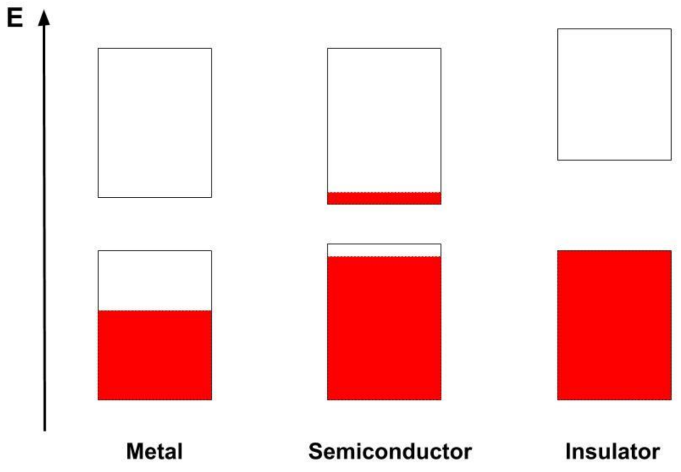
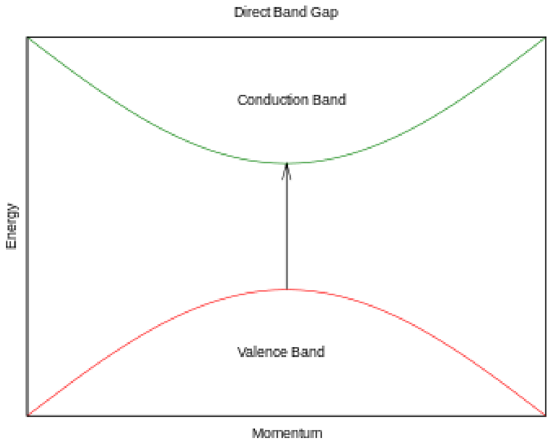
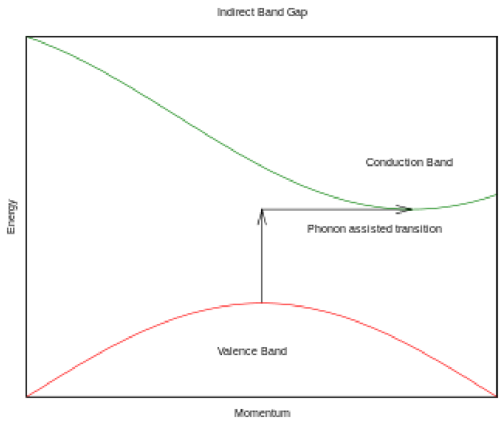
ECE 101

