ge) > E_g(C)$ d) $E_g(Si) > E_g(Ge) > E_g(C)$

347. Barrier potential of a *p-n* junction diode does not depend on

a) Forward bias b) Doping density c) Diode design d) Temperature

348. The nature of binding for a crystal with alternate and evenly spaced positive and negative ions is

a) Covalent b) Metallic c) Dipolar d) Ionic

349. The binary number 10111 is equivalent to the decimal number

a) 19 b) 31 c) 23 d) 22

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

a) In case of C the valance 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 electrons 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

351. The work function of oxide coated tungsten metal will be

a) 0.5 eV b) 1.0 eV c) 2.6 eV d) 4.5 eV

352. A logic gate is an electronic circuit which

a) Makes logic decisions b) Allows electrons flow only in one direction

c) Works binary algebra d) Alternates between 0 and 1 values

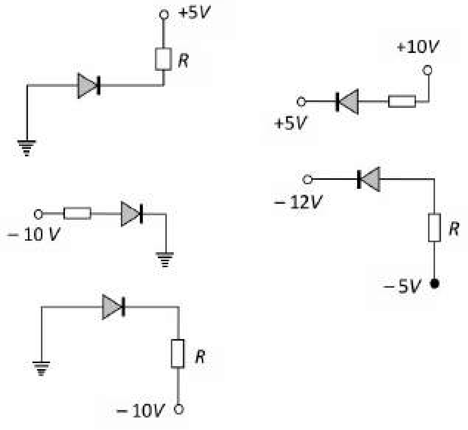
353. Consider the junction diode is ideal. The value of current in the figure is

a) Zero b) 10^{-2}A c) 10^{-1}A d) 10^{-3}A

354. A crystal has bcc structure and its lattice constant is 3.6 Å. What is the atomic radius?

a) 3.6 Å b) 1.8 Å c) 1.27 Å d) 1.567 Å

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



a) 1, 2, 3 b) 2, 4, 5 c) 1, 3, 4 d) 2, 3, 4

356. In space charge limited region, the plate current in a diode is 10 mA for plate voltage 150 V. If the plate voltage is increased to 600 V, then the plate current will be

a) 10 mA b) 40 mA c) 80 mA d) 160 mA

357. If D_e , D_b and D_c are the doping levels of emitter, base and collector respectively of a transistor, then

a) $D_e = D_b = D_c$ b) $D_e < D_b = D_c$ c) $D_e > D_b > D_c$ d) $D_e > D_c > D_b$

358. On applying a potential of -1 $volt$ at the grid of a triode, the following relation between plate voltage V_p ($volt$) and plate current I_p (in mA) is found $I_p = 0.125\ V_p - 7.5$. If on applying -3 $volt$ potential at grid and 300 V potential at plate, the plate current is found to be 5mA, then amplification factor of the triode is

a) 100 b) 50 c) 30 d) 20

359. A transistor has a base current of 1 mA and emitter current 90 mA. The collector current will be

a) 90 mA b) 1 mA c) 89 mA d) 91 mA

360. Suitable impurities are added to a semiconductor depending on its use. This is done to

a) Increase its life
b) Enable it to withstand high voltage
c) Increase its electrical conductivity
d) Increase its electrical resistivity

361. For a transistor, the current amplification factor is 0.8. The transistor is connected in common emitter configuration. The charge in the collector current when the base current changes by 6 mA is

a) 6 mA b) 4.8 mA c) 24 mA d) 8 mA

362. When p-n junction diode is forward biased then

a) The depletion region is reduced and barrier height is increased
b) The depletion region is widened and barrier height is reduced
c) Both the depletion region and barrier height are reduced
d) Both the depletion region and barrier height are increased

363. In LED visible light is produced by

a) Gallium phosphide
b) Gallium arsenide
c) Germanium phosphide
d) Silicon phosphide

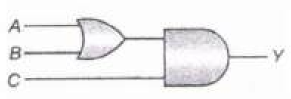
364. A researcher wants an alarm to sound when the temperature of air in his controlled research chamber rises above 40°C or falls below 20°C. The alarm can be triggered by the output of a

a) AND gate b) NAND gate c) NOT gate d) OR gate

365. A change of 0.8 mA in the anode current of a triode occurs when the anode potential is changed by 10 V. If $\mu = 8$ for the triode, then what change in the grid voltage would be required to produce a change of 4 mA in the anode current

a) 6.25 V b) 0.16 V c) 15.2 V d) None of these

366. To get an output Y =1 from the circuit shown, the inputs A, B and C must be respectively



a) 0, 1, 0 b) 1, 0, 0 c) 1, 0, 1 d) 1, 1, 0

367. The Binary Coded Decimal (BCD) equivalent of 429 is
a) 111001110 b) 010000101001 c) 110101101 d) 0100101001

368. The energy of radiation emitted by LED is
a) Greater than the band gap of the semiconductor used
b) Always less than the band gap of the semiconductor used
c) Always equal to the band gap of the semiconductor used
d) Equal to or less than the band gap of the semiconductor used

369. The inputs and outputs for different time intervals are given below the NAND gate.

Time	Input *A*	Input *B*	Output *Y*
t_1 to t_2	0	1	*P*
t_2 to t_3	0	0	Q
t_3 to t_4	1	0	R
t_4 to t_5	1	1	S

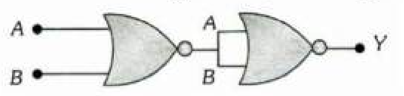
The values taken by *P, Q, R, S* are respectively
a) 1, 1, 1, 0 b) 0, 1, 0, 1 c) 0, 1, 0, 0 d) 1, 0, 1, 1

370. When the forward bias voltage of a diode is changed from 0.6 V to 0.7 V, the current changes from 5 mA to 15 mA. Then its forward bias resistance is
a) 0.01 Ω b) 0.1 Ω c) 10 Ω d) 100 Ω

371. To a germanium crystal equal number of aluminium and indium atoms are added. Then
a) It remains an intrinsic semiconductor
b) It becomes a n-type semiconductor
c) It becomes a p-type semiconductor
d) It becomes an insulator

372. A light emitting diode (LED) has a voltage drop of 2 V across it and passes a current of 10 mA. When it operates with 6 V battery through a limiting resistor R, the value of R is
a) 40 kΩ b) 4 kΩ c) 200 Ω d) 400 Ω

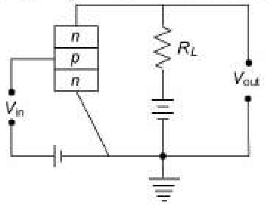
373. In the following circuit, the output Y for all possible inputs A and B is expressed by the truth table



A B Y

a) $\begin{vmatrix} 0 & 0 & 0 \\ 0 & 1 & 0 \\ 1 & 0 & 0 \\ 1 & 1 & 1 \end{vmatrix}$ b) $\begin{vmatrix} 0 & 0 & 1 \\ 0 & 1 & 1 \\ 1 & 0 & 1 \\ 1 & 1 & 0 \end{vmatrix}$ c) $\begin{vmatrix} 0 & 0 & 1 \\ 0 & 1 & 0 \\ 1 & 0 & 0 \\ 1 & 1 & 0 \end{vmatrix}$ d) $\begin{vmatrix} 0 & 0 & 0 \\ 0 & 1 & 1 \\ 1 & 0 & 1 \\ 1 & 1 & 1 \end{vmatrix}$

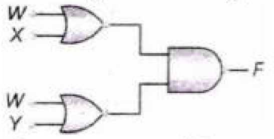
374. An $n-p-n-$ transistor circuit is arranged as shown in figure. It is



a) A common base amplifier circuit b) A common emitter amplifier circuit
c) A common collector amplifier circuit d) Neither of the above

375. The decimal equivalent of the binary number $(11010.101)_2$ is
a) 9.625 b) 25.265 c) 26.625 d) 26.265

376. The diagram of a logic circuit is given below.



The output F of the circuit is given by

a) $W \cdot (X + Y)$ b) $W \cdot (X \cdot Y)$ c) $W + (X \cdot Y)$ d) $W + (X + Y)$

377. If the ratio of the concentration of electrons to that of holes in a semiconductor is $\frac{7}{5}$ and the ratio of current is $\frac{7}{4}$, then what is the ratio of their drift velocities ?

a) $\frac{5}{8}$ b) $\frac{4}{5}$ c) $\frac{5}{4}$ d) $\frac{4}{7}$

378. In the presence of space charge in the diode valve the plate current is 10mA at the plate voltage 50V. Then the plate current at plate voltage 200 V will be

a) 20 mA b) 40 mA c) 80 mA d) None of these

379. The equivalent decimal number of binary number $(11001.001)_2$ is

a) 19.100 b) 19.050 c) 25.250 d) 25.125

380. Let n_e and n_h represent the number density of electrons and holes in a semiconductor. Then

a) $n_e > n_h$ if the semiconductor is intrinsic

b) $n_e < n_h$ if the semiconductor is intrinsic

c) $n_e \neq n_h$ if the semiconductor is intrinsic

d) $n_e = n_h$ if the semiconductor is intrinsic

381. A Ge specimen is doped with Al. The concentration of acceptor atoms is -10^{21} $atoms/m^3$. Given that the intrinsic concentration of electron hole pairs is $\sim 10^{19}/m^3$, the concentration of electron in the specimen is

a) $10^{17}/m^3$ b) $10^{15}/m^3$ c) $10^4/m^3$ d) $10^2/m^3$

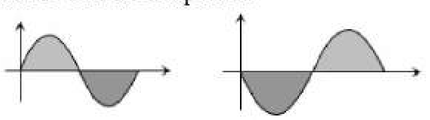
382. Atomic packing factor for a face centred cubic cells

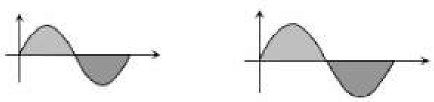
a) $\frac{\pi}{6}$ b) π c) $\frac{\sqrt{3}}{8}\pi$ d) $\frac{\sqrt{2}}{6}\pi$

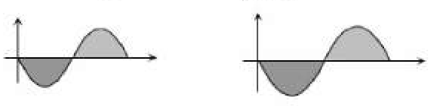
383. In a cubic unit cell of bcc structure, the lattice points (*ie*, number of atoms) are

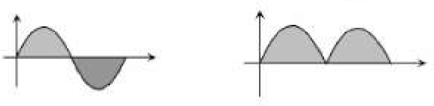
a) 2 b) 6 c) 8 d) 12

384. Which of the following figures correctly shows the phase relation between the input signal and the output signal of triode amplifier

a) 

b) 

c) 

d) 

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

a) Blue light b) Green light c) Ultraviolet rays d) Infrared rays

386. The density for simple cubic lattice is (where A is atomic weight, N is Avogadro's number and a is a lattice parameter)

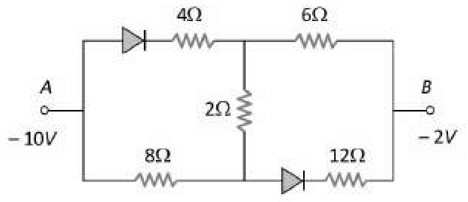
a) $\frac{4A}{Na^3}$ b) $\frac{2A}{Na^3}$ c) $\frac{A}{Na^3}$ d) $\frac{A}{Na^2}$

387. When germanium is doped with phosphorus, the doped material has

a) Excess positive charge b) Excess negative charge

c) More negative current carriers d) More positive current carriers

388. In the following circuit the equivalent resistance between A and B is

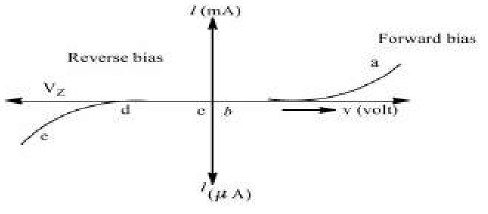


a) $\frac{20}{3}\Omega$ b) 10 Ω c) 16 Ω d) 20 Ω

389. The state of the energy gained by valance electrons when the temperature is raised or when electric field is applied in called as

a) Valance band b) Conduction band c) Forbidden band d) None of these

390. The graph given below represents the I-V characteristics of a zener diode. Which part of the characteristics curve is most relevant for its operation as a voltage regulator?



a) ab b) bc c) cd d) de

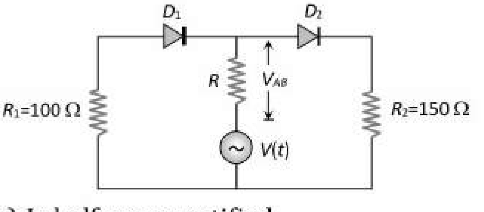
391. The relation between the energy E_f of fermi level, height E_b of potential barrier and work function W_0 is

a) $E_f = W_0 + E_b$ b) $E_b = W_0 - E_f$ c) $E_b = W_0 + E_f$ d) $W_0 = E_b + E_f$

392. The majority charge carriers in P-type semiconductor are

a) Electrons b) Protons c) Holes d) Neutrons

393. In the circuit given below, $V(t)$ is the sinusoidal 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

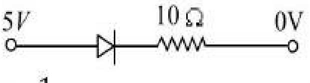
394. Which of these is unipolar transistor

a) Point contact transistor b) Field effect transistor
c) PNP transistor d) None of these

395. Electric conduction in semi-conductor takes place due to

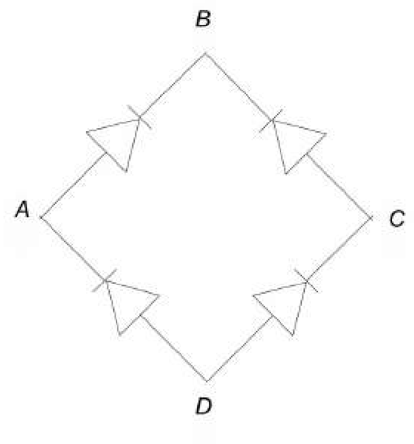
a) Electrons only b) Holes only
c) Both electrons and holes d) None of the above

396. A junction diode has a resistance of 25 Ω when forward biased and 2500 Ω when reverse biased. The current in the diode, for the arrangement shown will be



a) $\frac{1}{15}A$ b) $\frac{1}{7}A$ c) $\frac{1}{25}A$ d) $\frac{1}{480}A$

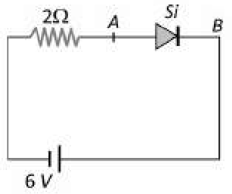
397. In the figure, the input is across the terminals A and C and the output is across B and D. Then the output is



a) Zero b) Same as the input c) Full wave rectified d) Have wave rectified

398. Current gain of a transistor in common base mode is 0.95. Its value in common emitter mode is
a) 0.95 b) 1.5 c) 19 d) $(19)^{-1}$

399. The diode shown in the circuit is a silicon diode. The potential difference between the points A and B will be



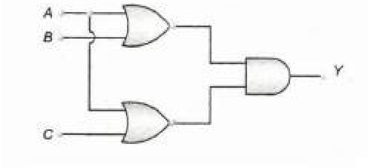
a) 6 V b) 0.6 V c) 0.7 V d) 0 V

400. If the output of a logic gate is 0 when all its inputs are at logic 1, then the gate is either
a) NAND or Ex-NOR b) NOR or OR c) Ex-OR or NOR d) AND or NOR

401. The conduction band in a solid is partially filled at 0 K. The solid sample is a
a) Conductor b) Semiconductor c) Insulator d) None of these

402. For a given triode $\mu = 20$. The load resistance is 1.5 times the anode resistance. The maximum gain will be
a) 16 b) 12 c) 10 d) None of the above

403. The output of given logic circuit is



a) A + B + C b) (A + B) · (A + C) c) A · (B · C) d) A · (B + C)

404. A transistor is operated in common-emitter configuration at $V_c = 2V$ such that a change in the base current from 100 μA produces a change in the collector current from 5 mA to 10 mA. The current gain is
a) 75 b) 100 c) 150 d) 50

405. $p - n$ junction is said to be forward biased, when
a) The positive pole of the battery is joined to the p-semiconductor and negative pole to the n-semiconductor
b) The positive pole of the battery is joined to the n-semiconductor and negative pole to the n-semiconductor and p-semiconductor
c) The positive pole of the battery is connected to n-semiconductor and p-semiconductor
d) A mechanical force is applied in the forward direction

406. A p-type material is electrically ....
a) Positive
b) Negative
c) Neutral

d) Depends on the concentration of p impurities

407. The slope of plate characteristic of a vacuum tube diode for certain operating point on the curve is $10^{-3}\frac{mA}{V}$. The plate resistance of the diode and its nature respectively

a) 100 *kilo-ohms* static
b) 1000 *kilo-ohms* static
c) 1000 *kilo-ohms* dynamic
d) 100 *kilo-ohms* dynamic

408. Bonding in a germanium crystal (semi-conductor) is

a) Metallic
b) Ionic
c) Vander Waal's type
d) Covalent

409. 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) $\mu_e < 0;\ \mu_h > 0$

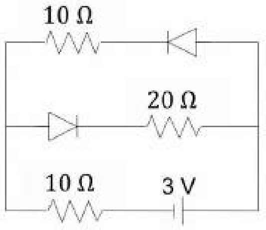
410. The voltage gain of triode amplifier is 30 and input voltage is $V_i = \sin 100\pi t$, then output voltage will be

a) $30 \sin 100\,\pi t$
b) $\sin 100\,\pi t$
c) $-30 \sin 100\,\pi t$
d) $- \sin 100\,\pi t$

411. In a common-base mode of a transistor, the collector current is 5.488 mA for an emitter current of 5.60 mA. The value of the base current amplification factor (β) will be

a) 49
b) 50
c) 51
d) 48

412. In the network show, the current flowing through the battery of negligible internal resistance is



a) 0.10 A
b) 0.15 A
c) 0.20 A
d) 0.30 A

413. In a transistor if collector current is 25 mA and base current is 1 mA, then current amplification factor α is

a) $\frac{25}{24}$
b) $\frac{24}{25}$
c) $\frac{25}{26}$
d) $\frac{26}{25}$

414. In a triode amplifier, the value of maximum gain is equal to

a) Half the amplification factor
b) Amplification factor
c) Twice the amplification factor
d) Infinity

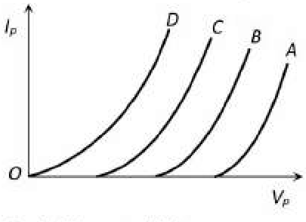
415. Which one of the following is the weakest kind of bonding in solids

a) Ionic
b) Metallic
c) Vander Waals
d) Covalent

416. The logic behind 'NOR' gate is that it gives

a) High output when both the inputs are low
b) Low output when both the inputs are low
c) High output when both the inputs are high
d) None of these

417. In the figure four plate characteristics of a triode at different grid voltages are shown. The difference between successive grid voltage is 1 V. Which curve will have maximum grid voltage and what is its value



a) $A, V_g = +4\ V$
b) $B, V_g = +4\ V$
c) $A, V_g = 0$
d) $D, V_g = 0$

418. The expected energy of the electrons at absolute zero is called

a) Fermi energy
b) Emission energy
c) Work function
d) Potential energy

419. In a transistor the base is

a) An insulator
b) A conductor of low resistance

c) A conductor of high resistance
d) An extrinsic semiconductor

420. If control grid is made negative, then the plate current will

a) Increase
b) Remain constant
c) Decrease
d) Cannot say from given data

421. P-type semiconductor is formed when

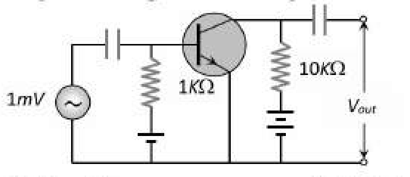
A. As impurity is mixed in Si
B. Al impurity is mixed in Si
C. B impurity is mixed in Ge
D. P impurity is mixed in Ge

a) A and C
b) A and D
c) B and C
d) B and D

422. The energy gap of silicon is 1.14 eV. The maximum wavelength at which silicon starts energy absorption, will be($h = 6.62 \times 10^{-34}$ Js; $c = 3 \times 10^8 \text{ms}^{-1}$)

a) 10.888 Å
b) 108.88 Å
c) 1088.8 Å
d) 10888 Å

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



a) 10 mV
b) 0.1 V
c) 1.0 V
d) 10 V

424. When plate voltage in diode valve is increased from 100 $volt$ to 150 $volt$ then plate current increases from 7.5 mA to 12 mA. The dynamic plate resistance will be

a) 10 $k\Omega$
b) 11 $k\Omega$
c) 15 $k\Omega$
d) 11.1 $k\Omega$

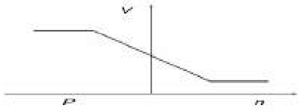
425. Current gain in common base configuration is less than 1 because

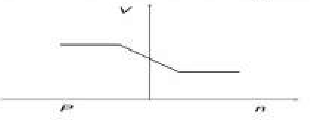
a) $I_e < I_b$
b) $I_b < I_e$
c) $I_c < I_e$
d) $I_e < I_c$

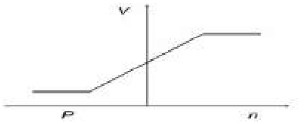
426. The output of OR gate is 1

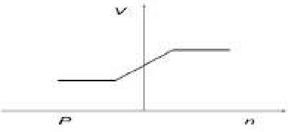
a) If both inputs are zero
b) If either or both inputs are 1
c) Only if both input are 1
d) If either input is zero

427. In a forward biased p-n junction diode, the potential barrier in the depletion region is of the form

a)


b)


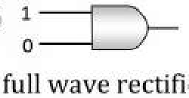
c)


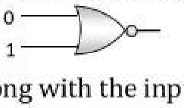
d)


428. A silicon specimen is made into a p-type semiconductor by dropping, on an average, one indium atom per 5×10^7 silicon atoms. If the number density of atoms in the silicon specimen is 5×10^{28} atoms m^{-3}, then the number of acceptor atoms in silicon per cubic centimeter will be

a) 2.5×10^{30} atoms cm^{-3}
b) 2.5×10^{35} atoms cm^{-3}
c) 1.0×10^{13} atoms cm^{-3}
d) 1.0×10^{15} atoms cm^{-3}

429. Which of the following gates will have an output of 1

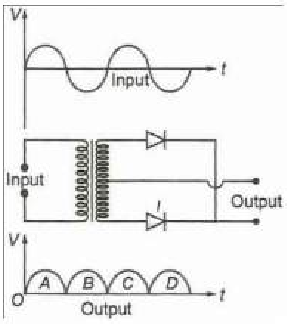
a)


b)


c)


d)


430. A full wave rectifier circuit along with the input and output are shown in the figure, the contribution from the diode I is (are)



a) C b) A, C c) B, D d) A, B, C, D

431. The output of a NAND gate is 0

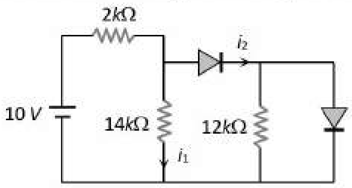
a) If both inputs are 0

b) If one input is 0 and the other input is 1

c) If both inputs are 1

d) Either if both inputs are 1 or if one of the inputs is 1 and the other 0

432. In the following circuit I_1 and I_2 are respectively

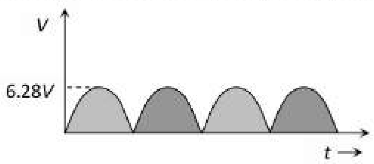


a) 0, 0 b) 5 mA, 5 mA c) 5 mA, 0 d) 0, 5 mA

433. Which impurity is doped in Si to form N-type semi-conductor

a) Al b) B c) As d) None of these

434. For given electric voltage signal dc value is

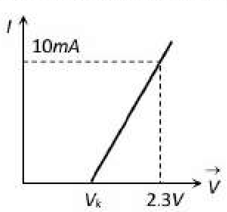


a) 6.28 V b) 3.14 V c) 4 V d) 0 V

435. The electrical conductivity of a semiconductor increases when electromagnetic radiation of wavelength shorter than 2480 nm, is incident on it. The band gap in (eV) for the semiconductor is

a) 1.1 eV b) 2.5 eV c) 0.5 eV d) 0.7 eV

436. The resistance of a germanium junction diode whose $V - I$ is shown in figure is ($V_k = 0.3\ V$)



a) 5 $k\Omega$ b) 0.2 $k\Omega$ c) 2.3 $k\Omega$ d) $\left(\frac{10}{2.3}\right) k\Omega$

437. When a p-n junction diode is reverse biased, then

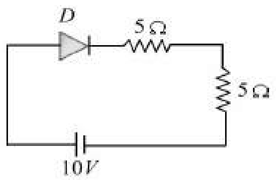
a) No current flows

b) The depletion region is increased

c) The depletion region is reduced

d) The height of the potential barrier is reduced

438. In the given circuit for ideal diode, the current through the battery is

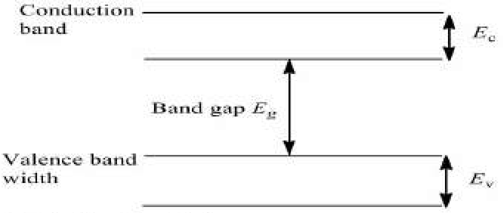


a) 0.5 A　b) 1.5 A　c) 1.0 A　d) 2 A

439. The plate current in a vacuum diode depends on
a) Cathode temperature only
b) Plate voltage only
c) Both plate voltage and cathode temperature
d) None of these

440. A common emitter amplifier given an output of 3 V for an input of 0.01 V. If β of the transistor is 100 and the input resistance is 1 kΩ, then the collector resistance is
a) 1 kΩ　b) 3 kΩ　c) 30 kΩ　d) 30 Ω

441. If the lattice constant of this semiconductor is decreased, then which of the following is correct?

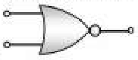


a) All E_c, E_g, E_v increase
b) E_c and E_v increase, but E_g decreases
c) E_c and E_v decrease, but E_g increases
d) All E_c, E_g, E_v decreases

442. A piece of copper and another of germanium are cooled from room temperature to 77 K, the resistance of
a) Each of them increases
b) Each of them decreases
c) Copper decreases and germanium increases
d) Copper increases and germanium decreases

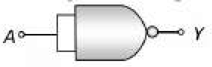
443. Potassium has a bcc structure with nearest neighbor distance 4.525 Å. Its molecular weight is 39. Its density in kg/m^3 is
a) 900　b) 494　c) 602　d) 802

444. In p-type semiconductors, conduction is due to
a) Greater number of holes and less number of electrons
b) Only electrons
c) Only holes
d) Greater number of electrons and less number of holes

445. Symbol  represents
a) NAND gate　b) NOR gate　c) NOT gate　d) XNOR gate

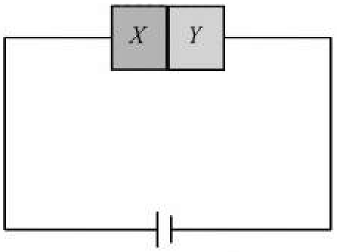
446. Identify the system of crystal structure, if $a = b \neq c$ $\alpha = \beta = 90°$ and $\gamma = 120°$.
a) Monoclinic　b) Triclinic　c) Hexagonal　d) Rhombohedral

447. This symbol represents



a) NOT gate　b) OR gate　c) AND gate　d) NOR gate

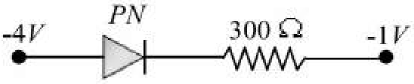
448. A semiconductor X is made by doping a germanium crystal with arsenic ($Z = 33$). A second semiconductor Y is made by doping germanium with indium ($Z = 49$). The two are joined end to end and connected to a battery as shown. Which of the following statements is correct



a) X is P-type, Y is N-type and the junction is forward biased
b) X is P-type, Y is P-type and the junction is forward biased
c) X is P-type, Y is N-type and the junction is reverse biased
d) X is N-type, Y is P-type and the junction is reverse biased

449. The difference in the variation of resistance with temperature in a metal and a semiconductor arises essentially due to the difference in the
a) Crystal structure
b) Variation of the number of charge carriers with temperature
c) Type of bonding
d) Variation of scattering mechanism with temperature

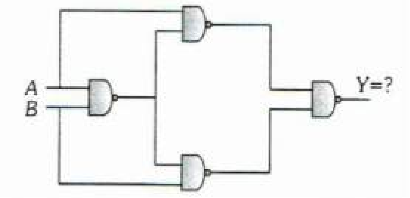
450. What is the current in the circuit shown below



a) 0 A
b) 10^{-2} A
c) 1 A
d) 0.10 A

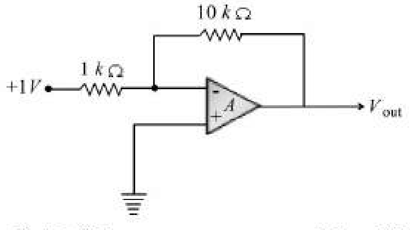
451. For a given plate-voltage, the plate current in a triode is maximum when the potential of
a) The grid is positive and plate is negative
b) The grid is positive and plate is positive
c) The grid is zero and plate is positive
d) The grid is negative and plate is positive

452. Select the outputs Y of the combination of gates shown below for inputs $A = 1, B = 0$; $A = 1, B = 1$ and $A = 0, B = 0$ respectively



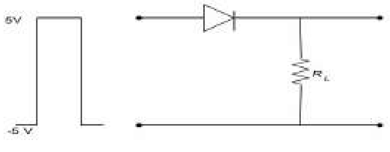
a) (0 1 1)
b) (0 0 1)
c) (1 0 0)
d) (1 1 1)

453. In the circuit shown below, an input of 1V is fed into the inverting input of an ideal OP-amplifier. The output signal V_{out} will be

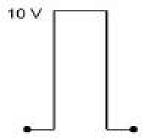


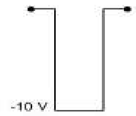
a) +10 V
b) −10 V
c) 0 V
d) Infinity

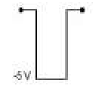
454. If in a p-n junction diode, a square input signal of 10 V is applied as shown

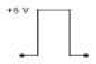


Then the output signal across R_L will be

a) 

b) 

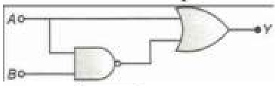
c) 

d) 

455. Two diodes have resistance 20 Ω and is centretapped with rms secondary voltage from centre tap to each end of secondary 50 V. If external resistance is 980 Ω. What is mean load?

a) 0.05 A b) 45 mA c) 0.25 A d) 25 mA

456. What is the output of the combination of the gates shown in the figure?



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

457. A logic gate having two inputs A and B and output C has the following truth table.

A	*B*	*C*
1	1	0
1	0	1
0	1	1
0	0	1

It is

a) An OR gate b) An AND gate c) A NOR gate d) A NAND gate

458. Which of the following is a dichroic crystal

a) Mica b) Selenite c) Quartz d) Tourmaline

459. The ionic bond is absent in

a) NaCl b) CsCl c) LiF d) H_2O

460. In a common emitter amplifier the input signal is applied across

a) Anywhere b) Emitter-collector c) Collector-base d) Base-emitter

461. A metallic surface with work function of 2 eV, on heating to a temperature of 800 K gives an emission current of 1 mA. If another metallic surface having the same surface area, same emission constant but work function 4 eV is heated to a temperature of 1600 K, then the emission current will be

a) 1 mA b) 2 mA c) 4 mA d) None of these

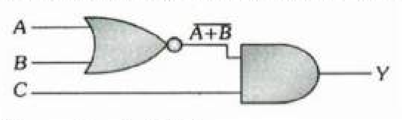
462. In a P-N junction diode if P region is heavily doped than n region then the depletion layer is

a) Greater in P region b) Greater in N region
c) Equal in both region d) No depletion layer is formed in this case

463. A potential difference of $2V$ is applied between the opposite faces of a Ge crystal plate of area 1 cm^2 and thickness 0.5 mm. If the concentration of electrons in Ge is $2 \times 10^{19}/m^3$ and mobilities of electrons and holes are $0.36 \frac{m^2}{volt-s}$ and $0.14 \frac{m^2}{volt-s}$ respectively, then the current flowing through the plate will be

a) 0.25 A b) 0.45 A c) 0.56 A d) 0.64 A

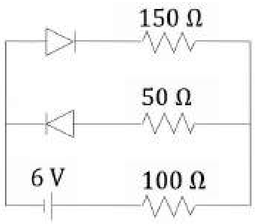
464. In the circuit given A, B and C are inputs and Y is the output



The output of Y is

a) High for all the high inputs b) High for all the low inputs
c) High when $A = 1, B = 1, C = 0$ d) Low for all low inputs

465. The circuit shown in the figure contains two diodes each with a forward resistance of 50 Ω and with infinite backward resistance. If the battery is 6 V, the current through the 100 Ω resistance (in ampere) is



a) Zero b) 0.02 c) 0.03 d) 0.036

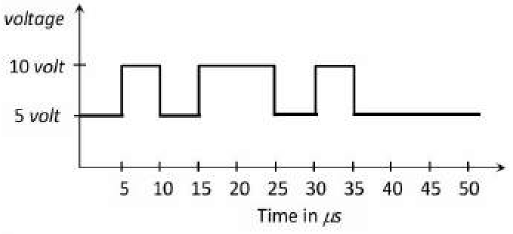
466. Which of the following materials is the best conductor of electricity
a) Platinum b) Gold c) Silicon d) Copper

467. If a zener diode ($V_Z = 5$ V and $I_Z = 10$ mA) is connected in series with a resistance and 20 V is applied across the combination, then the maximum resistance one can use without spoiling zener action is
a) 20 kΩ b) 15 kΩ c) 10 kΩ d) 1.5 kΩ

468. In a *PN* junction photo cell, the value of 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* junction
c) The intensity of the light falling on the cell
d) The frequency of the light falling on the cell

469. In a *n-p-n* transistor amplifier, the collector current is 9 mA. If 90% of the electrons from the emitter reach the collector, then
a) $\alpha = 0.9, \beta = 9.0$ b) The base current is 10 mA
c) The emitter current is 1 mA d) $\alpha = 9.0, \beta = 0.9$

