ROYAL INSTITUTE
OF TECHNOLOGY

IH1611
Halvledarkomponenter
VT 2013, period 4

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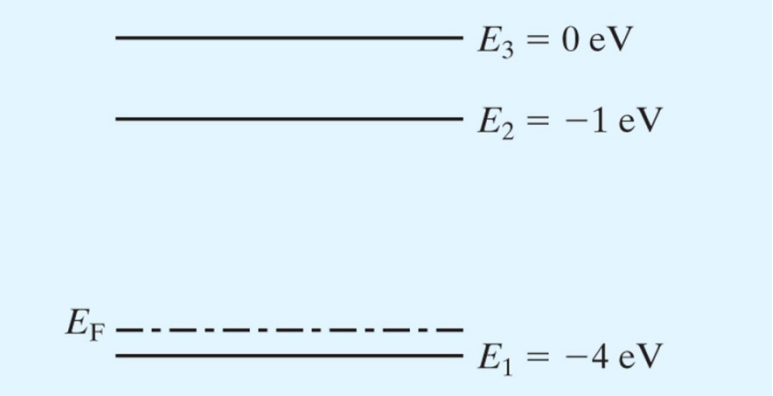


- I ett hypotetiskt system finns 3 energinivåer. Varje nivå kan endast vara besatt av en elektron. Hur många elektroner är det i systemet?

A: 3 B: ∞ C: 1 D: 2

Hur säker är du på ditt svar?

- Jag gissar
- Jag är rätt säker
- Jag vet att jag har rätt

Figure 1.12 Energy levels of donors and acceptors.

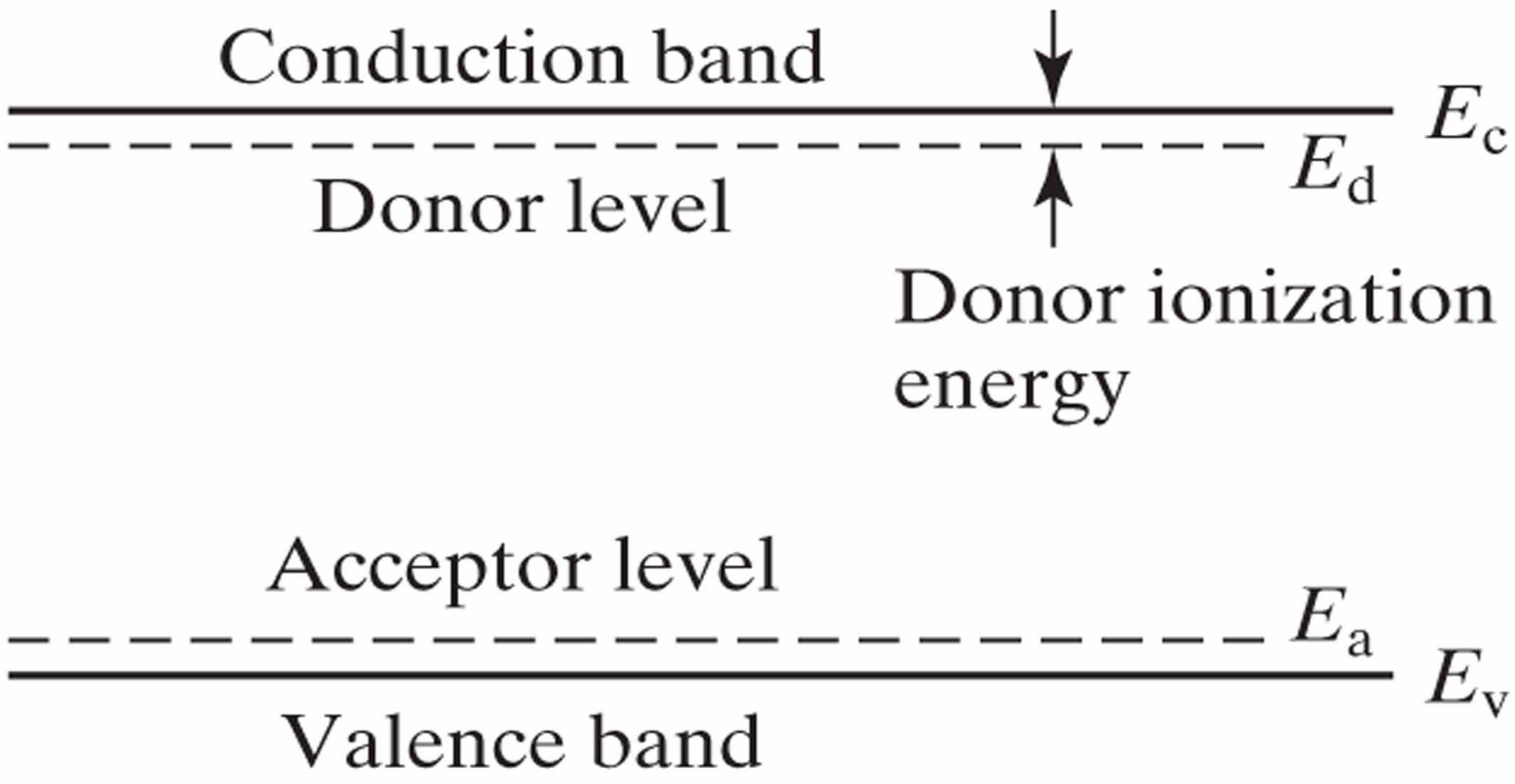


Table 1.2 Ionization energy of selected donors and acceptors in silicon.

TABLE 1–2 • Ionization energy of selected donors and acceptors in silicon.

	Donors			Acceptors		
Dopant	Sb	P	As	B	Al	In
Ionization energy, $E_c - E_d$ or $E_a - E_v$ (meV)	39	44	54	45	57	160

Figure 1.23 Location of E_F and E_d. Not to scale.