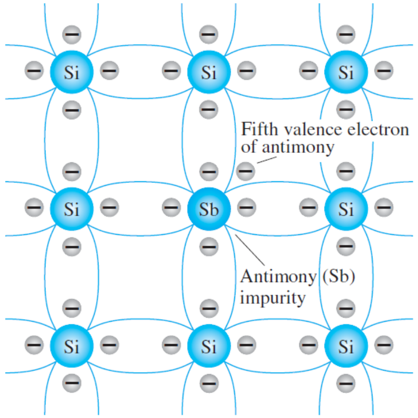
Fundamentals of Electronics

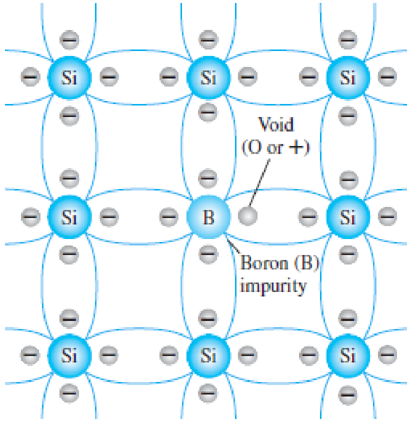
Review

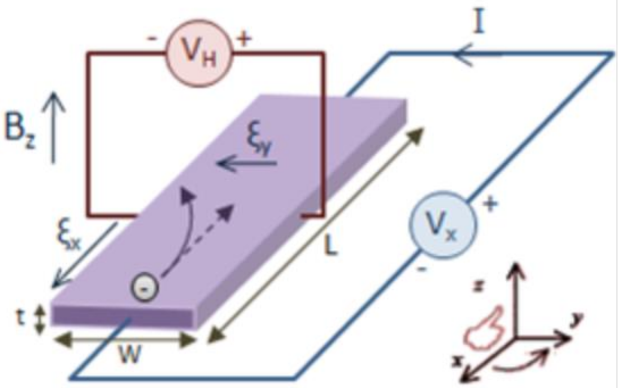










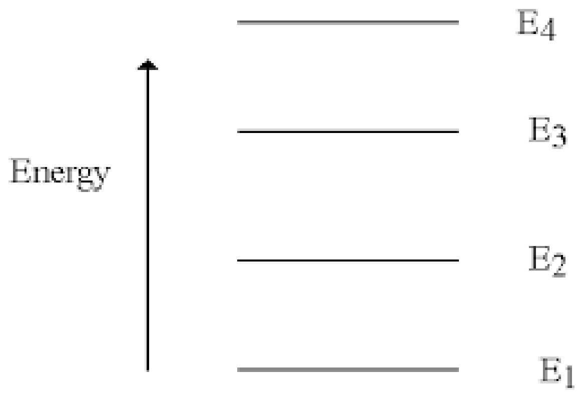


$$V_{\mathrm{H}} = \frac{I_x B_z}{nte}$$

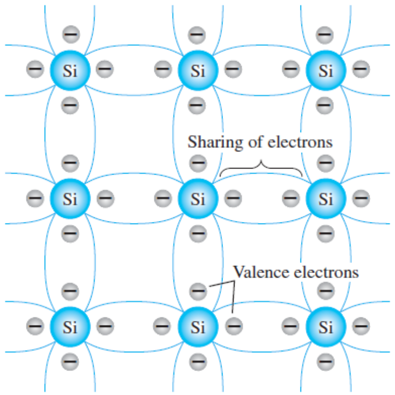
Summary

- Confinement leads to discretization

Photoelectric effect
Quantum mechanics



- When a lot of atoms come close to each other – bands are formed.



Intrinsic Carriers n_i

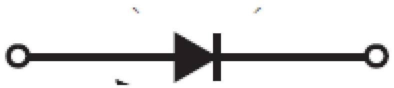
Semiconductor	Intrinsic Carriers (per cubic centimeter)
GaAs	1.7×10^6
Si	1.5×10^{10}
Ge	2.5×10^{13}

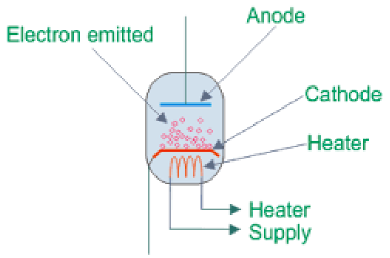
Relative Mobility Factor μ_n

Semiconductor	μ_n ($cm^2/V{\cdot}s$)
Si	1500
Ge	3900
GaAs	8500

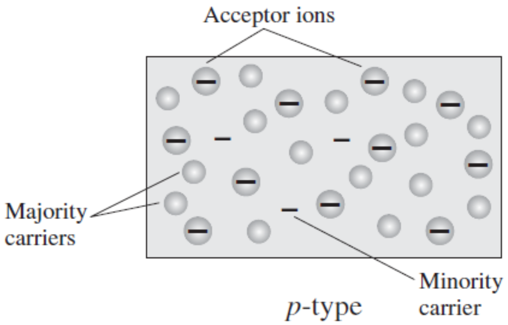
- Electrons and holes in semiconductors.

