1.The Drude Theory of Metals (经典自由电子理论)

In Drude theory, the metal is considered as a gas of electrons, we use the kinetic theory of gases to explain the electrical and thermal conduction.
Assumption:
1. molecules of a gas → identical solid spheres (单电子近似)
2. move in straight lines until collision
3. the time of collision is negligible (弛豫时间近似)
4. only the forces during collision (自由电子近似)
5. motion ~ Newton, distribution ~ Boltzmann (经典近似)
light, mobile elctrons + immobile heavier particle
metallic ions → immobile;
valence electrons → mobile
nuclei → eZ_a;
valence electrons → $-eZ$ → conduction electrons;
remaining (core) electrons → $-e(Z_a - Z)$

1.1 The Only Scale Factor: electron density

$n = \frac{N_A Z \rho_m}{A}$
Here:
n → electron density;
Z → **the number of valence electrons**(Hint: Z is not the atomic number);
ρ_m → mass density;
A → relative atomic mass

1.2 equivalent sphere radius r_s

$\frac{V}{N} = \frac{1}{n} = \frac{4\pi r_s^3}{3}$
We use equivalent sphere radius to describe the electron density.
Also we can use the ratio between equivalent sphere radius and Bohr radius $\left(\frac{4\pi\epsilon_0\hbar^2}{me^2}\right)$ to compare with the bound electron in isolated atom system.