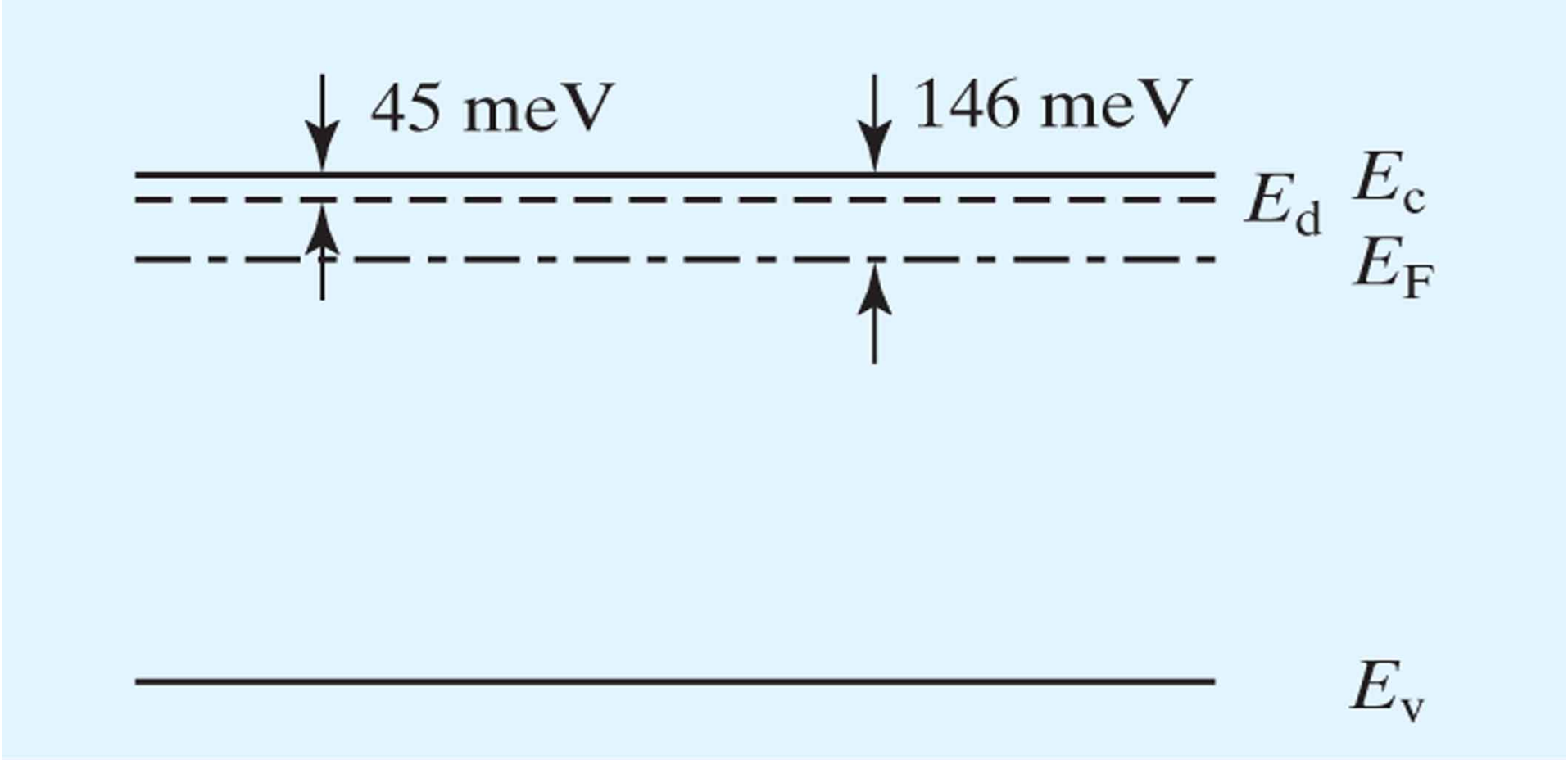
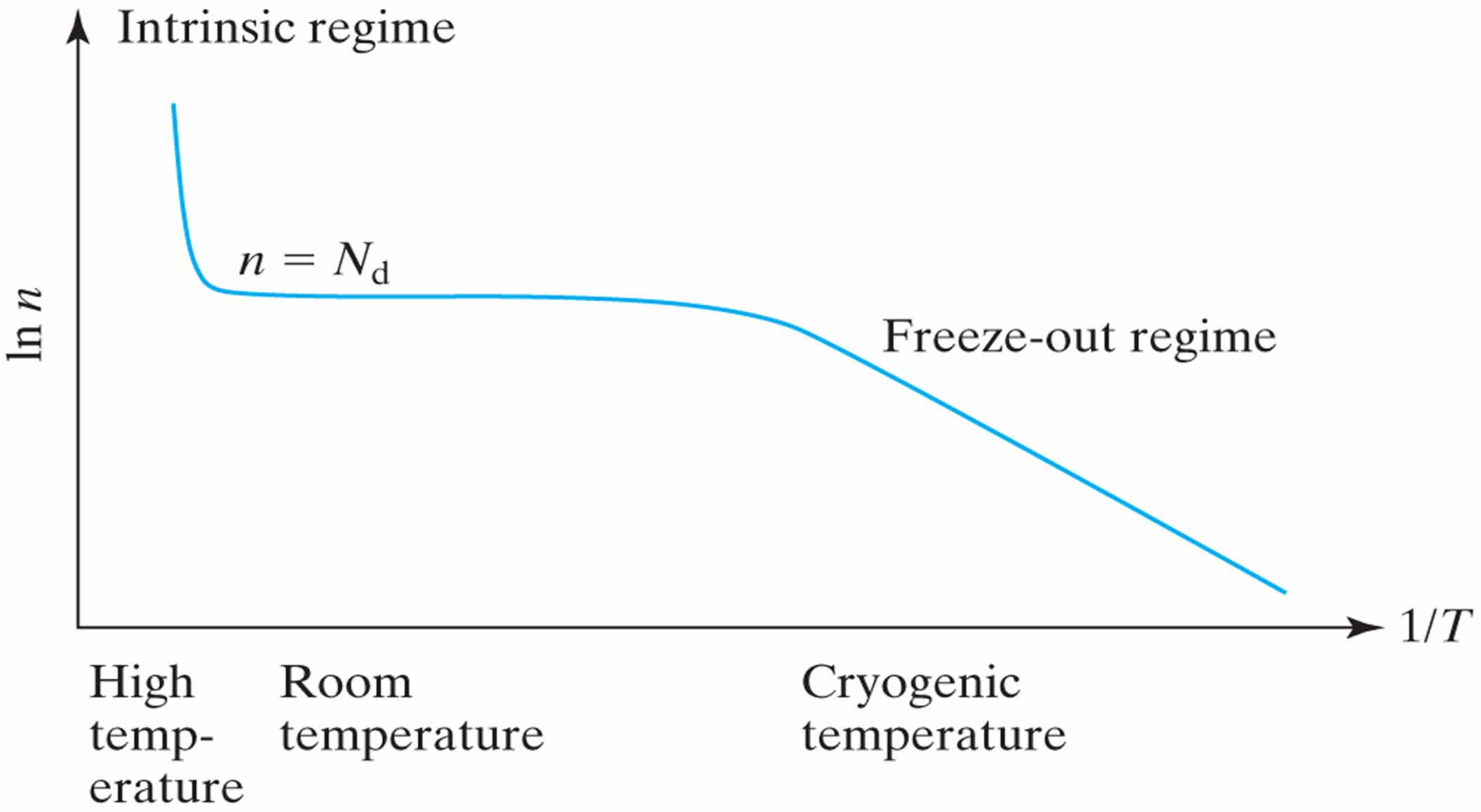


Figure 1.25 Variation of carrier concentration in an N-type semiconductor over a wide range of temperature.



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Kapitel 2

- Motion and Recombination of Electrons and Holes

Två typer av rörelse

Figure 2.1 The thermal motion of an electron or a hole changes direction frequently by scattering off imperfections in the semiconductor crystal.

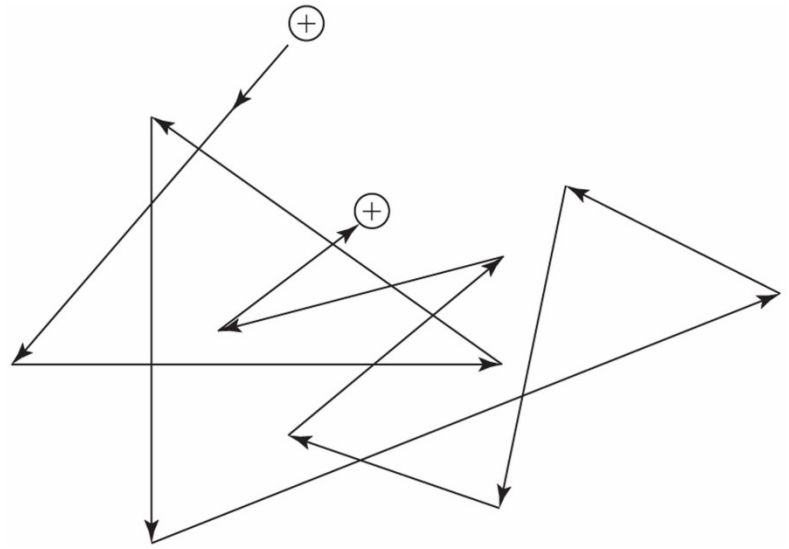


Figure 2.3 An electric field creates a drift velocity that is superimposed on the thermal velocity.