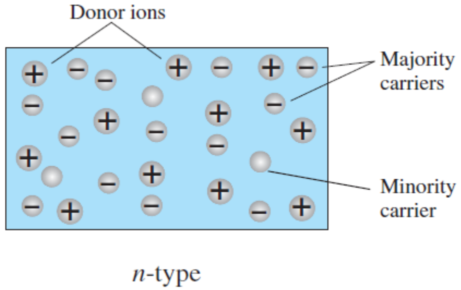
Diode: semiconductor junction

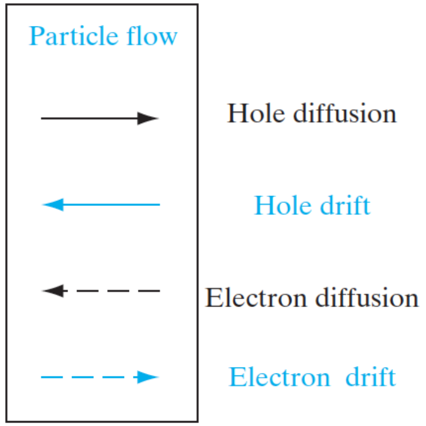


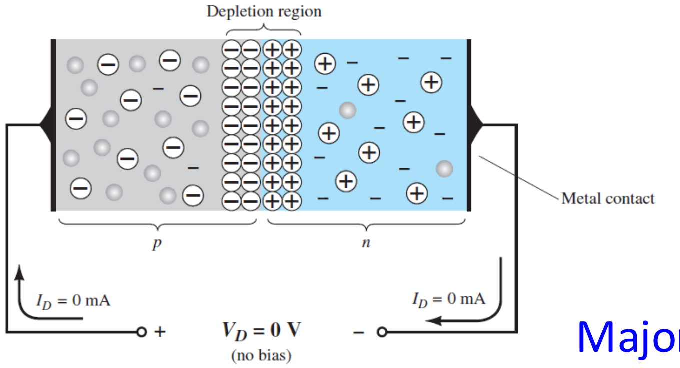


- Once we have both n-type and p-type materials available with us, what happens when we put two different kind of materials together.









Static and mobile charge.

$$J_p(\text{drift}) + J_p(\text{diff.}) = 0$$

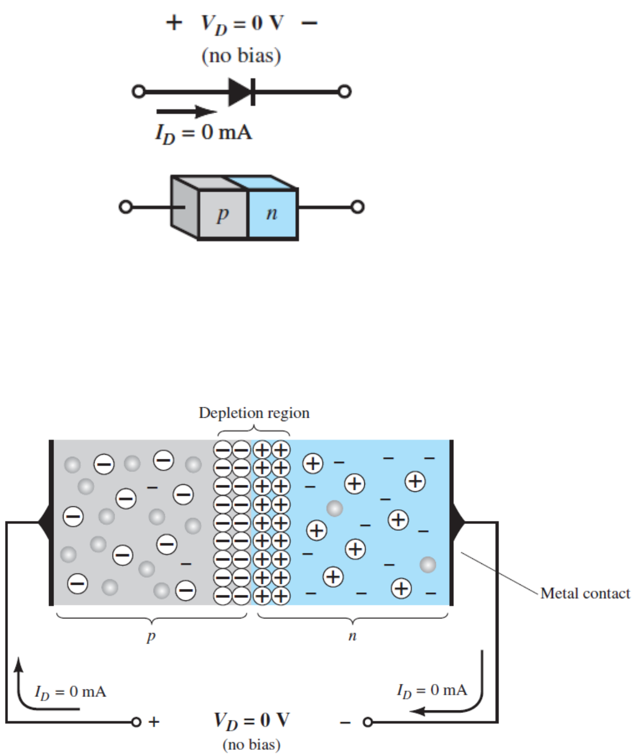
$$J_n(\text{drift}) + J_n(\text{diff.}) = 0$$

Majority and minority currents.

