

Table B.2 | Conversion factors

	Prefixes		
1 Å (angstrom) = $10^{-8}$ cm = $10^{-10}$ m	$10^{-15}$	femto-	= f
1 μm (micrometer) = $10^{-4}$ cm	$10^{-12}$	pico-	= p
1 mil = $10^{-3}$ in. = 25.4 μm	$10^{-9}$	nano-	= n
2.54 cm = 1 in.	$10^{-6}$	micro-	= μ
1 eV = $1.6 \times 10^{-19}$ J	$10^{-3}$	milli-	= m
1 J = $10^7$ erg	$10^{+3}$	kilo-	= k
	$10^{+6}$	mega-	= M
	$10^{+9}$	giga-	= G
	$10^{+12}$	tera	= T

Table B.3 | Physical constants

Avogadro's number	$N_A = 6.02 \times 10^{+23}$ atoms per gram molecular weight
Boltzmann's constant	$k = 1.38 \times 10^{-23}$ J/K $= 8.62 \times 10^{-5}$ eV/K
Electronic charge (magnitude)	$e = 1.60 \times 10^{-19}$ C
Free electron rest mass	$m_0 = 9.11 \times 10^{-31}$ kg
Permeability of free space	$\mu_0 = 4\pi \times 10^{-7}$ H/m
Permittivity of free space	$\epsilon_0 = 8.85 \times 10^{-14}$ F/cm $= 8.85 \times 10^{-12}$ F/m
Planck's constant	$h = 6.625 \times 10^{-34}$ J-s $= 4.135 \times 10^{-15}$ eV-s
	$\frac{h}{2\pi} = \hbar = 1.054 \times 10^{-34}$ J-s
Proton rest mass	$M = 1.67 \times 10^{-27}$ kg
Speed of light in vacuum	$c = 2.998 \times 10^{10}$ cm/s
Thermal voltage ( $T = 300$ K)	$V_t = \frac{kT}{e} = 0.0259$ V $kT = 0.0259$ eV

Table B.4 | Silicon, gallium arsenide, and germanium properties ( $T = 300\text{ K}$ )

Property	Si	GaAs	Ge
Atoms ( $\text{cm}^{-3}$ )	$5.0 \times 10^{22}$	$4.42 \times 10^{22}$	$4.42 \times 10^{22}$
Atomic weight	28.09	144.63	72.60
Crystal structure	Diamond	Zincblende	Diamond
Density ( $\text{g/cm}^3$ )	2.33	5.32	5.33
Lattice constant ( $\text{\AA}$ )	5.43	5.65	5.65
Melting point ( $^{\circ}\text{C}$ )	1415	1238	937
Dielectric constant	11.7	13.1	16.0
Bandgap energy (eV)	1.12	1.42	0.66
Electron affinity, $\chi$ (V)	4.01	4.07	4.13
Effective density of states in conduction band, $N_c$ ( $\text{cm}^{-3}$ )	$2.8 \times 10^{19}$	$4.7 \times 10^{17}$	$1.04 \times 10^{19}$
Effective density of states in valence band, $N_v$ ( $\text{cm}^{-3}$ )	$1.04 \times 10^{19}$	$7.0 \times 10^{18}$	$6.0 \times 10^{18}$
Intrinsic carrier concentration ( $\text{cm}^{-3}$ )	$1.5 \times 10^{10}$	$1.8 \times 10^6$	$2.4 \times 10^{13}$
Mobility ( $\text{cm}^2/\text{V-s}$ )			
Electron, $\mu_n$	1350	8500	3900
Hole, $\mu_p$	480	400	1900
Effective mass ( $\frac{m^*}{m_0}$ )			
Electrons	$m_i^* = 0.98$ $m_c^* = 0.19$	0.067	1.64 0.082
Holes	$m_{va}^* = 0.16$ $m_{vb}^* = 0.49$	0.082 0.45	0.044 0.28
Density of states effective mass			
Electrons ( $\frac{m_{dos}^*}{m_0}$ )	1.08	0.067	0.55
Holes ( $\frac{m_{dos}^*}{m_0}$ )	0.56	0.48	0.37
Conductivity effective mass			
Electrons ( $\frac{m_{cn}^*}{m_0}$ )	0.26	0.067	0.12
Holes ( $\frac{m_{cp}^*}{m_0}$ )	0.37	0.34	0.21