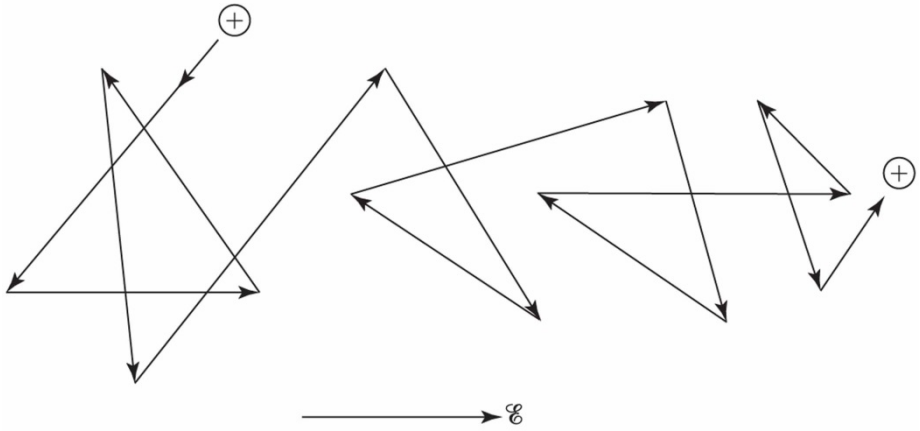


Figure 2.4 An electron can be scattered by an acceptor ion (a) and a donor ion (b) in a strikingly similar manner, even though the ions carry opposite types of charge. The same is true for a hole (not shown).

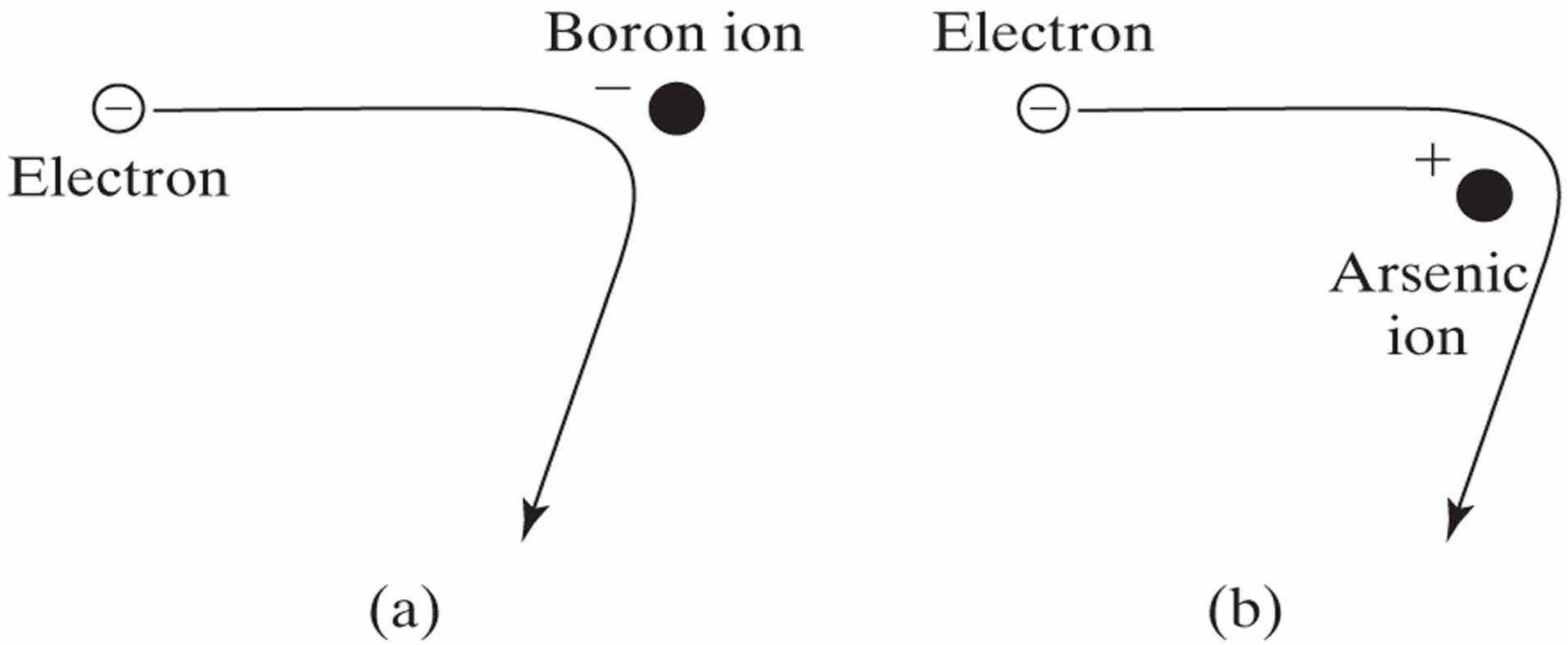


Figure 2.5 The electron and hole mobilities of silicon at 300 K. At low dopant concentration, the electron mobility is dominated by phonon scattering; at high dopant concentration, it is dominated by impurity ion scattering. (After [3].)

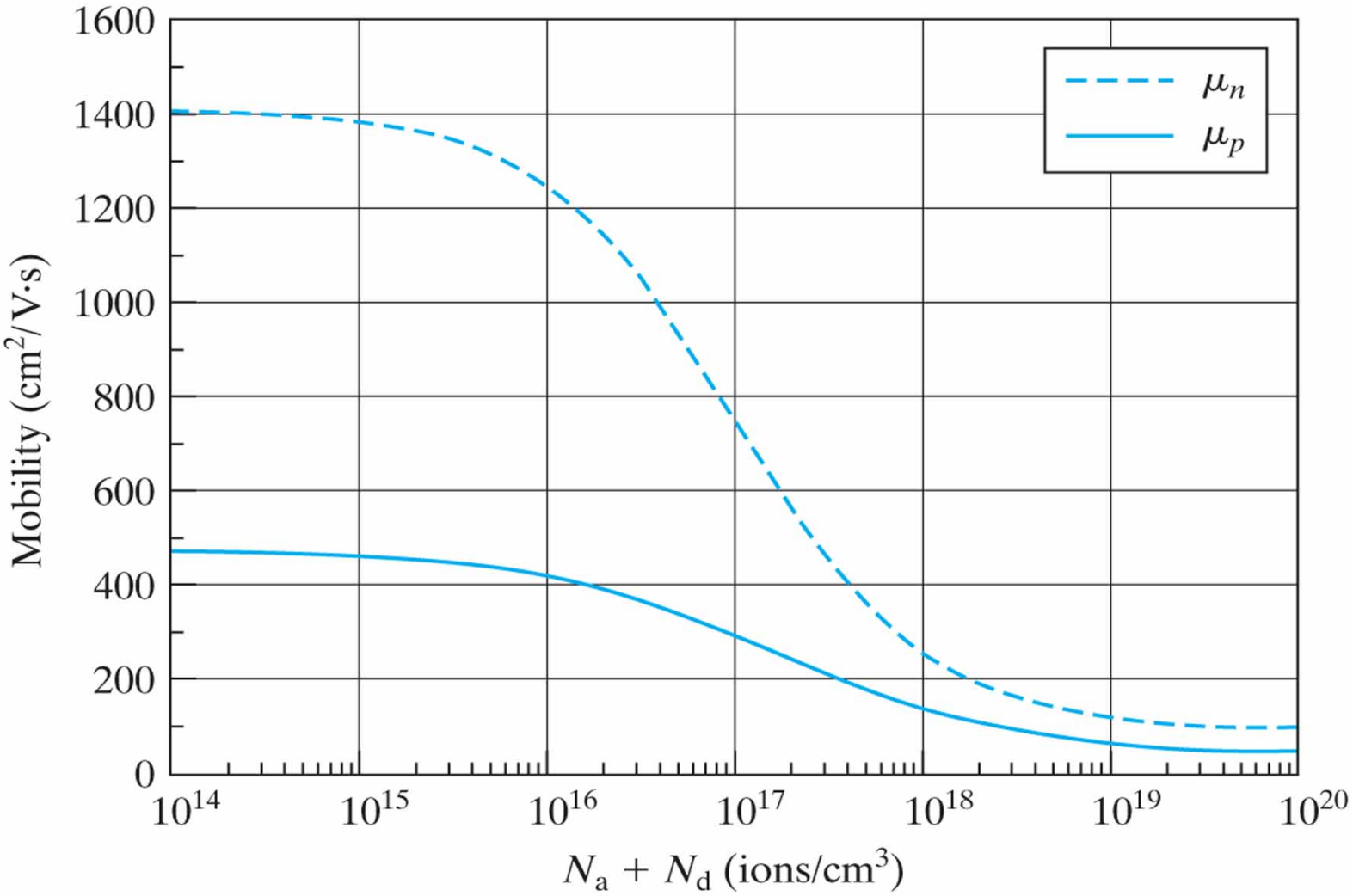


Figure 2.6 Temperature dependence of the electron mobility in Si. (After [4], reprinted by permission of John Wiley & Sons, Inc.)