Equilibrium and steady state

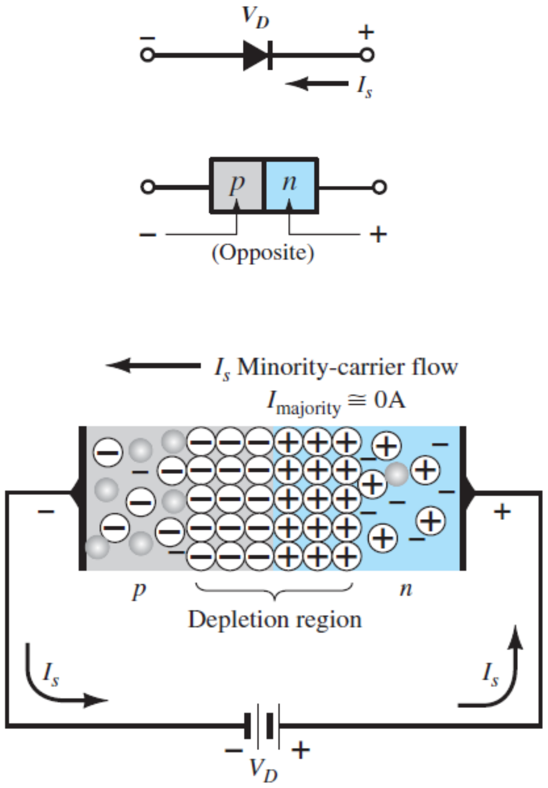
PN junction: under bias

No bias



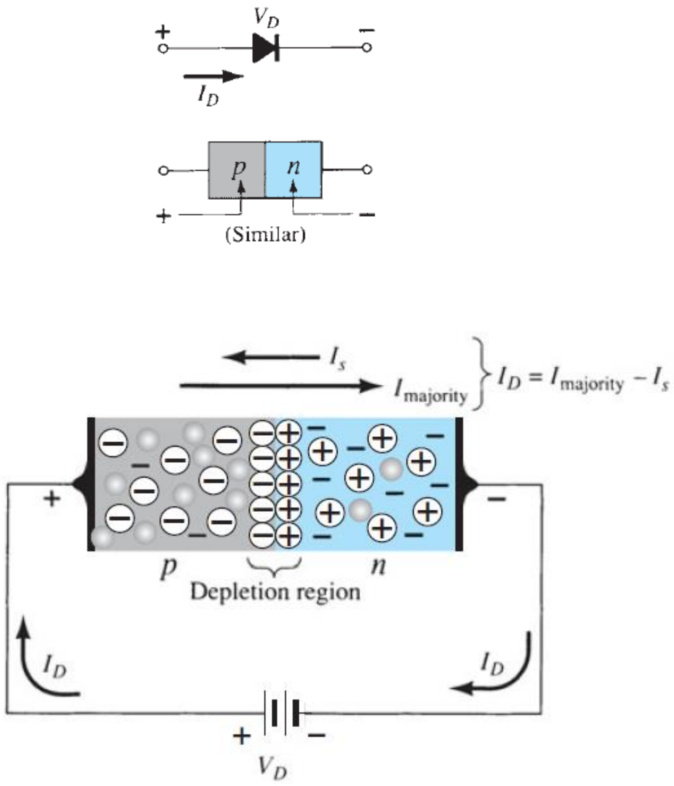
Depletion region

Reverse bias



The current that exists under reverse-bias conditions is called the reverse saturation current: nA - µA

Forward bias

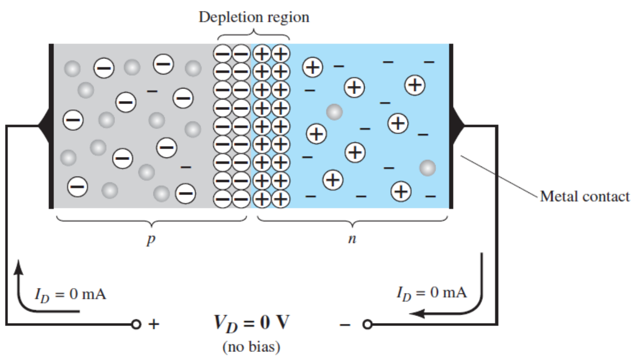


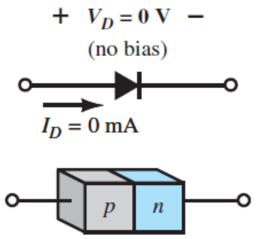
$$I_D = I_s(e^{V_D/nV_T} - 1)$$

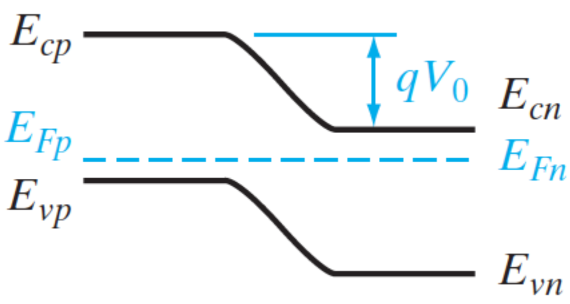
n – ideality factor of diode

PN junction: diode

Equilibrium conditions





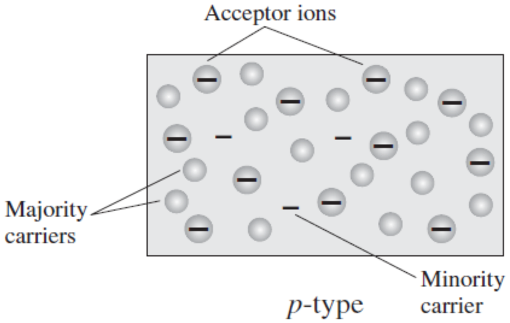


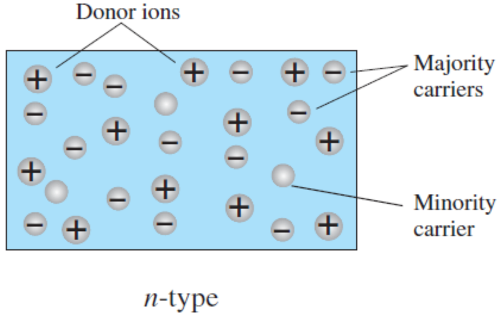
$$V_0 = \frac{kT}{q} \ln \frac{N_a}{n_i^2 / N_d} = \frac{kT}{q} \ln \frac{N_a N_d}{n_i^2}$$