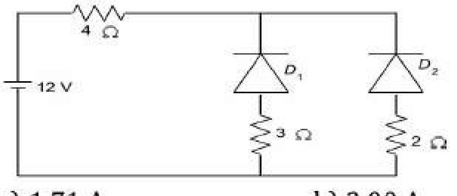
470. In a negative logic the following wave form corresponds to the



a) 0000000000 b) 0101101000 c) 1111111111 d) 1010010111

471. The *PN* junction diode is used as
a) An amplifier b) A rectifier c) An oscillator d) A modulator

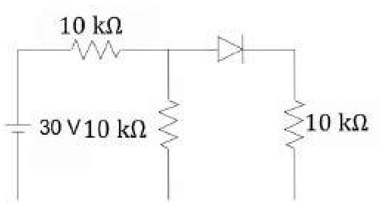
472. The circuit has two oppositely connected ideal diodes in parallel. What is the current flowing in the circuit?



a) 1.71 A b) 2.00 A c) 2.31 A d) 1.33 A

473. The mobility of free electron is greater than that of free holes because
a) The carry negative charge
b) They are light
c) They mutually collide less
d) They require low energy to continue their motion

474. In the figure, potential difference between *A* and *B* is



a) Zero b) 5 V c) 10 V d) 15 V

475. In a transistor the collector current is always less than the emitter current because
   a) Collector side is reverse biased and the emitter side is forward biased
   b) A few electrons are lost in the base and only remaining ones reach the collector
   c) Collector being reverse biased, attracts less electrons
   d) Collector side is forward biased and the emitter side is reverse biased

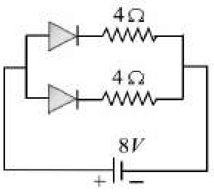
476. At room temperature, a P-type semiconductor has
   a) Large number of holes and few electrons
   b) Large number of free electrons and few holes
   c) Equal number of free electrons and holes
   d) No electrons or holes

477. n-p-n transistor are preferred to p-n-p transistor because they have
   a) Low cost b) Low dissipation energy
   c) Capability of handling large power d) Electrons having high mobility than holes

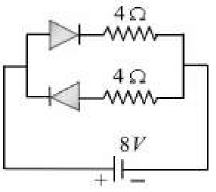
478. The output Y of the logic circuit shown in figure is best represented as

a) $\bar{A} + \overline{B \cdot C}$ b) $A + \bar{B} \cdot C$ c) $\overline{A + B \cdot C}$ d) $\overline{A + \bar{B} \cdot C}$

479. Currents flowing in each of the circuits A and B respectively are



(Circuit A)



(Circuit B)

a) 1 A, 2 A b) 2 A, 1 A c) 4 A, 2 A d) 2 A, 4 A

480. For a crystal system, $a = b = c, \alpha = \beta = \gamma \neq 90°$, the system is
   a) Tetragonal system b) Cubic system
   c) Orthorhombic system d) Rhombohedral system

481. The current gain of a transistor in a common emitter configuration is 40. If the emitter current is 8.2 mA, then base current is
   a) 0.02 mA b) 0.2 mA c) 2.0 mA d) 0.4 mA

482. In order to prepare a p-type semiconductor, pure silicon can be doped with
   a) Phosphorus b) Aluminium c) Antimony d) Germanium

483. The current in a triode at anode potential 100 V and grid potential -1.2 V is 7.5 mA. If grid potential is changed to -2.2 V, the current becomes 5.5 mA. the value of trans conductance (g_m) will be
   a) 2 *mili mho* b) 3 *mili mho* c) 4 *mili mho* d) 0.2 *mili mho*

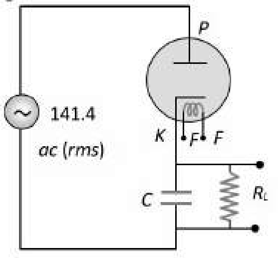
484. If A and B are two inputs in AND gate, then AND gate has an output of 1 when the values of A and B are
   a) $A = 0, B = 0$ b) $A = 1, B = 1$ c) $A = 1, B = 0$ d) $A = 0, B = 1$

485. A gate in which all the inputs must be low to get a high output is called
   a) A NAND gate b) An inverter c) A NOR gate d) An AND gate

486. A NPN transistor conducts when
   a) Both collector and emitter are positive with respect to the base

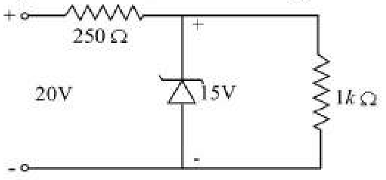
b) Collector is positive and emitter is negative with respect to the base
c) Collector is positive and emitter is at same potential as the base
d) Both collector and emitter are negative with respect to the base

487. An alternating voltage of $141.4V$ (rms) is applied to a vacuum diode as shown in the figure. The maximum potential difference across the condenser will be



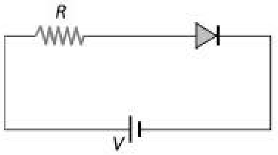
a) $100\ V$ b) $200\ V$ c) $100\sqrt{2}\ V$ d) $200\sqrt{2}V$

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



a) $20\ mA$ b) $5\ mA$ c) $10\ mA$ d) $15\ mA$

489. For the given circuit of PN-junction diode, which of the following statement is correct



a) In forward biasing the voltage across R is V
b) In forward biasing the voltage across R is $2V$
c) In reverse biasing the voltage across R is V
d) In reverse biasing the voltage across R is $2V$

490. Current gain in common emitter configuration is more than 1 becomes
a) $I_c < I_b$ b) $I_c < I_e$ c) $I_c > I_e$ d) $I_e > I_b$

491. The reason of current flow in P-N junction in forward bias is
a) Drifting of charge carriers
b) Minority charge carriers
c) Diffusion of charge carriers
d) All of these

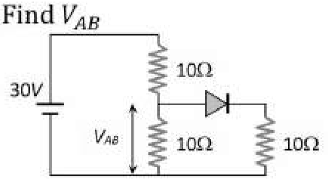
492. A triode whose mutual conductance is $2.5\ m\ A/volt$ and anode resistance is 20 $kilo\ ohm$, is used as an amplifier whose amplification is 10. The resistance connected in plate circuit will be
a) $1\ k\Omega$ b) $5\ k\Omega$ c) $10\ k\Omega$ d) $20\ k\Omega$

493. In the forward bias arrangement of a PN-junction diode
a) The N-end is connected to the positive terminal of the battery
b) The P-end is connected to the positive terminal of the battery
c) The direction of current is from N-end to P-end in the diode
d) The P-end is connected to the negative terminal of battery

494. If the forward voltage in a semiconductor diode is changed from 0.5 V to 0.7 V, then the forward current changes by 1.0 mA. The forward resistance of diode junction will be
a) 100 Ω b) 120 Ω c) 200 Ω d) 240 Ω

495. For a common base configuration of PNP transistor $\frac{I_C}{I_E} = 0.96$ then maximum current gain in common emitter configuration will be
a) 12 b) 24 c) 6 d) 5

496. Find V_{AB}



a) 10 V b) 20 V c) 30 V d) None of these

497. Thermionic emission from a heated filament varies with its temperature T as

a) T^{-1} b) T T c) T^2 d) $T^{3/2}$

498. The manifestation of band structure in solids is due to decreases the majority charge carries

a) Heisenberg's uncertainty principle
b) Pauli's exclusion principle
c) Bohr's correspondence principle
d) Boltzmann's law

499. A semiconductor dopped with a donor impurity is

a) P-type b) N-type c) NPN type d) PNP type

500. In semiconductors at a room temperature

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

501. A P-type semiconductor has acceptor levels 57 meV above the valence band. The maximum wavelength of light required to create a hole is (Planck's constant $h = 6.6 \times 10^{-34} J\text{-}s$)

a) 57 Å b) 57×10^{-3} Å c) 217100 Å d) 11.61×10^{-33} Å

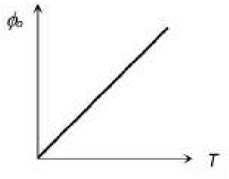
502. Which of the following is true

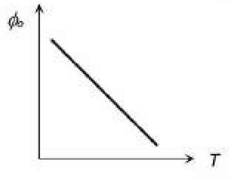
a) Common base transistor is commonly used because current gain is maximum
b) Common emitter is commonly used because current gain is maximum
c) Common collector is commonly used because current gain is maximum
d) Common emitter is the least used transistor

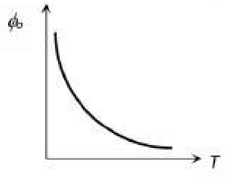
503. In comparison to half wave rectifier, the full wave rectifier gives lower

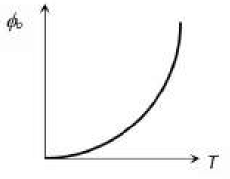
a) Efficiency b) Average dc
c) Average output voltage d) None of these

504. The curve between the work function of a metal (ϕ_o) and its temperature (T) will be

a)


b)


c)


d)


505. A P-type semiconductor can be obtained by adding

a) Arsenic to pure silicon b) Gallium to pure silicon
c) Antimony to pure germanium d) Phosphorous to pure germanium

506. Which is the wrong statement in following sentences? A device in which P and N-type semiconductors are used is more useful then a vacuum type because

a) Power is not necessary to heat the filament
b) It is more stable
c) Very less heat is produced in it
d) Its efficiency is high due to a high voltage across the junction

507. In a semiconductor

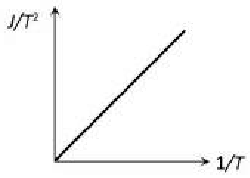
a) There are no free electrons at any temperature
b) The number of free electrons is more than that in a conductor
c) There are no free electrons at 0 K

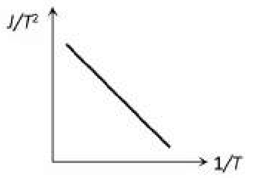
d) None of these

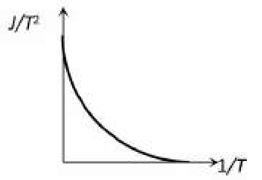
508. The collector supply voltage is 6 V and the voltage drop across a resistor of 600 Ω in the collector circuit is 0.6 V, in a transistor connector in common emitter mode. If the current gain is 20, the base current is
a) 0.25 mA b) 0.05 mA c) 0.12 mA d) 0.02 mA

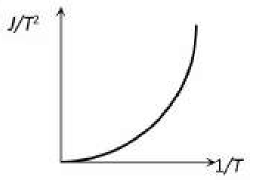
509. In Boolean algebra, $\overline{\overline{A} \cdot \overline{B}}$ is equal to
a) $\overline{A} \cdot \overline{B}$ b) $\overline{A} + \overline{B}$ c) $A \cdot B$ d) $A + B$

510. In a common base transistor circuit, the current gain is 0.98. On changing emitter current by 5.00 mA, the change in collector current is
a) 0.196 mA b) 2.45 mA c) 4.9 mA d) 5.1 mA

511. If the thermionic current density is J and emitter temperature is T then the curve between $\frac{J}{T^2}$ and $\frac{1}{T}$ will be
a) 

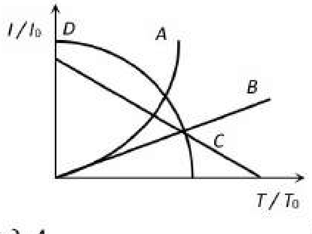
b) 

c) 

d) 

512. Which statement is correct
a) N-type germanium 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 positively charged and P-type germanium is negatively charged
d) Both N-type and P-type germanium are negatively charged

513. The ratio of thermionic currents is (I/I_0) for a metal when the temperature is slowly increased from T_0 to T as shown in figure. (I and I_0 are currents at T and respectively). Then which one is correct



a) A b) B c) C d) D

514. The current gain of a transistor in the common base mode is 0.9. If the change in the emitter current is 5 mA, the change in the collector current will be
a) 4 mA b) 4.5 mA c) 5.6 mA d) Zero

515. The current gain α of a transistor in common base mode is 0.995. Its gain β in the common emitter mode is
a) 200 b) 99 c) 0.995 d) None of these

516. Of the following which relation is true?
a) $\beta > \alpha$ b) $\alpha > \beta$ c) $\alpha\beta = 1$ d) $\alpha = \beta$

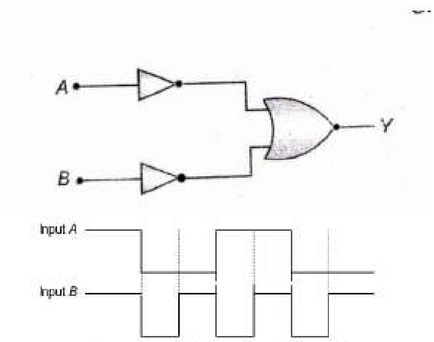
517. S certain triode shows the following readings

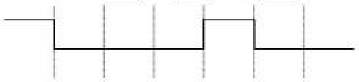
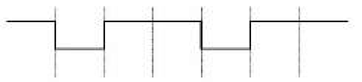
V_p	V_g	I_p
150V	−2V,	5 mA
150V	−3.5V,	3.2 mA
195V	−3.5V,	5 mA

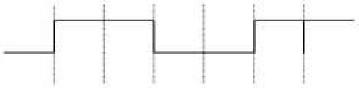
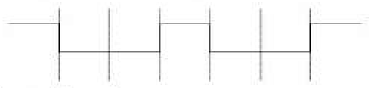
The amplification factor of the triode is
a) 22.5 b) 45 c) 30 d) 60

518. Atomic radius of fcc is
a) $\frac{a}{2}$ b) $\frac{a}{2\sqrt{2}}$ c) $\frac{\sqrt{3}}{4}a$ d) $\frac{\sqrt{3}}{2}a$

519. The logic circuit shown below has the input waveforms A and B as shown. Pick out the correct output waveform.



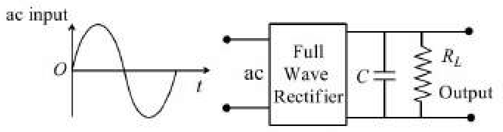
a)  b) 

c)  d) 

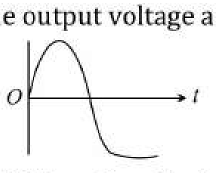
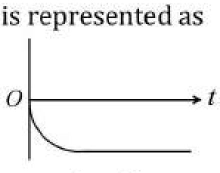
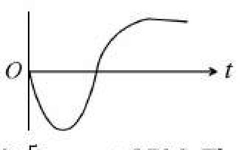
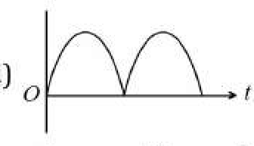
520. Which of the following has negative temperature coefficient of resistance
a) Copper b) Aluminium c) Iron d) Germanium

521. In a common emitter transistor amplifier, the output resistance is 500 kΩ and the current gain β=49. If the power gain of the amplifier is 5×10^6, the input resistance is
a) 325 Ω b) 165 Ω c) 198 Ω d) 240 Ω

522. A full-wave rectifier circuit with an ac input is shown

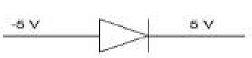


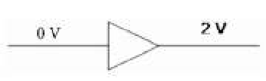
The output voltage across R_L is represented as

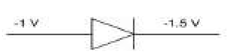
a)  b)  c)  d) 

523. In PN-junction diode the reverse saturation current is $10^{-5} amp$ at $27°C$. The forward current for a voltage of 0.2 $volt$ is
$[\exp(7.62) = 2038.6, k = 1.4 \times 10^{-23} J/K]$
a) $2037.6 \times 10^{-3} amp$ b) $203.76 \times 10^{-3} amp$ c) $20.376 \times 10^{-3} amp$ d) $2.0376 \times 10^{3} amp$

524. Which of the following is forward biased?

a) 

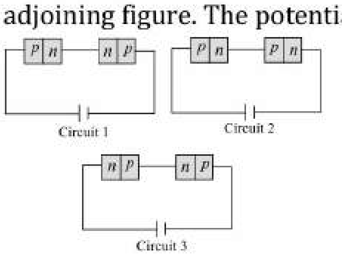
b) 

c) 

d) None of these

525. In the half wave rectifier circuit operating from 50 Hz mains frequency, the fundamental frequency in the rippel would be
a) 25 Hz b) 50 Hz c) 70.7 Hz d) 100 Hz

526. Two identical $p-n$ junction may be connected in series with a battery in three ways as shown in the adjoining figure. The potential drop across the $p-n$ junctions are equal in

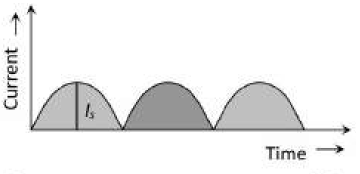


a) Circuit 1 and circuit 2 b) Circuit 2 and circuit 3 c) Circuit 3 and circuit 1 d) Circuit 1 only

527. Intrinsic germanium and silicon at absolute zero temperature behave like

a) Superconductor b) Good semiconductor c) Ideal insulator d) Conductor

528. The output current versus time curve of a rectifier is shown in the figure. The average value of the output current in this case is



a) 0 b) i_0/π c) $2i_0/\pi$ d) i_0

529. If n_e and n_h are the number of electrons and holes in a semiconductor heavily doped with phosphorus, then

a) $n_e >> n_h$ b) $n_e << n_h$ c) $n_e \leq n_h$ d) $n_e = n_h$

530. The truth table shown in figure is for

A	0	0	1	1
B	0	1	0	1
Y	1	0	0	1

a) XOR b) AND c) XNOR d) OR

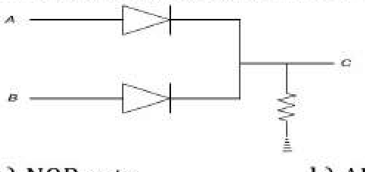
531. The temperature coefficient of a zener mechanism is

a) Negative b) Positive c) Infinity d) Zero

532. The resistance of a reverse biased P-N junction diode is about

a) 1 ohm b) 10^2 ohm c) 10^3 ohm d) 10^6 ohm

533. In the adjacent circuit, A and B represent two inputs and C represents the output. The circuit represents



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

534. The density for a fcc lattice is (A =atomic wt., N =Avogadro's number, a =lattice parameter)

a) $\frac{4A}{Na^3}$ b) $\frac{2A}{Na^3}$ c) $\frac{A}{Na^3}$ d) $\frac{A}{Na^2}$

535. When N-type of semiconductor is heated

a) Number of electrons increases while that of holes decreases

b) Number of holes increases while that of electrons decreases

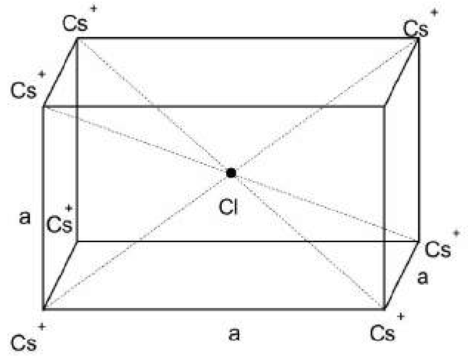
c) Number of electrons and holes remains same

d) Number of electrons and holes increases equally

536. If the slope of the characteristics curve of a vacuum tube diode corresponding to some point is 10^{-3}mAV^{-1}, then the plate resistance of diode and its nature are respectively

a) 100 kΩ, static b) 1000 kΩ, dynamic c) 100 kΩ, dynamic d) 1000 kΩ, static

537. What is the net force on an electron placed at the centre of the bcc structure of CsCl?



a) Zero
b) $\frac{ke^2}{a^2}$
c) ke^2a^2
d) Data is incomplete

538. If α and β are the collector emitter short circuit current amplification factor and collector base short circuit current amplification factor respectively of a transistor then α is equal to
a) $\frac{1+\beta}{\beta}$
b) $\frac{\beta}{1-\beta}$
c) $\frac{1-\beta}{\beta}$
d) $\frac{\beta}{1+\beta}$

539. Name the gate, which represents the Boolean expression $Y = \overline{A \cdot B}$
a) NAND
b) AND
c) NOT
d) NOR

540. The valence band and conduction band of a solid overlap at low temperature, the solid may be
a) A metal
b) A semiconductor
c) An insulator
d) None of these

541. The n-type semiconductors are obtained, when germanium is doped with
a) Arsenic
b) Phosphorus
c) Antimony
d) Any one of these

542. Frequency of given AC signal is 50 Hz. When it is connected to a half-wave rectifier, the number of output pulses given by rectifier within 1 s is
a) 50
b) 100
c) 25
d) 150

543. Metallic solids are always opaque because
a) Solids effect the incident light
b) Incident light is readily absorbed by the free electrons in a metal
c) Incident light is scattered by solid molecules
d) Energy band traps the incident light

544. In an amplifier the load resistance R_L is equal to the plane resistance (r_p). The voltage amplification is equal to
a) μ
b) 2μ
c) $\frac{\mu}{2}$
d) $\frac{\mu}{4}$

545. Semiconductor is damaged by the strong current due to
a) Lack of free electron
b) Excess of electrons
c) Excess of proton
d) None of these

546. In a $n-p-n$ transistor 10^{10} electrons enter the emitter in 10^{-6} s. 4% of the electrons are lost in base. The current transfer ratio will be
a) 0.98
b) 0.97
c) 0.96
d) 0.94

547. Identify the true statement for OR gate
a) Output Y will be 1 when input A or B or both are 1
b) Output Y will be 0 when the either of the inputs A or B is 1
c) Output Y will be 1 only when both the inputs A and B are 1
d) Output Y will be 1 only when either of the inputs A and B are 1

548. What controls the conduction of PN Junction
a) Majority carriers
b) Minority carriers
c) Holes
d) Electrons

549. A p-n photodiode is made of a material with a band gap of 2.0 eV. The minimum frequency of the radiation that can be absorbed by the material is nearly
a) 10×10^{14} Hz
b) 5×10^{14} Hz
c) 1×10^{14} Hz
d) 20×10^{14} Hz

550. The charge on a hole is equal to the charge of

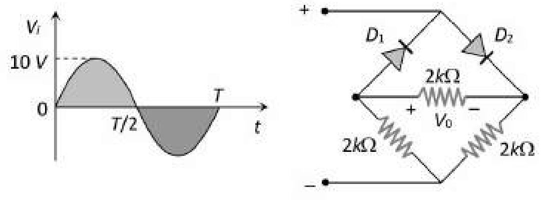
a) Zero b) Proton c) Neutron d) Electron

551. In silicon when phosphorus is doped ……. is formed

a) p-type semiconductor b) n-type semiconductor

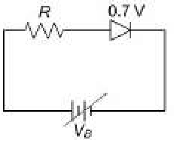
c) p-n junction d) None of these

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



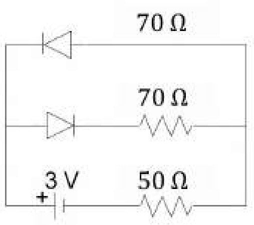
a) 0 V b) 5 V c) 10 V d) $\frac{5}{\sqrt{2}}V$

553. The junction diode in the following circuit requires a minimum current of 1mA to be above the knee point (0.7 V) of its $I-V$ characteristic curve. The voltage across the junction diode is independent of current above the knee point, if $V_B = 4$V, then the maximum value of R so that the voltage is above knee point will be



a) 3.3 kΩ b) 4.0 kΩ c) 4.7 kΩ d) 6.6 kΩ

554. The circuit shown in the figure contains two diodes each with a forward resistance of 30 Ω and with infinite backward resistance. If the battery is 3V, the current through the 50 Ω resistance (in ampere) is



a) Zero b) 0.01 c) 0.02 d) 0.03

555. A truth table is given below. Which of the following has this type of truth table

A	0	1	0	1
B	0	0	1	1
y	1	0	0	0

a) XOR gate b) NOR gate c) AND gate d) OR gate

556. A photodetector used to detect the wavelength of 1700 nm, has energy gap of about

a) 0.073 eV b) 1.2 eV c) 7.3 eV d) 0.73 eV

557. The current in a diode is related to the voltage V by the equation

a) $I \propto V^{1/2}$ b) $I \propto V^{3/2}$ c) $I \propto V^2$ d) $I \propto V$

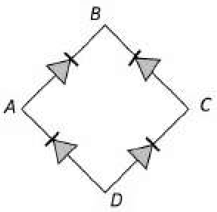
558. The approximate ratio of resistances in the forward and reverse bias of the PN-junction diode is

a) 10^2: 1 b) 10^{-2}: 1 c) 1 : 10^{-4} d) 1 : 10^4

559. 14×10^{15} electrons reach the anode per second. If the power consumed is 448 *milliwatts*, then the plate (anode) voltage is

a) 150 V b) 200V c) $14 \times 448V$ d) $448/14V$

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



a) Zero b) Same as input c) Full wave rectifier d) Half wave rectifier

561. In a p-n junction diode not connected to any circuit
  a) The potential is the same everywhere
  b) The p-type side has a higher potential than the n-type side
  c) There is an electric field at the junction directed from the n-type side to p-type side
  d) There is an electric field at the junction directed from the p-type side to n-type side

562. An n-type semiconductor is
  a) Negatively charged
  b) Positively charged
  c) Neutral
  d) Negatively or positively charged depending upon the amount of impurity

563. The reverse saturation of p-n diode
  a) Depends on doping concentrations
  b) Depends on diffusion lengths of carriers
  c) Depends on the doping concentrations and diffusion lengths
  d) Depends on the doping concentrations, diffusion length and device temperature

564. n-type semiconductor is
  a) Positively charged
  b) Negatively charged
  c) Neutral
  d) Positive or negative depending upon doping material

565. A common emitter amplifier has a voltage gain of 50, an input impedance of 100 Ω and an output impedance of 200 Ω. The power gain of the amplifier is
  a) 500 b) 1000 c) 1250 d) 100

566. Select the correct statement
  a) In a full wave rectifier, two diodes work alternately
  b) In a full wave rectifier, two diodes work simultaneously
  c) The efficiency of full wave and half wave rectifiers is same
  d) The full wave rectifier is bi-directional

567. The plate current i_p in a triode valve is given $i_p = K(V_p + \mu V_g)^{3/2}$ where i_p is in milliampere and V_p and V_g are in *volt*. If $r_p = 10^4$ *ohm*, and $g_m = 5 \times 10^{-3} mho$, then for $i_p = 8\ mA$ and $V_p = 300\ volt$, what is the value of K and grid cut off voltage
  a) $-6V, (30)^{3/2}$ b) $-6V, (1/30)^{3/2}$ c) $+6V, (1/30)^{3/2}$ d) $+6V, (1/30)^{3/2}$

568. In a common emitter amplifier, using output resistance of 5000 Ω and input resistance of 2000 Ω, if the peak value of input signal voltage is 10 mV and $\beta = 50$, then peak value of output voltage is
  a) 5×10^{-6} V b) 12.50×10^{-6} V c) 1.25 V d) 125.0 V

569. Consider a p-n junction as a capacitor, formed with p and n-materials acting as thin metal electrodes and depletion layer width acting as separation between them. Basing on this, assume that a n-p-n transistor is working as an amplifier in CE configuration. If C_1 and C_2 are the base-emitter and collector-emitter junction capacitances, then
  a) $C_1 > C_2$ b) $C_1 < C_2$ c) $C_1 = C_2$ d) $C_1 = C_2 = 0$

570. The depletion layer in the 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

571. Which of the following statements is not correct when a junction diode is in forward bias?
a) The width of depletion region decreases.
b) Free electrons on n-side will move towards the junction.
c) Holes on p-side move towards the junction.
d) Electrons on n-side and holes on p-side will move away from junction.

572. The input resistance of a common emitter transistor amplifier, if the output resistance is 500 $K\Omega$, the current gain $\alpha = 0.98$ and power gain is 6.0625×10^6, is
a) 198 Ω
b) 300Ω
c) 100Ω
d) 400Ω

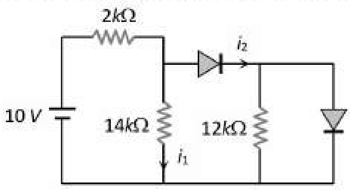
573. Identify the logic operation performed by the circuit given here.

a) OR
b) NOR
c) NOT
d) NAND

574. In depletion layer of unbiased p-n junction
a) Holes are present
b) Electrons are present
c) Only fixed ions are present
d) None of the above

575. Electrical conductivity of a semiconductor
a) Increases with the rise in its temperature
b) Decrease with the rise in its temperature
c) Decrease does not change with the rise in its temperature
d) First increase and then decreases with the rise in its temperature

576. In the following circuit find I_1 and I_2



a) 0, 0
b) 5 mA, 5 mA
c) 5 mA, 0
d) 0, 5 mA

577. In extrinsic semiconductors
a) The conduction band and valence band overlap
b) The gap between conduction band and valence band is more than 16 eV
c) The gap between conduction band and valence band is near about 1 eV
d) The gap between conduction band and valence band will be 100 eV and more

578. With a change of load resistance of a triode, used as an amplifier, from 50 *kilo ohms* to 100 *kilo ohms*, its voltage amplification changes from 25 to 30. Plate resistance of the triode is
a) 25 $k\Omega$
b) 75 $k\Omega$
c) 7.5 $k\Omega$
d) 2.5 $k\Omega$

579. The truth table given below is for (A and B are the inputs, Y is the output)

A	B	Y
0	0	1
0	1	1
1	0	1
1	1	0

a) NOR
b) AND
c) XOR
d) NAND

580. In case of a $p - n$ junction diode at high value of reverse dias, the current rises sharply. The value of reverse bias is known as
a) Cut-off voltage
b) Zener voltage
c) Inverse voltage
d) Critical voltage

581. In a PNP transistor working as a common-base amplifier, current gain is 0.96 and emitter current is 7.2 mA. The base current is
a) 0.4 mA
b) 0.2 mA
c) 0.29 mA
d) 0.35 mA

582. In the circuit of a triode value, there is no change in the plate current, when the plate potential is increased from 200 V to 220 V and the grid potential is decreased from −0.5 V to − 1.3 V. The amplification factor of the valve is

a) 15　　b) 20　　c) 25　　d) 35

583. 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) $0.1\ V$　　b) $1.0\ V$　　c) $1\ mV$　　d) $10\ mV$

584. In a PNP transistor the base is the N-region. Its width relative to the P-region is

a) Smaller　　b) Larger　　c) Same　　d) Not related

585. In a common emitter transistor, the current gain is 80. What is the change in collector current, when the change in base current is 250 μA

a) $80 \times 250\ \mu A$　　b) $(250-80)\mu A$　　c) $(250+80)\mu A$　　d) $250/80\ \mu A$

586. By increasing the temperature, the specific resistance of a conductor and a semiconductor

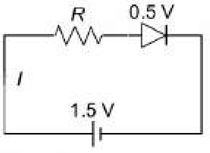
a) Increases for both　　b) Decreases for both

c) Increases, decreases respectively　　d) Decreases, increases respectively

587. The transconductance of a triode amplifier is 2.5 $mili\ mho$ having plate resistance of 20 $k\Omega$, amplification 10. Find the load resistance

a) $5\ k\Omega$　　b) $25\ k\Omega$　　c) $20\ k\Omega$　　d) $50\ k\Omega$

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



a) 1.5 Ω　　b) 5 Ω　　c) 6.67 Ω　　d) 200 Ω

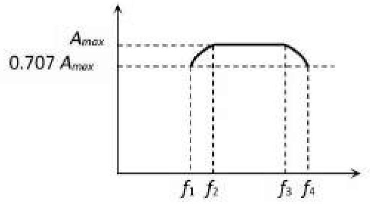
589. The voltage gain of a triode depends upon

a) Filament voltage　　b) Plate voltage　　c) Plate resistance　　d) Plate current

590. For a transistor the parameter $\beta = 99$. The value of the parameter is

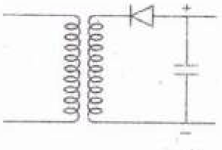
a) 0.9　　b) 0.99　　c) 1　　d) 9

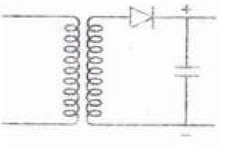
591. The frequency response curve of RC coupled amplifier is shown in figure. The band width of the amplifier will be

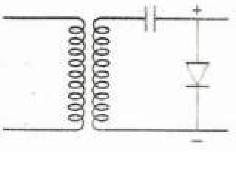


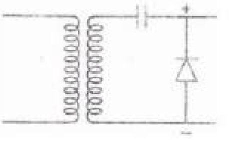
a) $f_3 - f_2$　　b) $f_4 - f_1$　　c) $\frac{f_4 - f_2}{2}$　　d) $f_3 - f_1$

592. Which is the correct diagram of a half-wave rectifier?

a) 

b) 

c) 

d) 

593. In a semiconductor, the concentration of electrons is $8 \times 10^{14}/cm^3$ and that of the holes is $5 \times 10^{12} cm^3$. The semiconductor is

a) P-type b) N-type c) Intrinsic d) PNP-type

594. An oscillator in nothing but an amplifier with

a) Positive feed back b) Large gain c) No feedback d) Negative feedback

595. In an NPN transistor the collector current is 24 mA. If 80% of electrons reach collector its base current in mA is

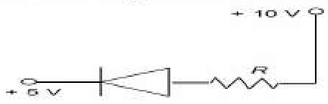
a) 36 b) 26 c) 16 d) 6

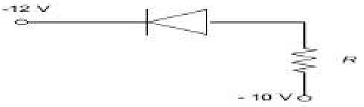
596. In breakdown region, a zener diode behaves as a

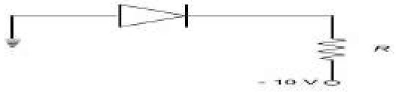
a) Constant current source b) Constant voltage source

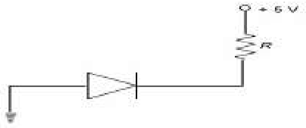
c) Constant resistance source d) Constant power source

597. In the following, which one of the diodes is reverse biased?

a) 

b) 

c) 

d) 