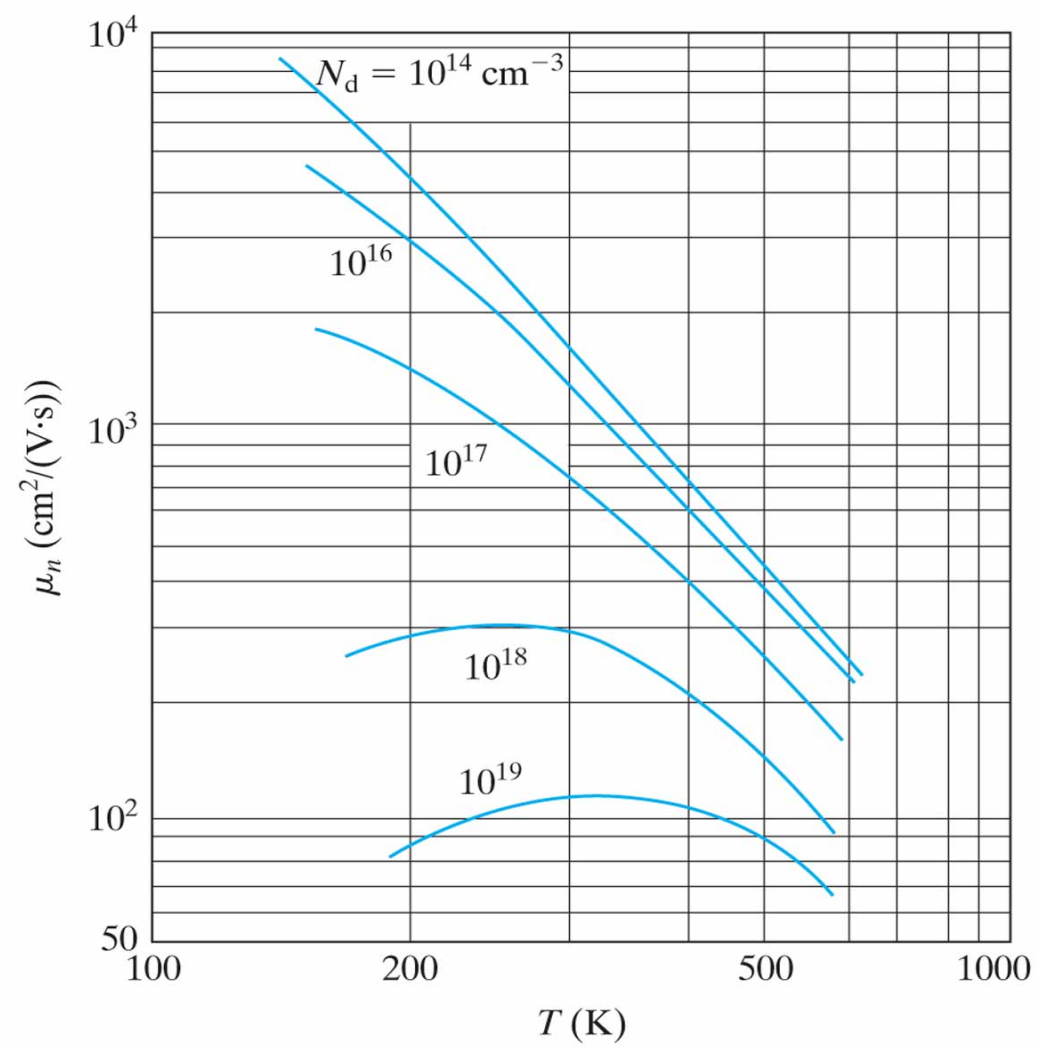


Figure 2.7 A P-type semiconductor bar of unit area is used to demonstrate the concept of current density.

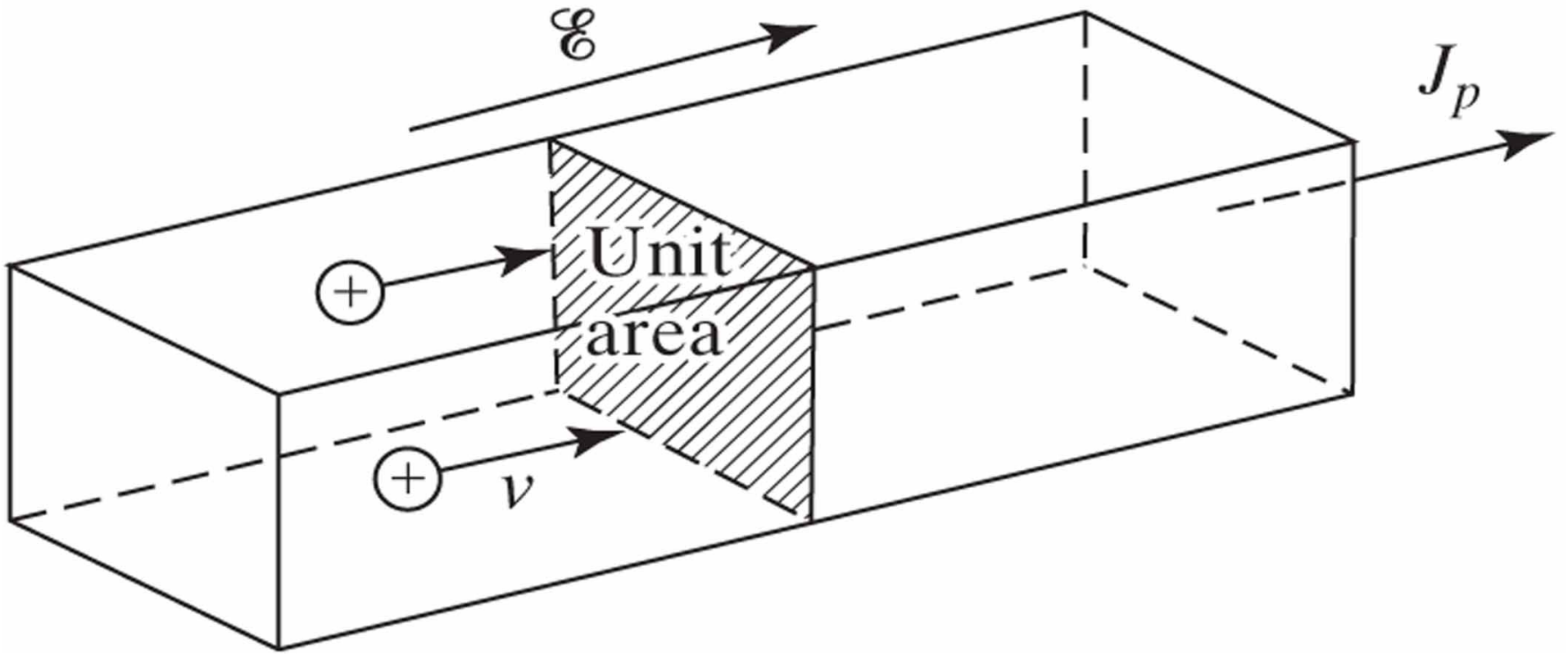


Figure 2.8 Conversion between resistivity and dopant density of silicon at room temperature. (After [3].)

