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Q5. What happens when a forward bias is applied to a p-n junction?

Answer:

We know that N-type semiconductor has excess of free electrons and P-type has excess of holes. The diffused electrons come into contact with holes on the P-side and the diffused holes on the N-side. The net result is the diffused electrons and holes are gets neutralized due to reunion, leaving behind the charged ions adjacent to the interface in a region with no mobile carriers this is called the depletion region.
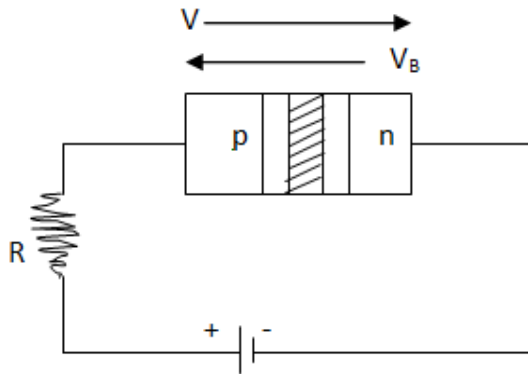
When a p-n junction is forward biased (p with +ve , n with –ve terminal of battery), the majority charge carries flow towards the junction, the width of the depletion layer decreases, as shown in the figure The applied voltage mostly drops across the depletion region, and the voltage drop across the p-side and n-side of the junction is negligible. The direction of the applied voltage (V) is opposite to the potential developed V_B. As a result, the depletion layer width decreases and the barrier height becomes (V- V_B).

Q6.

a) Distinguish between 'Analog' and 'Digital' forms of communication.
b) Explain briefly two commonly used applications of the 'Internet'.

Answer:

a)

Analog	Digital
The information is transmitted as a continuous wave form.	the information is sent as discrete or quantized signal levels in 0 and 1 form.
Distortion happens in analog transmission	It is practically free of distortion.
It can broadcast limited number of channels simultaneously.	It can broadcast large number of channels simultaneously.

b) Applications of the Internet:

i. E-mail: It allows the exchange of text or graphic material. We can write a letter send scan copy of documents as attachment and send instantly to the other person.

ii. E-commerce: We can buy,sell products through web site and make payment online.

Q7. Given the ground state energy $E_0 = -13.6$ eV and Bohr radius $a_0 = 0.53$Å. Find out how the de Broglie wavelength associated with the electron orbiting in the ground state would change when it jumps into the first excited state.

Answer: Given ground state energy $E_0 = -13.6$ eV

Energy in the first excited state = $E_1 = \frac{-13.6 \text{ eV}}{(2)^2} = -3.4$ eV

We know that, the de Broglie wavelength $\lambda = \frac{h}{mv}$

But, $\frac{1}{2}mv^2 = E_1$ or $v = \sqrt{\frac{2E_1}{m}}$ Therefore $\lambda = \frac{h}{m\sqrt{\frac{2E_1}{m}}}$

$\therefore \lambda = \frac{h}{\sqrt{2mE_1}}$

$= \frac{6.63 \times 10^{-34}}{\sqrt{2 \times (9.1 \times 10^{-31}) \times (3.4 \times 1.6 \times 10^{-19})}} = \frac{6.63 \times 10^{-34}}{9.95 \times 10^{-25}}$

$\lambda = 6.6 \times 10^{-10}$ m

Q8. State Bohr's postulate of hydrogen atom which successfully explains the emission lines in the spectrum of hydrogen atom. Use Rydberg formula to determine the wavelength of H_α line.

[Given: Rydberg constant R = 1.03×10^7 m^{-1}]

Answer: According to Bohr's postulate when an electron jumps from its non-radiating orbit to another such orbit, the energy difference between the initial and final states is emitted in the form of energy.

Mathematically

$E_i - E_f = h\upsilon = \frac{hc}{\lambda}$

We know that Rydberg formula for the Balmer series is

$\frac{1}{\lambda} = R\left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right)$ where R=constant called the Rydberg constant $= 1.03 \times 10^7$ m^{-1}
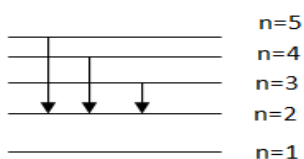
 The H_α − line of the Balmer series is obtained when an electron jumps to the second orbit $(n_f = 2)$ from the third orbit $(n_i = 3)$. Electron transition for higher level (n>2) and terminating at n=2 gives Balmer Series spectral line.	$\frac{1}{\lambda} = 1.03 \times 10^7\left(\frac{1}{2^2} - \frac{1}{3^2}\right)$ $\frac{1}{\lambda} = 1.03 \times 10^7\left(\frac{1}{4} - \frac{1}{9}\right)$ $\frac{1}{\lambda} = 1.03 \times 10^7\left(\frac{9-4}{36}\right)$ $\frac{1}{\lambda} = 1.03 \times 10^7\left(\frac{5}{36}\right)$ $\lambda = \frac{36}{5 \times 1.03 \times 10^7}$ $\lambda = 6.99 \times 10^{-7}$ $\lambda = 699 \times 10^{-9}$ $\lambda = 699$ nm The value of λ lies in the visible region.