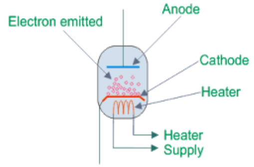
$$\boxed{W = \left[\frac{2\epsilon V_0}{q} \left(\frac{N_a + N_d}{N_a N_d} \right) \right]^{1/2} = \left[\frac{2\epsilon V_0}{q} \left(\frac{1}{N_a} + \frac{1}{N_d} \right) \right]^{1/2}}$$

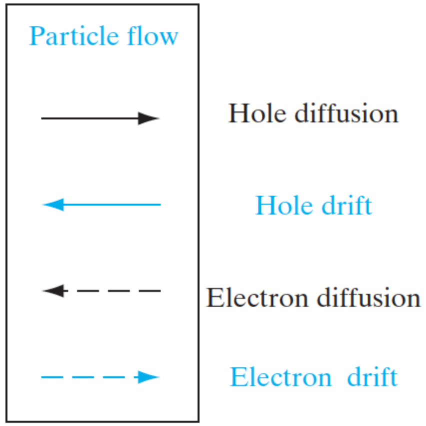
Depletion region

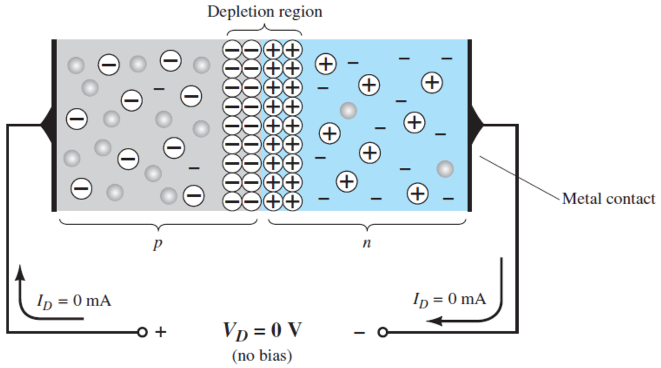
Summary



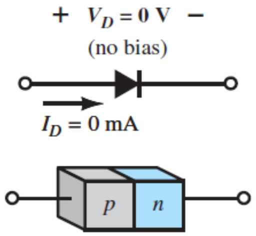








Equilibrium conditions



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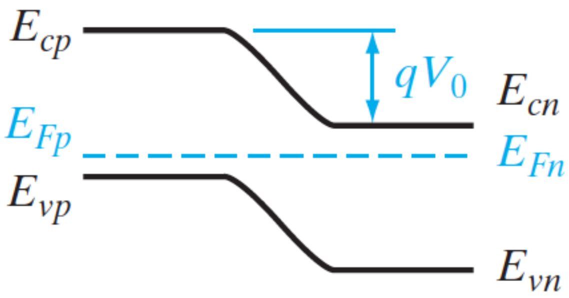

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Majority and minority currents.

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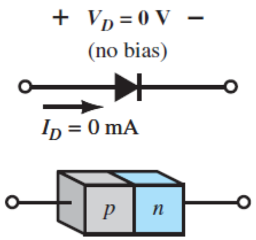
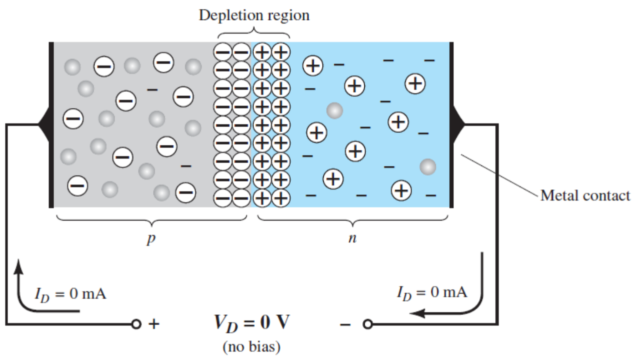
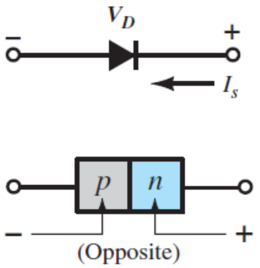
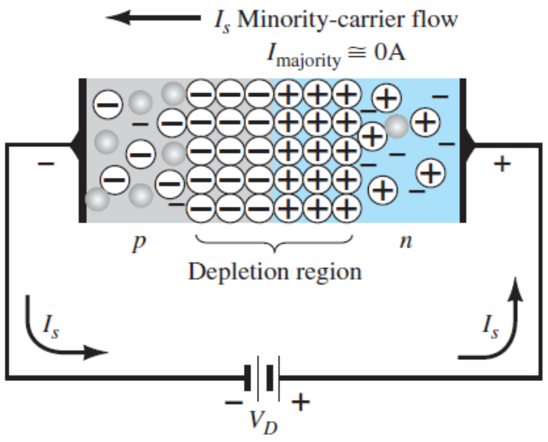