598. The value of D.C. voltage in Half wave rectifier in converting A.C. voltage $V = 100 \sin(314\, t)$ into D.C. is

a) 100 $volt$ b) 50 $volt$ c) 30.3 $volt$ d) 0

599. In a triode, cathode, grid and plate are at $0, -2$ and 80 V respectively. The electrons are emitted from the cathode with energy 3 eV. The energy of the electron reaching the plate is

a) 77 eV b) 85 eV c) 81 eV d) 83 eV

600. For a common emitter amplifier, the audio signal voltage across the collector resistance 2kΩ is 2 V. If the current amplification factor of the transistor is 220, and the base resistance is 1.5 Ω, the input signal voltage and base current are

a) 0.1 V and 1 μA b) 0.15 V and 10 μA c) 1.015 V and 1 A d) 0.0075 V and 5 μA

601. Which of the following does not vary with plate or grid voltages

a) g_m b) R_p c) μ d) Each of them varies

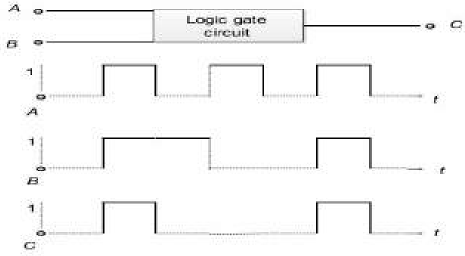
602. The ratio of work functions and temperatures of two emitters are 1 : 2, then the ratio of current densities obtained by them will be

a) 4:1 b) 2:1 c) 1:2 d) 1:4

603. What is the value of $A - \bar{A}$ in Boolean algebra?

a) Zero b) 1 (one) c) A d) $\bar{A}$

604. The following figure shows a logic gate circuit with two inputs A and B and the output C. The voltage waveforms of A, B and C are as shown below



The logic circuit gate is

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

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

a) 70.7 Hz b) 100 Hz c) 25 Hz d) 59 Hz

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

a) Dynamo b) Motor c) Transformer d) Rectifier

607. When n-p-n transistor is used as an amplifier

a) Electrons move from emitter to base
b) Electrons move from base to emitter
c) Electrons move from collector to base
d) Holes move from base to emitter

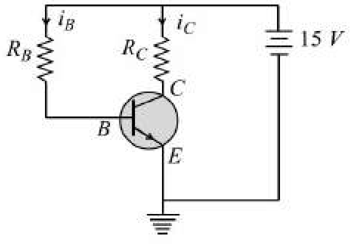
608. Minority carriers in a p-type semiconductor are

a) Free electrons
b) Holes
c) Neither holes nor free electrons
d) Both holes and free electrons

609. Diode valve is discovered by

a) Richardison
b) Dushman
c) Edison
d) Fleming

610. In the following common emitter circuit if $\beta = 100, V_{CE} = 7V, V_{BE} =$ negligible, $R_C = 2\ k\Omega$ then $I_B =$?



a) 0.01 mA
b) 0.04 mA
c) 0.02 mA
d) 0.03 mA

611. The contribution in the total current flowing through a semiconductor due to electrons and holes are $\frac{3}{4}$ and $\frac{1}{4}$ respectively. If the drift velocity of electrons is $\frac{5}{2}$ times that of holes at this temperature, then the radio of concentration of electrons and holes is

a) 6 : 5
b) 5 : 6
c) 3 : 2
d) 2 : 3

612. The ratio of electron and hole current in a semiconductor is 7/4 and the ratio of drift velocities of electrons and holes is 5/4, then ratio of concentrations of electrons and holes will be

a) 5/7
b) 7/5
c) 25/49
d) 49/75

613. If the amplification factor of a triode (μ) is 22 and its plate resistance is 6600 ohm, then the mutual conductance of this valve is mho is

a) $\frac{1}{300}$
b) 25×10^{-2}
c) 2.5×10^{-2}
d) 0.25×10^{-2}

614. Resistance of a semiconductor

a) Increases with increase in temperature
b) Decreases with increase in temperature
c) Is not affected by change in temperature
d) Increase for germanium and decrease for silicon

615. While a collector to emitter voltage is constant in a transistor, the collector current changes by 8.2 mA when the emitter current changes by 8.3 mA. The value of forward current ratio h_{fe} is

a) 82
b) 83
c) 8.2
d) 8.3

616. The potential in depletion layer is due to

a) Electrons
b) Holes
c) Ions
d) Forbidden band

617. Three semi-conductors are arranged in the increasing order of their energy gap as follows. The correct arrangement is

a) Tellurium, germanium, silicon
b) Tellurium, silicon, germanium
c) Silicon, germanium, tellurium
d) Silicon, tellurium, germanium

618. 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

619. Any digital circuit can be realised by repetitive use of only

a) NOT gate
b) OR gate
c) AND gate
d) NOR gate

620. In NPN transistor, if doping in base region is increased then collector current

a) Increases
b) Decreases
c) Remains same
d) None of these

621. The relation between number of free electrons (n) is a semiconductor and temperature (T) is given by

a) $n \propto T$ b) $n \propto T^2$ c) $n \propto \sqrt{T}$ d) $n \propto T^{3/2}$

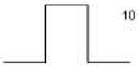
622. The energy gap of silicon is 1.5 eV. At what wavelength the silicon will stop to absorb the photon

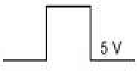
a) 8250 Å b) 7250 Å c) 6875.5 Å d) 5000 Å

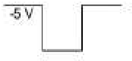
623. The current gain of a transistor in common emitter mode is 49. The change in collector current and emitter current corresponding to the change in base current by 5.0 μA are

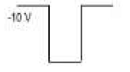
a) $\Delta i_C = 245\ \mu$A, $\Delta i_E = 250\ \mu$A
b) $\Delta i_C = 252\ \mu$A, $\Delta i_E = 145\ \mu$A
c) $\Delta i_C = 125\ \mu$A, $\Delta i_E = 250\ \mu$A
d) $\Delta i_C = 252\ \mu$A, $\Delta i_E = 230\ \mu$A

624. In a p-n junction diode, a square input signal of 10 V is applied as shown in figure. The output signal across R_L will be

a) 

b) 

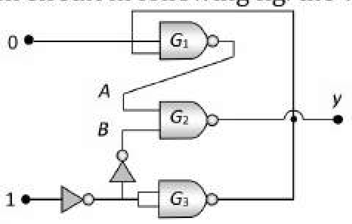
c) 

d) 

625. GaAs is

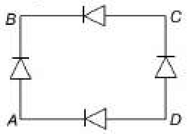
a) Element semiconductor
b) Alloy semiconductor
c) Bad conductor
d) Metallic semiconductor

626. In circuit in following fig. the value of Y is



a) 0
b) 1
c) Fluctuates between 0 and 1
d) Indeterminate as the circuit can't be realised

627. As shown if figure, the input is across the terminals A and C and the output is across B and D. Then the output is



a) Zero b) Same as the input c) Half wave rectified d) Full wave rectified

628. Plate resistance of two triode valves is 2 $k\Omega$ and 4 $k\Omega$, amplification factor of each of the valves is 40. The ratio of voltage amplification, when used with 4 $k\Omega$ load resistance, will be

a) 10 b) 4/3 c) 3/4 d) 16/3

629. The phase difference between input and output voltages of a CE circuit is

a) 0° b) 90° c) 180° d) 270°

630. A silicon specimen is made into a p-type semiconductor by doping, on an average, one indium atom per 5×10^7 silicon atoms. If the number density of atoms in the silicon specimen is 5×10^{28} atoms m^{-3}, then the number of acceptor atoms in silicon per cubic centimeter will be

a) 2.5×10^{30} atom cm^{-3}
b) 2.5×10^{35} atom cm^{-3}
c) 1×10^{13} atom cm^{-3}
d) 1×10^{15} atom cm^{-3}

631. The saturation current in a diode valve is governed by

a) Child's law b) Len's law c) Richardson's law d) Ampere's law

632. The slopes of anode and mutual characteristics of a triode are 0.02 $mA\ V^{-1}$ and 1 $mA\ V^{-1}$ respectively. What is the amplification factor of the valve

a) 5 b) 50 c) 500 d) 0.5

633. A p-n junction has acceptor impurity concentration of $10^{17}\ \text{cm}^{-3}$ in the P side and donor impurity concentration of $10^{16}\ \text{cm}^{-3}$ in the N side. What is the contact potential at the junction? (kT = thermal energy, intrinsic carrier concentration $n_i = 1.4\times\ 10^{10}\ \text{cm}^{-3}$)

a) $\left(\frac{kT}{e}\right)\ln(4\times10^{12})$ b) $\left(\frac{kT}{e}\right)\ln(2.5\times10^{23})$ c) $\left(\frac{kT}{e}\right)\ln(10^{23})$ d) $\left(\frac{kT}{e}\right)\ln(10^{9})$

634. In a common base amplifier circuit, calculate the change in base current if that in the emitter current is 2 mA and $\alpha = 0.98$

a) 0.04 mA b) 1.96 mA c) 0.98 mA d) 2 mA

635. In a P-type semiconductor, the acceptor impurity produces an energy level

a) Just below the valence band b) Just above the conduction band

c) Just below the conduction band d) Just above the valence band

636. In common emitter amplifier, the current gain is 62. The collector resistance and input resistance are 5 kΩ and 500 Ω respectively. If the input voltage is 0.01 V, the output voltage is

a) 0.62 V b) 6.2 V c) 62 V d) 620 V

637. When the electrical of a semi- conductor is due to the breaking of its covalent bonds, then the semiconductor is said to be

a) Donor b) Acceptor c) Intrinsic d) Extrinsic

638. Which one is correct relation for thermionic emission

a) $J = AT^{1/2}e^{-\phi/kT}$ b) $J = AT^{2}e^{-\phi/kT}$ c) $J = AT^{3/2}e^{-\phi/kT}$ d) $J = AT^{2}e^{-\phi/2kT}$

639. In a common emitter transistor amplifier β = 60, R_0 = 5000Ω and internal resistance of a transistor is 500Ω. The voltage amplification of amplifier will be

a) 500 b) 460 c) 600 d) 560

640. When phosphorus and antimony are mixed in germanium, then

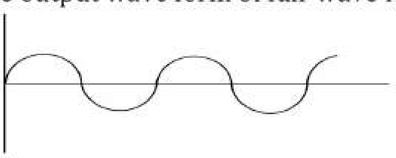
a) P-type semiconductor is formed b) N-type semiconductor is formed

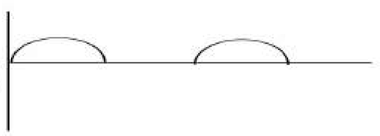
c) Both (a) and (b) d) none of these

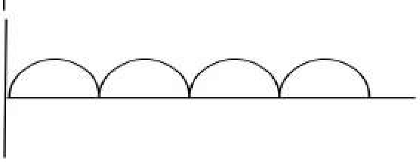
641. In the study of transistor as an amplifier, if $\alpha = I_c/I_e$ and $\beta = I_c/I_b$, where I_c, I_b and I_e are the collector, base and emitter currents, then

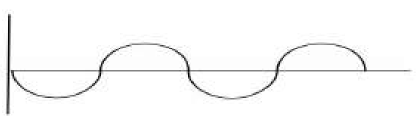
a) $\beta = \dfrac{1-\alpha}{\alpha}$ b) $\beta = \dfrac{\alpha}{1-\alpha}$ c) $\beta = \dfrac{\alpha}{1+\alpha}$ d) $\beta = \dfrac{1+\alpha}{\alpha}$

642. The output wave form of full-wave rectifier is

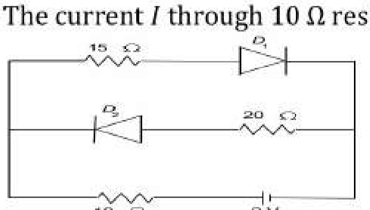
a) 

b) 

c) 

d) 

643. The current I through 10 Ω resistor in the circuit given below is



a) 50 mA b) 20 mA c) 40 mA d) 80 mA

644. The cause of the potential barrier in a P-N diode is

a) Depletion of positive charges near the junction

b) Concentration of positive charges near the junction

c) Depletion of negative charges near the junction

d) Concentration of positive and negative charges near the junction

645. Consider the following statement A and B and identify the correct choice of the given answers

(A) A zener diode is always connected in reverse bias

(B) The potential barrier of a PN junction lies between 0.1 to 0.3 V approximately

a) A and B are correct
b) A and B are wrong
c) A is correct but B is wrong
d) A is wrong but B is correct

646. Which one of the following statements is not correct

a) A diode does not obey Ohm's law
b) A PN junction diode symbol shows an arrow identifying the direction of current (forward) flow
c) An ideal diode is an open switch
d) An ideal diode is an ideal one way conductor

647. The coordination number of hexagonal close packing (hcp) is

a) 6
b) 8
c) 12
d) 16

648. In an n-type semiconductor, the fermi energy level lies

a) In the forbidden energy gap nearer to the conduction band
b) In the forbidden energy gap nearer to the valence band
c) In the middle of forbidden energy gap
d) Outside the forbidden energy gap

649. The amplification produced by a triode is due to the action of

a) Filament
b) Cathode
c) Grid
d) Plate

650. The relation between dynamic plate resistance (r_p) of a vacuum diode and plate current in the space charge limited region, is

a) $r_p \propto I_p$
b) $r_p \propto I_p^{3/2}$
c) $r_p \propto \frac{1}{I_p}$
d) $r_p \propto \frac{1}{(I_p)^{1/3}}$

651. The coordination number of body centred crystal is

a) 6
b) 8
c) 12
d) 16

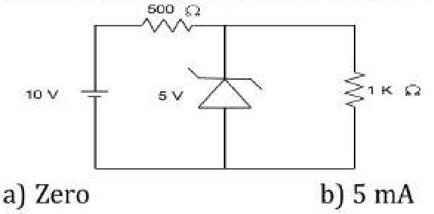
652. The part of a transistor which is heavily doped to produce a large number of majority carriers is

a) Base
b) Emitter
c) Collector
d) None of these

653. A piece of copper and other of germanium are cooled from the room temperature to 80 K, then

a) Resistance of each will increase
b) Resistance of each will decrease
c) The resistance of copper will increase, while that of germanium will decrease
d) The resistance of copper will decrease, while that of germanium will increase

654. In the following circuit, the current flowing through 1 kΩ resistor is



a) Zero
b) 5 mA
c) 10 mA
d) 15 mA

655. When a semiconductor is heated, its resistance

a) Decreases
b) Increases
c) Remains unchanged
d) Nothing is definite

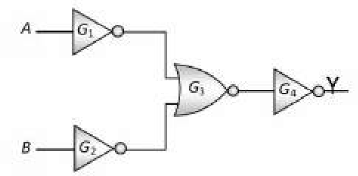
656. In a diode valve the cathode temperature must be (ϕ = work function)

a) High and ϕ should be high
b) High and ϕ should be Low
c) Low and ϕ should be high
d) Low and ϕ should be low

657. The phenomenon of thermionic emission was discovered by

a) Marcoini
b) Fleming
c) Forest
d) Thomas Edison

658. The combination of gates shown below produces



a) AND gate b) XOR gate c) NOR gate d) NAND gate

659. The plate current will be zero in triode, if the negative potential applied on grid is (here μ is amplification factor, R_p is plate resistance, V_p is plate potential)

a) V_p/μ b) μV_p c) $V_p R_p$ d) V_p/R_p

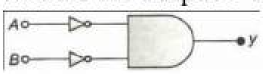
660. Energy gap between valence band and conduction band of a semiconductor is

a) Zero b) Infinite c) 1 eV d) 10 eV

661. Name of a p-n junction, which can be used as the regulator, is

a) Zener diode b) Tunnel diode c) Gunn diode d) None of these

662. What is the output Y of the gate circuit shown in figure?

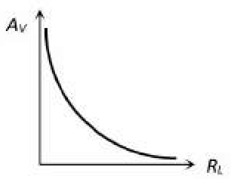


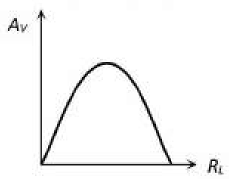
a) $A \cdot B$ b) $\bar{A} \cdot \bar{B}$ c) $\bar{A} \cdot \bar{B}$ d) $\overline{A \cdot B}$

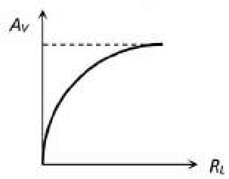
663. The unit of mutual conductance of a triode valve is

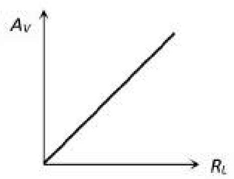
a) Siemen b) *Ohm* c) *Ohm metre* d) *Joule coulomb*$^{-1}$

664. The correct curve between voltage gain (A_v) and load resistance (R_L) is

a) 

b) 

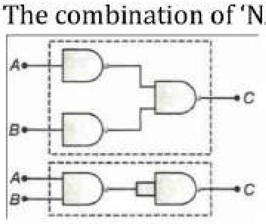
c) 

d) 

665. For a junction diode the ratio of forward current (I_F) and reverse current (I_r) is
[I_e =electronic charge, V =voltage applied across junction, k = Boltzmann constant, T =temperature in kelvin]

a) $e^{-V/kT}$ b) $e^{V/kT}$ c) $(e^{-eV/kT} + 1)$ d) $(e^{V/kT} - 1)$

666. 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

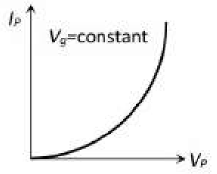
667. Electronic configuration of germanium is 2, 8, 18 and 4. To make it extrinsic semiconductor small quantity of antimony is added

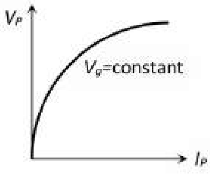
a) The material obtained will be N-type germanium in which electrons and holes are equal in number
b) The material obtained will be P-type germanium
c) The material obtained will be N-type germanium which has more electrons than holes at room temperature
d) The material obtained will be N-type germanium which has less electrons than holes at room temperature

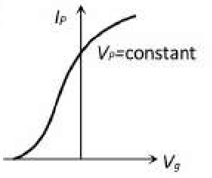
668. Amplification factor of a triode is 10. When the plate potential is 200 *volt* and grid potential is -4 *volt*, then the plate current of $4mA$ is observed. If plate potential is changed to 160 *volt* and grid potential is kept at -7 *volt*, then the plate current will be

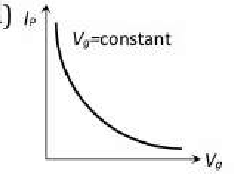
a) 1.69 mA b) 3.95 mA c) 2.87 d) 7.02 mA

669. The mutual characteristic of triode is

a) 

b) 

c) 

d) 

670. If no external voltage is applied across P-N junction, there would be

a) No electric field across the junction

b) An electric field pointing from N-type to P-type side across the junction

c) An electric field pointing from P-type to N-type side across the junction

d) A temporary electric field during formation of P-N junction that would subsequently disappear

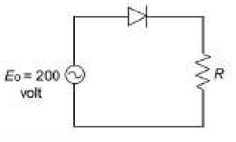
671. What is the coordination number of sodium ions in the case of sodium chloride structure

a) 6 b) 8 c) 4 d) 12

672. A diode having potential difference 0.5 V across its junction which does not depend on current, is connected in series with resistance of 20Ω across source. If 0.1 A current passes through resistance then what is the voltage of the source?

a) 1.5 V b) 2.0 V c) 2.5 V d) 5 V

673. A sinusoidal voltage of peak value 200 volt is connected to a diode and resistor R in the circuit figure, so that halfwave rectification occurs. If the forward resistance of the diode is negligible compared to R, the RMS voltage (in volt) across R is approximately



a) 200 b) 100 c) $\frac{200}{\sqrt{2}}$ d) 280

674. When a battery is connected to a P-type semiconductor with a metallic wire, the current in the semiconductor (predominantly), inside the metallic wire and that inside the battery respectively is due to

a) Holes, electrons, ions b) Holes, ions, electrons c) Electrons, ions, holes d) Ions, electrons, holes

675. In CE mode, the input characteristics of a transistor is the variation of

a) I_B against V_{BE} at constant V_{CE} b) I_C against V_{CE} at constant V_{BE}

c) I_B against I_C d) I_E against I_C

676. 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 the barrier potential

677. A transistor is used as an amplifier in CB mode with a load resistance of 5 k Ω. The current gain of amplifier is 0.98 and the input resistance is 70 Ω, the voltage gain and power gain respectively are

a) 70, 68.6 b) 80, 75.6 c) 60, 66.6 d) 90, 96.6

678. A $p-n$ junction diode contains a depletion layer

a) Only if it is unbiased

b) Only if is forward biased

c) Only if it is reverse biased

d) Irrespective of whether it is biased or unbiased

679. In an intrinsic semiconductor, the Fermi level is

a) Nearer to valency band than conduction band

b) Equidistance from conduction band and valency band

c) Nearer to conduction band than valency band

d) Bisecting the conduction band

680. For a cubic crystal structure which one of the following relations indicating the cell characteristic is correct?

a) $a \neq b \neq c$ and $\alpha \neq \beta$ and $\gamma \neq 90^0$ b) $a \neq b \neq c$ and $\alpha = \beta = \gamma = 90^0$
c) $a = b = c$ and $\alpha \neq \beta \neq \gamma = 90^0$ d) $a = b = c$ and $\alpha = \beta = \gamma = 90^0$

681. Copper has face-centred cubic (fcc) lattice with interatomic spacing equal to 2.54 Å. The value of lattice constant for this lattice is

a) 1.27 Å b) 5.08 Å c) 2.54 Å d) 3.59 Å

682. The coordination number of simple cubic crystal is

a) 6 b) 8 c) 12 d) 16

683. The temperature of germanium is decreased from room temperature to 100 K, the resistance of germanium

a) Decreases b) Increases
c) Unaffected d) Depends on external conditions

684. The linear portions of the characteristic curves of a triode valve give the following readings $V_g(volt)$

$V_g(volt)$	0	−2	−4	−6
$I_p(mA)$ for $V_p = 150\ volts$	15	12.5	10	7.5
$I_p(mA)$ for $V_p = 120\ volts$	10	7.5	5	2.5

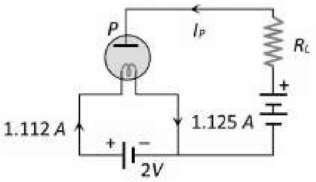
The plate resistance is

a) 2000 *ohms* b) 4000 *ohms* c) 8000 *ohms* d) 6000 *ohms*

685. In a transistor in common-emitter configuration, the ratio of power gain to voltage gain is

a) α b) $\frac{\beta}{\alpha}$ c) β × β d) β

686. The value of plate current in the given circuit diagram will be

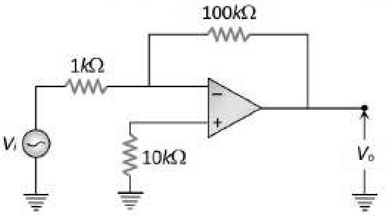


a) 3 *mA* b) 8 *mA* c) 13 *mA* d) 18 *mA*

687. When a solid with a band gap has a donor level just below its empty energy band, the solid is

a) An insulator b) A conductor
c) *p*-type semiconductor d) *n*-type semiconductor

688. The voltage gain of the following amplifier is

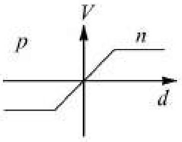


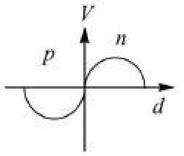
a) 10 b) 100 c) 1000 d) 9.9

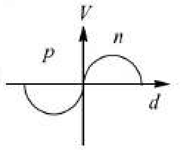
689. The amplification factor of a triode is 18 and its plate resistance is $8 \times 10^3 \Omega$. A load resistance of $10^4 \Omega$ is connected in the plate circuit. The voltage gain will be

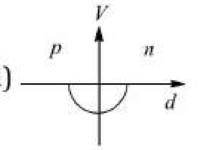
a) 30 b) 20 c) 10 d) 1

690. The correct curve between potential (V) and distance (d) near $p - n$ junction is

a) 

b) 

c) 

d) 

691. How many NAND gates are required to form an AND gate?

a) 1 b) 2 c) 3 d) 4

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

a) The number of free conduction electrons is significant in C but small in Si and Ge

b) The number of free conduction electrons 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

693. The correct relation for a triode is

a) $g_m = \left|\frac{\Delta I_p}{\Delta V_p}\right|_{V_g = constt}$ b) $g_m = \left|\frac{\Delta I_p}{\Delta V_g}\right|_{V_p = constt}$ c) Both d) None of these

694. The current gain of a transistor in common base mode is 0.995. the current gain of the same transistor in common emitter mode is

a) 197 b) 201 c) 198 d) 199

695. If β, R_L and r are the ac current gain, load resistance and the input resistance of a transistor respectively in CE configuration, the voltage and the power gains respectively are

a) $\beta\frac{R_L}{r}$ and $\beta^2\frac{R_L}{r}$ b) $\beta\frac{r}{R_L}$ and $\beta^2\frac{r}{R_L}$ c) $\beta\frac{R_L}{r}$ and $\beta\left(\frac{R_L}{r}\right)^2$ d) $\beta\frac{r}{R_L}$ and $\beta\left(\frac{r}{R_L}\right)^2$

696. If the forward voltage in a diode is increased, the width of the depletion region

a) Increases b) Decreases c) Fluctuates d) No change

697. In a transistor, the base is

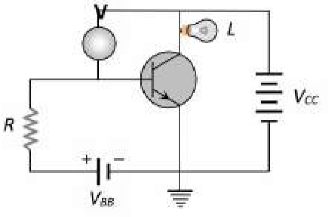
a) A conductor of low resistance b) A conductor of high resistance

c) An insulator d) An extrinsic semiconductor

698. In a semiconductor, the forbidden energy gap between the valence band and the conduction band is of the order is

a) 1 MeV b) 0.1 MeV c) 1 eV d) 5 eV

699. In the following circuit, a voltmeter V is connected across a lamp L. What change would occur in voltmeter reading if the resistance R is reduced in value



a) Increases b) Decreases c) Remains same d) None of these

700. Pick out the statement which is not correct

a) At a low temperature, the resistance of a semiconductor is very high

b) Movement of holes is restricted to the valence band only

c) Width of the depletion region increases as the forward bias voltage increases in case of a N-P junction diode

d) In a forward bias condition, the diode heavily conducts

701. A semiconductor 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 revered, the current drops almost to zero. The device may be

a) A p-type semiconductor b) An n-type semiconductor

c) A $p - n$ junction d) An intrinsic semiconductor

702. Application of a forward bias to a p-n junction

a) Increase the number of donors on the n-side

b) Increase the electric field in the depletion zone

c) Increase the potential difference across (the depletion zone)

d) Widens the depletion zone

703. How many NAND gates are used in an OR gate?

a) Four b) Two c) Three d) Five

704. Formation of covalent bonds in compounds exhibits

a) Wave nature of electron

b) Particle nature of electron

c) Both wave and particle nature of electron

d) None of the above

705. For transistor action

(1) Base, emitter and collector regions should have similar size and doping concentrations

(2) The base region must be very thin and lightly doped

(3) The emitter-base junction is forward biased and base-collector junction is reverse biased

(4) Both the emitter-base junction as well as the base collector junction are forward biased

Which of the following pairs of statements is correct

a) (4), (1) b) (1), (2) c) (2), (3) d) (3), (4)

706. In semiconductor the concentration of electrons and holes are $8 \times 10^{18}/m^3$ and $5 \times 10^{18}/m$ respectively. If the mobilities of electrons and holes are 2.3 $m^2/volt\text{-}s$ and 0.01 $m^2/vol\text{-}s$ respectively, then semiconductor is

a) N-type and its respectively is 0.34 $ohm\text{-}metre$

b) P-type and its respectively is 0.034 $ohm\text{-}metre$

c) N-type and its respectively is 0.034 $ohm\text{-}metre$

d) P-type and its respectively is 3.40 $ohm\text{-}metre$

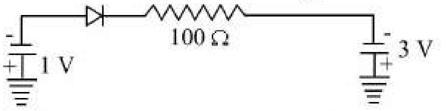
707. Three amplifier stages each with a gain of 10 are cascaded. The overall gain is

a) 10 b) 30 c) 1000 d) 100

708. The energy band gap (distance between the conduction band and valence band) in conductor is

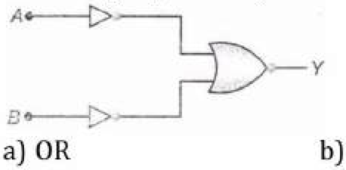
a) Zero b) 4 Å c) 10 Å d) 100 Å

709. What is the current through an ideal PN-junction diode shown in figure below



a) Zero b) 10 mA c) 20 mA d) 50 mA

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



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

711. When the temperature of silicon sample is increased from 27°C to 100°C, the conductivity of silicon will be

a) Increased b) Decreased c) Remain same d) Zero

712. At ordinary temperatures, the electrical conductivity of semi conductors in $mho/metre$ is in the range

a) 10^3 to 10^{-4} b) 10^6 to 10^9 c) 10^{-6} to 10^{-10} d) 10^{-10} to 10^{-16}

713. For a transistor, in a common emitter arrangement, the alternating current gain β is given by

a) $\beta = \left(\frac{\Delta I_C}{\Delta I_B}\right)_{V_C}$ b) $\beta = \left(\frac{\Delta I_B}{\Delta I_C}\right)_{V_C}$ c) $\beta = \left(\frac{\Delta I_C}{\Delta I_E}\right)_{V_C}$ d) $\beta = \left(\frac{\Delta I_E}{\Delta I_C}\right)_{V_C}$

714. Regarding a semiconductor which one of the following is wrong

a) There are no free electrons at room temperature

b) There are no free electrons at 0 K

c) The number of free electrons increases with rise of temperature

d) The charge carriers are electrons and holes

715. Biaxial crystal among the following is

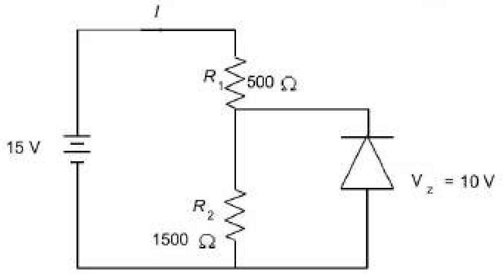
a) Calcite b) Quartz c) Selenite d) Tourmaline

716. Intrinsic semiconductor is electrically neutral. Extrinsic semiconductor having large number of current carriers would be
a) Positively charged
b) Negatively charged
c) Positive charged or negatively charged depending upon the type of impurity that has been added
d) Electrically neutral

717. The forbidden energy gap in Ge is 0.72 eV, given, $hc = 12400$ eV-Å. The maximum wavelength of radiation that will generate electron hole pair is
a) 172220 Å b) 172.2 Å c) 17222 Å d) 1722 Å

718. The ripple factor in a half wave rectifier is
a) 1.21 b) 0.48 c) 0.6 d) None of these

719. In the circuit given the current through the zener diode is



a) 10 mA b) 6.67 mA c) 5 mA d) 3.33 mA

720. The gate for which output is high, if at least one input is low?
a) NAND b) NOR c) AND d) OR

SEMICONDUCTOR ELECTRONICS: MATERIALS,DEVIES AND SIMPLE CIRCUITS

: ANSWER KEY :

1)	a	2)	c	3)	a	4)	b	161)	b	162)	a	163)	c	164)	a
5)	d	6)	b	7)	d	8)	d	165)	a	166)	a	167)	d	168)	b
9)	d	10)	d	11)	a	12)	a	169)	d	170)	b	171)	c	172)	b
13)	c	14)	c	15)	d	16)	d	173)	b	174)	b	175)	b	176)	a
17)	c	18)	a	19)	d	20)	b	177)	a	178)	a	179)	c	180)	d
21)	a	22)	a	23)	b	24)	a	181)	b	182)	d	183)	b	184)	d
25)	b	26)	a	27)	a	28)	c	185)	b	186)	c	187)	c	188)	d
29)	b	30)	b	31)	b	32)	c	189)	b	190)	c	191)	c	192)	a
33)	b	34)	a	35)	a	36)	a	193)	b	194)	b	195)	b	196)	c
37)	b	38)	b	39)	d	40)	d	197)	a	198)	b	199)	b	200)	a
41)	a	42)	a	43)	a	44)	b	201)	b	202)	b	203)	c	204)	c
45)	a	46)	b	47)	c	48)	a	205)	a	206)	a	207)	b	208)	a
49)	b	50)	a	51)	c	52)	c	209)	d	210)	d	211)	c	212)	c
53)	c	54)	c	55)	d	56)	c	213)	a	214)	b	215)	b	216)	c
57)	a	58)	a	59)	c	60)	d	217)	c	218)	d	219)	a	220)	c
61)	c	62)	b	63)	c	64)	b	221)	d	222)	c	223)	c	224)	a
65)	b	66)	d	67)	d	68)	b	225)	c	226)	d	227)	c	228)	b
69)	a	70)	c	71)	c	72)	d	229)	a	230)	c	231)	a	232)	d
73)	b	74)	d	75)	a	76)	d	233)	b	234)	b	235)	c	236)	d
77)	a	78)	d	79)	c	80)	d	237)	c	238)	b	239)	a	240)	b
81)	c	82)	d	83)	b	84)	b	241)	c	242)	a	243)	a	244)	d
85)	b	86)	c	87)	b	88)	d	245)	c	246)	c	247)	d	248)	a
89)	b	90)	b	91)	c	92)	a	249)	c	250)	a	251)	a	252)	a
93)	d	94)	b	95)	b	96)	b	253)	b	254)	a	255)	a	256)	c
97)	c	98)	b	99)	b	100)	a	257)	d	258)	d	259)	a	260)	b
101)	a	102)	b	103)	b	104)	d	261)	c	262)	b	263)	a	264)	c
105)	c	106)	b	107)	c	108)	c	265)	c	266)	d	267)	a	268)	b
109)	b	110)	a	111)	c	112)	d	269)	d	270)	d	271)	a	272)	c
113)	a	114)	a	115)	b	116)	b	273)	a	274)	d	275)	c	276)	a
117)	c	118)	c	119)	a	120)	b	277)	d	278)	c	279)	d	280)	c
121)	d	122)	b	123)	d	124)	a	281)	c	282)	d	283)	c	284)	a
125)	c	126)	a	127)	d	128)	b	285)	c	286)	c	287)	b	288)	b
129)	d	130)	d	131)	a	132)	c	289)	a	290)	c	291)	b	292)	c
133)	a	134)	c	135)	b	136)	b	293)	d	294)	a	295)	a	296)	b
137)	b	138)	d	139)	b	140)	c	297)	c	298)	b	299)	c	300)	d
141)	b	142)	a	143)	d	144)	a	301)	b	302)	a	303)	a	304)	a
145)	a	146)	b	147)	a	148)	b	305)	a	306)	b	307)	d	308)	a
149)	a	150)	c	151)	c	152)	b	309)	a	310)	d	311)	b	312)	b
153)	a	154)	d	155)	a	156)	a	313)	b	314)	b	315)	a	316)	d
157)	b	158)	b	159)	a	160)	c	317)	a	318)	d	319)	c	320)	b