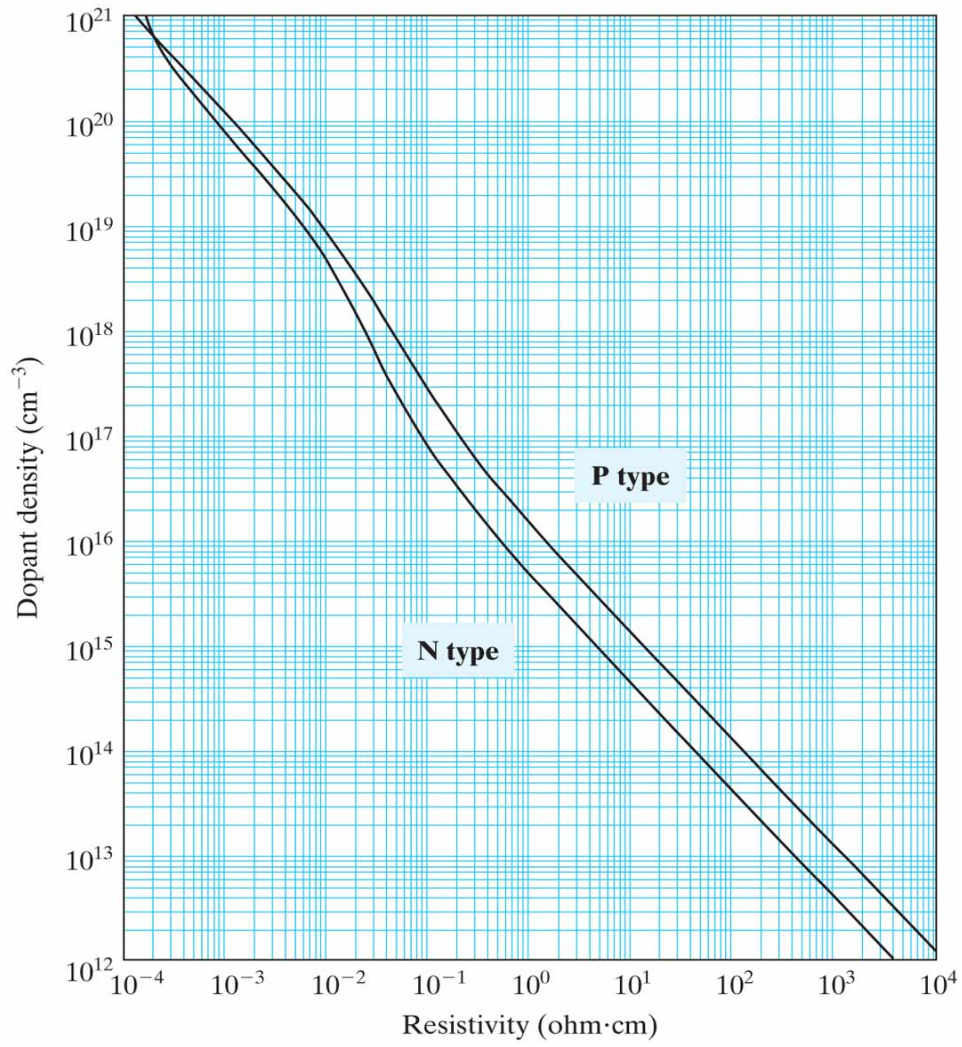


Figure 2.9 Particles diffuse from high-concentration locations toward low-concentration locations.

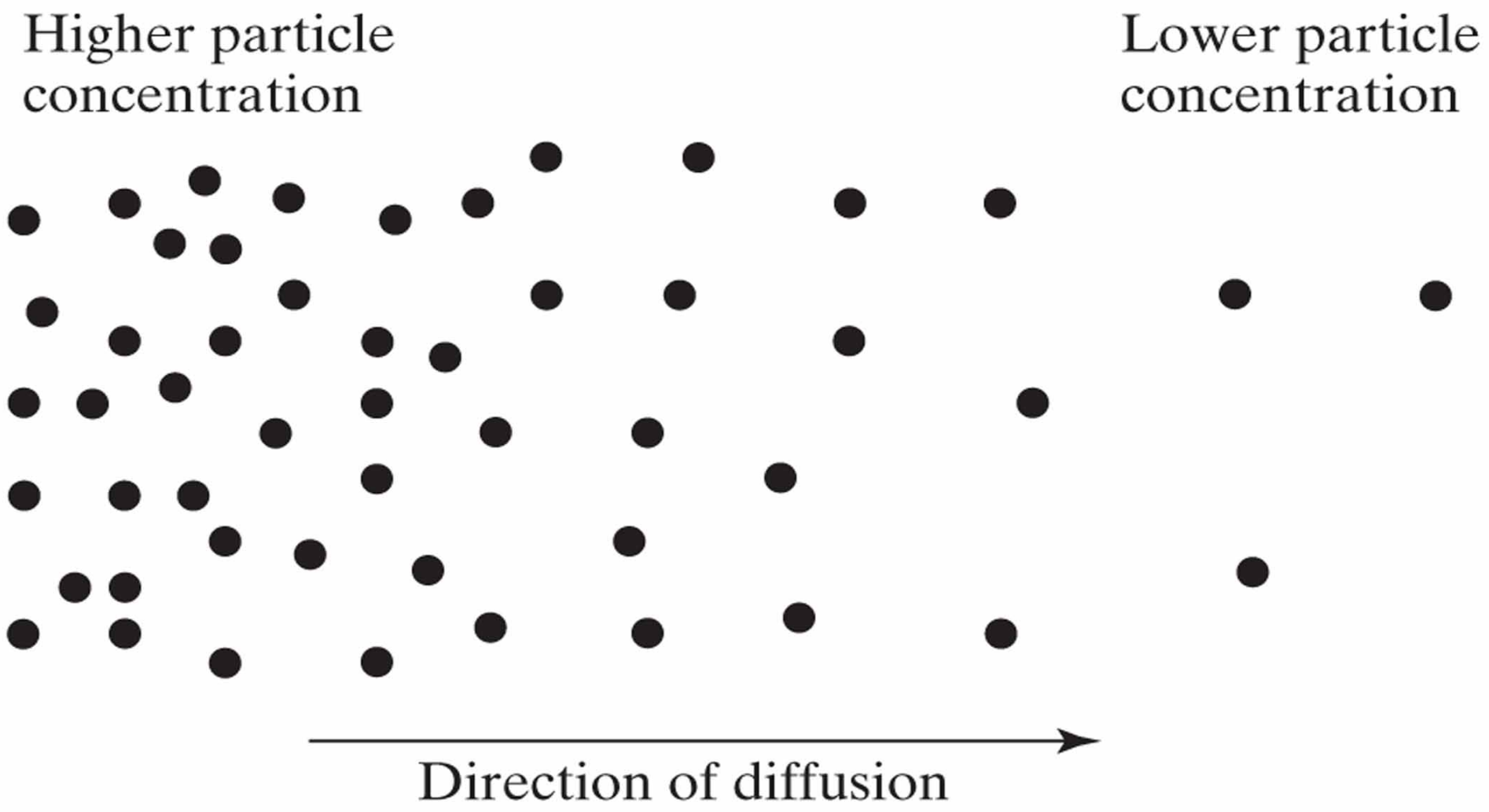


Figure 2.10 A positive slope of carrier concentration produces a positive electron diffusion current (a), but a negative hole diffusion current (b).