Depletion region

Reverse bias





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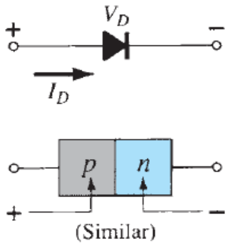

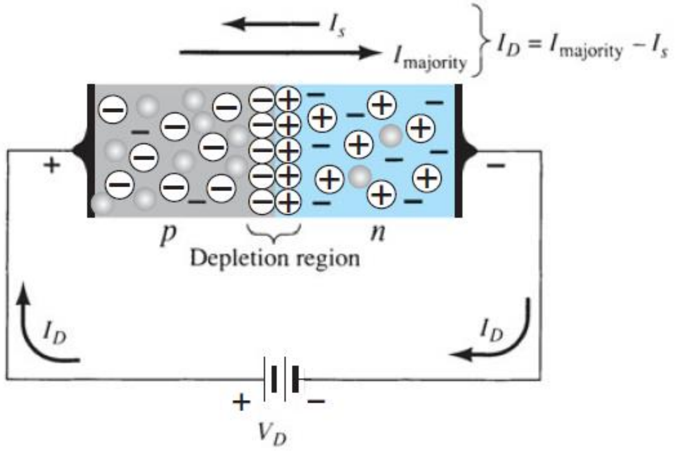

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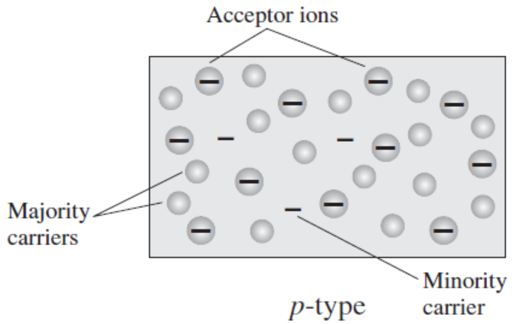
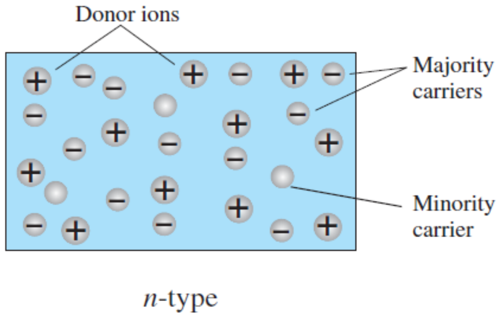
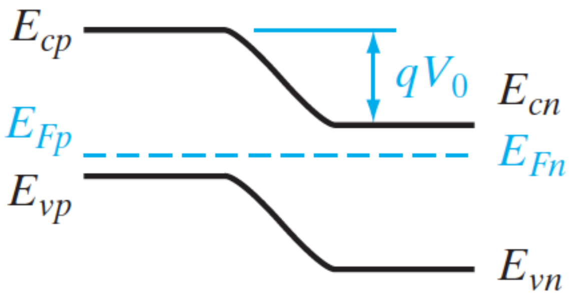
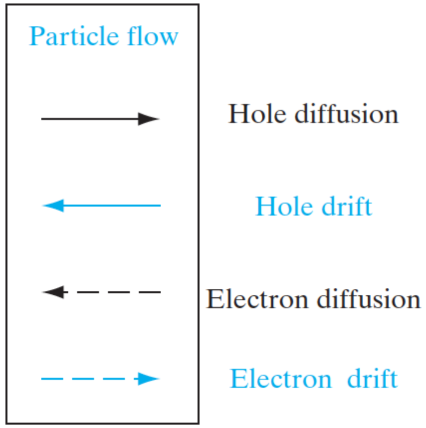
n – ideality factor of diode