321)	b	322)	b	323)	c	324)	c
325)	c	326)	c	327)	c	328)	d
329)	b	330)	c	331)	b	332)	d
333)	a	334)	c	335)	d	336)	c
337)	b	338)	c	339)	c	340)	a
341)	a	342)	b	343)	a	344)	c
345)	b	346)	b	347)	c	348)	d
349)	c	350)	c	351)	b	352)	a
353)	b	354)	d	355)	b	356)	c
357)	d	358)	a	359)	c	360)	c
361)	c	362)	c	363)	b	364)	d
365)	a	366)	c	367)	c	368)	d
369)	a	370)	c	371)	c	372)	d
373)	d	374)	b	375)	c	376)	c
377)	c	378)	c	379)	d	380)	d
381)	a	382)	d	383)	a	384)	a
385)	d	386)	c	387)	c	388)	c
389)	b	390)	d	391)	c	392)	c
393)	d	394)	b	395)	c	396)	b
397)	c	398)	c	399)	a	400)	a
401)	a	402)	b	403)	b	404)	d
405)	a	406)	c	407)	b	408)	d
409)	a	410)	c	411)	a	412)	b
413)	c	414)	b	415)	c	416)	a
417)	d	418)	a	419)	b	420)	c
421)	c	422)	d	423)	c	424)	d
425)	c	426)	b	427)	d	428)	d
429)	c	430)	c	431)	c	432)	d
433)	c	434)	c	435)	c	436)	b
437)	b	438)	c	439)	c	440)	b
441)	c	442)	c	443)	a	444)	a
445)	b	446)	c	447)	a	448)	d
449)	b	450)	a	451)	b	452)	c
453)	b	454)	d	455)	b	456)	a
457)	d	458)	d	459)	d	460)	d
461)	c	462)	b	463)	d	464)	d
465)	b	466)	d	467)	d	468)	c
469)	a	470)	d	471)	b	472)	b
473)	d	474)	c	475)	b	476)	a
477)	d	478)	d	479)	c	480)	d
481)	b	482)	b	483)	a	484)	b
485)	b	486)	b	487)	b	488)	b
489)	a	490)	d	491)	c	492)	b
493)	b	494)	c	495)	b	496)	a
497)	c	498)	b	499)	b	500)	a
501)	c	502)	b	503)	d	504)	c
505)	b	506)	d	507)	c	508)	b
509)	d	510)	c	511)	c	512)	b
513)	a	514)	b	515)	a	516)	a
517)	c	518)	b	519)	a	520)	d

521)	d	522)	d	523)	c	524)	c
525)	b	526)	b	527)	c	528)	c
529)	a	530)	c	531)	a	532)	d
533)	d	534)	a	535)	d	536)	b
537)	a	538)	d	539)	a	540)	a
541)	d	542)	a	543)	b	544)	c
545)	b	546)	c	547)	a	548)	a
549)	b	550)	b	551)	b	552)	b
553)	a	554)	c	555)	b	556)	d
557)	b	558)	d	559)	b	560)	c
561)	c	562)	c	563)	d	564)	c
565)	c	566)	a	567)	b	568)	c
569)	a	570)	b	571)	d	572)	a
573)	a	574)	c	575)	a	576)	d
577)	c	578)	a	579)	d	580)	b
581)	c	582)	c	583)	d	584)	a
585)	a	586)	c	587)	a	588)	b
589)	c	590)	b	591)	b	592)	b
593)	b	594)	a	595)	d	596)	b
597)	d	598)	c	599)	d	600)	d
601)	d	602)	d	603)	a	604)	a
605)	b	606)	d	607)	a	608)	a
609)	d	610)	b	611)	a	612)	b
613)	a	614)	b	615)	a	616)	c
617)	a	618)	b	619)	d	620)	b
621)	d	622)	a	623)	a	624)	b
625)	b	626)	a	627)	d	628)	b
629)	c	630)	d	631)	c	632)	b
633)	a	634)	a	635)	d	636)	b
637)	c	638)	b	639)	c	640)	b
641)	b	642)	c	643)	d	644)	d
645)	c	646)	c	647)	c	648)	a
649)	c	650)	d	651)	b	652)	b
653)	d	654)	b	655)	a	656)	b
657)	d	658)	d	659)	a	660)	c
661)	a	662)	b	663)	a	664)	c
665)	d	666)	a	667)	c	668)	a
669)	c	670)	b	671)	a	672)	c
673)	c	674)	a	675)	a	676)	a
677)	a	678)	d	679)	b	680)	d
681)	d	682)	a	683)	b	684)	d
685)	d	686)	c	687)	d	688)	b
689)	c	690)	a	691)	b	692)	d
693)	b	694)	d	695)	a	696)	b
697)	d	698)	c	699)	a	700)	c
701)	c	702)	a	703)	c	704)	a
705)	c	706)	a	707)	c	708)	a
709)	c	710)	c	711)	a	712)	b
713)	a	714)	a	715)	c	716)	d
717)	c	718)	a	719)	d	720)	a

SEMICONDUCTOR ELECTRONICS: MATERIALS,DEVIES AND SIMPLE CIRCUITS

: HINTS AND SOLUTIONS :

1 **(a)**

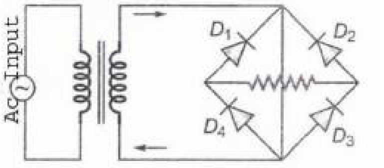
In p-type semiconductor crystal has freely moving (positive) holes and an equal number of stationary negatively charged acceptor ions. Hence, p-type semiconductor material has fewer free electrons.

3 **(a)**

In SCR (Space charge region) electrons collect around the plate, this cloud decreases the emission of electrons from the cathode, hence plate current decreases

4 **(b)**

The given question is based on bridge rectifier. This is the most widely used full wave rectifier. It makes use of four diodes D_1, D_2, D_3, D_4 connected in the four arms of a bridge.



Bridge rectifier does not required a centre tapped transformer. It has several advantages over wave rectifier.

5 **(d)**

$\alpha = 0.96$

$$\beta = \frac{\alpha}{1-\alpha} = \frac{0.96}{1-0.96} = 24$$

$$I_C = \frac{V_C}{R} = \frac{0.5}{500} = 10^{-3} A$$

$$I_b = \frac{I_c}{\beta} = \frac{10^{-3}}{24} = \frac{1}{24} mA$$

6 **(b)**

In a transistor amplifier for better amplification the emitter-base junction of a transistor is forward biased while the collector-base junction is reverse biased.

7 **(d)**

Given that, change in emitter current, $\Delta I_E = 8$ mA and change in collector current, $\Delta I_C = 7.9$ mA

We know that,

$$\alpha = \frac{\Delta I_C}{\Delta I_E}$$

$$\Rightarrow = \frac{7.9}{8} \Rightarrow \alpha \approx 0.99$$

Also, we know that

$$\beta = \frac{\alpha}{1-\alpha}$$

$$\Rightarrow = \frac{\frac{7.9}{8}}{1-\frac{7.9}{8}} = \frac{7.9}{8-7.9}$$

Or $\beta = \frac{7.9}{0.1} = 79$

Hence, the required answer is $\alpha = 0.99$ and $\beta = 79$.

8 **(d)**

In sample x no impurity level seen, so it is undoped. In sample y impurity energy level lies below the conduction bond so it is doped with fifth group impurity.

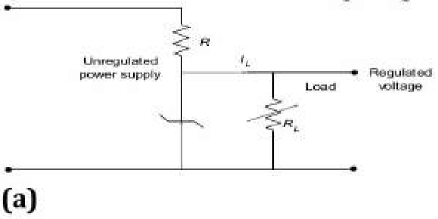
In sample z, impurity energy level lies above the valence band so it is doped with third group impurity

9 **(d)**

For this, the boolean expanssion is $Y = \overline{\boldsymbol{A} + \boldsymbol{B}}$, which is for NOR gate.

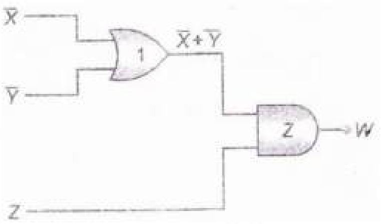
10 **(d)**

Zener diode is a highly doped p-n junction which is not damaged by high reverse current. It can operate continuously without being damaged in the region of reverse breakdown voltage. In the forward bias, the zener diode acts as ordinary diode. It can be used as voltage regulator.



11 **(a)**

We can realize the combination as shown below.



Gate-1 is OR gate while gate-2 is AND gate.
Output of OR gate, $W_1 = \bar{X} + \bar{Y}$
Thus, output of AND gate,
$W = W_1 \cdot Z = (\bar{X} + \bar{Y}) \cdot Z$

13 **(c)**
In that states output X, Y and Z changes to 0, 1, 0.

14 **(c)**
Change in temperature affects the conductivity of semiconductor and hence affects $V - I$ characteristics of $p - n$ junction.

16 **(d)**
Due to forward biasing, the diffusion current increases.

17 **(c)**
In a p-type semiconductor, holes are the majority, charge carriers and electrons are minority charge carriers. So, holes are in larger numbers and electrons in smaller numbers.

18 **(a)**
Given, $\beta = \frac{\alpha}{1-\alpha} = \frac{0.98}{1-0.98} = 49$
$\therefore$ Voltage gain $= \beta \frac{R_2}{R_1} = 49 \times 1000 = 49 \times 10^3$

19 **(d)**
At high reverse voltage, due to high electric field, the minority charge carriers, while crossing the junction acquire very high velocities. These by collision breaks down the covalent bonds generating more carriers. A chain reaction is established giving rise to high current. This mechanism is called avalanche breakdown.

20 **(b)**
In an n-type semiconductor, majority charge carriers are electrons and minority charge carriers are holes.
Therefore, $n_E >> n_H$

22 **(a)**
The donor level is found only in n-type semiconductors. The donor level lies closely below the bottom of the conduction band.

23 **(b)**
The diode in lower branch is forward biased and diode in upper branch is reverse biased

$\therefore i = \frac{5}{20 + 30} = \frac{5}{50} A$

24 **(a)**
(a) The different processes involved in the fabrication of an IC are
(i) Epitaxial growth of n or p-type layer, whenever desired. This involves cracking of silane
(ii) Oxidation which gives a layer of insulating SiO_2 and can be used to separate one region of the silicon chip from the other
(iii) Photolithography is a processes in which different regions of silicon chip are cur from different components that can be fabricated in different regions
(iv) Diffusion of different impurities to obtain different device structure
(v) Metallisation involves deposition of metal films which inter-connect different components on a chip to obtain the circuit
Hence, option (a) is not involved in fabrication of IC

25 **(b)**
Gallium is trivalent impurity

26 **(a)**
In a triclinic crystal $a \neq b \neq c$ and $\alpha \neq \beta \neq \gamma \neq 90°$

27 **(a)**
$\frac{I_2}{I_1} = \left(\frac{V_2}{V_1}\right)^{3/2}$ or $I_2 = I_1 \left(\frac{V_2}{V_2}\right)^{3/2}$
$= 80 \left(\frac{400}{200}\right)^{3/2} = 80 \times 2\sqrt{2} = 160\sqrt{2}$

28 **(c)**
Because N-side is more positive as compared to P-side

29 **(b)**
Consider the case when Ge and Si diodes are connected as show in the given figure.
Equivalent voltage drop across the combination Ge and Si diode $= 0.3\ V$
$\Rightarrow$ Current $i = \frac{12-0.3}{5\ k\Omega} = 2.34\ mA$
$\therefore$ Out put voltage $V_0 = Ri = 5\ k\Omega \times 2.34\ mA = 11.7\ V$
Now consider the case when diode connection are reversed. In this case voltage drop across the diode's combination $= 0.7\ V$
$\Rightarrow$ Current $i = \frac{12-0.7}{5\ k\Omega} = 2.26\ mA$
$\therefore V_0 = iR = 2.26\ mA \times 5\ k\Omega = 11.3\ V$
Hence charge in the value of $V_0 = 11.7 - 11.3 = 0.4\ V$

31 **(b)**

In this condition $P - N$ junction is reverse biased

33 **(b)**

By using $g_m = \frac{\Delta i_p}{\Delta v_g} \Rightarrow 3 \times 10^{-4} = \frac{\Delta i_p}{-1-(-3)}$

$\Rightarrow \Delta i_p = 6 \times 10^{-4} A = 0.6\ mA$

34 **(a)**

A p-n diode is said to be reverse biased if its p side is at low potential with respect to n side.

In option (a) p side is at $-$ 6 V while n is at $-$3 V.

36 **(a)**

Factual

37 **(b)**

In the Colpitt oscillator, the tank circuit has a single inductor, tapped in the middle with two capacitors instead of two inductors and a single capacitor as in the case of the Hartley oscillator

38 **(b)**

Higher the temperature of cathode, the larger is the value of saturation current.

39 **(d)**

Diagram (d) represents semiconductor because in semiconductor the forbidden energy gap between valance and conduction band is equal to the energy corresponding to room temperature.

40 **(d)**

108 electrons enter the emitter in $10^{-8}\ s$

$i.e., i_E = \frac{108 \times 1.6 \times 10^{-19}}{10^{-8}} A = 172.8 \times 10^{-11} A$

$\therefore$ 1% of i_E is lost in base $i.e., i_B = \frac{i_E}{100}$

$\Rightarrow$ 99% i_E $i.e., \frac{99}{100} i_E$ enters the collector

$\Rightarrow I_C = 0.99\ i_E$

Current amplification factor

$\beta = \frac{i_C}{i_B} = \frac{0.99 i_E}{0.01 i_E} = 99$

41 **(a)**

Since no conduction is found when multimeter is connected across P and Q it means either both P and Q are n-type or p-type. So, it means R is base. When R is connected to common terminal and conduction is seen when other terminal is connected to P and Q, so it means transistor is in p-n with R as base.

42 **(a)**

Here, the output of AND gate is made as the input of NOT gate, we get NAND gate.

43 **(a)**

In n-p-n transistor as CE amplifier

$i_e = i_b + i_c$

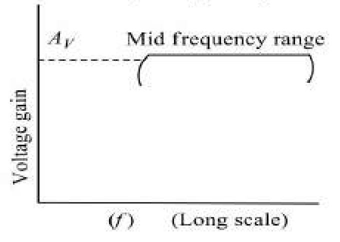
Therefore, the emitter current is more than the collector current.

45 **(a)**

Due to the reverse biasing the width of depletion region increases and current flowing through the diode is almost zero. In this case electric field is almost zero at the middle of the depletion region.

46 **(b)**

For a transistor amplifier, the voltage gain is low at high and low frequency and constant in the middle frequency range.



47 **(c)**

Comparing the given equation with standard equation

$i = AT^2 e^{qv/kT} \Rightarrow V_L = \frac{kT}{V}$

48 **(a)**

In a junction transistor, both the electron and hole play role, hence they are called the bi-polar devices or the bi-polar transistors and they are abbreviated as BJT is short form.

There are three parts in a transistor, namely emitter, base and collector. In the emitter part of the transistor the doping is more and it is less in collector part. The doping is very less in the base part. So, emitter current is actually the sum of base and collector current.

ie., $I_E = I_B + I_C$

Hence, maximum current flows in emitter region.

50 **(a)**

From the given waveforms, the following truth table can be made

Time interval	Inputs		Output
	A	B	Y
$0 \rightarrow T_1$	0	0	0
$T_1 \rightarrow T_2$	0	1	0
$T_2 \rightarrow T_3$	1	0	0
$T_3 \rightarrow T_4$	1	1	1

This truth table is equivalent to 'AND' gate

52 **(c)**

In reverse biasing negative terminal of the battery is connected to N-side

55 **(d)**

The Boolean expression for 'AND' gate is $R + P.Q$

$\Rightarrow 1.1 = 1, 1.0 = 0, 0.1 = 0, 0.0 = 0$

56 **(c)**

The figure shown in the circuit is a half wave rectifier. During the positive half of the input cycle, when junction diode conducts, output across R_L will vary in accordance with AC input. During the negative half cycle, junction diode will get reverse biased and hence no output will be obtained across R_L.

57 **(a)**

In circuit 2, each *p-n* junction is reverse biased, some current will flow giving equal potential difference across each *p-n* junction diode. In circuit 3, each *p-n* junction is forward biased, hence same current flows, giving same potential difference across *p-n* junctions.

58 **(a)**

If i is the current in the diode and V is voltage drop across it, then for given figure voltage equation is

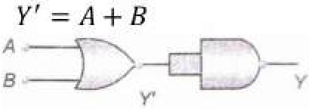
$$i \times 100 + V = 8 \Rightarrow i = -\frac{1}{100}V + \frac{8}{100}$$

$$\Rightarrow i = -(0.01)V + 0.08$$

Thus the slope of *i-V* graph $= \frac{1}{R_L} = 0.01$

59 **(c)**

$Y' = A + B$



And $\quad Y = \bar{Y}' = \overline{A + B}$

ie, out of a NOR gate.

60 **(d)**

At 0K there is no free electrons for conduction. Therefore, at 0K an intrinsic semiconductor behaves as insulator.

61 **(c)**

$$i_b = \frac{5 - 0.7}{8.6} = 0.5\ mA \Rightarrow I_c = \beta\ I_b$$

$$= 100 \times 0.5\ mA$$

By using $V_{CE} = V_{CC} - I_c R_L = 18 - 50 \times 10^{-3} \times 100 = 13V$

62 **(b)**

Bonds in semiconductor are covalent bonds.

63 **(c)**

A solid is not transparent to visible light if the value of wavelength of light is greater than the bond length (covalent bonds) between the atom/molecules/ions of material. Conductivity depends upon the number of free charge carriers present in the substance at a given temperature or resistance of that material at that temperature.

64 **(b)**

Absence of one electron creates the positive charge of magnitude equal to that of electronic charge

65 **(b)**

Impurity increases the conductivity

67 **(d)**

$$E = \frac{hc}{\lambda} \Rightarrow \lambda = \frac{12400}{E(ev)} = \frac{12400}{2.5} = 4960\text{Å}$$

This is the maximum wavelength i.e., the signals having wavelength greater than this value are not detected by photodiode. Hence correct option is (d)

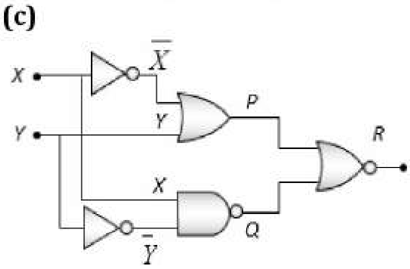
68 **(b)**

Due to forward bias at the emitter-base junction, the majority charge carrier electrons of emitter get repelled from the negative terminal and move towards base. Some of these electrons combine with the majority charge carrier holes present in the base and most of the electrons reach the collector, crossing the collector-base junction. This implies that collector current is always less than the emitter current due to the reason (b).

69 **(a)**

In a directly heated filament, the source of emf used to heat the filament causes variation in the potential along the length of the filament

70 **(c)**



The truth table can be written as

X	Y	$\bar{X}$	$\bar{Y}$	$P = \bar{X} + Y$	$Q = \overline{X.\bar{Y}}$	$R = \overline{P+Q}$
0	1	1	0	1	1	0
1	1	0	0	1	1	0
1	0	0	1	0	0	1
0	0	1	1	1	1	0

Hence $X = 1, Y = 0$ gives output $R = 1$

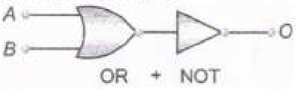
71 **(c)**

r_p varies with i_p according to relation $r_p \propto r_p^{-1/3}$, *i.e.*, when i_p increases, r_p decreases, hence graph C represents the variation of r_p

μ doesn't depend upon i_p, hence graph A is correct

72 **(d)**

The combination of OR gate with NOT gate is called NOR gate.



The Boolean equation for NOT gate is

$O = \overline{X + Y}$

73 **(b)**

Reverse biased potential for the zener breakdown

$V_r = Ed = 10^6 \times 2.5 \times 10^{-6} = 2.5$ volt

74 **(d)**

The emitter is heavily doped so that it can inject a large number of charge carriers (electrons or holes) into the base. The base is lightly doped and very thin, it passes most of the emitter injected charge carriers to the collector. The collector is moderately doped.

75 **(a)**

In p-region direction of conventional current is same as flow of holes. In n-regoin direction of conventional current is opposite to direction of flow electrons.

78 **(d)**

Total resistance $= 50 + 5000 = 5050\ \Omega$

$\therefore$ Forward current $i = \frac{50}{5050} = \frac{1}{101} = 9.9$ mA

79 **(c)**

Amplification factor,

$$\mu = \frac{\Delta V_p}{\Delta V_g} = \frac{\Delta V_p}{\Delta V_g} \times \frac{\Delta I_p}{\Delta I_p} \times \frac{\Delta I_p/\Delta V_g}{\Delta V_p/\Delta V_p}$$

$$= \frac{\text{slope of naode characteristies}}{\text{slope of mutual charactristies}}$$

80 **(d)**

The ratio of collector current (I_c) to emitter current (I_e) is known as current gain (α) of a transistor. Therefore,

$\alpha = \frac{\Delta I_c}{\Delta I_e}$ ...(i)

Also, emitter current is equal to sum of change of base current and collector current. Therefore,

$\Delta I_e = \Delta I_b + \Delta I_c$ ...(ii)

From Eqs. (i) and (ii), we get

$$\alpha = \frac{I_c}{\Delta I_b + \Delta I_c}$$

Given, $\alpha = 0.9, \Delta I_b = 4$ mA

$0.9 = \frac{I_c}{4 + \Delta I_c}$

$\Rightarrow\ 0.9\,(4 + I_c) = I_c$

$\Rightarrow\ 3.6 + 0.9\,I_c = I_c$

$\Rightarrow\ 3.6 = 0.1\,I_c$

$\Rightarrow\ I_c = 36$ mA

82 **(d)**

We know the repetitive use of NAND and NOR gate gives digital circuits.

83 **(b)**

Because in case (1) N is connected with N. This is not a series combination of transistor

84 **(b)**

If V is the voltage across the junction and I is the circuit current, then

$V + IR = E$

or $I = \frac{E}{R} - \frac{V}{R} = -\frac{V}{R} + \frac{E}{R}$

Slope of load line $= -\frac{1}{R} = \frac{1}{1000} = 10^{-3}\text{AV}^{-1}$.

85 **(b)**

In a $p - n$ junction, the direction of diffusion current is from p-region to n-region only.

86 **(c)**

Metals reflect incident light by the vibrations of free electrons under the influence of electric field of incident wave. The conductivity of metals decreases with increase of temperature due to increases in random motion of free electrons. The bonding is therefore metallic.

87 **(b)**

Pure Cu is already an excellent conductor, since it has a partially filled conduction band, furthermore, Cu forms a metallic crystal as opposed to the covalent crystals of silicon or germanium, so the covalent crystals of silicon or germanium, so the scheme of using an impurity to donate or accept an electron does not work for copper. In fact adding impurities to copper decreases the conductivity because an impurity tends to scatter electrons, impeding the flow of current

88 **(d)**

Here D_1 is in forward bias and D_2 is in reverse bias so

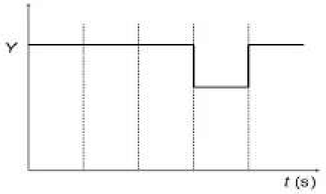
$$I = \frac{V}{R} = \frac{5}{10} = \frac{1}{2} Amp$$

89 **(b)**

From real time variation of input signals, we can from truth table for A and B and conclude output from NAND gate.

Inputs		Output
A	***B***	***Y***
0	0	1
1	0	1
0	0	1
1	1	0
0	0	1

From output, we can show real time variation of output signal as below.



90 **(b)**

In forward biasing P-side is connected with positive terminal and N-side with negative terminal of the battery

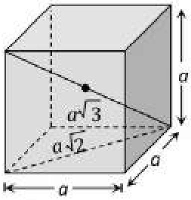
91 **(c)**

$$\mu = r_p \times g_m \Rightarrow r_p = \frac{20}{10^{-3}} = 2 \times 10^4 \Omega$$

92 **(a)**

Sodium has bcc structure. The distance between body centre and a corner $= \frac{\sqrt{3}\,a}{2}$

$$= \frac{\sqrt{3} \times 4.225}{2} = 3.66 \text{ Å}$$



94 **(b)**

The difference in the variation of resistance with temperature in metal and semiconductor is caused due to difference in the variation of the number of charge carriers with temperature.

96 **(b)**

$$v = \frac{1}{2\pi\sqrt{LC}} = \frac{1}{2\pi} \frac{1}{\sqrt{\frac{10}{\pi^2} \times 10^{-3} \times 0.04 \times 10^{-6}}}$$

$= 25\, kH_Z$

97 **(c)**

In a common base amplifier the input signal is amplified but remain in phase with output signal.

99 **(b)**

I → ON

III → OFF

In IInd state it is used as a amplifier it is active region

100 **(a)**

The average value of output direct current in a half wave rectifier is

= (average value of current over a cycle)/2

$= (2I_0/\pi)/2 = I_0/\pi.$

101 **(a)**

In ionic bonding electrons are transferred from one type of atoms to the other type creating positive and negative ions. For example in $NaCl$, Na loses one electron and Cl gains one so that Na^+ and Cl^- ions have a stable shell structure

103 **(b)**

In N-type semiconductor impurity energy level lies just below the conduction band

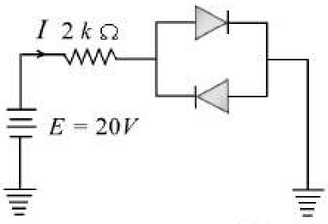
106 **(b)**

Resistance of semiconductor $\propto \frac{1}{\text{Temperature}}$

108 **(c)**

Total resistance in the circuit $= 2k\Omega$

$E = 20V$



$\therefore$ The current $= \frac{20}{2000\Omega} = 10\ mA$

109 **(b)**

The temperature co-efficient of resistance of a semiconductor is always negative

110 **(a)**

Voltage gain, $A_V = 1000$

In dB, voltage gain

$A = 10 \log_{10} 1000$ dB

$= (10 \times 3)\ \log_{10} 10$ dB

$= \because \log_{10} 10 = 1$

111 **(c)**

The given truth table express the Boolean expression as

$Y = A + B$

Since, $0 = 0 + 0$

$1 = 0 + 1$

$1 = 1 + 0$

$1 = 1 + 1$

This the Boolean expression of OR gate.

112 **(d)**

In N-type semiconductors, electrons are majority charge carriers

113 **(a)**

AND + NOT → NAND

114 **(a)**

Both energy gap, $E = \frac{hc}{\lambda}$

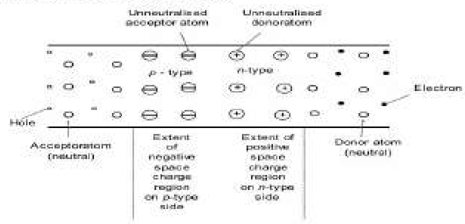
$$= \frac{6.62 \times 10^{-34} \times 3 \times 10^8}{6000 \times 10^{-10}} = 3.31 \times 10^{-19} J$$

115 **(b)**

In the positive half cycle of input ac signal diode D_1 is forward biased and D_2 is reverse biased so in the output voltage signal, A and C are due to D_1. In negative half cycle of input ac signal D_2 conducts, hence output signals B and D are due to D_2

116 **(b)**

In a p-n junction diode, electrons in conduction band on n-type side travel across the junction and leave the positively ionized impurity atoms unneutralised. Consequently, there is positively charged region adjacent to the junction in n-type material. On p-type side the electrons which have traversed the boundary recombine with positive holes in the valence



band and form a layer of unneutralised negatively ionised trivalent impurity atoms making a negatively charged region as shown in figure. The region around the junction is called charge depletion region or space charge region. Hence, within the depletion region, p-side is negative and n-side is positive.

117 **(c)**

For the breakdown condition of the Zener diode, the applied voltage $V_I > V_Z$ In that case, for a wide range of values, the current will change but the voltage remains constant

119 **(a)**

When diode is forward biased, then there is a small voltage drop across it

$$i = \frac{V - V'}{R}$$

Given, $V = 8$ volt, $V' = 0.5$ volt,

$R = 2.2\text{ k}\,\Omega = 2.2 \times 10^3\Omega$

$\therefore = \frac{8-0.5}{2.2\times10^3} = \frac{7.5\times10^3}{2.2} = 3.4 \times 10^{-3}$ A

$i = 3.4$ mA.

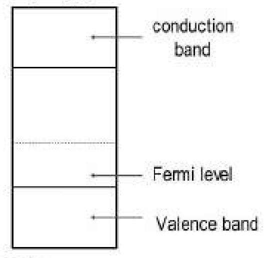
120 **(b)**

Current gain $\beta = \frac{\Delta i_c}{\Delta i_b} \Rightarrow \Delta_b = \frac{1\times10^{-3}}{100} = 10^{-5}A = 0.01\ mA$

By using $\Delta i_e = \Delta i_b + \Delta i_c \Rightarrow \Delta i_e = 0.01 + 1 = 1.01mA$

122 **(b)**

In p-type doping, the impurities have left holes in the atomic structure which tend to attract and hold free electrons. This pulls the fermi level down until it gets close to the valence bond. Hence, name of level formed due to impurity atom is p-type in the forbidden gap is acceptor level.



123 **(d)**

In P-type semiconductors, holes are majority charge carries and electrons are minority charge carriers

125 **(c)**

$E = -\frac{dV}{dr} = \frac{0.6}{10^{-6}} = 6 \times 10^5\ \text{Vm}^{-1}$

126 **(a)**

It doesn't obey ohm's law

128 **(b)**

Potential difference across diode

$= 3.2 - 3 = 0.2$ V

$\therefore$ Current through diode

$i = \frac{0.2}{100} = 2 \times 10^{-3}$ A

129 **(d)**

Amorphous solid is a solid in which there is no long range order of the positions of the atoms. Glass is a uniform amorphous solid material, usually produced when the viscous molten material cools very rapidly to below its glass transition temperature, without sufficient time for a regular crystal lattice to form.

130 **(d)**

In a properly biased transistor, emitter-base depletion layer is small but base-collector depletion layer is large.

131 **(a)**

Amplification factor $\mu = 20$

Plate resistance R_p =10 k$\Omega = 10 \times 10^3\Omega$

$\therefore$ Mutual conductance

$g_m = \frac{\mu}{R_p} = \frac{20}{10\times10^3} = 2 \times 10^{-3}$ mho

$= 2$ milli mho

132 **(c)**

Under normal reverse voltage, a very little reverse current flows through a p-n junction. However, if the reverse voltage attains a high value, the

junction may breakdown with sudden rise in reverse current.
If reverse voltage is increased continuously, the kinetic energy of electrons (minority carriers) may become high enough to knock out electrons from the semiconductor atoms. At this stage breakdown of the junction occurs characterised by a sudden rise of reverse current and a sudden fall of the resistance of barrier region. This may destroy the junction permanently.

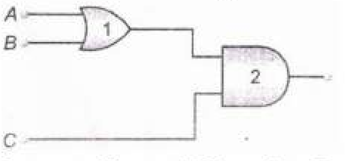
133 **(a)**

By using $\mu = -\frac{\Delta V_p}{\Delta V_g} = r_p \times g_m$

$\Rightarrow 7 \times 10^3 \times 2.5 \times 10^{-3} = -\frac{50}{\Delta V_g} \Rightarrow \Delta V_g = -2.86$

134 **(c)**

We can realize the gate circuit as



Output of gate 1, $Y_1 = A + B$

Output of gate 2, $Y_2 = Y_1 \cdot C = (A + B) \cdot C$

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

$$Y_2 = (0 + 1) \cdot 0 = 1 \cdot 0 = 0$$

(b) If $A = 1, B = 0, C = 0$, then

$$Y_2 = (1 + 0) \cdot 0 = 1 \cdot 0 = 0$$

(c) If $A = 1, B = 0, C = 1$, then

$$Y_2 = (1 + 0) \cdot 1 = 1 \cdot 1 = 1$$

(d) If $A = 1, B = 1, C = 0$, then

$$Y_2 = (1 + 1) \cdot 0 = 1 \cdot 0 = 0$$

136 **(b)**

The temperature coefficient of resistivity is negative for semiconductors. This means that the resistivity decreases as we raise the temperature of such a material. The magnitude of the temperature coefficient of resistivity is often quite large for a semiconducting material. The electrical resistance of semiconductor decreases (or conductivity increases) with rise in temperature.

137 **(b)**

Atomic radius for bcc structure is $r = \frac{a\sqrt{3}}{4}$

or $a = \frac{4r}{\sqrt{3}} = \frac{4(3.7/2)}{\sqrt{3}} = \frac{4 \times 1.75}{1.732} = 4.3Å$

139 **(b)**

The potential across R is $= 17\,V - 9\,V = 8\,V$

140 **(c)**

It is a semiconductor,

For Ge, $\Delta E_g = 0.72$ eV

For Si, $\Delta E_g = 1.1$ eV

141 **(b)**

A diode is a component that restricts the direction of movement of charge carriers. It allows an electric current to flow in one direction but essentially blocks it in the opposite direction. Thus, acting as a rectifier.

Thermocouples are a widely used type of temperature sensor and can also be use as a means to convert thermal energy into electrical energy.