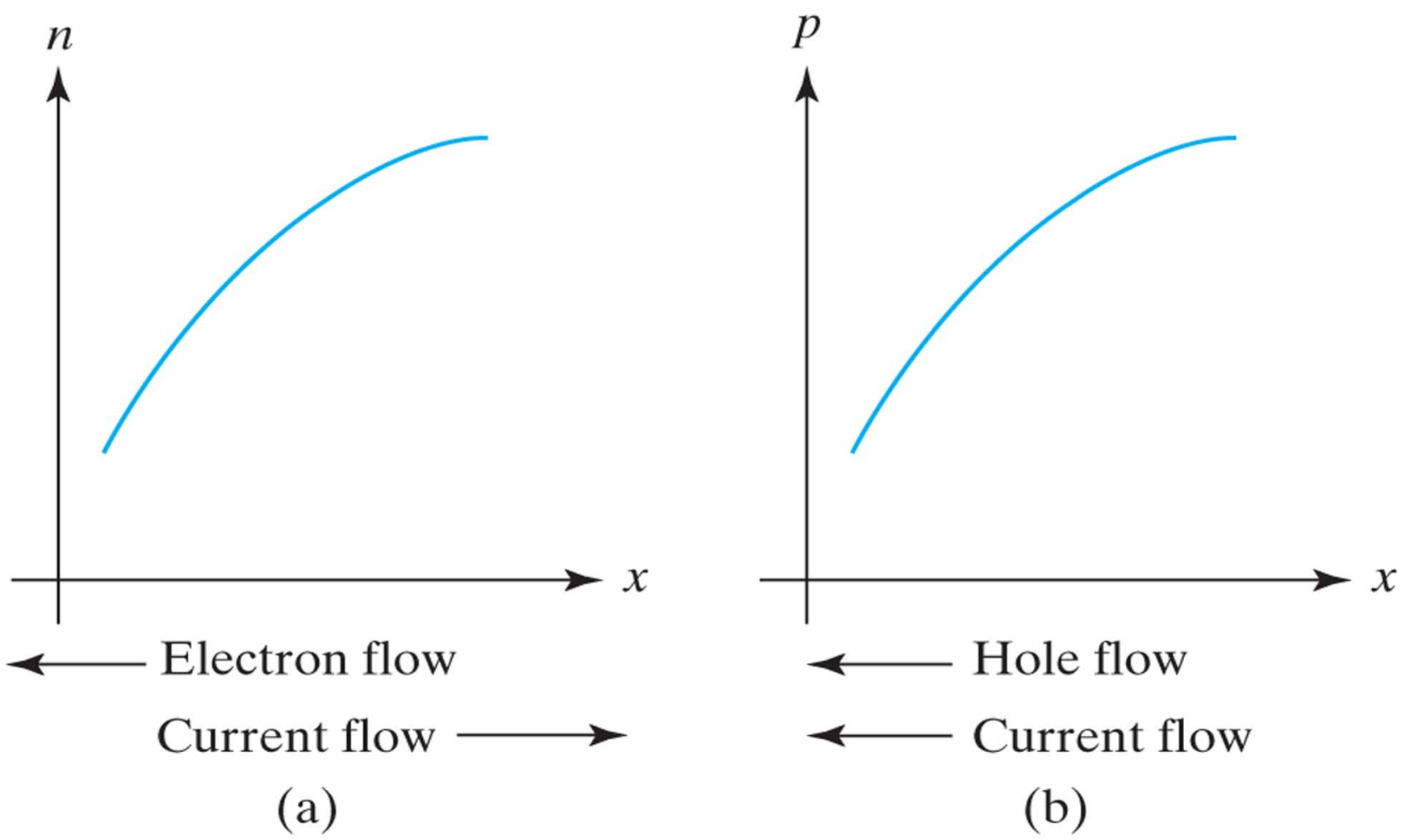


Figure 2.11 Energy band diagram of a semiconductor under an applied voltage. 0.7 eV is an arbitrary value.

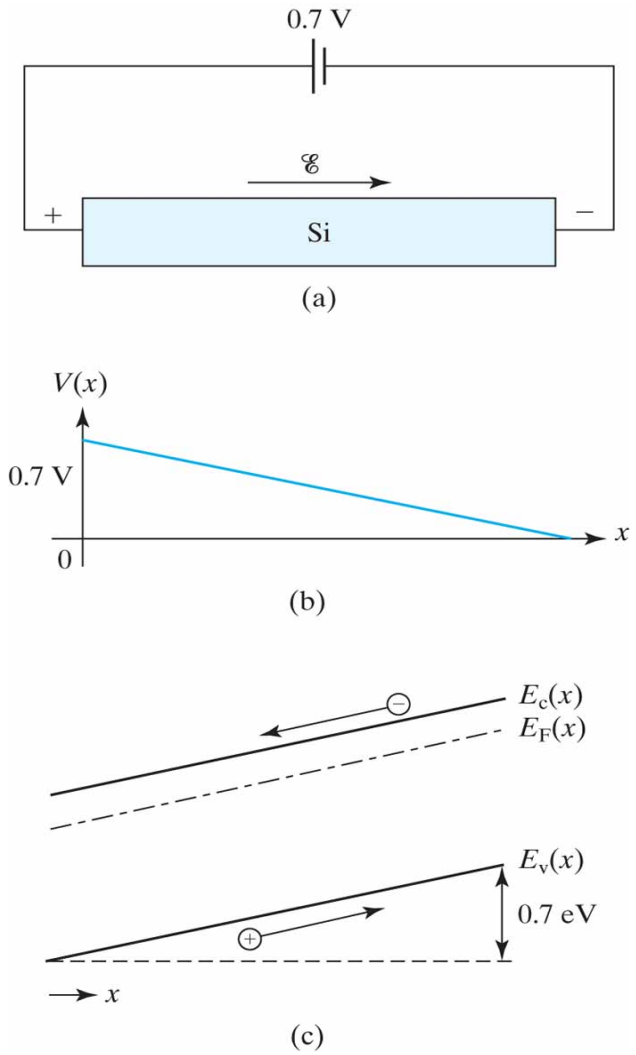


Figure 2.12 A piece of N-type semiconductor in which the dopant density decreases toward the right.