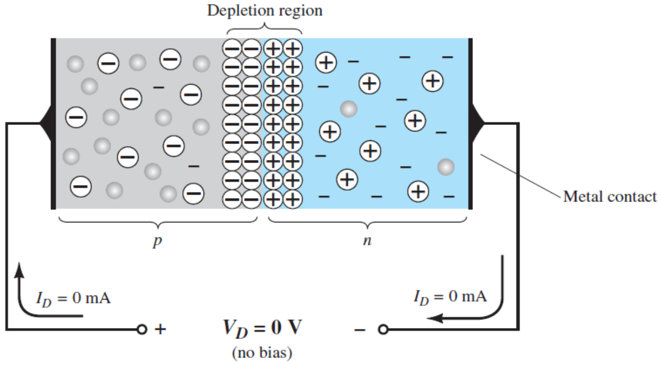
Review











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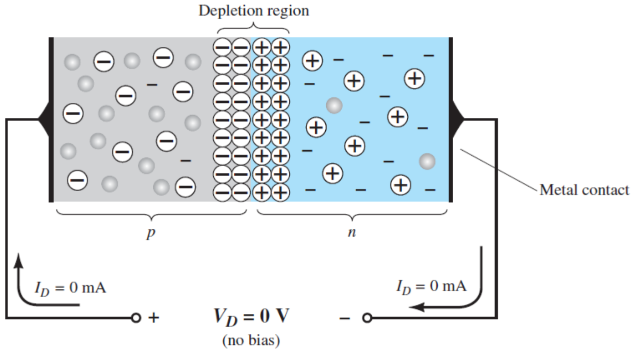
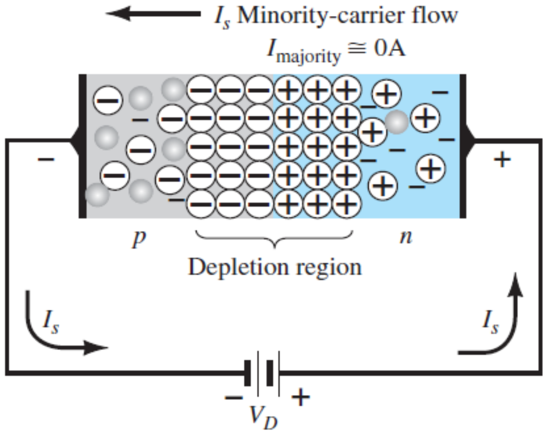
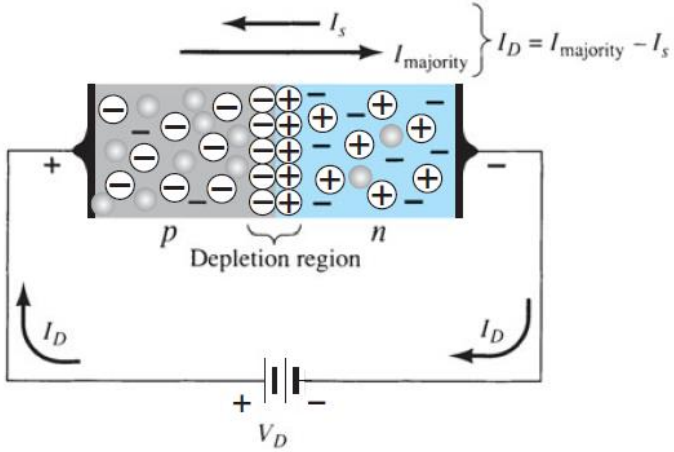