Triode is a type of vacuum tube consisting of filament or cathode grid and plate or anode. It is used as an amplification device. Transistor is a solid state semiconductor device that can be used for amplification, switching, voltage stabilization, signal amplification etc.

142 **(a)**

(1 = high, 0 = low)

Input to A is in the sequence, 1,0,1,0

Input to B is in the sequence, 1, 0, 0, 1

Sequence is inverted by NOT gate

Thus inputs to OR gate becomes 0, 1, 0, 1 and 0, 1, 1, 0 output of OR gate becomes 0, 1, 1, 1

Since for OR gate $0 + 1 = 1$. Hence choice (a) is correct

143 **(d)**

$I_p = 0.004(V_p + 10V_g)^{3/2} \times 10^{-3}$ ...(i)

Differentiating it w.r.t. V_g, keeping V_p constant, we have

$\frac{\Delta I_p}{\Delta V_g} = 0.004 \times \frac{3}{2}(V_p + 10\,V_g)^{1/2} \times 10 \times 10^{-3}$

or $g_m = 0.004 \times \frac{3}{2}[120 + 10 \times (-2)]^{1/2} \times 10^{-2}$

$= 6 \times 10^{-4}$ mho

144 **(a)**

The output of NOR gate gives $y' = \overline{A + B}$

The output of NAND gate gives

$y'' = \overline{\overline{(A+B)}.\overline{(A+B)}}$

$= \overline{\overline{(A+B)}} + \overline{\overline{(A+B)}}$

$= (A + B) + (A + B) = A + B$

The output of NOT gate, $y = \overline{A + B}$

It is a boolen expression for NOR gate

146 **(b)**

Boron has valency three. When boron is doped in a pure semiconductor, then p-type semiconductor is formed.

147 **(a)**

Because $v_d = \frac{i}{(n_e)eA}$

148 **(b)**

The relation between α and β is

$$\beta = \frac{\alpha}{1-\alpha}$$

Putting this value in the given equation, we have

$$\frac{\beta-\alpha}{\alpha\beta} = \frac{\frac{\alpha}{1-\alpha}-\alpha}{\alpha\cdot\frac{\alpha}{1-\alpha}} = \frac{\alpha^2}{\alpha^2} = 1$$

149 **(a)**

To get smooth DC output from a rectifier circuit filter is used.

150 **(c)**

$$\mu = \frac{\Delta V_p}{\Delta V_g} \Rightarrow \Delta V_p = \mu \Delta V_g = 15 \times 0.3 = 4.5\ volt$$

151 **(c)**

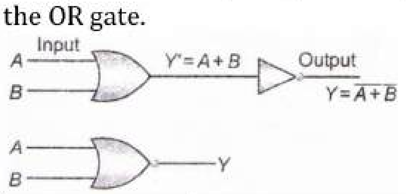
With rise in temperature, resistivity of semiconductors decreases exponentially

152 **(b)**

Zener breakdown can occur in heavily doped diodes. In lightly doped diodes the necessary voltage is higher, and avalanche multiplication is then the chief process involved

153 **(a)**

NOR gate is a combination of OR gate and NOT gate. In other words, output of OR gate is connected to the input of a NOT gate as shown in figure. Note that output of OR gate is inverted to form NOR gate. This is illustrated in the truth table for NOR gate. It is clear that truth table for NOR gate is developed by inverting the output of the OR gate.



Inputs		Outputs	
A	***B***	**OR(Y')**	**NOR(Y**
0	0	0	1
1	0	1	0
0	1	1	0
1	1	1	0

The Boolean expression for NOR function is

$Y = \overline{A+B}$

154 **(d)**

For a transistor amplifier in common emitter configuration, current gain

$$A_i = \frac{h_{fe}}{1 + h_{oe}R_L}$$

where h_{fe} and h_{oe} are hybrid parameters of a transistor.

$$\therefore A_i = \frac{50}{1 + 25 \times 10^{-6} \times 1 \times 10^3} = -48.78$$

155 **(a)**

$$g_m = \frac{\Delta i_p}{\Delta V_g} = \frac{(20-15)\times 10^{-3}}{(4-2)} = 2.5\ milli\ mho$$

156 **(a)**

At high reverse voltage, the minority charge carriers acquire very high velocities. These by collision break down the covalent bonds, generating more carriers. This mechanism is called Avalanche breakdown

159 **(a)**

Depletion layer consists of mainly stationary ions

160 **(c)**

Because with rise in temperature, resistance of semiconductor decreases, hence overall resistance of the circuit decreases which in turn increases the current in the circuit

161 **(b)**

In forward biasing width of depletion layer decreases

163 **(c)**

The reverse current is identical in two diodes if the identical reverse bias is applied across the diodes.

164 **(a)**

$A = \frac{\mu R_L}{r_p + R_L} = \frac{14\times12}{10+12} = \frac{84}{11}$. Peak value of output signal $V_0 = \frac{84}{11} \times 2\sqrt{2}V$

$$\Rightarrow V_{rms} = \frac{V_0}{\sqrt{2}} = \frac{84\times 2}{11}V$$

$\Rightarrow r.m.s.$ value of current through the load

$$= \frac{84 \times 2}{11 \times 12 \times 10^3}A = 1.27\ mA$$

165 **(a)**

The given symbol is of 'AND' gate

166 **(a)**

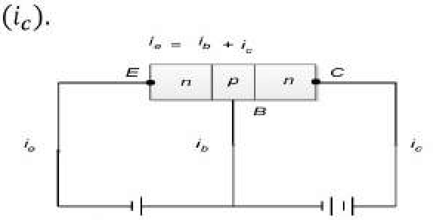
Here $\Delta V_c = 0.5\ V, \Delta i_c = 0.05mA = 0.05 \times 10^{-3}A$

Output resistance is given by

$$R_{out} = \frac{\Delta V_c}{\Delta i_c} = \frac{0.5}{0.05 \times 10^{-3}} = 10^4\Omega = 10k\Omega$$

168 **(b)**

In an *n-p-n* transistor emitter current (i_e) is the sum of base current (i_b) and collector current (i_c).



Given, $\frac{90}{100} i_e = i_c$ ...(i)

Also, $i_c = 10$ mA ...(ii)

From Eqs. (i) and (ii), we get

$$i_e = \frac{10 \times 100}{90} = 11\, mA$$

169 **(d)**

The given number is first converted from binary to decimal equivalence

$(100010)_2 = 2^5 \times 1 + 2^4 \times 0 + 2^3 \times 0 + 2^2 \times 0 + 2^1 \times 1 + 2^0 \times 0$

$= 32 + 0 + 0 + 2 + 0$

$= (34)_{10}$

and $(11011)_2 = 2^4 \times 1 + 2^3 \times 1 + 2^2 \times 0 + 2^1 \times 1 + 2^0 \times 1$

$= 16 + 8 + 0 + 2 + 1$

$= (27)_{10}$

$\therefore$ Sum $(100010)_2 + (11011)_2 = (34)_{10} + (27)_{10} = (61)_{10}$

Now,

2	61
2	30-1
2	15-0
2	7-1
2	3-1
2	1-1
	0-1

$\therefore$ Required sum (in binary system)

$(100010)_2 + (11011)_2 = (111101)_2$

171 **(c)**

When donor impurity (+5 valence) is added to a pure silicon (+4 valence), the +5 valence donor atom sits in the place of +4 valence silicon atom. So it has a net additional +1 electronic charge. The four valence electrons form covalent bond and get fixed in the lattice. The fifth electron (with net −1 electronic charge) can be approximated to revolve around +1 additional charge. The situation is like the hydrogen atom for which energy is given by $E = -\frac{13.6}{n^2} eV$. For the case of hydrogen, the permittivity was taken as ε_0. However, if the medium has a permittivity ε_r, relative to ε_0, then $E = -\frac{13.6}{\varepsilon_r^2 n^2} eV$

For $Si, \varepsilon_r = 12$ and for $n = 1, E \simeq 0.1\, eV$

172 **(b)**

$$R = \frac{\rho l}{A} = \frac{L}{n_i e(\mu_e + \mu_h)A}$$

$$= \frac{0.928 \times 10^{-2}}{2.5 \times 10^{19} \times 1.6 \times 10^{-19}(0.39 + 0.19) \times 10^{-6}}$$

$= 4000\, \Omega$

173 **(b)**

When *p-n* junction diode is forward biased, more number of charge carriers (electrons in *n*-side and holes in *p*-side) moves through the junction. Therefore, in forward biasing barrier potential is reduced. Thus, increasing the current in the circuit.

174 **(b)**

In forward biasing the diffusion current increases and drift current remains constant so not current is due to the diffusion

In reverse biasing diffusion becomes more difficult so net current (very small) is due to the drift

177 **(a)**

A donor impurity means the impurity of valence five. The doping of donor impurity will result production of *n*-type.

178 **(a)**

According to Richardson-Dushman equation

$J = AT^2 e^{-b/T}$

Taking log of this equation

$$\log_e \frac{J}{T^2} = \log_e A - \frac{b}{T}$$

i.e., graph between $\log_e \frac{J}{T^2}$ and $\frac{1}{T}$ will be a straight line having negative slope and positive intercept ($\log_e A$) on $\log_e \frac{J}{T^2}$ axis

179 **(c)**

$I_e = I_b + I_c$ or $\frac{I_e}{I_c} = \frac{I_b}{I_c} + 1$

or $\frac{1}{\alpha} = \frac{1}{\beta} + 1 = \frac{1+\beta}{\beta}$ or $\alpha = \frac{\beta}{1+\beta}$.

180 **(d)**

We know that plate resistance is given by

$$r_p = \frac{\delta V}{\delta I}$$

where δV is change in voltage and δI is change in current.

Also, at saturation change in current is zero.

$$\therefore r_p = \frac{\delta V}{0} = \infty$$

Hence, plate resistance will be infinite.

181 **(b)**

In unbiased condition of *PN*-junction, depletion region is generated which stops the movement of charge carriers

182 **(d)**

In case of constants α and β of a transistor $\alpha < 1$ and $\beta > 1$.

183 **(b)**

Time $t = CR$ is known as time constant. It is time in which charge on the capacitor decreases to $\frac{1}{e}$ times of it's initial charge (steady state charge).

In figure (i) PN junction diode is in forward bias, so current will flow the circuit $i.e.$, charge on the capacitor decrease and in time t it becomes $Q = \frac{1}{e}(Q_o)$; where

$$Q_o = CV \Rightarrow Q = \frac{CV}{e}$$

In figure (ii) P-N junction diode is in reverse bias, so no current will flow through the circuit hence change on capacitor will not decay and it remains same, $i.e.$, CV after time t

184 **(d)**

In insulators, the forbidden energy gap is largest and it is of the order of 6 eV

185 **(b)**

Phosphorous is pentavalent and Boron is trivalent material.

187 **(c)**

For an insulator $E_g > 3$ eV, that is why electron transition from valence band to conduction band is not possible. For semiconductor E_g. is 0.2 eV to 0.3 eV while for metals $E_g > 3$ eV.

188 **(d)**

Positive charge (*ie*, holes) should move in the direction of current and negative charge (*ie*, electrons) should move opposite to the direction of current.

189 **(b)**

$$R = \frac{\text{Voltage drop}}{\text{Current}}$$

$\therefore$ Current in circuit, $I = \frac{P}{V} = \frac{100\times10^{-3}}{0.5} = 0.2$ A

$$R = \frac{1}{0.2} = 5\ \Omega$$

190 **(c)**

Voltage gain $= \frac{V_{\text{out}}}{V_{\text{in}}} = \frac{\mu}{1+\frac{r_p}{R_L}} \Rightarrow \frac{V_{\text{out}}}{0.05} = \frac{25}{1+\frac{40\times10^3}{10\times10^3}}$

$\Rightarrow V_{\text{out}} = 2.5\ V$

191 **(c)**

Ionisation energy of a donor in silicon semiconductor is about 0.1 eV.

193 **(b)**

The truth table of the circuit is given

A	B	C	$X = \overline{AB}$	$Y = \overline{BC}$	$Z = \overline{X+Y}$
0	0	0	1	1	0
1	0	0	1	1	0
0	0	1	1	1	0
1	0	1	1	1	0
0	1	0	1	1	0
1	1	0	0	1	0
0	1	1	1	0	0
1	1	1	0	0	1

Output Z of single three input gate is that of AND gate

194 **(b)**

In insulators, the forbidden energy gap is very large, in case of semiconductor it is moderate and in conductors the energy gap is zero

195 **(b)**

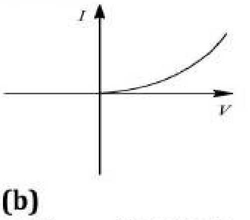
The main cause of zener breakdown is production of electron-hole pairs due to thermal excitation.

196 **(c)**

A transistor oscillator is a amplifier with positive feel back. A transistor oscillator is the one in which DC supply energy is converted into AC output energy.

197 **(a)**

When the junction diode is forward biased, *ie*, *p*-side is kept at higher potential, the current in the diode changes with the voltage applied across the diode. The current increases very slowly till the voltage across the diode crosses a certain value. After this voltage, the diode current increases rapidly even for very small increase in the diode voltage. The current-voltage relation for diode is shown.



199 **(b)**

$(37)_{10} = (100101)_2 \Rightarrow$ 6 binary digits

200 **(a)**

At room temperature some covalent bonds break and semiconductor behaves slightly as a conductor

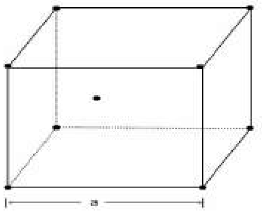
201 **(b)**

At a particular reverse voltage in PN-junction, a huge current flows in reverse direction known as avalanche current

202 **(b)**

In a bcc lattice, the atoms touch one another along the body diagonal. For cube of length a and atomic radius r, we have

$$r = \frac{\sqrt{3}}{4}a$$



∴ Distance between two atoms $= \frac{2\times\sqrt{3}a}{4} = \frac{\sqrt{3}}{2}a$

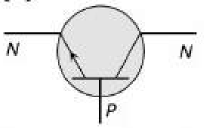
203 **(c)**

By doping a semiconductor with some impurity atoms increases the conductivity and hence decreases the resistivity (as $\rho = 1/\sigma$).

204 **(c)**

PN junction has low resistance in one direction of potential difference $+V$, so a large current flows (forward biasing). It has a high resistance in the opposite potential difference direction $-V$, so a very small current flows (reverse biasing)

205 **(a)**



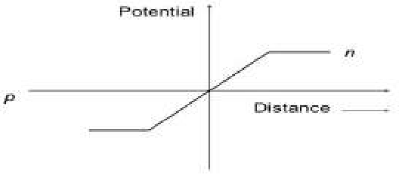
The arrow head in the transistor symbol always shows the direction of hole flow in the emitter region

206 **(a)**

For proper amplification of signal without distortion, we should use only straight portion of mutual characteristics.

207 **(b)**

Graph between potential and distance in a p-n junction diode is given by



∴ potential at p is less than that at n.

209 **(d)**

Cu has fcc structure, for fcc structure co-ordination number =12

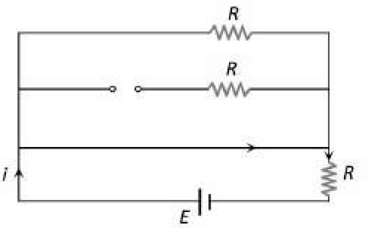
210 **(d)**

Conductor has positive temperature coefficient of resistance but semiconductor has negative temperature coefficient of resistance

213 **(a)**

Diodes D_1 and D_3 are forward biased and D_2 is reverse biased so the circuit can be redrawn as follows

$\Rightarrow i = \frac{E}{R}$



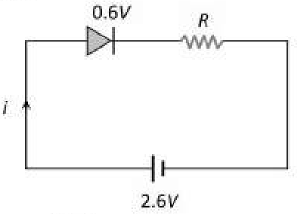
214 **(b)**

Resistivity of a semiconductor at room temperature is in between $0.5\ \Omega\text{m}$ to $10^4\ \Omega$ m *ie*, 10^2 to $10^6\ \Omega$ cm.

215 **(b)**

In transistor, base is least doped

216 **(c)**



$$R = \frac{(2.6-0.6)}{5\times10^{-3}} = 400\ \Omega$$

218 **(d)**

The P-N junction will conduct only when it is forward biased, $i.e.$, when $-5V$ is fed to it, so it will conduct only for 3rd quarter part of signal shown and when it conducts potential drop 5 *volt* will be across both the resistors, so output voltage across R_2 is 2.5 V

$\therefore V_0 = -2.5\ V$

219 **(a)**

$$I_e = 10^{10}\times1.6\times10^{-19}\times\frac{1}{10^{-6}}$$

$$= 1.6\ mA\ \left[\because I = \frac{Q}{t}\right]$$

Since 2% electrons are absorbed by base, hence 98% electrons reach the collector, $i.e.$, $\alpha = 0.98$

$\Rightarrow I_c = \omega I_e = 0.98\times1.6 = 1.568\ mA \approx 1.57\ mA$

Also current amplification factor $\beta = \frac{\alpha}{1-\alpha} = \frac{0.98}{0.02} = 49$

220 **(c)**

Germanium is semiconductor, whereas copper is conductor.

For conductors, $R \propto \Delta t$

For semiconductors,

$R \propto \frac{1}{\Delta t}$

Hence, when both are cooled, then resistance of copper decreases whereas that of germanium increases.

221 **(d)**

For transistor $i_e = i_c + i_b$

$i_c = 95\%$ of i_e

$i_b = 5\%$ of i_e

So, $i_e > i_c$

223 **(c)**

For a wide range of values of load resistance, the current in the zener diode may change but the voltage across it remains unaffected. Thus the output voltage across the zener diode is a regulated voltage

224 **(a)**

$$\mu = -\left(\frac{\Delta V_p}{\Delta V_g}\right)_{\Delta i_p=\text{const.}}$$

$$\mu = \frac{-(80-60)}{[-6-(-4)]} = \frac{20}{2} = 10$$

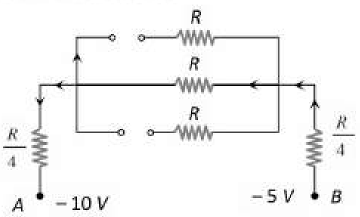
225 **(c)**

Boolean expression for OR gate is $Y = A + B$

227 **(c)**

1. $V_A = -10V$ and $V_B = -5V$

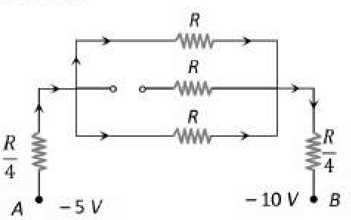
Diodes D_1 and D_3 are reverse biased and D_2 is forward biased



$$\Rightarrow R_{AB} = R + \frac{R}{4} + \frac{R}{4} = \frac{3}{2}R$$

2. When $V_A = -5V$ and $V_B = -10V$

Diodes D_2 is reverse biased D_1 and D_3 are forward biased



$$\Rightarrow R_{AB} = \frac{R}{4} + \frac{R}{2} + \frac{R}{4} = R$$

(iii) In this case equivalent resistance between A and B is also R

Hence (ii) = (iii) < (i)

228 **(b)**

$$R_e = \frac{\Delta V}{\Delta I} = \frac{(13-8)}{(60-40)\times 10^{-6}} = 2.5 \times 10^5 \Omega.$$

229 **(a)**

In sodium chloride the Na^+ and Cl^- ions both have noble gas electron configuration corresponding to completely filled bands. Since the bands do not overlap, there must be a gap between the filled bands and the empty bands above them, so $NaCl$ is an insulator

230 **(c)**

Peak value of rectified output voltage

= peak value of input voltage – barrier voltage

= 2 – 0.7 = 1.3 V

232 **(d)**

'NOR' gates are considered as universal gates, because all the gates like AND, OR, NOT can be obtained by using only NOR gates

233 **(b)**

The current at $2V$ is 400 mA and at 2.1 V it is 800 mA. The dynamic resistance in this region

$$R = \frac{\Delta V}{\Delta i} = \frac{(2.1-2)}{(800-400)\times 10^{-3}} = \frac{1}{4} = 0.25\Omega$$

234 **(b)**

Reverse resistance $= \frac{\Delta V}{\Delta I} = \frac{1}{0.5\times 10^{-6}} = 2\times 10^6\ \Omega$

235 **(c)**

As RC time constant of the capacitor is quite large ($\tau = RC = 10\times 10^3 \times 10 \times 10^{-6} = 0.1\ s$), it will not discharge appreciably. Hence voltage remains nearly constant

237 **(c)**

In a crystalline solid all the interatomic bonds are of equal strength.

238 **(b)**

Output of $G_1 = (A+B)$;

Output of $G_2 = \overline{A\cdot B}$;

Output of $G_3 = (A+B).\overline{\boldsymbol{A\cdot B}}$

Which give XOR gate.

239 **(a)**

The given Boolean expression can be written as

$Y = (\overline{A+B}).(\overline{A.B}) = (\bar{A}.\bar{B}).(\bar{A}+\bar{B})$

$= (\bar{A}\,\bar{A}).\bar{B} + (\bar{B}.\bar{B})$

$= \bar{A}.\bar{B} + \bar{A}\,\bar{B} = \bar{A}\,\bar{B}$

A	*B*	*Y*
0	0	1
1	0	0
0	1	0
1	1	0

240 **(b)**

Formation of energy bands in solids are due to Pauli's exclusion principle

241 **(c)**

The circuit diagram of a NAND gate when its two inputs are shorted, is given as

NAND = AND + NOT

The truth table of the logic gate is given as

A	Y	$\bar{Y}$
0	0	1
1	1	0

Hence, if the input is zero then output is 1 and when input is 1 than output is zero.
So, the resulting gate is NOT gate.

243 **(a)**
In diode value the plate current is not directly proportional to plate voltage, hence not a linear device.

244 **(d)**
At absolute zero temperature semiconductor behaves as insulator

245 **(c)**
A diode is used as a rectifier to convert ac to dc

247 **(d)**
Gallium, boron and aluminum are trivalent

248 **(a)**
Current gain for common base transistor

$$\alpha = \left(\frac{\Delta I_c}{\Delta I_e}\right)_{Ve}$$

Given, $\alpha = 0.96, \Delta I_E = 10.0$ mA

$0.96 = \frac{\Delta I_c}{10}$

$\Delta I_c = 0.96 \times 10 = 9.6$ mA

250 **(a)**
The reverse bias potential that results in this sudden change in characteristics is called the zener potential and is given by the symbol V_Z.
When the voltage across diode is increased in the reverse bias region, the minority carriers gain velocity and associated kinetic energy. These minority carriers are responsible for the reverse saturation current. The collisions of these minority carriers with atomic structure will result in an ionisation process and a very high current is established. This current is called avalanche current and the region in which this current is established is called avalanche breakdown region.
The magnitude of zener potential may be decreased by increasing doping levels in the p and n-type materials.
When the V_Z decreases to a very low level, there is a strong electric field in the region of the junction that can break the bonds with C in the atom and generate charge carriers. This mechanism is called zener breakdown.

251 **(a)**
We know that,

$$E = hv = \frac{hc}{\lambda}$$

$$\Rightarrow = \frac{hc}{E}$$

$$\lambda = \frac{6.6 \times 10^{-34} \times 3 \times 10^8}{1.14 \times 1.6 \times 10^{-19}}$$

$\lambda = 10877$ Å.

252 **(a)**
When a junction diode is forward biased, energy is released at the junction due to recombination of electrons and holes. In the junction diode made of gallium arsenide or indium phosphide the energy is released in visible region. Such a junction diode is called a light emitting diode or LED.

253 **(b)**

$$r_p = \frac{1}{\text{slope}} = \frac{1}{2 \times 10^{-2} \times 10^{-3}} = 50k\Omega$$

254 **(a)**
From circuit

$Y = \overline{\overline{A \cdot B}} = A \cdot B$

This is an output of an AND gate.

255 **(a)**
For N-type semiconductor, the impurity should be pentavalent

257 **(d)**
Current gain $\beta = \frac{I_c}{I_b}$

$\therefore \quad I_c = \beta \times I_b = 0.9 \times 2 = 1.8\ \mu$A

258 **(d)**
Plate current in a diode value depends on plate potential and temperature of cathodes.

259 **(a)**
The temperature co-efficient of resistance of conductor is positive

260 **(b)**
The ripple factor for full wave rectifier is 0.482 which is 48.2%.

261 **(c)**
In photodiode, it is illuminated by light radiations, which in turn produces electric current

262 **(b)**
Power gain = voltage gain × current gain

Voltage gain $= \frac{\text{Power gain}}{\text{Current gain}} = \frac{300}{50} = 6$

263 **(a)**
In P-type semiconductors, holes are majority charge carriers

264 **(c)**
The probability of occupation of the highest electron state in valence band at room

temperature becomes half according to Fermi distribution.

265 **(c)**

$$R_a = \frac{\mu}{g_m} = \frac{50}{2 \times 10^{-3}} = 25 \times 10^3 \Omega;$$

$$A_v = \frac{\mu R_L}{R_a + R_L} = \frac{50 \times 25 \times 10^3}{25 \times 10^3 + 25 \times 10^3} = 25$$

266 **(d)**

The diode D will conduct for positive half cycle of $a.c.$ supply because this is forward biased. For negative half cycle of $a.c.$ supply, this is reverse biased and does not conduct. So out put would be half wave rectified and for half wave rectified out put

$$V_{rms} = \frac{V_0}{2} = \frac{200\sqrt{2}}{2} = \frac{200}{\sqrt{2}}$$

267 **(a)**

The diode is in reverse biasing so current through it is zero

268 **(b)**

One atom of pentavalent impurity, donates one electron

269 **(d)**

Efficiency of a rectifier is given by

$$\eta = \frac{\text{DC power output}}{\text{AC power input}}$$

For full wave rectifier

DC power output $= I_{DC}^2 \times R_L = \left(\frac{2I_0}{\pi}\right)^2 \times R_L$

AC input power $= I_{\text{rms}}^2 (r_f + R_L) = \left(\frac{I_0}{\sqrt{2}}\right)^2 (r_f + R_L)$

∴ Rectifier efficiency

$$\eta = \frac{\left(\frac{2I_0}{\pi}\right)^2 R_L}{\left(\frac{I_0}{\sqrt{2}}\right)^2 (r_f + R_L)} = \frac{0.812\, R_L}{r_f + R_L}$$

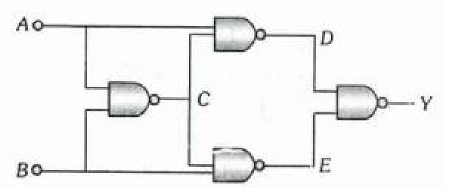
η will be maximum, if r_f is negligible as compared to R_L.

∴ Maximum rectified efficiency = 81.2%.

270 **(d)**

After saturation plate current can be increased by increasing the temperature of filament. It can be done by increasing the filament current

271 **(a)**



A	B	C	$D = \overline{A.C}$	$E = \overline{C.B}$	Y
0	0	1	1	1	0
0	1	1	1	0	1
1	0	1	0	1	1
1	1	0	1	1	0

273 **(a)**

AC input should be connected across B and D and DC output would appear across A and C.

275 **(c)**

Antimony is pentavalent

276 **(a)**

Since diode in upper branch is forward biased and in lower branch is reversed biased. So current through circuit $i = \frac{V}{R + r_d}$; here r_d = diode resistance in forward biasing = 0

$$\Rightarrow i = \frac{V}{R} = \frac{2}{10} = 0.2A$$

277 **(d)**

The cut off grid voltage is that negative grid bias corresponding to which the plate current becomes zero. At point $P, i_p = 0$

279 **(d)**

Here Boolean expression is $Y = \overline{(A + B) \cdot C}$. so $Y = \overline{A.B} = \overline{0.1} = 1$ as the boolean expression of it is $Y = \overline{A.B}$.

281 **(c)**

For 'NOT' gate $X = \bar{A}$

283 **(c)**

Atomic radius for fcc crystal is

$$r = \frac{a}{2\sqrt{2}} = \frac{3.6\text{Å}}{2\sqrt{2}} = 1.27\ \text{Å}$$

285 **(c)**

Intensity ∝ Number of electrons

286 **(c)**

Voltage gain = β × Resistance gain

$$\beta = \frac{\alpha}{1 - \alpha} = \frac{0.99}{(1 - 0.99)} = 99$$

Resistance gain $= \frac{10 \times 10^3}{10^3} = 99$

⇒ Voltage gain = 99 × 10 = 990

287 **(b)**

In superconductors, the current flows on the surface so that it exactly cancels the magnetic field inside the metal. Therefore statement (b) is not correct

289 **(a)**

The forward voltage overcomes the barrier voltage. Due to which the forward current is high but depends upon the forward voltage applied. The reverse voltage supports the barrier voltage, due to which the reverse current is low.

292 **(c)**

By using mass action law $n_i^2 = n_e n_h$

$$\Rightarrow n_h = \frac{n_i^2}{n_e} = \frac{(10^{16})^2}{10^{21}} = 10^{11} per\ m^3$$

293 **(d)**

$\beta = 50, R_i = 1000\ \Omega, V_i = 0.01V$

$\beta = \frac{i_c}{i_b}$ and $i_b = \frac{V_i}{R_i} = \frac{0.01}{10^3} = 10^{-5}A$

Hence $i_c = 50 \times 10^{-5}A = 500\ \mu A$

294 **(a)**

$$E = \frac{V}{d} = \frac{0.5}{5 \times 10^{-7}} = 10^6\ V/m$$

295 **(a)**

The probability of electrons to be found in the conduction band of an intrinsic semiconductor

$P(E) = \frac{1}{1+e^{\frac{(E-E_F)}{kT}}}$; where k = Boltzmann's constant

Hence, at a finite temperature, the probability decreases exponentially with increasing band gap

296 **(b)**

$$A_v = \frac{\mu R}{r_p + R} = \frac{\mu R}{(\mu/g_m) + R}$$

$$= \frac{42 \times (50 \times 10^3)}{42/(2 \times 10^{-3}) + 50 \times 10^3}$$

$= 29.57$

297 **(c)**

In N-type semiconductor majority charge carriers are electrons

298 **(b)**

Voltage amplification (gain) is given by

$$A = \frac{\mu}{1 + \frac{r_p}{R_L}}$$

where μ is amplification factor, r_P is plate resistance and R_L is load resistance.

Given, $\mu = 36, r_P = 10000\ \Omega, R_L = 30000\ \Omega$

Putting in the relation, we obtain

$$A = \frac{36}{1 + \frac{10000}{30000}} = \frac{36}{1 + \frac{1}{3}} = \frac{36 \times 3}{4} = 27$$

299 **(c)**

At the higher temperature only electrons cross the forbidden gap and reach in valance band, so statement (c) is wrong.

300 **(d)**

The conditions for a circuit to oscillate are (i) the feedback is positive (ii) the fraction of the output voltage feedback *ie*, $\beta = \frac{1}{A}$ *ie*, the reciprocal of the voltage gain without feedback.

302 **(a)**

We know that

$\beta = \frac{\Delta I_c}{\Delta I_b}$ or $\Delta I_c \Delta\beta\Delta I_b = 40 \times 100\mu A$

303 **(a)**

Number of atoms per unit cells is given by

$$N = N_b + \frac{N_f}{2} + \frac{N_C}{8}$$

where, N_b is the number of atoms centered in the body of the cell, N_f is the number of atoms centered in the face of the unit cell and N_C is the number of atoms centered at the corner.

For fcc lattice $N_b = 0, N_f = 6$ and $N_C = 8$

$$\therefore = 0 + \frac{6}{2} + \frac{8}{8} = 3 + 1 = 4$$

305 **(a)**

First diode is in reverse biasing it acts as open circuit, hence no current flows

306 **(b)**

Here $p - n$ junction as forward biased with voltage

$= 5 - 3 = 2$ V.

$$\therefore \text{Current } I = \frac{2}{200} = \frac{1}{100} = 10^{-2}\text{A}$$

307 **(d)**

Radiowaves of constant amplitude can be produced by using oscillator with proper feedback.

308 **(a)**

$$I_p = 0.004\left(V_p + 10V_g\right)^{3/2} mA$$

$$\Rightarrow \frac{\Delta I_p}{\Delta V_g} = 0.004\left[\frac{3}{2}\left(V_p + 10V_g\right)^{1/2} \times 10\right] \times 10^{-3}$$

$$\Rightarrow g_m = 0.004 \times \frac{3}{2}(120 + 10 \times -2)^{1/2} \times 10 \times 10^{-3}$$

$\Rightarrow g_m = 6 \times 10^{-4} mho = 0.6\ m\ mho$

Comparing the given equation of I_p with standard equation $I_p = K\left(V_p + \mu V_g\right)^{3/2}$ we get $\mu = 10$

Also from $\mu = r_p \times g_m \Rightarrow r_p = \frac{\mu}{g_m} = \frac{10}{0.6 \times 10^{-3}}$

$\Rightarrow r_p = 16.67 \times 10^3 \Omega = 16.67 k\Omega$

309 **(a)**

In $p - n$ junction, the barrier potential offers resistance to free electrons in n-region and holes in p-region.

310 **(d)**

$$V_{g_2} = V_{g_1}\left(\frac{V_{p_2}}{V_{p_1}}\right) = -5\left(\frac{200}{150}\right) = -6.66\ \text{V}$$

311 **(b)**

Resistivity is the intrinsic property, it doesn't depend upon length and shape of the semiconductors

313 **(b)**

$n_i^2 = n_e n_h$

$(1.5 \times 10^{16})^2 = n_e(4.5 \times 10^{22})$

$n_e = 0.5 \times 10^{10} = 5 \times 10^9$

$n_h = 4.5 \times 10^{22}$

$n_h \gg n_e$

Semiconductor is p-type and $n_e = 5 \times 10^9 m^{-3}$

314 **(b)**

The output of the circuit is,

$Y = \overline{\overline{A} + \overline{B}}$

$= \overline{\overline{A}} \cdot \overline{\overline{B}}$

$= A \cdot B \quad (\because \overline{\overline{A}} = A \text{ and } \overline{\overline{B}} = B)$

Which is the output of an AND gate.