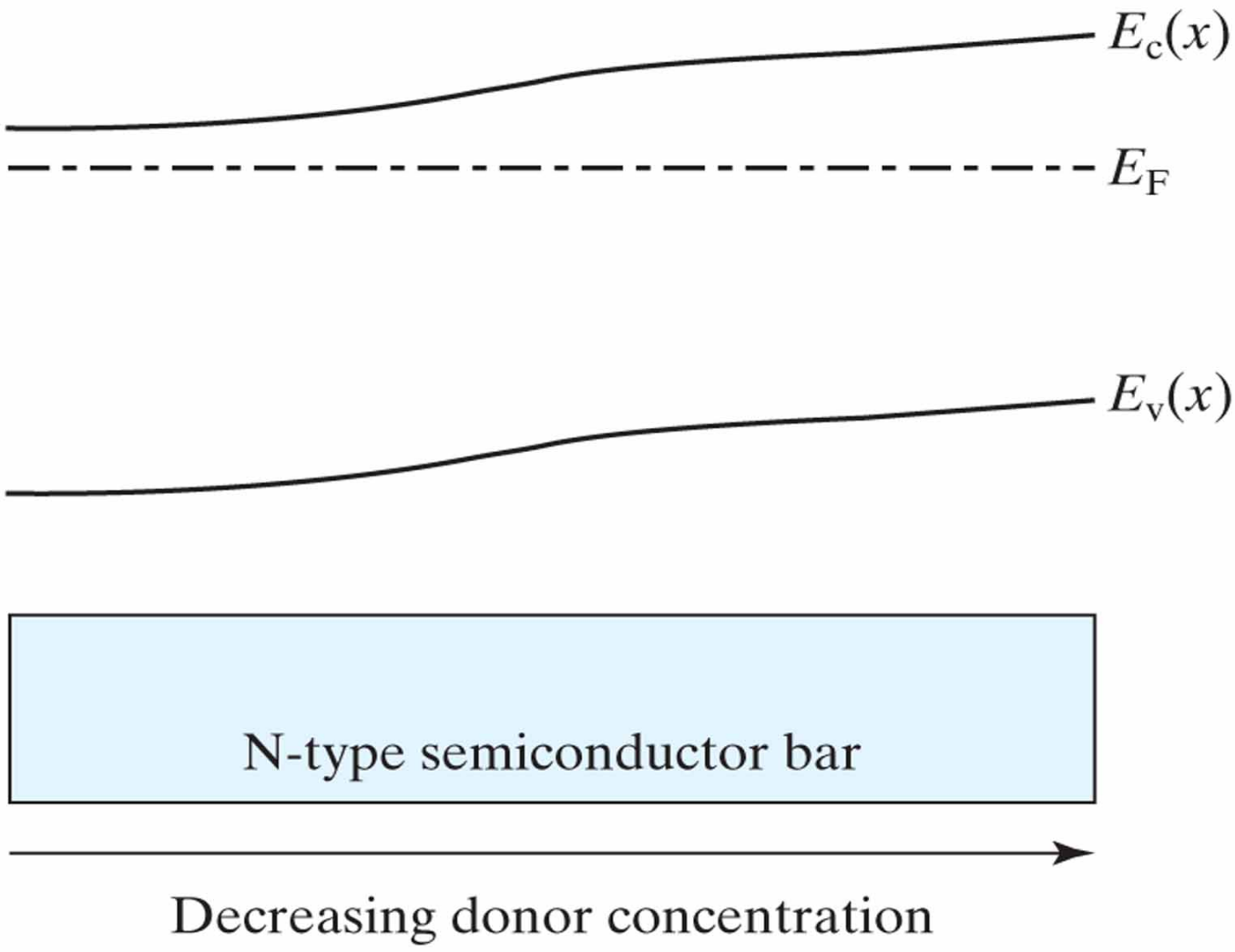


Figure 2.13 An electron–hole pair recombines when an electron drops from the conduction band into the valence band. In silicon, direct recombination is unimportant and the lifetime is highly variable and determined by the density of recombination centers.

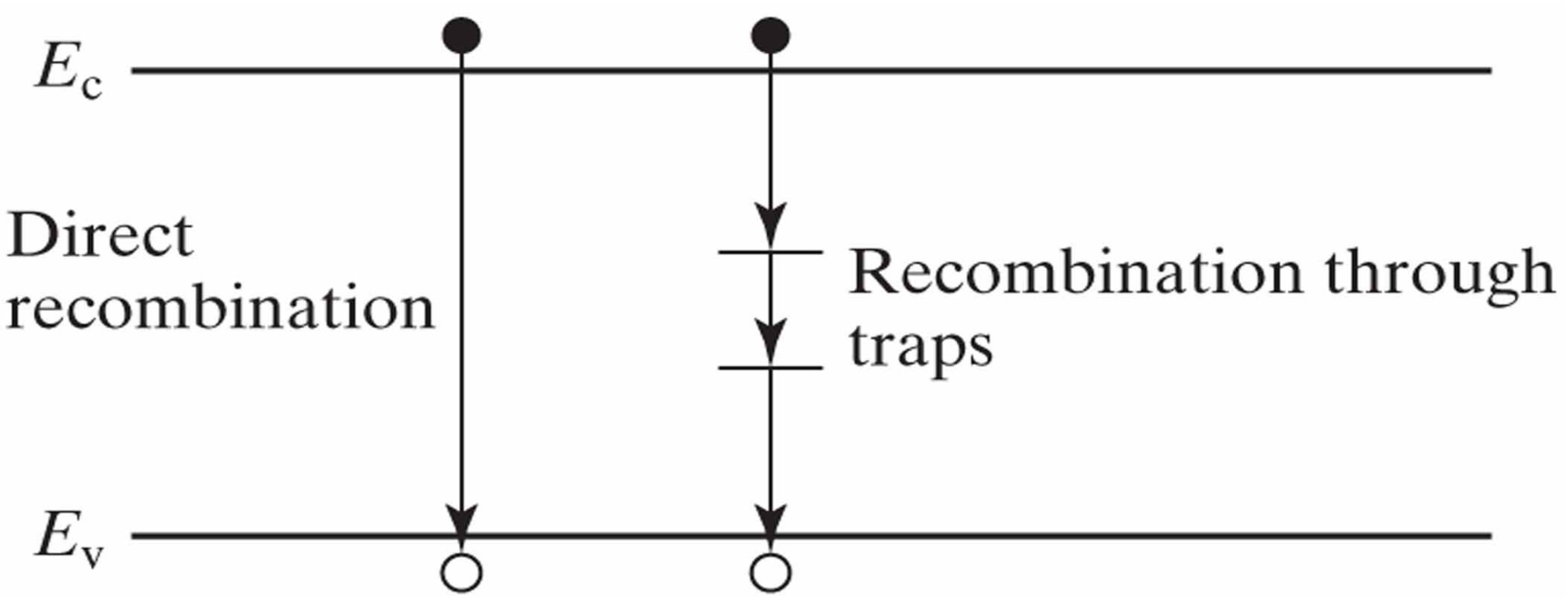


Figure 2.14 Location of E_F, E_{Fn}, and E_{Fp}.

