

**Lecture 12: Semiclassical dynamics of electrons, Bloch oscillation and quantization
of orbits in a uniform magnetic field**

The semiclassical equation of motion is derived for a constant electric field and the criterion for the adiabatic approximation described. It is related to the Zener tunnelling in the problem set. The orbits in the presence of a uniform magnetic field is described. Cyclotron resonance is explained with applications to semiconductors. The relation between the orbit in real space and in \vec{k} space is described. The scaling factor involves the important flux quantum $\phi_0 = 2\pi\hbar c/e \approx 4.4 \times 10^{-7}$ gauss \cdot cm². The orbits are quantized using the Bohr-Sommerfeld rule and it is shown that the magnetic flux penetrating the area between successive orbits in real space is the flux quantum ϕ_0 .

Reading: Mardar 16.2, 16.3, 16.5.2, 21.2

Ashcroft and Mermin, p.230