315 **(a)**

For $Ge, E_g = 0.7\ eV = 0.7 \times 1.6 \times 10^{-19} J = 1.12 \times 10^{-19} J$

318 **(d)**

Boron is a trivalent impurity having three valence electrons. When it is introduced to pure silicon, then such type of semiconductors are called p-type or acceptor type semiconductors.

319 **(c)**

In reverse bias applied to a p-n junction diode raises the potential barrier because p-type material connected to the negative terminal and pulled the holes away from the junction similarly n-type material connected to positive terminal and pulled the electrons. Therefore the depletion region wider.

320 **(b)**

In half wave rectifier $V_{dc} = \frac{V_0}{\pi} = \frac{10}{\pi}$

321 **(b)**

$\overline{A \cdot \overline{A}} = \overline{A} + \overline{\overline{A}} = \overline{A} + A = 1$

$A \cdot \overline{A} = 0$

$A + \overline{A} = 1$

$A + 1 = 1$

322 **(b)**

The conductivity of an intrinsic semiconductor decreases with decrease in temperature and so it behaves as an insulator at 0 K. The conductivity of an insulator is zero. Therefore, the electrical conductivity of an intrinsic semiconductor at 0 K is equal to zero.

325 **(c)**

When a $p-n$ junction is formed, n-side attains positive potential and p-side attains negative. When ends of p and n of a $p-n$ junction are joined by a wire, there will be a steady conventional current from n-side to p-side through the wire and p-side to n-side through the $p-n$ junction.

326 **(c)**

Wood is non-crystalline

327 **(c)**

At ordinary temperature $n_e = n_h$.

328 **(d)**

As shown, we conclude that A and C are analogue signals but B is digital signal.

329 **(b)**

In reverse biasing, width of depletion layer increases

330 **(c)**

$$R_p = \frac{V_p}{i_p} = \frac{50}{150 \times 10^{-3}} = 333.3\ \Omega$$

331 **(b)**

$$V_b - i_b R_b \Rightarrow R_b = \frac{9}{35 \times 10^{-6}} = 257\ k\Omega$$

332 **(d)**

In forward biasing both V_B and x decreases

333 **(a)**

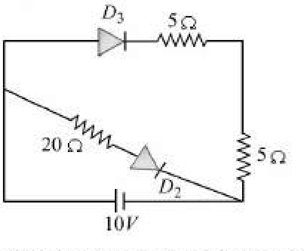
Truth table for given combination is

A	B	X
0	0	0
0	1	1
1	0	1
1	1	1

This comes out to be truth table of OR gate.

334 **(c)**

In the given circuit, diode D_1 is reverse biased, so it will not conduct. Diodes D_2 and D_3 are forward biased, so they will conduct. The corresponding equivalent circuit is as shown in the figure



The equivalent resistance of the circuit is

$$R_{eq} = \frac{(5+5) \times 20}{(5+5)+20} = \frac{10 \times 20}{10+20} = \frac{200}{30} = \frac{20}{3}\Omega$$

Current through the battery, $I = \frac{10V}{\frac{20}{3}\Omega} = 1.5A$

336 **(c)**

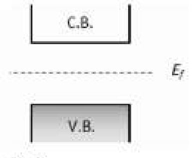
If the voltage of the DC source is increased then both conductor and semiconductor registers same current *ie*, semiconductor is in forward biased condition and it conducts. So, ammeters connected to both semiconductor and conductor will register the same current.

337 **(b)**

The temperature coefficient of resistance of silicon (*ie*, semiconductor) is negative and that of platinum (*ie*, conductor) is positive.

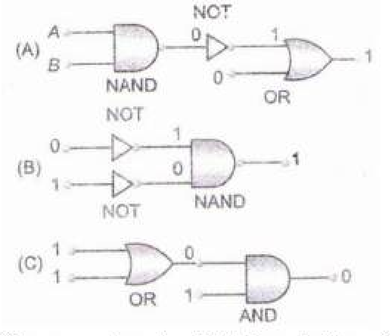
338 **(c)**

In forward biasing of PN junction diode width of depletion layer decreases. In intrinsic semiconductor fermi energy level is exactly in the middle of the forbidden gap



340 **(a)**

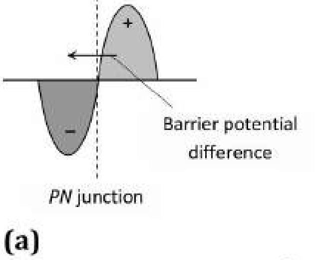
The output gate circuit will be as shown below.



Hence, outputs of A, B and C are 1, 1, and 0 respectively.

341 **(a)**

In the depletion layer of PN junction, stationary, positive ions exist in the N-side and stationary negative ions exist in the P-side



343 **(a)**

$\mu = r_p \times g_m = 2.5 \times 10^4 \times 2 \times 10^{-3} = 50$

344 **(c)**

From the graph it is clear that for $V_g = -4V, i_p = 0$, so cut off voltage is $-4\ volt$

345 **(b)**

Amplification with negative feedback is $A' = \frac{A}{1+\beta A}$

Where β = fraction of output feedback to input

$\because \beta = \frac{9}{100} = 0.09$ and $A' = 10$

$\Rightarrow 10 = \dfrac{A}{1+0.09A} \Rightarrow A = 100$

347 **(c)**

Barrier potential does not depend on diode design while it depends on temperature doping density and forward biasing.

348 **(d)**

Ionic bonds come into being when atoms that have low ionization energies, and hence lose electrons rapidly, interact with other atoms to acquire excess electrons. The former atoms give up electrons to the latter and they there upon become positive and negative ions respectively

349 **(c)**

Hence, $(10111)B = 1 \times 2^4 + 0 \times 2^3 + 1 \times 2^2 + 1 \times 2^1 + 1 \times 2^0$

$= 16 + 0 + 4 + 2 + 1 = 23$

350 **(c)**

${}^6C = 1S^2, 2S^2\ 2P^2$

${}^{14}Si = 1S^2, 2S^2\ 2p^6, 3S^2\ 3P^2$

353 **(b)**

$$I_f = \frac{4-1}{300} = \frac{1}{100} = 10^{-2}\text{A}$$

354 **(d)**

Atomic radius for bcc structure,

$$r = \frac{a\sqrt{3}}{4} = \frac{3.6\sqrt{3}}{4} = 1.56\ \text{Å}$$

355 **(b)**

In figure 2, 4 and 5 P-crystals are more positive as compared to N-crystals

356 **(c)**

In space charge limited region, the plate current is given by Child's law $i_p = KV_p^{3/2}$

Thus, $\frac{i_{p2}}{i_{p1}} = \left(\frac{V_{p2}}{V_{p1}}\right)^{3/2} = \left(\frac{600}{150}\right)^{3/2} = (4)^{3/2} = 8$

Or $i_{p2} = i_{p1} \times 8 = 10 \times 8\ mA = 80\ mA$

357 **(d)**

In transistor emitter is heavily doped and base is lightly doped.

So, $D_e > D_c > D_b$

358 **(a)**

At $V_g = -3V, V_p = 300\ V$ and $I_p = 5mA$

At $V_g = -1V$, for constant plate current

$i.e., I_p = 5mA$

From $I_p = 0.125\ V_p - 7.5$

$\Rightarrow 5 = 0.125\,V_p - 7.5 \Rightarrow V_p = 100V$

$\therefore$ change in plate voltage $\Delta V_p = 300 - 100 = 200V$

Change in grid voltage $\Delta V_g = -1 - (-3) = 2V$

So, $\mu = \frac{\Delta V_p}{\Delta V_g} = \frac{200}{2} = 100$

359 **(c)**

$I_c = I_e - I_b = 90 - 1 = 89$ mA.

361 **(c)**

$$\alpha = 0.8 \Rightarrow \beta = \frac{0.8}{(1-0.8)} = 4$$

Also $\beta = \frac{\Delta i_c}{\Delta i_b} \Rightarrow \Delta i_c = \beta \times \Delta i_b = 4 \times 6 = 24mA$

362 **(c)**

When p-end of p-n junction is connected to positive terminal of battery and n-end to negative terminal of battery, then p-n junction is said to be in forward bias. In forward bias, the more numbers of electrons go from n-region to p-region and more number of holes go from p-region to n-region. Therefore, major current due to both types of carriers takes place through the junction causing, more recombination of electron hole pairs thus causing reduction in height of depletion region and barrier potential.

363 **(b)**

In materials like gallium arsenide the number of photons of light energy is sufficient to produce quite intense visible light.

365 **(a)**

The first data gives value of plate resistance

$$r_p = \frac{\Delta V_p}{\Delta i_p} = \frac{10}{0.8 \times 10^{-3}} = \frac{10^5}{8}\Omega$$

Also $g_m = \frac{\Delta i_p}{\Delta V_g}$ and $g_m = \frac{\mu}{r_p}$

$$\Rightarrow \Delta V_g = \frac{\Delta i_p \times r_p}{\mu} = \frac{4 \times 10^{-3} \times 10^5/8}{8} = 6.25\ V$$

366 **(c)**

For the given combination

$Y = (A + B) \cdot C$

$Y = 1$

If $A = 1$

$B = 0$

$C = 1$

367 **(c)**

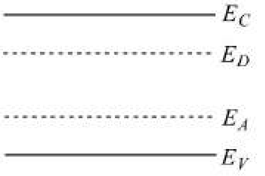
To convert decimal to binary we divide progressively the decimal number by 2 and write 5down remainder after each division. The remainder taken in reverse order, form the binary number.

2	429-1
2	241-0
2	107-1
2	53-1
2	26-0
2	13-1
2	6-0
2	3-1
	1-0

Hence, BCD equivalent of 429 is 110101101.

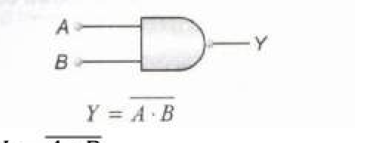
368 **(d)**

The energy emitted by LED is equal to or less than the band gap, because one has also two other energy bands due to the acceptor and donor levels just above E_V and just below E_C



369 **(a)**

NAND gate is obtained when the output of AND gate is made as the input of NOT gate Boolean expression for NAND gate is



$Y = \overline{A \cdot B}$

A	B	Y
0	0	1
1	0	1
0	1	1
1	1	0

370 **(c)**

Forward biased resistance $= \frac{\Delta V}{\Delta I} = \frac{0.7-0.6}{(15-5)\times 10^{-3}}$

$$= \frac{0.1}{10 \times 10^{-3}} = 10\,\Omega$$

371 **(c)**

If trivalent impurity is mixed with pure germanium crystal, the crystal so obtained is called p-type semiconductor. Here, aluminium and indium atoms are trivalent impurity atoms.

372 **(d)**

Current in the circuit = 10 mA = 10×10^{-3} A

and voltage in the circuit = 6−2 = 4 V

from Ohm's law,

$V = IR$

$$\therefore = \frac{V}{I} = \frac{4}{10 \times 10^{-3}} = 400\,\Omega$$

373 **(d)**

Boolean expression of the given circuit is $Y = \overline{\overline{A+B} + \overline{A+B}} = A + B$

374 **(b)**

Here emitter is forward biased and is common between input and output circuit. Thus the circuit is of $n-p-n$ transistor with a common emitter amplifier mode.

375 **(c)**

$(11010.101) = 1 \times 2^4 + 1 \times 2^3 + 0 \times 2^2 + 1 \times 2^1 + 0 \times 2^0 + 1 \times 2^{-1} + 0 \times 2^{-2} + 1 \times 2^{-3}$

$$= 16 + 8 + 0 + 2 + 0 + \frac{1}{2} + 0 + \frac{1}{8} = 26 + \frac{1}{2} + \frac{1}{8}$$

$$= 26\frac{5}{8} = 26.625$$

376 **(c)**

$Y = \overline{AB} + \overline{BA}$

$\left.\begin{matrix} A = 0 & B = 0 \\ \bar{A} = 1 & \bar{B} = 1 \end{matrix}\right] Y = 0$

$\left.\begin{matrix} A = 0 & B = 1 \\ \bar{A} = 1 & \bar{B} = 0 \end{matrix}\right] Y = 1$

$\left.\begin{matrix} A = 1 & B = 0 \\ \bar{A} = 0 & \bar{B} = 1 \end{matrix}\right] Y = 1$

$\left.\begin{matrix} A = 1 & B = 1 \\ \bar{A} = 0 & \bar{B} = 0 \end{matrix}\right] Y = 0$

377 **(c)**

$I = n_e A v_d$

$\frac{I_e}{I_h} = \frac{n_e \times (v_d)_e}{n_h \times (v_d)_h}$

Here, $\frac{n_e}{n_h} = \frac{7}{5}, \frac{I_e}{I_h} = \frac{7}{4}$

$\frac{7}{4} = \frac{7}{5} \times \frac{(v_d)_e}{(v_d)_h}$

$\Rightarrow \frac{(v_d)_e}{(v_d)_h} = \frac{5}{7} \times \frac{7}{4} = \frac{5}{4}$

378 **(c)**

$$I_2 = I_1 \left(\frac{V_2}{V_1}\right)^{3/2} = 10 \left(\frac{200}{50}\right)^{3/2} = 80 \text{ mA}$$

379 **(d)**

$(11001.001)_2 = 1 \times 2^0 + 0 \times 2^1 + 0 \times 2^2 + 1 \times 2^3 + 1 \times 2^4 + 0 \times 2^{-1} + 0 \times 2^{-2} + 1 \times 2^{-3} = 25.125$

380 **(d)**

In an intrinsic semiconductor, $n_e = n_h$

381 **(a)**

$n_i^2 = n_h n_e \Rightarrow (10^{19})^2 = 10^{21} \times n_e \Rightarrow n_e = 10^{17}/m^3$

382 **(d)**

Atomic packing factor $= \frac{\text{volume occupied by the atoms in a unit cell}}{\text{volume of the unit cell}}$

383 **(a)**

Number of lattice points in a crystal structure will be

$$n = \frac{N_C}{8} + \frac{N_F}{2} + \frac{N_i}{1}$$

In bcc crystal, $N_C = 8, N_F = 0$ and $N_i = 1$

$$n = \frac{8}{8} + \frac{0}{1} + \frac{1}{1} = 2$$

384 **(a)**

Output signal voltage has phase difference of 180° with respect to input

385 **(d)**

GaAs ($Eg = 1.5\ eV$) is used for making infrared LED

386 **(c)**

In simple cubic lattice, volume, $V = a^3$

density $= \frac{\text{mass of unit cell}}{\text{volume of unit cell}} = \frac{A/N}{V} = \frac{A}{Na^3}$

387 **(c)**

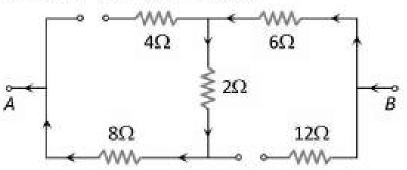
Phosphorus is pentavalent impurity

388 **(c)**

According to the given figure A is at lower potential $w.r.t. B$. hence both diodes are in reverse biasing, so equivalent circuit can be redrawn as follows

$\Rightarrow$ Equivalent resistance between A and B

$R = 8 + 2 + 6 = 16\ \Omega$



390 **(d)**

When reverse bias is increased the electron field across the junction also increases. At some stage the electric field becomes so high that it breaks the covalent bonds creating electron-hole pairs. This mechanism is known as zener breakdown. In breakdown region for a long range of load (R_L) the voltage remains the same though the current may be large.

391 **(c)**

Potential barrier energy (E_b) =work function (W_0) +fermi energy (E_f).

392 **(c)**

In P-type semiconductors, holes are the majority charge carriers

393 **(d)**

In positive half cycle one diode is in forward biasing and other is in reverse biasing while in negative half cycle their polarity reverses, and direction of current is opposite through R for positive and negative half cycles so out put is not rectified.

Since R_1 and R_2 are different hence the peaks during positive half and negative half of the input signal will be different

394 **(b)**

FET is unipolar

395 **(c)**

Electric conduction in semi-conductor takes place due to both electrons and holes.

396 **(b)**

For forward bias, $I = \frac{V}{R} = \frac{5}{25+10} = \frac{5}{35} = \frac{1}{7}A$

397 **(c)**

The output $F = (W + X)\,(W + Y) = W + (X \cdot Y)$

398 **(c)**

$$\beta = \frac{\alpha}{1-\alpha} = \frac{0.95}{1-0.95} = \frac{0.95}{0.05} = 19$$

399 **(a)**

In the given condition diode is in reverse biasing so it acts as open circuit. Hence potential difference between A and B is $6V$

400 **(a)**

If $A = 1, B = 1$ and $Y = 0$, the gate can be NOR gate, NAND gate or exclusive NOR gate (*ie*, XOR gate).

402 **(b)**

Voltage gain $A_v = \frac{\mu}{1+\frac{r_p}{R_L}}$

$$\because R_L = 1.5r_p \Rightarrow A_v = \frac{\mu}{1+\frac{r_p}{1.5r_p}} = \frac{3}{5}\mu = \frac{3}{5} \times 20$$

$$= 12$$

404 **(d)**

$$\beta = \frac{\Delta i_c}{\Delta i_b} = \frac{(10-5)\times 10^{-3}}{(200-100)\times 10^{-6}} = 50$$

405 **(a)**

For forward biasing of $p-n$ junction, the positive terminal of external battery is to be connected to p-semiconductor and negative terminal of battery to the n-semiconductor.

406 **(c)**

A p-type material is electrically neutral.

407 **(b)**

Plate resistance $= \frac{1}{slope} = \frac{1}{10^{-3}\times 10^{-3}} = 10^6\Omega$

$= 1000\ k\Omega$ (static)

408 **(d)**

Covalent bonding exists in semi-conductor

409 **(a)**

Because electrons need less energy to move

410 **(c)**

$$A_v = -\frac{V_o}{V_i}$$

or $V_o = -A_V \times V_i = -30 \sin 100\pi t.$

411 **(a)**

$\beta = \frac{I_C}{I_B}$ and $I_E = I_C + I_B$

$$\therefore = \frac{I_C}{I_E - I_C} = \frac{5.488}{5.60-5.488} = 49$$

412 **(b)**

The upper junction diode is forward biased and middle junction diode is reverce biased. So, effective resistance of circuit= $10 + 10 = 20\ \Omega$.

$$I = \frac{3}{20} = 0.15\text{ A}$$

413 **(c)**

Here,

Collector current, $I_C = 25mA$

Base current, $I_B = 1mA$

As $I_E = I_B + I_C = (1 + 25)mA = 26mA$

As $\alpha = \frac{I_C}{I_E} = \frac{25mA}{26mA} = \frac{25}{26}$

414 **(b)**

The maximum voltage gain $(A_v)_{max} = \mu$

(Which is obtained when $R_L = \infty$)

415 **(c)**

Vander Waal's force is weak dipole-dipole interaction

416 **(a)**

The Boolean expression for 'NOR' gate is $Y = \overline{A+B}$

$i.e.$, if $A = B = 0$ (Low), $Y = \overline{0+0} = \bar{0} = 1$ (High)

417 **(d)**

Grid is maintained between 0 *volt* to certain negative voltage

418 **(a)**

The highest energy level which an electron can occupy in the valence band at 0 K, is called Fermi energy level

419 **(b)**

In a transistor the base is a conductor of low resistance.

420 **(c)**

For any fixed value of the grid bias, the plate current increases as the plate voltage is increased, because more of electrons are drawn towards the anode. Also, for any fixed value of the plate voltage, more plate current flows when the grid is positive. As grid is made more and more negative, electrons are repelled back and very few reach the anode, when the grid becomes highly negative no electrons reach the plate. Thus, for a fixed plate voltage, it is possible to cut out anode current completely by making the grid suitably negative. This is called the cut-off voltage, hence, plate current is reduced.

421 **(c)**

The resistance of semiconductor decreases with the increase in temperature

422 **(d)**

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

423 **(c)**

Voltage gain $= \frac{\text{Output voltage}}{\text{Input voltage}}$

$\Rightarrow V_{out} = V_{in} \times$ Voltage gain

$\Rightarrow V_{out} = V_{in} \times$ Current gain $\times$ Resistance gain

$= V_{in} \times \beta \times \frac{R_L}{R_{BE}} = 10^{-3} \times 100 \times \frac{10}{1} = 1V$

424 **(d)**

$$r_p = \frac{\Delta V_p}{\Delta i_p} = \frac{150 - 100}{(12 - 7.5) \times 10^{-3}} = \frac{50}{4.5} \times 10^3$$
$$= 11.1 k\Omega$$

425 **(c)**

$\alpha = \frac{I_c}{I_e} < 1$ or $I_c < I_e$.

426 **(b)**

The input of OR gate is $Y = A + B$

427 **(d)**

In a forward biased p-n junction, the applied potential is opposite to the junction barrier potential V_B. The consequence of this is the effective barrier potential reduces. Hence, the graph (d) is correctly shown.

428 **(d)**

Number density of atoms in silicon specimen $= 5 \times 10^{28}$ atoms/m$^2 = 5 \times 10^7$ silicon atoms, so total number of indium atoms doped per atoms, so total number of indium atoms doped per cm^3 of silicon will be

$n = 5 \times 10^{22}/5 \times 10^7 = 10^{15}$ atoms cm^{-3}.

429 **(c)**

For 'NAND' gate (option c), output $= \overline{0.1} = \overline{0} = 1$

430 **(c)**

The junction diode I will provide output when forward biased. It will be so during negative half cycle of input AC voltage applied.

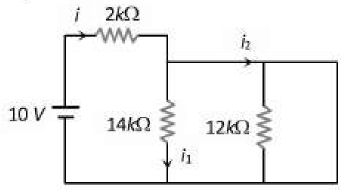
431 **(c)**

If inputs are A and B then output for NAND gate is $Y = \overline{AB}$

$\Rightarrow$ If $A = B = 1, Y = \overline{1.1} = \overline{1} = 0$

432 **(d)**

Equivalent circuit can be redrawn as follows



$i = \frac{10}{2} = 5\ mA = i_2$

$i_1 = 0$

433 **(c)**

Because As is pentavalent impurity

434 **(c)**

$$V_{dc} = V_{ac} = \frac{2V_0}{\pi} = \frac{2 \times 6.28}{3.14} = 4V$$

435 **(c)**

$$E_g = hv = \frac{hc}{\lambda} = \left(\frac{6.63 \times 10^{-34} \times 3 \times 10^8}{2480 \times 10^{-9} \times 1.6 \times 10^{-19}}\right) = 0.5\ \text{eV}$$

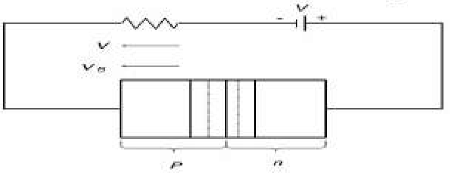
436 **(b)**

$V_k =$ knee voltage $= 0.3\ V$

$\therefore$ Resistance $= \frac{\Delta V}{\Delta i} = \frac{(2.3-0.3)}{(10-0)\times 10^{-3}} = 200\Omega = 0.2k\Omega$

437 **(b)**

In reverse biasing, the applied voltage V on the n-side is positive and is negative on the p-side. The applied bias V and the barrier potential V_B are in the same direction making the effective junction potential $V + V_B$. As a result, the junction width will increase. The higher junction potential would restrict the flow of majority carriers to a much greater extent. However, such a field will favour the flow of minority carriers. So, reverse bias current will be due to the minority carriers only.



438 **(c)**

The current through the battery is

$$I = \frac{10V}{5\Omega + 5\Omega} = \frac{10V}{10\Omega} = 1A$$

440 **(b)**

In common emitter amplifier

Voltage gain = current gain × resistance gain

Or $A_V = \beta \times \frac{R_o}{R_i}$

Or $\frac{V_o}{V_i} = \beta\ \frac{R_o}{R_i}$

Or $\frac{3}{0.01} = 100 \times \frac{R_o}{1\times10^3}$

Or $R_o = \frac{3}{0.01}$ =3 kΩ

441 **(c)**

If lattice constant of semiconductor is decreased, then E_c and E_v decrease, but E_g increases.

442 **(c)**

We know that resistance of conductor is directly proportional to temperature ($ie, R \propto \Delta t$), while resistance of semiconductor is inversely proportional to temperature $\left(ie, R \propto \frac{1}{\Delta t}\right)$.

Therefore, it is clear that resistance of conductor decreases with decrease in temperature of *vice-versa*, while in case of semiconductor, resistance increase with decrease in temperature of *vice-versa*.

Since, copper is pure conductor and germanium is a semiconductor hence, due to decrease in temperature, resistance of conductor decreases while that of semiconductor increases.

443 **(a)**

Density $\rho = \frac{nA}{N(a)^3}$

where $n = 2$ for bcc structure, $A = 39 \times 10^{-3} kg$

$N = 6.02 \times 10^{23}, a = \dfrac{2}{\sqrt{3}} d$

$= \dfrac{2}{\sqrt{3}} \times (4.525 \times 10^{-10}) m$

[d = nearest neighbor distance = distance between centres of two neighbouring atoms = $\frac{\sqrt{3}}{2} a$]

On putting the values we get $\rho = 907$

444 **(a)**

In p-type semiconductor holes are majority carriers and electrons are minority carriers.

445 **(b)**

It is the symbol of 'NOR' gate

446 **(c)**

For hexagonal crystal structure, $a = b \neq c$ and $\alpha = \beta = 90°$ but $\gamma = 120°$.

448 **(d)**

Arsenic has five valence electrons, so it a donor impurity. Hence X becomes N-type semiconductor. Indium has only three outer electrons, so it is an acceptor impurity. Hence Y becomes P-type semiconductor. Also N ($i.e., X$) is connected to positive terminal of battery and P($i.e., Y$) is connected to negative terminal of battery so PN-junction is reverse biased

449 **(b)**

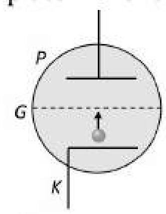
The difference in the variation of resistance with temperature in a metal and semiconductor is caused due to the difference in the variation of the number of charge carriers with temperature.

450 **(a)**

The potential of P-side is more negative that of N-side, hence diode is in reverse biasing. In reverse biasing it acts as open circuit, hence no current flows

451 **(b)**

When grid is given positive potential more electrons will cross the grid to reach the positive plate P. Hence current increases



453 **(b)**

This is operational or OP-inverting amplifier

$A = \dfrac{V_0}{V_i} = -\dfrac{R_f}{R_i}$

Given $V_i = 1V, R_f = 10k\Omega, R_i = 1k\Omega$

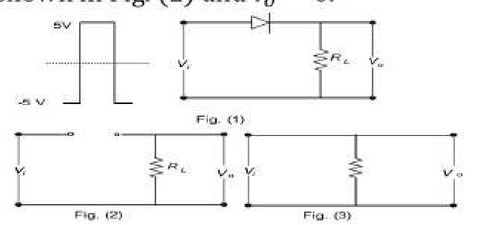
$\therefore V_0 = -V_i \dfrac{R_f}{R_i} = -1 \times \dfrac{10}{1} \Rightarrow V_0 = -10\ V$

V_0 is negative because V_{input} is $+1V$ (positive)

454 **(d)**

For $V_i < C$

the diode is reverse biased and hence offer infinite resistance, so circuit would be like as shown in Fig. (2) and $V_o = 0$.



For $V_i > 0$,the diode is forward biased and circuit would be as shown in Fig. (3) and $V_o = V_i$.

Hence, the optical (d) is correct.

455 **(b)**

Maximum load current $I_m = \frac{V_m}{r_f + R_L} = \frac{50\sqrt{2}\text{V}}{(20+980)\Omega}$

= 70.7 mA

$\therefore$ Mean load current. $I_{DC} = \frac{2I_m}{\pi} = \frac{2\times70.7}{\pi}$ = 45 mA

456 **(a)**

The input of OR gate is A and $\overline{(A \cdot B)}$. Hence $Y = A + \overline{(A \cdot B)}$.

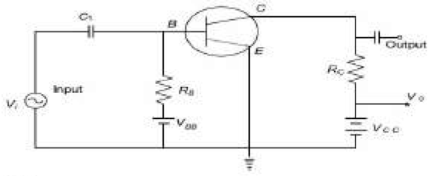
457 **(d)**

The given truth table follows a NAND gate whose output is 1 only if at least one of its input is zero.
Its Boolean expression is
$Y = \overline{A \cdot B}$
So that $\overline{1 \cdot 1} = \bar{1} = 0$
$\overline{1 \cdot 0} = \bar{0} = 1$
$\overline{0 \cdot 1} = \bar{0} = 1$
$\overline{0 \cdot 0} = \bar{0} = 1$

458 **(d)**
Tourmaline is the dichroic crystal

459 **(d)**
Ionic bond is a type of chemical bond based on electrostatic forces between two oppositely charged ions. Bond between NaCl, CsCl and LiF are ionic, while H_2O forms a covalent bond.

460 **(d)**
In CE amplifier, the input signal is applied across base-emitter junction as shown in the figure below.

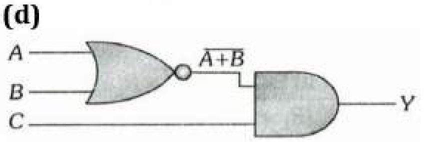


461 **(c)**
The emission current $i = AT^2Se^{-\phi/kT}$
For the two surfaces $A_1 = A_2, S_1 = S_2, T_1 = 800\ K$, $T_2 = 1600\ K, \phi_1/T_1 = \phi_2/T_2$
Therefore, $\frac{i_2}{i_1} = \left(\frac{T_2}{T_1}\right)^2 = (2)^2 = 4 \Rightarrow i_2 = 4i_1 =$ $4\ mA$

462 **(b)**
Depletion layer is more in less doped side

463 **(d)**
$\sigma = ne(\mu_e + \mu_h)$
$= 2 \times 10^{19} \times 1.6$
$\times 10^{-19}(0.36 + 0.14)$
$= 1.6\ (\Omega - m)^{-1}$
$$R = \rho\frac{l}{A} = \frac{l}{\sigma A} = \frac{0.5 \times 10^{-3}}{1.6 \times 10^{-4}} = \frac{25}{8}\Omega$$
$$\therefore i = \frac{V}{R} = \frac{2}{25/8} = \frac{16}{25}A = 0.64\ A$$

464 **(d)**



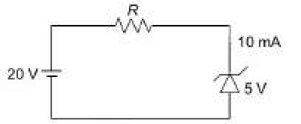
The output Y is
$Y = \overline{(A + B)} \cdot C$
The truth table of the given circuit is as shown in the table

A	B	C	$\overline{A+B}$	$Y = \overline{(A+B)}.C$
0	0	0	1	0
0	0	1	1	1
0	1	0	0	0
0	1	1	0	0
1	0	0	0	0
1	0	1	0	0
1	1	0	0	0
1	1	1	0	0

465 **(b)**
In circuit the upper diode junction is forward biased and the lower diode junction is reverse biased. Thus there will be no conduction across lower diode junction. Now the total resistance of circuit$= 100 + 150 + 50 = 300\Omega$
Current in $100\Omega = \frac{6}{300} = 0.02$ A.

466 **(d)**
Among the given materials copper is the best conductor of electricity

467 **(d)**
Voltage available across load resistance
$R = 20 - 5 = 15$ V
Resistance of load,



$$R = \frac{15}{10 \times 10^{-3}} = 1.5 \times 10^3$$
$= 1.5\ \text{k}\Omega$

468 **(c)**
When a light (wavelength sufficient to break the covalent bond) falls on the junction, new hole electron pairs are created. No. of produced electron hole pairs depend upon no. of photons. So photo $e.m.f.$ or current is proportional to intensity of light

469 **(a)**
Let I_e be the emitter current.
$\therefore \quad \frac{90}{100} \times I_e = I_c$
$\Rightarrow \quad I_e = \frac{100\ I_c}{90} = \frac{10}{9}\ I_c$
$$\therefore \alpha = \frac{I_c}{I_e} = \frac{9}{10} = 0.9$$
And
$$\beta = \frac{I_c}{I_e} = \frac{I_c}{I_e - I_c} = \frac{1}{\frac{I_e}{I_c} - 1} = \frac{1}{\frac{10}{9} - 1} = \frac{9}{1} = 9$$

470 **(d)**
5 *volt* is low signal (0) and 10 *volt* is high signal (1) and taking 5 μ-s as 1 unit, in a negative logic, low signal (0) gives high output (1) and high

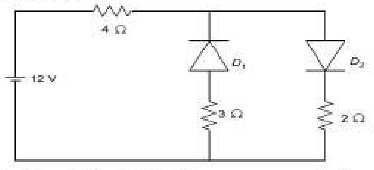
signal (1) gives low output (0). The output is therefore 1010010111

471 **(b)**

It is used to convert *ac* into *dc* (rectifier)

472 **(b)**

In the given circuit diode D_1 is reverse biased while D_2 is forward biased, so the ircuit can be redrawn as



[∵ For ideal diodes, reverse biased means open and forward biased means short]

Apply KVL to get current flowing through the circuit.

$-12 + 4i + 2i = 0$

$\Rightarrow = \frac{12}{6} = 2\ A$

474 **(c)**

Here $p-n$ junction is forward biased. If $p-n$ junction ideal, its resistance is zero. The effective resistance across A and B

$= \frac{10 \times 10}{10 + 10} = 5\text{k}\Omega.$

Current in the circuit $I = \frac{V}{R} = \frac{30}{15\times10^3} = \frac{2}{10^3}$ A

Current in arm $AB = I = \frac{2}{10^3}$

Potential difference across A and $B = \frac{2}{10^3} \times 5 \times 10^3 = 10$ V.

475 **(b)**

Due to forward bias at the emitter-base junction, the majority charge carrier electrons of emitter get repelled from the negative terminal and move towards base. Some of these electrons combine with the majority charge carrier holes present in the base and most of the electrons reach the collector, crossing the collector-base junction. This implies that collector current is always less than the emitter current due to the reason (b).

476 **(a)**

In P-type semi conductor, holes are majority charge carriers

477 **(d)**

n-p-n transistor is formed by combining two *n*-types crystals between which a thin *p*-type crystal is there. Electrons are charge carriers within the *n-p-n* transistor whereas holes are charge carriers within the *p-n-p* transistor. Since, electrons move more easily than holes, hence *n-p-n* transistors are preferred compared to *p-n-p*.