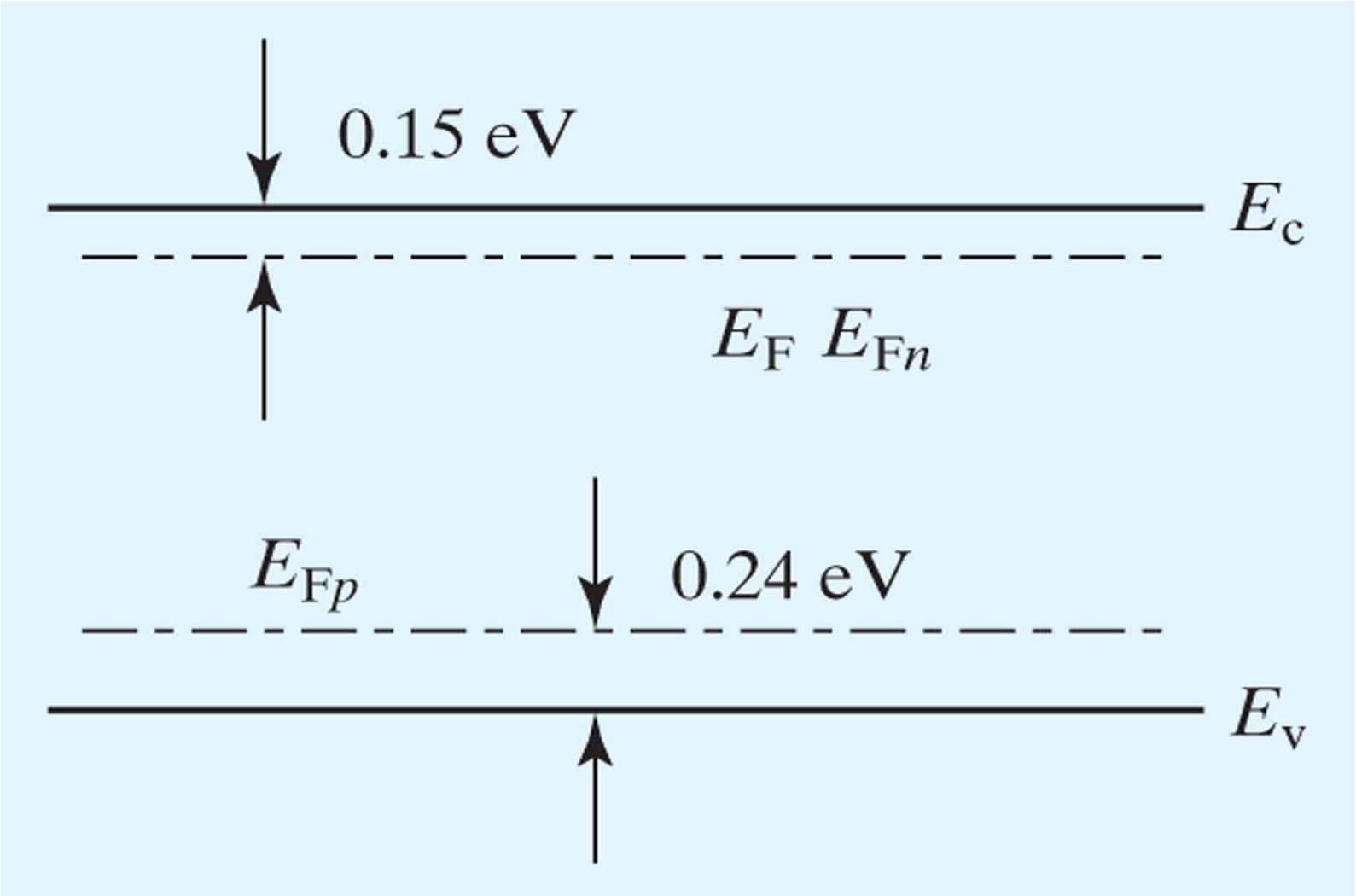


Figure 2.15

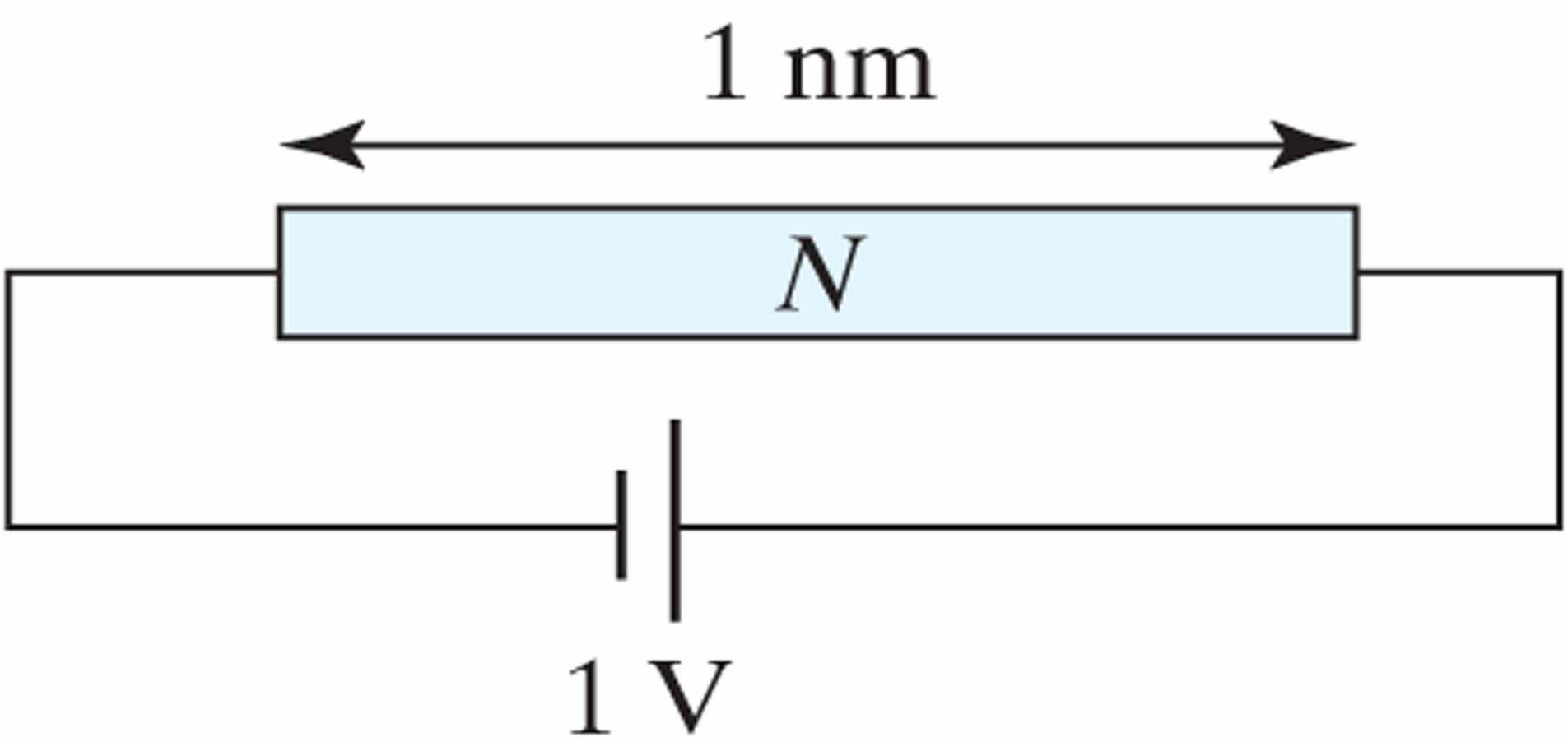
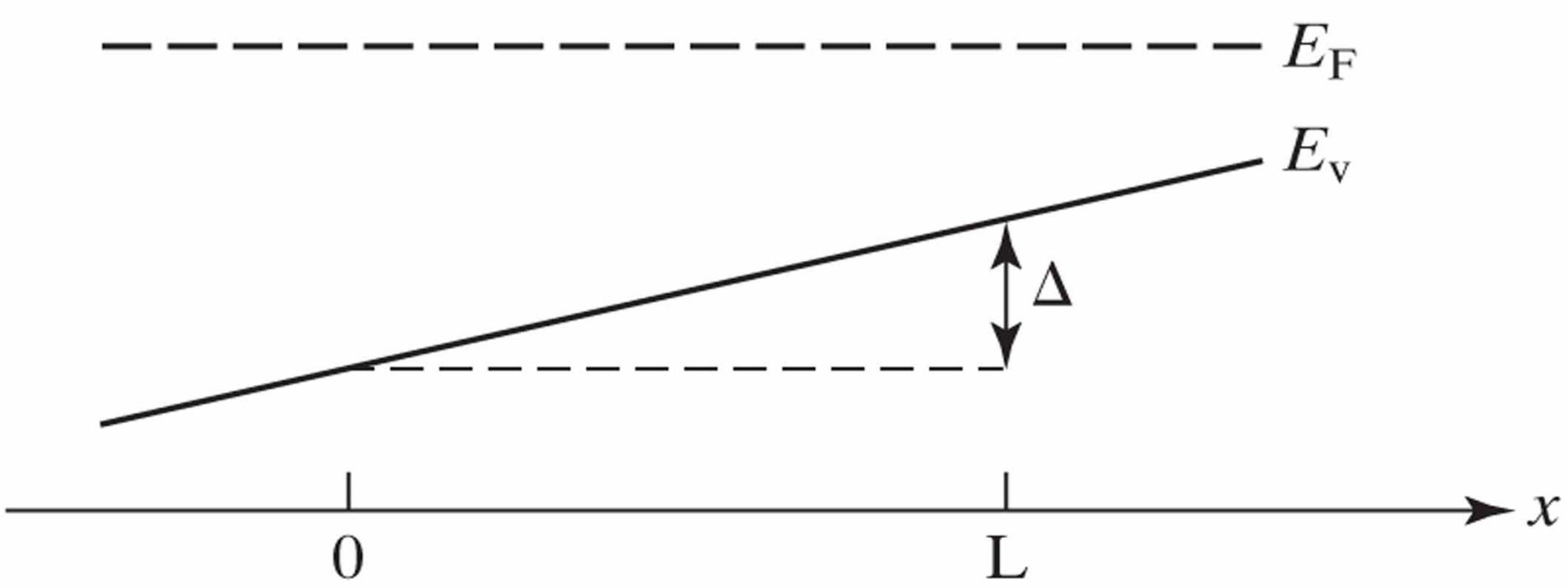


Figure 2.16



Till nästa gång

Schedule and Reading Instructions

The Laboratory session is not scheduled signup will be in Daisy. L=Lecture, S=Student recitation, Sem=Seminar, I=Individually meet a teacher, T=Tentamen,

Activity	Date	Time	Place	Content	Reading Instruction
L1	20/3	10-12	531	Course-PM, Bond model, Energy Band model, Fermi-Dirac distribution function	**Ch. 1.1-1.9, 1.11, 2.1-2.2**
L2	21/3	10-12	533	Energy Band model, n_o and p_o, Drift Current	**Ch. 1.1-1.9, 1.11, 2.1-2.2**
L3	26/3	10-12	533	Diffusion currents Generation/Recombination	**Ch. 2.3-2.9**
S1	27/3	13-15	431	Student recitation 1	**Online S1**
L4	28/3	10-12	533	Process Technology 'Förbered kapitel 3, en tävling med pris kommer att baseras på detta material'	**Ch. 3**