(1) **(C).** When polarity of the battery is reversed, the P-N junction becomes reverse biased so no current flows.

(2) **(D).** Resistance in forward biasing

$R_{fr} \approx 10\,\Omega$ and resistance in reverse biasing

$$R_{Rw} \approx 10^5\,\Omega \Rightarrow \frac{R_{fr}}{R_{Rw}} = \frac{1}{10^4}$$

(3) **(A).** If doping is small, breakdown occurs at high currents. As $I \propto V_d$, so V_d is large. If doping is large then field in depletion region is high enough to cause breakdown.

(4) **(B).** At a particular reverse voltage in PN-junction, a huge current flows in reverse direction known as avalanche current.

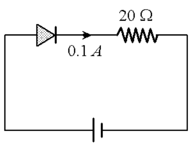
(5) **(A).** At high reverse voltage, the minority charge carriers, acquires very high velocities. These by collision break down the covalent bonds, generating more carriers. This mechanism is called Avalanche breakdown.

(6) **(B).** Because P-side is more negative as compared to N-side.

(7) **(B).** In this condition P–N junction is reverse biased.

(8) **(C).** When a light (wavelength sufficient to break the covalent bond) falls on the junction, new hole electron pairs are created. Number of electron hole pair produced depends upon number of photons. So photo emf or current is proportional to intensity of light.

(9) **(C).**



$V' = V + IR = 0.5 + 0.1 \times 20 = 2.5$ V

(10) **(D).** $\Delta i_E = \Delta i_C + \Delta i_B \Rightarrow 8 = 7.8 + \Delta i_B$

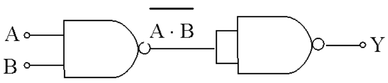
$\Rightarrow \Delta i_B = 0.2\text{mA} = 200\ \mu\text{A}$.

(11) **(A).** The Boolean expression for 'NOR' gate is

$Y = \overline{A+B}$ i.e. if $A = B = 0$ (Low),

$Y = \overline{0+0} = \overline{0} = 1$ (High)

(12) **(B).** Two 'NAND' gates are required as :



$Y = \overline{\overline{AB}.\overline{AB}} = AB$

(13) **(C).** For 'NOT' gate $X = \overline{A}$.

(14) **(B).** Filter circuits are used to get smooth dc π-filter is the best filter.

(15) **(B).** Current flow is possible and

$$i = \frac{V}{R} = \frac{(4-1)}{300} = 10^{-2}\text{ A}$$

(16) **(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.

(17) **(C).** Voltage gain = $\beta \times$ Resistance gain

$$\beta = \frac{\alpha}{1-\alpha} = \frac{0.99}{(1-0.99)} = 99$$

$$\text{Resistance gain} = \frac{10 \times 10^3}{10^3} = 10$$

$\Rightarrow$ Voltage gain = 99 × 10 = 990.

(18) **(A).** $\Delta i_C = \alpha \Delta i_E = 0.98 \times 2 = 1.96\,\text{mA}$

$\therefore \Delta i_B = \Delta i_E - \Delta i_C = 2 - 1.96 = 0.04\,\text{mA}$

(19) **(D).** The Boolean expression for 'AND' gate is $R = P.Q$

$\Rightarrow 1.1 = 1,\ 1.0 = 0,\ 0.1 = 0,\ 0.0 = 0$

(20) **(A).** AND + NOT $\rightarrow$ NAND

(21) **(C).** When A and B are closed, bulb is short circuited. When B = 1, Y = 0

When A = 0, Y = 0 (No supply the bulb)

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

(22) **(C).** Here,

(i) represents ideal modulation.

(ii) represents square law diode modulation.

(iii) represents constant current source.

(iv) represents part of it as square law modulation.

Thus, for modulation, (ii) and some regions of (iv) can be used.

(23) **(D).**

(A) In a transistor, base part is least size and least doped.

(B) On increasing the reverse bias to a large value in a P–N junction diode current suddenly increases.

(24) **(C).** When npn transistor is used as an amplifier electron move emitter to base and then base to collector.

(25) **(D).** For n-type a pentavalent impurity is used. Pentavalent elements are phosphorus, arsenic antimony.