478 **(d)**

At logic gate I, the Boolean expression is $\bar{B} \cdot C = Y'$

At logic gate II, the Boolean expression is $A + (\bar{B} \cdot C) = Y''$

At logic gate III, the Boolean expression is

$\overline{A + (\bar{B} \cdot C)} = Y$

479 **(c)**

In circuit A, both $(p-n)$ junction diode act as forward biased. Hence, current flows in circuit A,

Total resistance R is given by

$\frac{1}{R} = \frac{1}{4} + \frac{1}{4} \Rightarrow \frac{1}{R} = \frac{2}{4} \Rightarrow R = 2\Omega$

According to Ohm's law

$V + I_A R \Rightarrow 8 = I_A \times 2 \Rightarrow I_A = 4\ A$

In circuit B, lower P-N junction diode is reverse biased. Hence, no current will flow but upper diode is forward biased, so current can flow through it

$V = I_B R \Rightarrow 8 = I_B \times 4 \Rightarrow I_B = 2\ A$

480 **(d)**

For tetragonal, cubic and orthorhombic system $\alpha = \beta = \gamma = 90°$

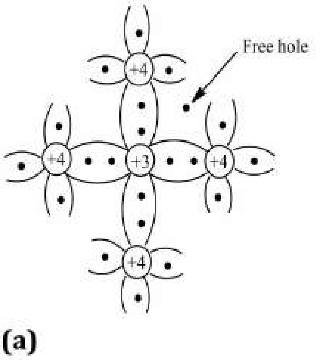
481 **(b)**

$\beta = \frac{I_c}{I_b} = \frac{I_e - I_b}{I_b} = \frac{I_e}{I_b} - 1$ or $\frac{I_e}{I_b} = 1 + \beta$

or $I_b = \frac{I_e}{1+\beta} = \frac{8.2}{1+40} = \frac{8.2}{41} = 0.20$ mA.

482 **(b)**

When an impurity atom with 3 valence electrons (as aluminium) is introduced in a pure silicon crystal, all the three of its valence electrons form covalent bonds with one each valence electrons of the nearest silicon atom while the valence electron of the fourth nearest silicon atom is not able to form the bond, leading to formation of hole or p-type semiconductor. While phosphorus being a pentavalent impurity leads to formation of n-type semiconductor.



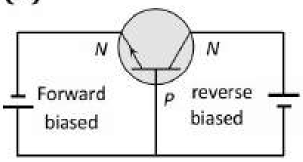
483 **(a)**

$$g_m = \left(\frac{\Delta I_p}{\Delta V_g}\right)_{V_p=\text{constant}} = \frac{(7.5-5.5)}{-1.2-(-2.2)}$$
$$= 2m\ mho$$

484 **(b)**

For 'AND' gate, if output is 1 then both inputs must be 1

486 **(b)**

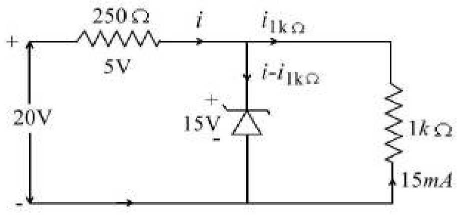


487 **(b)**

$V_{peak} = \sqrt{2}\, V_{rms} = \sqrt{2} \times 141.4 = 200\ V$

488 **(b)**

Voltage across zener diode is constant



$$i_{1k\Omega} = \frac{15\ volt}{1k\Omega} = 15mA$$
$$i_{250\Omega} = \frac{(20-15)V}{250\Omega} = \frac{5V}{250\Omega} = \frac{20}{1000}A = 20mA$$
$\therefore i_{\text{zener diode}} = (20-15) = 5\ mA$

489 **(a)**

In forward biasing, resistance of PN junction diode is zero, so whole voltage appears across the resistance

490 **(d)**

$\beta = \frac{I_c}{I_b} > 1$ or $I_c > I_b$.

491 **(c)**

In forward biasing of PN-junction diode, current mainly flows due to the diffusion of majority charge carriers

492 **(b)**

$\mu = r_p \times g_m = 20 \times 2.5 = 50$

From $A = \frac{\mu R_L}{r_p + R_L} \Rightarrow r_p + R_L = \frac{\mu R_L}{A} = \frac{50 R_L}{10} = 5R_L$

$\Rightarrow 4R_L = r_p \Rightarrow R_L = \frac{r_p}{4} = \frac{20}{4} = 5k\Omega$

494 **(c)**

Forward resistance

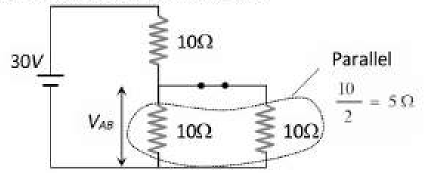
$$= \frac{\Delta V}{\Delta I} = \frac{0.7-0.5}{1.0 \times 10^{-3}} = 200\Omega.$$

495 **(b)**

$$\beta = \frac{\alpha}{1-\alpha} = \frac{0.96}{1-0.96} = 24$$

496 **(a)**

Diode is in forwards biasing hence the circuit can be redrawn as follows



$$V_{AB} = \frac{30}{(10+5)} \times 5 = 10\ V$$

497 **(c)**

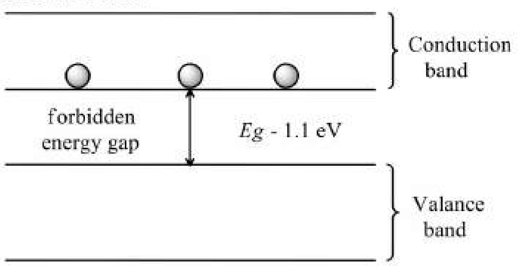
According to Richardson-Dushman equation, number of thermions emitted per sec per unit area $J = AT^2 e^{-W_0/kT} \Rightarrow J \propto T^2$

498 **(b)**

According to Pauli's exclusion principle, the electronic configuration of number of subshells existing in a shell and number of electrons entering each subshell is found. Hence, on the basis of Pauli's exclusion principle, the manifestation of band structure in solids can be explained.

500 **(a)**

The energy band scheme of semiconductors is shown here.



In semiconductors, valence band and conduction band are separated by an energy gap called the forbidden energy gap. It is very small. At room temperature some electrons in valence band acquire thermal energy. This energy is more than forbidden energy gap E_g, thus they jump into the conduction band and leaves their vacancy in the valence band which act as holes. Hence, at room temperature valence band is partially empty and conduction band is partially filled.

501 **(c)**

$$E = \frac{hc}{\lambda} \Rightarrow \lambda = \frac{hc}{E} = \frac{6.6 \times 10^{-34} \times 3 \times 10^8}{57 \times 10^{-3} \times 1.6 \times 10^{-19}}$$
$$= 217100Å$$

504 **(c)**

With rise in temperature, work function decreases (non-linearly)

505 **(b)**

Ga has a valancy of 3

507 **(c)**

At 0 K semiconductor behaves as an insulator

508 **(b)**

The collector current is given by

$$I_C = \frac{V_C}{R_C} = \frac{0.6V}{600\Omega} = 1 \times 10^{-3}A = 1mA$$

$$\beta = \frac{I_C}{I_B} \Rightarrow I_B = \frac{I_C}{\beta} = \frac{1mA}{20} = 0.05mA$$

509 **(d)**

According to De-Morgan's theorem

$\overline{A} \cdot \overline{B} = (\overline{A+B})$

$\therefore \overline{\overline{A} \cdot \overline{B}}) = (\overline{\overline{A+B}})$

$= (A+B) \quad (\because \bar{\bar{A}} =$

$A)$

$\therefore \overline{\overline{A} \cdot \overline{B}} = (A+B)$

510 **(c)**

$\Delta I_c = \alpha \Delta I_e = 0.98 \times 5.00 = 4.90$ mA.

511 **(c)**

$J = AT^2 e^{-b/T}$

$\Rightarrow \frac{J}{T^2} \propto e^{-b/T}$

$i.e., \frac{J}{T^2}$ will vary exponentially with $\frac{1}{T}$, having negative slope

513 **(a)**

$$i \propto T^2 \Rightarrow \frac{i}{i_0} = \left(\frac{T}{T_0}\right)^2$$

This is the equation of a parabola

514 **(b)**

$$\text{Current gain} = \frac{\text{small change in collector current } (\Delta i_c)}{\text{small change in emitter current } (\Delta i_c)}$$

$0.9 = \frac{\Delta i_c}{5}$

$\Rightarrow \Delta i_c = 0.9 \times 5 = 4.5$ mA

515 **(a)**

$$\beta = \frac{\alpha}{1-\alpha} = \frac{0.995}{1-0.995} = 199 \approx 200$$

516 **(a)**

α and β-parameters of a transistor are defined as

$\alpha = \frac{i_C}{i_E}$ and $\beta = \frac{i_C}{i_B}$

where i_C = collector current,

i_E = emitter current,

i_B = base current

As i_B is about 1 to 5% of i_E, α is about 0.95 to 0.99 and β $\left(\frac{\alpha}{1-\alpha}, \text{bysimple mathematics}\right)$ is about 20 to 100, we conclude that $\beta > \alpha$.

517 **(c)**

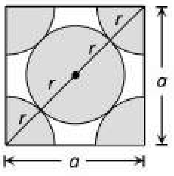
$$\mu = \left(\frac{\Delta V_p}{\Delta V_g}\right)_{\Delta I_p \text{ is constant}} = \frac{195 - 150}{-2-(-3.5)} = \frac{45}{1.5} = 30$$

518 **(b)**

For the fcc structure

$4r = (a^2 + a^2)^{1/2} = a\sqrt{2}$

$\Rightarrow r = \frac{a\sqrt{2}}{4} = \frac{a}{2\sqrt{2}}$



520 **(d)**

Temperature co-efficient of semiconductor is negative

521 **(d)**

Given, $R_o = 500$ kΩ, $\beta = 49$ and $P = 5 \times 10^6$

We have $\quad P = \beta^2 \frac{R_o}{R_i}$

$$5 \times 10^6 = \frac{(49)^2 \times 500}{R_i}$$

$R_i = \frac{49 \times 49 \times 500}{5 \times 10^6} = 240\ \Omega$

523 **(c)**

The forward current

$$i = i_s(e^{eV/kT} - 1) = 10^{-5}\left[e^{\frac{1.6\times10^{-19}\times0.2}{1.4\times10^{-23}\times300}} - 1\right]$$

$= 10^{-5}[2038.6 - 1] = 20.376 \times 10^{-3}A$

524 **(c)**

In given options, in Fig. (c) circuit is forward biased, as p-side is at higher potential than the n-side.

525 **(b)**

In half wave rectifier, we get the output only in one half cycle of input AC therefore, the frequency of the ripple of the output is same as that of input AC *ie*, 50 Hz.

526 **(b)**

In circuit 1, N is connected with N, which is not a series combination of $p-n$ junction. In circuit 2, each $p-n$ junction is forward biased, hence same current flows, giving same potential difference across $p-n$ junction. In circuit 2, each $p-n$ junction is reverse biased, same leakage current will flow, giving equal potential difference across each $p-n$ junction diode.

529 **(a)**

Phosphorus is a pentavalent impurity so $n_e > n_h$

530 **(c)**

For 'XNOR' gate $Y = \bar{A}\,\bar{B} + AB$

$i.e., \bar{0}.\bar{0} + 0.0 = 1.1 + 0.0 = 1 + 0 = 1$

$\bar{0}.\bar{1} + 0.1 = 1.0 + 0.1 = 0 + 0 = 0$

$\bar{1}.\bar{0} + 1.0 = 0.1 + 1.0 = 0 + 0 = 0$

$\bar{1}.\bar{1} + 1.1 = 0.0 = 1.1 = 0 + 1 = 1$

531 **(a)**

Zener breakdown occurs in heavily doped *p-n* junction. The temperature coefficient of the zener mechanism is negative or the breakdown voltage for a particular diode decreases with increasing temperature.

533 **(d)**

If we give the following inputs to A and B, then corresponding output is shown in table.

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	1

The above table is similar to OR gate.

534 **(a)**

In fcc lattice, the no. of atoms per unit cell - 4

$$\text{Density} = \frac{\text{mass of unit cell}}{\text{volume of unit cell}}$$

$$= \frac{4A/N}{a^3} = \frac{4A}{Na^3}$$

535 **(d)**

When a free electron is produced, simultaneously a hole is also produced

536 **(b)**

$$R = \frac{V}{I} = \frac{1}{10^{-3} \times 10^{-3}} = 10^6 \Omega = 1000 \text{ k}\Omega.$$

537 **(a)**

From Coulomb's law the force of repulsion between similar charges (q, q) separated at a distance r is given by

$$F = \frac{1}{4\pi\varepsilon_0} \cdot \frac{q^2}{r^2}$$

From the symmetry of the eight charges with respect to the centre of the cube, it follows that the force at the centre due to two opposite charges cancel in pairs. Hence, the net force at centre is zero.

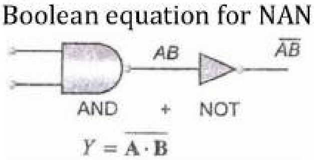
538 **(d)**

Relation between α and β is given by,

$$\beta = \frac{\alpha}{1-\alpha} \text{ or } \alpha = \frac{\beta}{1+\beta}$$

539 **(a)**

Boolean equation for NAND gate is



540 **(a)**

In conductors valence band and conduction band overlaps

541 **(d)**

When a pure (intrinsic) semiconductor such as germanium is doped with pentavalent impurity, then n-type semiconductor is obtained. Arsenic, phosphorus and antimony all are pentavalent impurity, so the correct option is (d).

542 **(a)**

In half-wave rectification, there is only one output pulse for each complete cycle of the input AC voltage. Therefore output frequency is same as that of AC supply frequency, *ie*,

$$f_{out} = f_{in}$$

So, pulse obtained in 1 s by half-wave rectifier will be 50.

543 **(b)**

Metallic solids are opaque because incident light is absorbed by the free electrons in a metal

544 **(c)**

Voltage gain $A_v = \frac{\mu}{1+\frac{r_p}{R_L}}$, for $r_p = R_L \Rightarrow A_v = \frac{\mu}{2}$

545 **(b)**

When a strong current passes through the semiconductor it heats up the crystal and covalent bonds are broken. Hence because of excess number of free electrons it behaves like a conductor

546 **(c)**

No. of electrons reaching the collector,

$$n_c = \frac{96}{100} \times 10^{10} = 0.96 \times 10^{10}$$

Emitter current, $I_e = \frac{n_e \times e}{t}$

Collector current, $I_c = \frac{n_c \times e}{t}$

Current transfer ratio, $\alpha = \frac{I_c}{I_e} = \frac{n_c}{n_e}$

$$= \frac{0.96 \times 10^{10}}{10^{10}} = 0.96$$

547 **(a)**

In an OR gate, output Y is 1 only when either or both the inputs A and B are 1.

The truth table is shown below.

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	1

549 **(b)**

p-n photodiode is a semiconductor diode that produces a significant current when illuminated.

It is reversed biased but is operated below the breakdown voltage.

Energy of radiation = band gap energy

i.e., $h\nu = 2.0$ eV

or $\nu = \frac{2.0 \times 1.6 \times 10^{-19}}{6.6 \times 10^{-34}} \approx 5 \times 10^{14}$ Hz

550 **(b)**

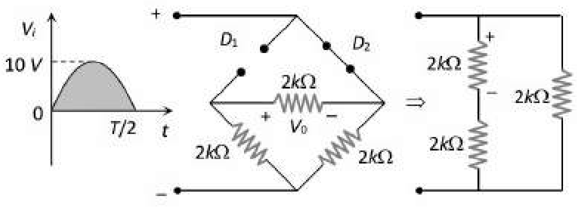
The charge on hole is positive

551 **(b)**

Phosphorus is pentavalent, so n-type semiconductor is formed.

552 **(b)**

For the positive half cycle of input the resulting network is shown below



$\Rightarrow (V_0)_{\max} = \frac{1}{2}(V_i)_{\max} = \frac{1}{2} \times 10 = 5\ V$

553 **(a)**

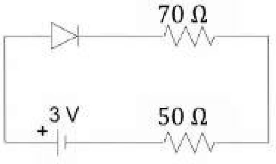
$V_B = V_{\text{knee}} + IR$

or $4 = 0.7 + 10^{-3}\ R$

or $R = 3.3/10^{-3} = 3.3 \times 10^3 \Omega$

554 **(c)**

In the circuit the upper diode D_1 is reverse biased and the lower diode D_2 is forward biased. Thus there will be no current across upper diode junction. The effective circuit will be as shown in figure.



Total resistance of circuit

$R = 50 + 70 + 30 = 150\ \Omega$

Current in circuit, $I = \frac{V}{R} = \frac{3}{150} = 0.02$ A.

555 **(b)**

In 'NOR' gate $Y = \overline{A + B}$

$i.e., \overline{0+0} = \bar{0} = 1, \overline{1+0} = \bar{1} = 0$

$\overline{0+1} = \bar{1} = 0, \overline{1+1} = \bar{1} = 0$

556 **(d)**

$\text{Energy} = \frac{hc}{\lambda} = \frac{6.6 \times 10^{-34} \times 3 \times 10^8}{1700 \times 10^{-9} \times 1.6 \times 10^{-19}}\ \text{eV} = 0.73\ \text{eV}$

557 **(b)**

Child Langmuir law states that the space charge limited current in a diode valve is given by as

$I \propto k\, V^{3/2}$ [where V is voltage]

558 **(d)**

Resistance in forward biasing $R_{fr} \approx 10\ \Omega$ and resistance in reverse biasing $R_{R\omega} = 10^5 \Omega$

$\Rightarrow \frac{R_{fr}}{R_{R\omega}} = \frac{1}{10^4}$

559 **(b)**

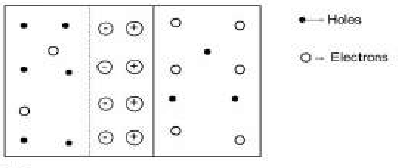
$P = Vi \Rightarrow V = \frac{P}{i} = \frac{448 \times 10^{-3}}{14 \times 10^{15} \times 1.6 \times 10^{-19}}$
$= 200V$

560 **(c)**

The given circuit is full wave rectifier

561 **(c)**

At junction a potential barrier/depletion layer is formed with n-side at higher potential and p-side at lower potential. Therefore, there is an electric field at the junction directed from the n-side to p-side.



562 **(c)**

n-type semiconductor is having excess of free electrons (unbound electrons) for conduction. The total number of electrons in an atom is equal to total number of protons in the nucleus. Therefore, n-type semiconductor is neutral.

563 **(d)**

The reverse saturation of p-n diode depends on doping concentrations, diffusion length and device temperature.

564 **(c)**

An n-type semiconductor is formed by doping pure germanium or silicon crystal with suitable impurity atoms of valence five. As the impurity atoms take the positions of Ge atoms in germanium crystal, its four electrons form covalent bonds by sharing electrons with the neighbouring four atoms of germanium whereas the fifth electron is left free. Since, the atom on the whole is electricall neutral, the n-type semiconductor is also neutral.

565 **(c)**

$\text{AC power gain} = \frac{\text{Change in output power}}{\text{Change in input power}}$

$= \frac{\Delta V_c \times \Delta i_c}{\Delta V_i \times \Delta i_b} = \left(\frac{\Delta V_c}{\Delta V_i}\right) \times \left(\frac{\Delta i_c}{\Delta i_b}\right) = A_V \times \beta_{AC}$

where A_V is voltage gain and $(\beta)_{AC}$ is AC current gain.

Also,

$A_V = \beta_{AC} \times \text{resistance gain} \left(= \frac{R_o}{R_i}\right)$

Given, $A_V = 50, R_o = 200\ \Omega, R_i = 100\ \Omega$

Hence, $50 = \beta_{AC} \times \frac{200}{100}$

$\therefore \beta_{AC} = 25$

Now, AC power gain $= A_V \times \beta_{AC} = 50 \times 25 = 1250$

567 **(b)**

$\mu = r_p g_m = 50$

From $i_p = KV_p^{3/2} \Rightarrow \frac{\Delta V_p}{\Delta i_p} = r_p = \frac{2i_p^{-1/3}}{3K^{2/3}}$

$\Rightarrow g_m = \frac{\mu}{r_p} = \frac{3\mu K^{2/3}/i_p^{1/3}}{2}$

$= \frac{3}{2}\mu K^{2/3}\left[K^{1/3}(V_p + \mu V_g)^{1/2}\right]$

$= \frac{3}{2}\mu K(V_p + \mu V_g)^{1/2} = 75\ K\ (i_p/K)^{1/3}$

Because i_p was in mA, g_m is substituted as $5\ m\mho$

$\Rightarrow 5 = 75K^{2/3}i_p^{1/3} = 75\ K^{2/3}(8)^{1/3} \Rightarrow K = \left(\frac{1}{30}\right)^{3/2}$

Cut off grid voltage $V_G = -\frac{V_P}{\mu} = -\frac{300}{50} = -6V$

568 **(c)**

$A_v = \frac{\Delta V_0}{\Delta V_i} = \beta\frac{R_0}{R_i}$; So, $\Delta V_0 = \Delta V_i \times \beta\frac{R_0}{R_i}$

$\therefore \Delta V_0 = 10 \times 50 \times \frac{500}{2000} = 1250\ \text{mV} = 1.25\ \text{V}.$

570 **(b)**

Due to the large concentration of electrons in N-side and holes in P-side, they diffuses from their own side to other side. Hence depletion region produces

571 **(d)**

In forward biasing both electrons and protons move towards the junction and hence the width of depletion region decreases.

572 **(a)**

Voltage gain $= A_v = \beta\frac{R_2}{R_1}$

Also, current gain $\beta = \frac{\alpha}{1-\alpha} = \frac{0.98}{1-0.98} = 49$

$A_V = (49)\left[\frac{500 \times 10^3}{R_1}\right]$

Power gain

$= 6.0625 \times 10^6 = 49 \times \left[\frac{500 \times 10^3}{R_1}\right] \times 49$

$\therefore R_1 = 198\Omega$

573 **(a)**

The given gate circuit is a combination of two NOR gates.

$\therefore \qquad y = \overline{\overline{A+B}} = A + B$

It is boolean expression of OR gate.

574 **(c)**

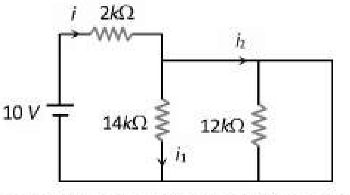
In the vicinity of the junction, a region is created, which is devoid of free charge carriers and has immobile ions.

575 **(a)**

Electrical conductivity of a semiconductor increases with rise in temperature because more covalent bonds will be broken with rise in temperature. Due to which more number of electrons and holes will be available for the conduction of electricity in a semiconductor.

576 **(d)**

The equivalent circuit can be redrawn as



From figure it is clear that current drawn from the battery $i = i_2 = \frac{10}{2} = 5mA$ and $i_1 = 0$

578 **(a)**

Voltage amplification $A_v = \frac{\mu}{1+\frac{r_p}{R_L}}$

$\Rightarrow 25 = \frac{\mu}{1 + \frac{r_p}{50\times10^3}}$ ... (i)

and $30 = \frac{\mu}{1+\frac{r_p}{100\times10^3}}$ ...(ii)

On solving equations (i) and (ii), $r_p = 25k\Omega$

579 **(d)**

The output Y is a combination of AND + NOT gate. Hence, the truth table is for NAND gate.

580 **(b)**

In reverse bias of $p - n$ junction when high voltage is applied, electric break down of junction takes place, resulting large increase in reverse current. This high voltage applied is called zener voltage.

581 **(c)**

$\alpha = \frac{i_c}{i_e} = 0.96$ and $i_e = 7.2\ mA$

$\Rightarrow i_c = 0.96 \times i_e = 0.96 \times 7.2 = 6.91\ mA$

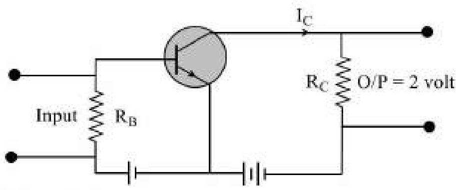
$\therefore i_e = i_c + i_b \Rightarrow 7.2 = 6.91 + i_b \Rightarrow i_b = 0.29\ mA$

582 **(c)**

$\mu = \left(\frac{\Delta V_p}{\Delta V_g}\right)\Delta I_p$ is constant

$= \frac{220 - 200}{-0.5 - (-1.3)} = \frac{20}{0.8} = 25$

583 **(d)**



$V_0 = I_c R_c = 2$

$I_c = \dfrac{2}{2 \times 10^3} = 10^{-3}\, Amp$

Current gain $= \frac{I_C}{I_B} = 100$

$I_B = \dfrac{I_C}{100} = \dfrac{10^{-3}}{100} = 10^{-5}\, Amp$

$V_i = R_B I_B = 1 \times 10^3 \times 10^{-5} = 10^{-2}\, Volt$

$= 10\, mV$

584 **(a)**

The base is always thin

585 **(a)**

Current gain $\beta = \frac{\Delta i_c}{\Delta i_b} \Rightarrow \Delta i_c = \beta \times \Delta i_b = 80 \times 250\, \mu A$

587 **(a)**

Voltage amplification $A_v = \frac{\mu}{1+\frac{r_p}{R_L}} = \frac{r_p \times g_m \times R_L}{R_L + r_p}$

$\Rightarrow 10 = \dfrac{20 \times 10^3 \times 2.5 \times 10^{-3} \times R_L}{(R_L + 20 \times 10^3)} \Rightarrow R_L = 5k\Omega$

588 **(b)**

Current through circuit,

$I = \dfrac{P}{V} = \dfrac{100 \times 10^{-3}}{0.5} = 0.2$ A.

Voltage drop across $R = 1.5 - 0.5 = 1.0$ V

Hence, $R = 1/0.2 = 5\Omega$.

590 **(b)**

$\alpha = \dfrac{\beta}{1+\beta} = \dfrac{99}{1+99} = 0.99$

591 **(b)**

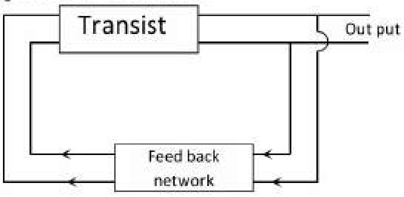
The band width is defined as the frequency band in which the amplifier gain remains above $\frac{1}{\sqrt{2}} = 0.707$ of the mid frequency gain (A_{max}). The low frequency f_1 at which the gain fall to $\frac{1}{\sqrt{2}}$, *i.e.*, 0.707 times it's mid frequency value is called lower cut off frequency and the high frequency f_4 at which the gain falls to $\frac{1}{\sqrt{2}}$, *i.e.*, 0.707 times of it's mid frequency is known as higher cut off frequency so band width $= f_4 - f_1$

593 **(b)**

Since $n_e > n_h$; the semiconductor is N-type

594 **(a)**

In oscillator, a portion of the output power is returned back (feed back) to the input in phase with the starting power. This process is termed as positive feedback



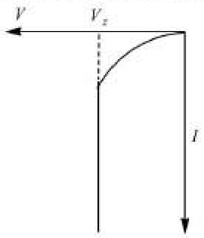
595 **(d)**

Given $i_c = \frac{80}{100} \times i_e \Rightarrow 24 = \frac{80}{100} \times i_e \Rightarrow i_e = 30\, mA$

By using $i_e = i_b + i_c \Rightarrow i_b = 30 - 24 = 6\, mA$

596 **(b)**

When the reverse voltage across a zener diode exceeds the breakdown voltage V_Z, the current increases very sharply. In this region, the curve is almost vertical. It means voltage across zener diode is constant at V_Z even though the current through it changes. Therefore, a zener diode behaves as a constant voltage source.



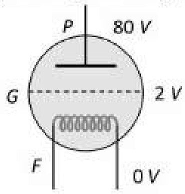
Reverse charcteristic of zener diode

597 **(d)**

For reverse biasing of an ideal diode, the potential of n-side should be higher than potential of p-side. Only option (d) is satisfying the criterion for reverse biasing.

599 **(d)**

There is a loss of kinetic energy of 2 eV from filament to grid. The energy of the electron after passing through the grid will be $3 - 2 = 1\, eV$



The potential difference between plate and grid is $80 - (-2) = 82V$. The electron will gain energy 82 eV from the grid to the plate. The energy of electron reaching the plate $= 1 + 82 = 83\, eV$

600 **(d)**

The collector current

$I_C = \beta I_b = \dfrac{2}{2 \times 10^3}$

$I_C = 1 \times 10^{-3}$ A

The base current

$I_b = \frac{10^{-3}}{200}$

$I_b = 5 \times 10^{-6}$ A

$I_b = 5\mu$A

602 **(d)**

$\frac{J_1}{J_2} = \frac{AT_1^2 e^{-1W_1/kT_1}}{AT_2^2 e^{-W_2/kT_2}} = \left(\frac{T_1}{T_2}\right)^2 e^{-W_1/kT_1 + W_2/kT_2}$

$= \left(\frac{T_1}{T_2}\right)^2 e^{-W_1/kT_1\left(1 - \frac{W_2}{W_1} \times \frac{T_1}{T_2}\right)}$

$= \left(\frac{1}{2}\right)^2 e^{-W_1/kT_1(1-2/1\times1/2)} = \frac{1}{4}e^0 = \frac{1}{4}$

603 **(a)**

When $A = 1$,

then $A \cdot \bar{A} = 1.0 = 0$

and when $A = 0$,

then $A \cdot \bar{A} = 0.1 = 0$.

604 **(a)**

From truth table it is clear that output is high if at least one input is low. The Boolean expression which satisfies the output of this logic gate is $C = A \cdot B$, which is for AND gate.

605 **(b)**

For full wave rectifier, ripple frequency

$= 2\times$ input frequency

$= 2 \times 50 = 100$ Hz

606 **(d)**

Rectifier is n device which converts AC into DC.

607 **(a)**

When, n-p-n transistor is used as a common base amplifier, the emitter-base input circuit is forward biased and collector-base output circuit is reverse biased.

When i_E, i_B, i_C are emitter, base and collector current.

The arrow from base to emitter represents the direction of hole current that is the conventional current which is opposite to direction of electron current. Thus, electrons move from emitter to base.

608 **(a)**

In p-type semiconductor density of mobile holes exceeds that of conduction electrons. Hence, minority carriers in p-type semiconductor are conduction (free) electrons.

609 **(d)**

Diode valve is discovered by Fleming.

610 **(b)**

$V = V_{CE} + I_C R_L$

$\Rightarrow 15 = 7 + I_C \times 2 \times 10^3 \Rightarrow i_C = 4\,mA$

$\because \beta = \frac{i_C}{i_B} \Rightarrow i_B = \frac{4}{100} = 0.04\,mA$

611 **(a)**

As we know, current density $J = nqv$

$\Rightarrow \quad j_e = n_e q v_e$

and $\quad J_h = n_h q v_h$

$\frac{j_e}{J_h} = \frac{n_e}{n_h} \times \frac{v_e}{v_n}$

$\Rightarrow \frac{3/4}{1/4} = \frac{n_e}{n_h} \times \frac{5}{2}$

$\Rightarrow \frac{n_e}{n_h} = \frac{6}{5}$

612 **(b)**

$I = nAev_d$ or $I \propto nv_d$

$\therefore \frac{I_e}{I_h} = \frac{n_e v_e}{n_h v_h}$

or $\frac{n_e}{n_h} = \frac{I_e}{I_h} \times \frac{v_h}{v_e} = \frac{7}{4} \times \frac{4}{5} = \frac{7}{5}$

613 **(a)**

$\mu = r_p \times g_m \Rightarrow g_m = \frac{\mu}{r_p} = \frac{22}{6600} = \frac{1}{300}$

614 **(b)**

The electric resistance of a typical intrinsic (non doped) semiconductor decreases exponentially with temperature

$$R = R_0\, e^{\alpha/T}$$

615 **(a)**

$h_{fe} = \left(\frac{\Delta i_c}{\Delta i_b}\right)_{V_{ce}} = \frac{8.2}{8.3 - 8.2} = 82$

616 **(c)**

The potential in depletion layer is due to ions. It appears as if some fictitious battery is connected across the junction with its negative pole connected to p-region and positive pole connected to n-region. The potential difference developed across the junction due to migration of majority charge carries in potential barrier.

618 **(b)**

When reverse bias is increased, the electric field at the junction also increases. At some stage the electric field breaks the covalent bond, thus the large number of charge carriers are generated. This is called Zener breakdown

619 **(d)**

NOR and NAND gates are universal gates. Any digital circuit can be realised by repetitive use of these (NOR and NAND) gates.

620 **(b)**

Number of holes in base region increases hence recombination of electron and hole are also increases in this region. As result base current increases which in turn decreases the collector current

621 **(d)**

For semiconductor, $n = AT^{3/2}e^{-E_g/2kT}$;

So, $n \propto T^{3/2}$.

622 **(a)**

$$\lambda = \frac{hc}{E} = \frac{6.6 \times 10^{-34} \times 3 \times 10^{8}}{1.5 \times 1.6 \times 10^{-19}} = 8.25 \times 10^{-7} m$$
$$= 8250\text{Å}$$

The photon having wavelength equal to 8250Å or more than this will not be able to overcome the energy gap of silicon

623 **(a)**

Current gain in common emitter mode of transistor

$$\beta = \frac{\Delta i_C}{\Delta i_B}$$

Or $\Delta i_C = \beta \Delta i_B$

Given, $\beta = 49$, $\Delta i_B = 5.0\ \mu A$

$\Delta i_C = 49 \times 5.0 = 245 \mu A$

For a transistor, emitter current is the sum of base current and collector current.

