De Broglie relations:

$$E = \hbar\omega = hf$$

$$\vec{p} = \hbar\vec{k}, \quad k = 2\pi/\lambda$$

Ionic bonding energy:

$$E_B = \frac{Q^2}{4\pi\varepsilon_0}\frac{\alpha}{r}$$

Volume of a unit cell:

$$V = \vec{a_1} \cdot (\vec{a_2} \times \vec{a_3})$$

Distance of net planes in an orthorhombic system:

$$d_{hkl}^2 = \frac{1}{(h/a)^2 + (k/b)^2 + (l/c)^2}$$

Bragg equation:

$$2d_{hkl}\sin\Theta = n\lambda$$

Structure factor:

$$F_{hkl} = \sum_j f_j e^{2\pi\imath(h\alpha_j + k\beta_j + l\gamma_j)}$$

with

$$\vec{r_j} = \alpha_j\vec{a_1} + \beta_j\vec{a_2} + \gamma_j\vec{a_3}$$

Dispersion relation of lattice vibrations for a two atomic chain ($a = 2d$):

$$\omega_\pm^2(k) = \frac{C(m_1 + m_2)}{m_1 m_2}\left[1 \pm \sqrt{1 - \frac{4m_1 m_2}{(m_1 + m_2)^2}\sin^2(\frac{ka}{2})}\right]$$

ω_+: optical branch
ω_-: acoustic branch

Sound velocity = Group velocity of acoustic phonons at k=0:

$$v_G = \left.\frac{\partial\omega}{\partial k}\right|_{k=0} = d\sqrt{\frac{C}{m}} = \sqrt{\frac{E}{\rho}}$$

Energy of a particle with mass m:

$$E = \frac{p^2}{2m} = \frac{\hbar^2 k^2}{2m}$$

Effective mass of an electron:

$$m_{\text{eff}} = \hbar^2\left(\frac{\partial^2 E}{\partial k^2}\right)^{-1}$$

Fermi energy of a free electron gas:

$$E_F = \frac{\hbar^2}{2m}\left(3\pi^2 n\right)^{2/3}$$

Fermi velocity:

$$v_F = \frac{\hbar}{m}\left(3\pi^2 n\right)^{1/3}$$

Density of states:

$$D(E) = \frac{1}{2\pi^2}\left(\frac{2m}{\hbar^2}\right)^{3/2}\sqrt{E}$$

Boltzmann distribution:

$$F_B = \mathrm{e}^{\frac{E-E_0}{k_B T}}$$

Fermi-Dirac distribution:

$$F_F = \frac{1}{\mathrm{e}^{\frac{E-E_F}{k_B T}}+1}$$

Current density:

$$\vec{j} = \sigma\vec{E}$$

Drift velocity:

$$\vec{v_D} = -\mu\vec{E}$$

Mobility:

$$\mu = \frac{e}{m}\tau$$

Conductivity:

$$\sigma = 1/\rho = ne\mu$$

Relaxation time:

$$\tau = \frac{\sigma m}{ne^2}$$

Electron density in the conduction band of a semiconductor:

$$n(T) = N_C\,\mathrm{e}^{-\frac{E_C-E_F}{k_B T}}$$

Intrinsic electron density in a semiconductor:

$$n_i(T) = \sqrt{N_C N_V}\,\mathrm{e}^{-\frac{E_C-E_V}{2k_B T}} = n_{i0}T^{3/2}\,\mathrm{e}^{-\frac{E_C-E_V}{2k_B T}}$$

$$A_V = 6.02\cdot 10^{23}\ \text{particles/mol}$$

$$c = 3\cdot 10^{8}\ \text{m/s}$$

$$\hbar = h/(2\pi) = 1.0545\cdot 10^{-34}\ \text{Js} = 6.5821\cdot 10^{-16}\ \text{eVs}$$

$$k_B = 1.38\cdot 10^{-23}\ \text{J/K} = 8.614\cdot 10^{-5}\ \text{eV/K}$$

$$\varepsilon_0 = 8.86\cdot 10^{-12}\ \text{C/(Vm)}$$

$$e = 1.602\cdot 10^{-19}\ \text{As}$$

$$m_e = 9.11\cdot 10^{-31}\ \text{kg}$$