(26) **(C).** Zero

(27) **(A).** $\frac{I_e}{I_h} = \frac{n_e eAV_e}{n_h eAV_h}$

$\frac{7}{4} = \frac{7}{5} \times \frac{V_e}{V_h}$; $\frac{V_e}{V_h} = \frac{5}{4}$

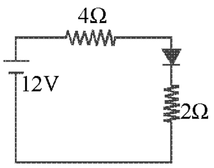
(28) **(C).** $\beta = \frac{I_C}{I_B} = \frac{5.488\text{mA}}{I_B}$

$I_E = I_C + I_B$; $5.6 = 5.488 + I_B$

$I_B = 0.112$ mA ; $\beta = \frac{5.488}{0.112} = 49$

(29) **(D).** D_1 is in reverse biasing, so current will not flow through D_1.

$I = 12/6 = 2A$



(30) **(C).** $n_e n_h = n_i^2$

$n_i = 6 \times 10^8$ per m^3 ; $n_e = 9 \times 10^{12}$ per m^3

$\therefore \quad n_h = \frac{n_i^2}{n_e} = \frac{(6\times10^8)^2}{9\times10^{12}} = 4 \times 10^4$ per m^3

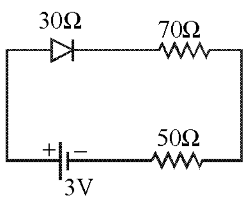
(31) **(B).** Height of potential barrier decreases when p-n junction is forward biased and it increases when junction is reverse biased.

(32) **(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.

Total resistance of circuit

$R = 50 + 70 + 30$

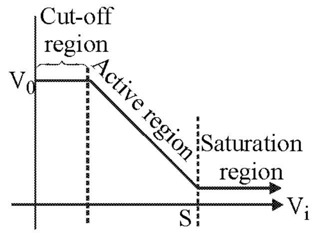
$= 150\ \Omega$



Current in the circuit,

$I = \frac{V}{R} = \frac{3V}{150\ \Omega} = 0.02A$

(33) **(B).** Transistor is used as an amplifier in active region. In cut-off region, output is high (switch turned off), as transistor is in cut off region, i.e., not functioning properly.



In saturation region, output is low. (switch turned on), transister having high input voltage.

(34) **(C).** Initially, diffusion current is large and drift current is small. As the diffusion process continues, the space-charge regions on either side of the junction extend, thus increasing the electric field strength and hence drift current. This process continues until the diffusion current equals the drift current. Thus a p-n junction is formed. In a p-n junction under equilibrium there is no net current.

(35) **(D).** Gallium, Boron and aluminum all are trivalent impurities. These impurities make germanium p-type semiconductor.

(36) **(D).** Potential difference across capacitor,

$V = \text{peak voltage} = V_{rms}\sqrt{2} = 220\sqrt{2}$ V.

(37) **(C).** In depletion region, after equilibrium, no recombination can occur as electron and holes are not 'free'. In depletion region there are immobile charged ions but no mobile charges; equal number of holes and electrons exist.

(38) **(C).**

(A) In case of conductors either the conduction and valance band overlap or conduction band is partially filled.

(B) Insulators have energy gap of 5eV to 10eV.

(C) Resistivity (opposite of conductivity) decreases with increase in temperature.

(D) With increase in temperature more and more electrons jump to the conduction band. So, conductivity increases.

(39) **(A).** Due to strong electronegativity of carbon.

(40) **(C).** Number of donors is more because electron from –ve terminal of the cell pushes (enters) the n side and decreases the number of uncompensated pentavalent ion due to which potential barrier is reduced. The neutralised pentavalent atom are again in position to donate electrons.

(41) **(C).** At a certain reverse bias voltage, zener diode allows current to flow through it and hence maintains the voltage supplied to any load. Hence it is used for stabilisation.

(42) **(D).** On the basis of given graph following table is possible

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

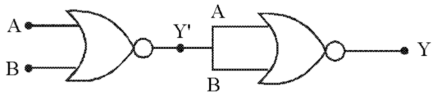
It is the truth table of AND gate.

(43) **(B).** $\Delta I_B = +50\mu A,\ \Delta I_C = 5 \times 10^{-3}$ A

$$\beta = \frac{\Delta I_C}{\Delta I_B} = \frac{5\times10^{-3}}{50\times10^{-6}} = \frac{5\times1000}{50} = 100$$

(44) **(C).** In forward biasing of a diode, the emitter should be at a higher potential. Here, only in option (C) emitter is at higher potential.

(45) **(C).**



$Y' = \overline{A+B}$

$Y = \overline{\overline{A+B}} = A+B$

Therefore truth table :

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