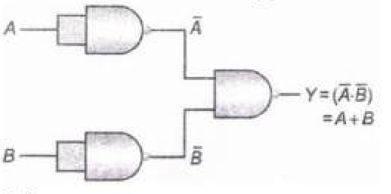
ie, $i_E = i_C + i_B$

$\Rightarrow \Delta i_E = \Delta i_C + \Delta i_B$

$\therefore \Delta i_E = 245 + 5.0 = 250\ \mu A$

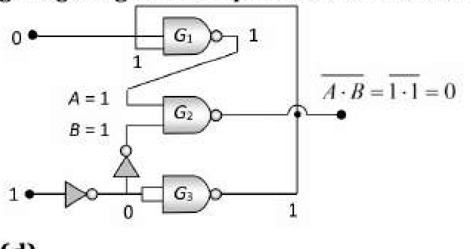
624 **(b)**

For this purpose we use three NAND gates in manner as shown. The first two NAND gates are operated as NOT gates and their output are fed to the third. The resulting circuit is OR gate.



626 **(a)**

Lower NOT gate inverts input to zero. NOT gate from NAND gate inverts this output to 1 upper NAND gate converts this input 1 and input 0 to 1. Thus $A = 1$ and $B = 1$ become inputs of NAND gate giving final output as zero. Choice A is correct



627 **(d)**

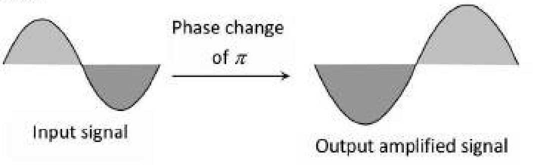
It is a circuit of full wave rectifier.

628 **(b)**

Voltage amplification $A_v = \frac{\mu}{1+\frac{r_p}{R_L}} = \frac{\mu R_L}{R_L + r_p}$

$$\Rightarrow \frac{A_1}{A_2} = \frac{4+4}{2+4} = \frac{4}{3}$$

629 **(c)**



630 **(d)**

Number density of atoms in silicon specimen

$= 5 \times 10^{28}$ atoms-m^{-3} $= 5 \times 10^{22}$ atoms cm^{-3}.

Since, 1 atom of indium is doped in 5×10^{7} silicon atoms, so total number of indium atoms doped per cm^3 of silicon will be

$$n = \frac{5 \times 10^{22}}{5 \times 10^{7}} = 10^{15} \text{ atom-cm}^{-3}.$$

631 **(c)**

For a triode, the relation is

$\mu = r_p \times g_m$

μ = amplification factor

r_p = plate resistance

g_m = mutual conductance

632 **(b)**

The slope of anode characteristic curve $= \frac{1}{r_p}$

$$\Rightarrow r_p = \frac{1}{0.02\ mA/V} = 50 \frac{V}{mA} = 50 \times 10^{3} \frac{V}{A}$$

The slope of mutual characteristic curve $= g_m$ $= 1 \times 10^{-3} A/V$

$\therefore \mu = r_p \times g_m = 50 \times 10^{3} \times 10^{-3} = 50$

633 **(a)**

Constant potential at the junction

$$V_{constant} = \frac{kT}{e} \ln\left(\frac{n_a n_d}{n_i^2}\right)$$

$$V_{constant} = \frac{kT}{e} \ln\left(\frac{10^{17} \times 10^{16}}{(1.4 \times 10^{10})^2}\right) = \frac{kT}{e} \ln(4 \times 10^{12})$$

634 **(a)**

$\alpha = \frac{\Delta I_c}{\Delta I_e} \Rightarrow \Delta I_c = 0.98 \times 2 = 1.96$ mA

$\Delta I_b = \Delta I_e - \Delta I_c = 2 - 1.96 = 0.04$ mA.

635 **(d)**

Also know that in an N-type semiconductor the donor energy level lies just below the conduction band

636 **(b)**

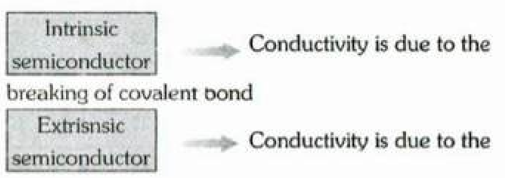
Voltage gain = resistance gain × current gain

Or $\frac{V_{out}}{V_{in}} = \frac{R_{out}}{R_{in}} \times \beta$

Or $V_{out} = \frac{R_{out}}{R_{in}} \times \beta \times V_{in}$

$\therefore \ V_{out} = \frac{5000}{500} \times 62 \times 0.01 = 6.2 \text{ V}$

637 **(c)**



breaking of covalent bond and excess of charge carriers due to impurity

639 **(c)**

$$A_V = \beta \frac{R_0}{R_i} = 60 \times \frac{5000}{500} = 600.$$

640 **(b)**

Antimony and phosphorus both are pentavalent

641 **(b)**

As we know $i_E = i_C + i_B$

$$\Rightarrow \frac{i_e}{i_c} = 1 + \frac{i_b}{i_c} \Rightarrow \frac{1}{\alpha} = 1 + \frac{1}{\beta} \Rightarrow \beta = \frac{\alpha}{1-\alpha}$$

643 **(d)**

Here, diode D_2 is reverse biased while D_1 is forward biased.

So, no current flows across

D_2, current flows through diode D_1.

$$I = \frac{V}{R} = \frac{2}{10+15} = \frac{2}{15} = 0.08 \text{ A} = 80 \text{ mA}.$$

646 **(c)**

Diode acts as open switch only when it is reverse biased

647 **(c)**

Hexagonal close packing is 12 for face centred crystal.

648 **(a)**

In an n-type semiconductor, the fermi energy level lies near the conduction band in the forbidden energy gap.

650 **(d)**

The dynamic plate resistance is $r_p = \frac{\Delta V_p}{\Delta i_p}$

Now for a vacuum diode $i_p = KV_p^{3/2} \Rightarrow V_p = \left(\frac{i_p}{K}\right)^{2/3}$

$$\Rightarrow \frac{\Delta V_p}{\Delta i_p} = \frac{2}{3K^{2/3}} i_p^{\left(\frac{2}{3}-1\right)}$$

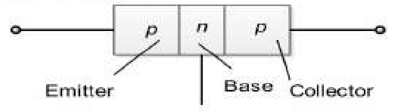
$$\Rightarrow r_p = (\text{constant}) i_p^{-1/3} \Rightarrow r_p \propto \frac{1}{I_p^{1/3}}$$

651 **(b)**

In a body centred crystal each atom is in contact with eight atoms at the corners of the simple cubic cell, hence coordination number of bcc crystal is 8.

652 **(b)**

The transistor has three regions, namely emitter, base and collector. The base is much thinner than the emitter, while collector is wider than both as shown in figure.



The emitter is heavily doped, so that it can inject a large number of charge carriers (electrons or holes) into the base. The base is lightly doped and very thin, it passes most of the emitter injected charge carriers to the collector. The collector is moderately doped.

653 **(d)**

The temperature coefficient of resistance of copper is positive and germanium is negative.

654 **(b)**

Voltage across zener diode will always constant

$V = IR$

$S = 1 \times 10^3$

$I = \frac{5}{10^3}$

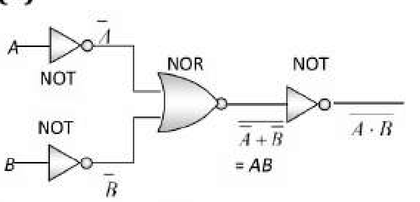
$I = 5 \times 10^{-3}$

$I = 5 \text{ mA}$

657 **(d)**

Thermonic emission was discovered by Thomson Edison.

658 **(d)**



Hence option (d) is correct

659 **(a)**

$$\mu = \frac{(V_p - 0)}{(-V_g - 0)} = \frac{V_p}{-V_g} \text{ or } -V_g = \frac{V_p}{\mu}.$$

661 **(a)**

Zener diode has a relatively constant voltage across it, regardless of the value of current through the device. This permits the zener diode to be used as a voltage regulator.

662 **(b)**

The input to AND gate will be $\overline{A}$ and $\overline{B}$. So the output is $Y = \overline{A}.\overline{B}$.

664 **(c)**

According to $|A_v| = \frac{\mu}{1+\frac{r_p}{R_L}}$

As R_L increases A_v also increases

When R_L becomes too high then A_v = maximum $= \mu$

Hence only option (c) is correct

665 **(d)**

Current in junction, V is positive; In reverse bias V is negative. Then $I_r = I_0$

$$\frac{I_F}{I_r} = \frac{I_0(e^{eV/kT} - 1)}{I_0} = (e^{eV/kT} - 1)$$

666 **(a)**

For first case, the Boolean expression is, $Y = \overline{\bar{A} \cdot \bar{B}} = A + B$ hence for OR gate and for second case, the Boolean expression is $Y = \overline{\bar{A} \cdot \bar{B}} = A \cdot B$, hence for AND gate.

667 **(c)**

Artimony is a fifth group impurity and is therefore a donor of electrons

668 **(a)**

$i_p = k(V_p + \mu V_g)^{3/2} mA$

$\Rightarrow 4 = k(200 - 10 \times 4)^{3/2} = k \times (160)^{3/2}$ ...(i)

and $i_p = k(160 - 10 \times 7)^{3/2} = k \times (90)^{3/2}$ ...(ii)

From equation (i) and (ii), we get

$$i_p = 4 \times \left(\frac{90}{160}\right)^{3/2} = 4 \times \left(\frac{3}{4}\right)^3 = 1.69\ mA$$

669 **(c)**

This is the graph between i_p and V_g and i_p becomes zero at certain negative potential

670 **(b)**

Across the $P - N$ junction, a barrier potential is developed whose direction is from N region to P region

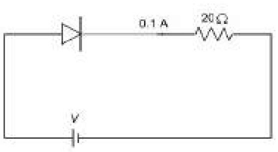
671 **(a)**

In $NaCl$ crystal Na^+ ions is surrounded by 6 Cl^- ion, therefore coordination number of Na^+ is 6

672 **(c)**

The circuit diagram of the given situation is shown. Since, it is a closed mesh, the voltage is

$$V = V' + IR$$



Given, $V' = 0.5$ V, $I = 0.1$ A, $R = 20\Omega$

$I = 0.5 + 0.1 \times 20$

$V = 2.5$ volt

673 **(c)**

If half wave rectifier the output voltage is the RMS voltage

$$= \frac{V_0}{\sqrt{2}} = \frac{200}{\sqrt{2}}$$

674 **(a)**

Charge carriers inside the P-type semiconductor are holes (mainly). Inside the conductor charge carriers are electrons and for cell ions are the charge carriers

675 **(a)**

Input characteristics of transistor in CE mode is the curve between base current I_B and base-emitter voltage V_{BE} at constant collector-emitter voltage V_{CE}.

677 **(a)**

Here, in CB mode $\alpha = 0.98$,

$R = 5\ k\Omega = 5 \times 10^3$

$R_{in} = 70\ \Omega$

Voltage gain

$$A_V = \alpha \times \frac{R}{R_{in}} = 0.98 \times \frac{5 \times 10^3}{70} = 70$$

Power gain = current gain × voltage gain

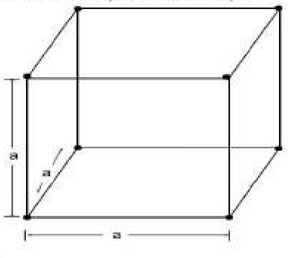
$= 0.98 \times 70 = 68.6$

679 **(b)**

In intrinsic semiconductor of Fermi level is near the middle of the forbidden gap.

680 **(d)**

In cubic crystals, the crystal axes are perpendicular to one another ($\alpha = \beta = \gamma = 90^0$) and the repetitive interval is the same along the three axes ($a = b = c$).



681 **(d)**

Interatomic spacing for a fcc lattice

$$r = \left[\left(\frac{a}{2}\right)^2 + \left(\frac{a}{2}\right)^2 + (0)^2\right]^{1/2} = \frac{a}{\sqrt{2}}$$

a being lattice constant.

$\therefore = \sqrt{2}r = \sqrt{2} \times 2.54 = 3.59$ Å.

682 **(a)**

The coordination number of simple cubic crystal is 6. As an atom at an corner of a simple cubic cell is in touch with two atoms along X-axis, 2 atoms along Y-axis and 2 atoms along Z-axis.

683 **(b)**

Germanium is a semiconductor and possesses negative temperature coefficient. Therefore, when temperature of germanium is decreased its resistance increases.

684 **(d)**

$$g_m = \left(\frac{\Delta i_p}{\Delta V_g}\right)_{V_p=\text{constant}} = \frac{(15-10)\times 10^{-3}}{0-(-4)}$$
$$= 1.25 \times 10^{-3}\Omega$$
$$\mu = \left(\frac{\Delta V_p}{\Delta V_g}\right)_{I_p=\text{constant}} = \frac{150-120}{0-(-4)} = 7.5$$
$$\therefore r_p = \frac{\mu}{g_m} = \frac{7.5}{1.25\times 10^{-3}} = 6000\ ohms$$

685 **(d)**

In a common-emitter configuration, the voltage gain is defined as the ratio of change in the output voltage to the change in the input voltage.

$A_V = \beta \times$ resistance gain ...(i)

Also, power gain is defined as the ratio of the change in the output power to the change in input power.

$A_p = \beta^2 \times$ resistance gain ...(ii)

Dividing Eq. (ii) by Eq. (i), we get

$$\frac{A_p}{A_V} = \beta$$

686 **(c)**

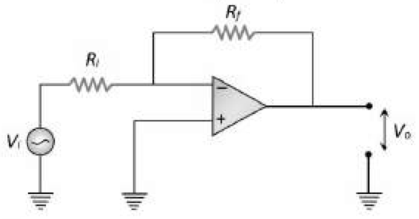
$i_p = 1.125 - 1.112 = 0.013A = 13\ mA$

687 **(d)**

In n-type semiconductor donor energy level lies just below the conduction band also called empty band of minimum energy.

688 **(b)**

Voltage gain $A + \frac{V_o}{V_i} = \frac{R_f}{R_i} = \frac{100\ k\Omega}{1\ k\Omega} = 100$



689 **(c)**

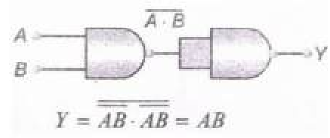
Voltage gain $A_v = \frac{\mu}{1+\frac{r_p}{R_L}} = \frac{18}{1+\frac{8\times10^3}{10^4}} = 10$

690 **(a)**

$V-d$ curve near the junction will be as shown by curve (a).

691 **(b)**

Two NAND gates are required as follows



692 **(d)**

The number of free electrons for conduction is significant only in Si and Ge but small in C, as C is an impurity.

694 **(d)**

$$\beta = \frac{\alpha}{1-\alpha} = \frac{0.995}{1-0.995} = \frac{0.995}{0.005} = 199$$

696 **(b)**

On increasing the forward bias voltage, the barrier energy decreases. This results in the flow of majority charge carriers. Hence, width of depletion region decreases.

699 **(a)**

Here the emitter base junction of N-P-N transistor is forward biased with battery V_{BB} through resistance R. When the value of R is reduced, then the emitter current i_e will increase. As a result the collector current will also increase. $(i_c = i_e - i_b)$. Due to increase in i_c, the potential difference across L increases and hence the reading of voltmeter will increases

700 **(c)**

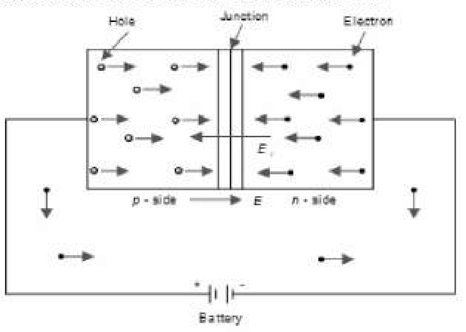
In case of a N-P junction diode, width of the depletion region decreases as the forward bias voltage decreases

701 **(c)**

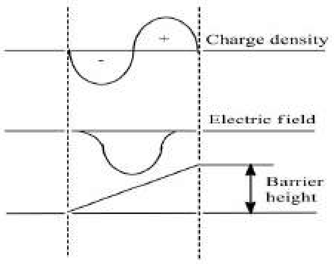
The reverse biasing of $p-n$ junction supports the barrier voltage. Due to which the current through the junction due to majority carriers becomes nearly zero.

702 **(a)**

When p-side of junction diode is connected to positive of battery and n-side to the negative, then junction diode is forward biased.



In this condition, more number of electrons enter in n-side from battery theryby increasing the number of donors on n-side.



703 **(c)**

The given figure is the symbol of NAND gate.

704 **(a)**

For motion of covalent bonds in compounds exhibits nature of electron.

706 **(a)**

$n_e = 8 \times 10^{18}/m^3, n_h = 5 \times 10^{18}/m^3$

$\mu_e = 2.3 \dfrac{m^3}{volt - sec}, \mu_h = 0.01 \dfrac{m^2}{volt - sec}$

$\because n_e > n_h$ so semiconductor is N type

Also conductivity $\sigma = \frac{1}{\text{Resistivity}(\rho)} = e(n_e\mu_e + n_h\mu_h)$

$\Rightarrow \dfrac{1}{\rho} = 1.6 \times 10^{-19}[8 \times 10^{18} \times 2.3 + 5 \times 10^{18} \times 0.01]$

$\Rightarrow \rho = 0.34\ \Omega\text{-}m$

707 **(c)**

In K is a gain of one stage, then total gain of n stages

$= (K)^n = 10^3 = 1000$

708 **(a)**

The valence band and conduction band overlap each other or have extremely small energy gap between them approximately equal to zero.

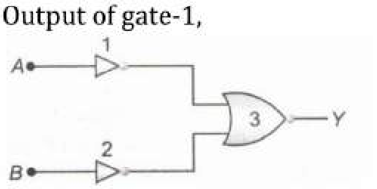
709 **(c)**

The potential of N-Side is more negative than that of P-Side, hence diode is in forward biasing from circuit resultant potential is $2V$

$\therefore I = \dfrac{2}{100} = 20\ mA$

710 **(c)**

Output of gate-1,



Output of gate-2,

Output of gate 3 $Y_1 = \bar{A}$

$Y_2 = \bar{B}$

$Y = \overline{Y_1 + Y_2} = \overline{\bar{A} + \bar{B}} = \overline{\overline{AB}} = AB$

which is the output of AND gate.

711 **(a)**

Conductivity of semiconductors increases with rise in temperature

714 **(a)**

At room temperature, few bonds break and electron hole pair generates inside the semiconductor

715 **(c)**

Calcite, quartz and tourmaline are uniaxial crystals

716 **(d)**

Extrinsic semiconductor (N-type or P-type) are neutral

717 **(c)**

Energy gap, $E_g = \frac{hc}{\lambda}$

$\lambda = \dfrac{hc}{E_g} = \dfrac{12400}{0.72} = 17222\ \text{Å}$

718 **(a)**

Ripple factor $r = \sqrt{\left(\frac{I_{rms}}{I_{dc}}\right)^2 - 1} = \sqrt{\frac{(I_0/2)^2}{(I_0/\pi)^2} - 1} = 1.21$

719 **(d)**

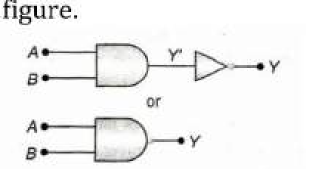
Given circuit, $V_{r_2} = 10$ V and $I_{r_2} = 6.67$ mA

$I_{r_1} = \frac{5}{500} = 10$ mA

$\therefore I_2 = 10 - 6.67 = 3.33$ mA

720 **(a)**

If we connect the output Y' of AND gate to the input of a NOT gate as shown in figure, the gate so obtained is called NAND gate. The truth table of NAND gate can be obtained by logically using the truth table of AND and NOT gates as shown in figure.



Truth Table

A	B	Y
0	0	1
1	0	1
0	1	1
1	1	0

SEMICONDUCTOR ELECTRONICS: MATERIALS,DEVIES AND SIMPLE CIRCUITS

Assertion - Reasoning Type

This section contain(s) 0 questions numbered 1 to 0. Each question contains STATEMENT 1(Assertion) and STATEMENT 2(Reason). Each question has the 4 choices (a), (b), (c) and (d) out of which **ONLY ONE** is correct.

a) Statement 1 is True, Statement 2 is True; Statement 2 **is** correct explanation for Statement 1

b) Statement 1 is True, Statement 2 is True; Statement 2 **is not** correct explanation for Statement 1

c) Statement 1 is True, Statement 2 is False

d) Statement 1 is False, Statement 2 is True

1

Statement 1: NAND or NOR gates are called digital building blocks.

Statement 2: The repeated use of NAND or NOR gates can produce all the basics or completed gates.

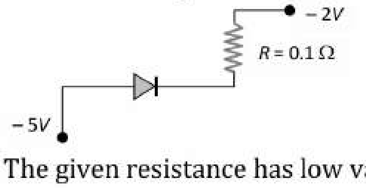
2

Statement 1: A P-N photodiode is made from a semiconductor for which $E_g = 2.8\ eV$. This photo diode will not detect the wavelength of 6000 nm

Statement 2: A PN photodiode detects wavelength λ if $\frac{hc}{\lambda} > E_g$

3

Statement 1: In the following circuit the potential drop across the resistance is zero



Statement 2: The given resistance has low value

4

Statement 1: Silicon is preferred over germanium for making semiconductor devices

Statement 2: The energy gap germanium is more than the energy gap of silicon

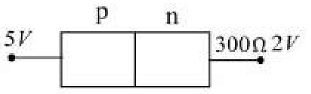
5

Statement 1: NOT gate is also called invertor.

Statement 2: NOT gate inverts the input signals.

6

Statement 1: The value of current through $p-n$ junction in the adjoining figure will be 10 mA.



Statement 2: In the above figure, p-side at higher potential than n-side.

7

Statement 1: Electron has higher mobility than hole in a semiconductor

Statement 2: Mass of electron is less than the mass of hole

8

Statement 1: We can measure the potential barrier of a PN junction by putting a sensitive voltmeter across its terminals

Statement 2: The current through the PN junction is not same in forward and reversed bias

9

Statement 1: The energy gap between the valence band and conduction band is greater in silicon than in germanium

Statement 2: Thermal energy produces fewer minority carriers in silicon than in germanium

10

Statement 1: In transistor common emitter mode as an amplifier is preferred over common base mode

Statement 2: In common emitter mode the input signal is connected in series with the voltage applied to the base emitter junction

11

Statement 1: In a common base circuit, current gain is 0.95. If base current is 60 μA, then emitter current is 1200 μA.

Statement 2: Current gain in common base circuit is $\alpha = \frac{I_c}{I_E}$.

12

Statement 1: If forward current changed by 1.5 mA when forward voltage in semiconductor triode is changed from 0.5 V to 2V, the forward resistance of diode will be 1Ω.

Statement 2: The forward resistance is given by

$$R_f = \frac{\Delta V_f}{\Delta I_f}.$$

13

Statement 1: The current gain in common base circuit is always less than one

Statement 2: At constant collector voltage the change in collector current is more than the change in emitter current

14

Statement 1: In vacuum tubes (valves) vacuum is necessary for the movement of electrons between electrodes otherwise electrons collide with air particle and lose their energy

Statement 2: In semiconductors devices, external heating or vacuum is not required

15

Statement 1: The dominant mechanism for motion of charge carriers in forward and reverse biased silicon P-N junction are drift in both forward and reverse bias

Statement 2: In reverse biasing, no current flows through the junction

16

Statement 1: The temperature coefficient of resistance is positive for metals and negative for P-type semiconductor

Statement 2: The effective charge carriers in metals are negatively charged whereas in P-type semiconductor they are positively charged

17

Statement 1: A p-n junction with reverse bias can be used as a photo-diode to measure light intensity

Statement 2: In a reverse bias condition the current is small but it is more sensitive to changes in incident light intensity

18

Statement 1: The co-ordination number of face centred crystal is 8.

Statement 2: The co-ordination number is number of the closest neighbouring atoms in a crystal structure.

19

Statement 1: Two P-N junction diodes placed back to back, will work as a NPN transistor

Statement 2: The P-region of two PN junction diodes back to back will form the base of NPN transistor

20

Statement 1: In a common emitter transistor amplifier the input current is much less than the output current

Statement 2: The common emitter transistor amplifier has very high input impedance

21

Statement 1: In common base configuration, the current gain of the transistor is less than unity

Statement 2: The collector terminal is reverse biased for amplification

22

Statement 1: The resistivity of a semiconductor increases with temperature.

Statement 2: The atoms of a semiconductor vibrate with larger amplitude at higher temperature thereby increasing its resistivity.

23

Statement 1: An N-type semiconductor has a large number of electrons but still it is electrically neutral

Statement 2: An N-type semiconductor is obtained by doping an intrinsic semiconductor with a pentavalent impurity

24

Statement 1: Thickness of depletion layer is fixed in all semiconductor devices.

Statement 2: No free charge carriers are available in depletion layer.

25

Statement 1: The logic gates NOT can be built using diode.

Statement 2: The output voltage and the input voltage of the diode have 180° phase difference.

26

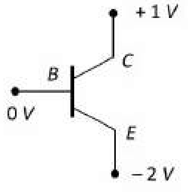
Statement 1: V-i characteristic of P-N junction diode is same as that of any other conductor

Statement 2: P-N junction diode behaves as conductor at room temperature

27

Statement 1: When PN-junction is forward biased then motion of charge carriers at junction is due to diffusion. In reverse biasing the cause of motion of charge is drifting

Statement 2: In the following circuit emitter is reverse biased and collector is forward biased



28

Statement 1: Zener diode works on a principle of breakdown voltage

Statement 2: Current increases suddenly after breakdown voltage

29

Statement 1: A transistor amplifier in common emitter configuration has a low input impendence

Statement 2: The base to emitter region is forward biased

30

Statement 1: Light emitting diode (LED) emits spontaneous radiation

Statement 2: LED are forward biased $p - n$ junction

31

Statement 1: 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

Statement 2: It is due to law of mass action

32

Statement 1: When base region has larger width, the collector current increases.

Statement 2: Electron hole combination in base results in increase of base current

33

Statement 1: If the temperature of a semiconductor is increased then it's resistance decreases

Statement 2: The energy gap between conduction band and valence band is very small

34

Statement 1: The resistivity of a semiconductor increases in temperature

Statement 2: In a conducting solid, the rate of collisions between free electrons and ions increases with increase of temperature

SEMICONDUCTOR ELECTRONICS: MATERIALS,DEVIES AND SIMPLE CIRCUITS

: ANSWER KEY :

1)	a	2)	a	3)	b	4)	c	21)	b	22)	d	23)	b	24)	d
5)	a	6)	b	7)	a	8)	d	25)	d	26)	d	27)	b	28)	a
9)	b	10)	b	11)	b	12)	a	29)	a	30)	a	31)	a	32)	c
13)	c	14)	b	15)	d	16)	b	33)	a	34)	d				
17)	a	18)	c	19)	d	20)	c								

SEMICONDUCTOR ELECTRONICS: MATERIALS,DEVIES AND SIMPLE CIRCUITS

: HINTS AND SOLUTIONS :

1 **(a)**
NAND or NOR gates are called universal (digital) building blocks because using repeated order of these two types of gates we can produce all the basic gates namely OR, AND or complex gates.

2 **(a)**
For detection of a particular wavelength (λ) by a PN photo diode, energy of incident light $> E_g \Rightarrow \frac{hc}{E_g} > \lambda$

For $E_g = 2.8\ eV, \frac{hc}{E_g} = \frac{6.6\times10^{-34}\times3\times10^{8}}{2.8\times1.6\times10^{-19}} = 441.9\ nm$

$i.e., \frac{hc}{E_g} < 6000\ nm$, so diode will not detect the wavelength of 6000Å

3 **(b)**
Potential difference across the resistance is zero, because diode is in reverse biasing hence no current flows

4 **(c)**
The energy gap for germanium is less ($0.72\ eV$) than the energy gap of silicon ($1.1 eV$). Therefore, silicon is preferred over germanium for making semiconductor devices

5 **(a)**
NOT gate inverts the input signal ie, if input is 1 then output will be zero or $vice - versa$. Therefore, it is called as invertor. NOT gate inverts the input order means that for low input, it gives high output or for high input, it gives low output.

6 **(b)**
The p-side of $p - n$ junction is taken at higher potential than n-side so, $p - n$ junction is forward biased. Taking its resistance to be zero and applying Ohm's law.

$$\frac{V}{R} = \frac{5-2}{300} = 10^{-2}\text{A}$$

$$= 10^{-2} \times 10^{3}\ \text{mA}$$

$$= 10\ \text{mA}$$

7 **(a)**
The ratio of the velocity to the applied field is called the mobility. Since electrons are lighter than holes, they move faster in applied field than holes

8 **(d)**
We cannot measure the potential barrier of a PN-junction by connecting a sensitive voltmeter across its terminals because in the depletion region, there are no free electrons and holes and in the absence of forward biasing, PN-junction offers infinite resistance

9 **(b)**
The energy gap between valence band and conduction band in germanium is $0.76\ eV$ and the energy gap between valence band and conduction band in silicon is $1.1\ eV$. Also, it is true that thermal energy produces fewer minority carriers in silicon than in germanium

10 **(b)**
Common emitter is preferred over common base because all the current, voltage and power gain of common emitter amplifier is much more than the gains of common base amplifier

11 **(b)**
In a common base configuration

$$\alpha = \frac{I_C}{I_E} = \frac{I_E - I_B}{I_E} = 1 - \frac{I_B}{I_E}$$

or $\frac{I_B}{I_E} = 1 - \alpha = 1 - 0.95 = 0.05$

So, $I_E = \frac{I_B}{0.05}\ \mu\text{A} = 1200\ \mu\text{A}.$

12 **(a)**

$$R_f = \frac{\Delta V_f}{\Delta I_f} = \frac{(2-0.5)\text{V}}{1.5 \times 10^{-3}\text{A}}$$

$= 10^3 \Omega$

$= 1 \text{ k}\Omega$

13 **(c)**
The current gain in common base circuit $\alpha = \left(\frac{\Delta I_C}{\Delta I_E}\right)_{V_C}$
The change in collector current is always less than the change in emitter current
$\Delta I_C < \Delta I_E$. Therefore, $\alpha < 1$

14 **(b)**
In vacuum tubes, vacuum is necessary and the working of semiconductor devices is independent of heating or vacuum

15 **(d)**
In PN-junction, the diffusion of majority carriers takes place when junction is forward biased and drifting of minority carriers takes place across the function, when reverse biased. The reverse bias opposes the majority carriers but makes the minority carriers to cross the PN-junction. Thus the small current in μA flows during reverse bias

18 **(c)**
The coordination number of face centred crystal is 12. It is the number of the closest neighbouring atom in a crystal structure.

19 **(d)**
Two PN-junctions placed back to back cannot work as NPN transistor because in transistor the width and concentration of doping of P-semiconductor is less as compared to width doping of N-type semiconductor type

20 **(c)**
In common emitter transistor amplifier current gain $\beta > 1$, so output current > input current, hence assertion is correct.
Also, input circuit has low resistance due to forward biasing to emitter base junction, hence reason is false

21 **(b)**
Current gain is less because $i_c < i_e$

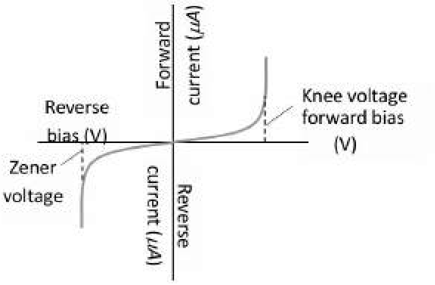
22 **(d)**
Assertion is not true as resistivity of a semiconductor decreases with increase of temperature. The atoms of a semiconductor vibrate with large amplitude at higher temperatures thereby increasing its conductivity not its resistivity.

24 **(d)**
Depletion layer of semiconductor is affected by various factors *eg*, biasing, temperature condition etc. So, it cannot be a fixed layer.

In depletion layer, negatively and positively immobile ions are present. Therefore, no free charge carriers are available in such layer.

25 **(d)**
NOT gate inverts the signal applied to it. But in diode, the input and output are in same phase. Thus, NOT gate cannot be built by a diode

26 **(d)**
The V-i characteristic of PN-diode depends whether the junction is forward biased or reverse biased. This can be shown by graph between voltage and current



27 **(b)**
In forward biasing of PN junction current flows due to diffusion of majority charge carriers. While in reverse biasing current flows due to drifting of minority charge carriers.
The circuit given in the reason is a PNP transistor having emitter more negative $w.r.t.$ base so it is reverse biased and collector is more positive $w.r.t.$ base so it is forward biased

28 **(a)**
When the reverse voltage across the zener diode is equal to or more than the breakdown voltage, the reverse current increases sharply

29 **(a)**
Input impedance of common emitter configuration

$$= \left|\frac{\Delta V_{BE}}{\Delta i_B}\right|_{V_{CE}=\text{constant}}$$

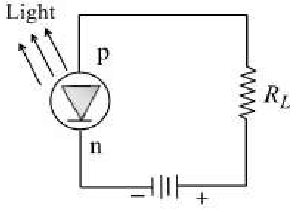
Where ΔV_{BE} = voltage across base and emitter (base emitter region is forward biased)

$\Delta i_B =$ base current which is order of few microampere.

Thus input impedance of common emitter is low

30 **(a)**

When a junction diode is forward biased as shown in figure, energy is released at the junction due to recombination of electrons and holes. In the junction diode made of gallium arsenide or indium phosphide, the energy is released in visible region. Such a junction diode is called light emitting diode or LED. The radiated energy emitted by LED is equal or less than the band gap of semiconductor



31 **(a)**

According to law of mass action, $n_i^2 = n_e n_h$. In intrinsic semiconductors $n_i = n_e = n_h$ and for P-type semiconductor n_e would be less than n_i, since n_h is necessarily more than n_i

32 **(c)**

When base region has large width, electron hole combination increases the base current. The output collector current decreases from $I_e + I_b + I_c$ =constant

33 **(a)**

In semiconductors the energy gap between conduction band and valence band is small ($\approx 1\ eV$). Due to temperature rise, electron in the valence band gain thermal energy and may jumpy across the small energy gap, (to the conduction band). Thus conductivity increases and hence resistance decreases

34 **(d)**

Resistivity of semiconductors decreases with temperature. The atoms of a semiconductor vibrate with larger amplitudes at higher temperatures there by increasing it's conductivity not resistivity