Physics 5491

Condensed Matter Physics I

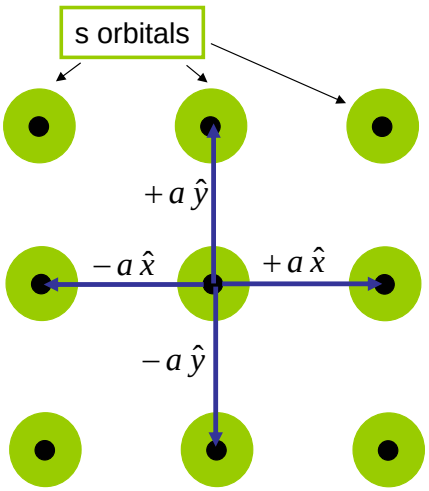
Problem Set 7

Due: Thursday, Oct. 25

7.1 Problem 4, Chapter 9 of A&M, Pg. 172.

7.2 Problem 1, Chapter 10 of A&M, Pg. 189.

7.3 Consider a two-dimensional square lattice of atoms with lattice spacing a.



(a) Show that if we keep only nearest-neighbor tunneling the tight binding s-band for this lattice has energy dispersion

$$\mathcal{E}(\vec{k}) = \mathcal{E}_0 - 2t(\cos(k_x a) + \cos(k_y a)). \tag{1}$$

(b) Sketch the Fermi surface for this band in the first Brillouin zone when the Fermi energy is $\mathcal{E}_F = \mathcal{E}_0$. How many electrons per unit cell does this case correspond to?

(c) Sketch the Fermi surface for $\mathcal{E}_F < \mathcal{E}_0$ and $\mathcal{E}_F > \mathcal{E}_0$. Compare your results with that of the nearly free electron model.