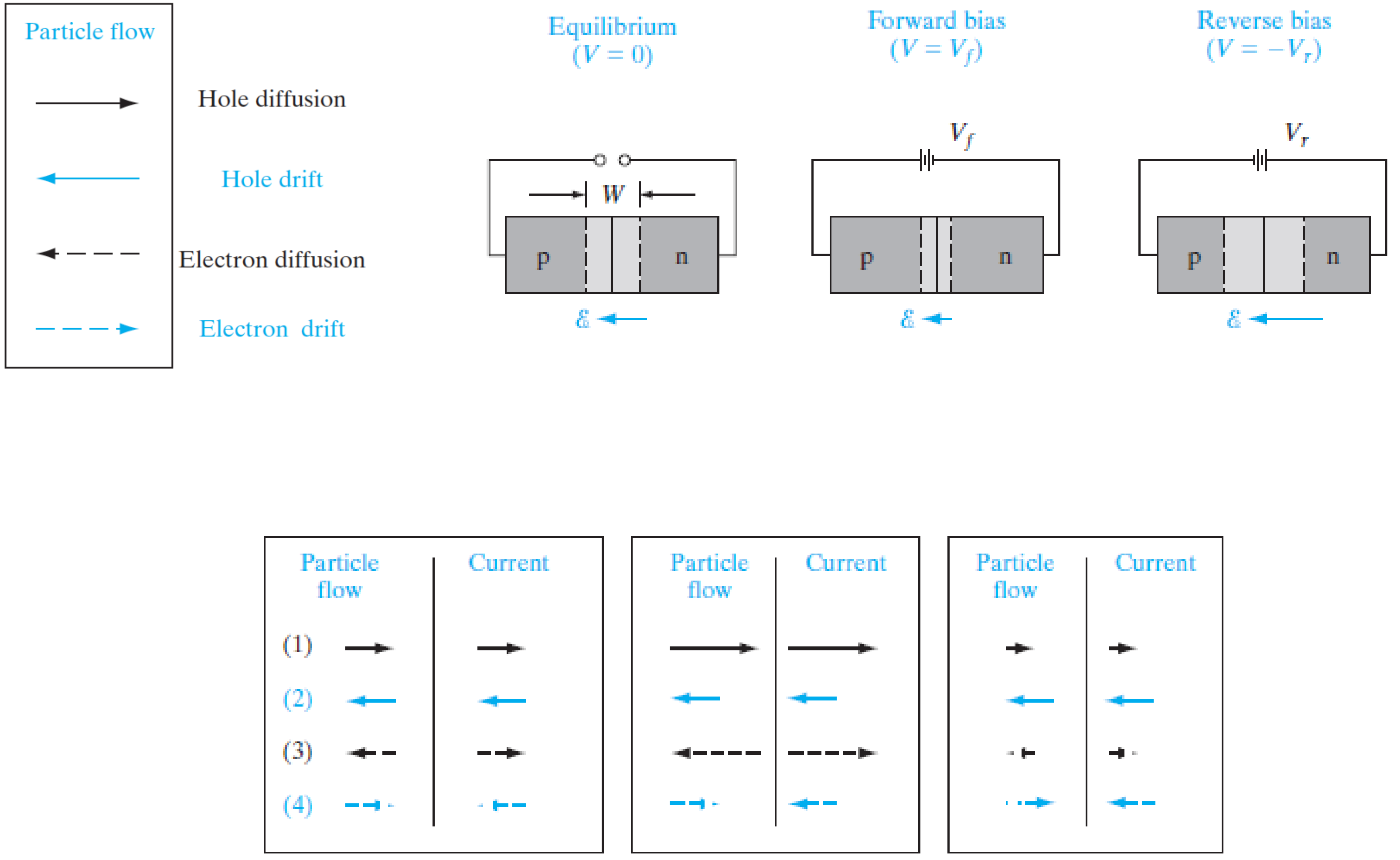
No bias



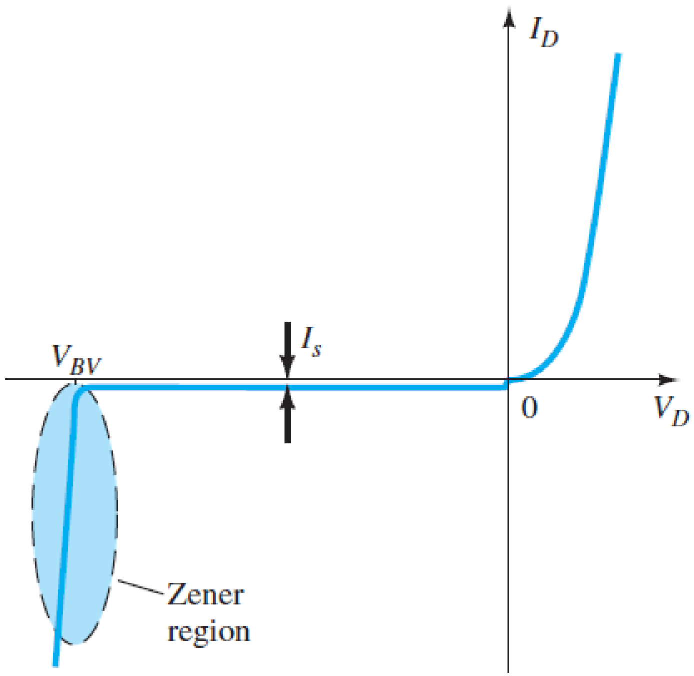
Reverse bias



Forward bias



(1) Hole diffusion
(2) Hole drift
(3) Electron diffusion
(4) Electron drift



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Thank you