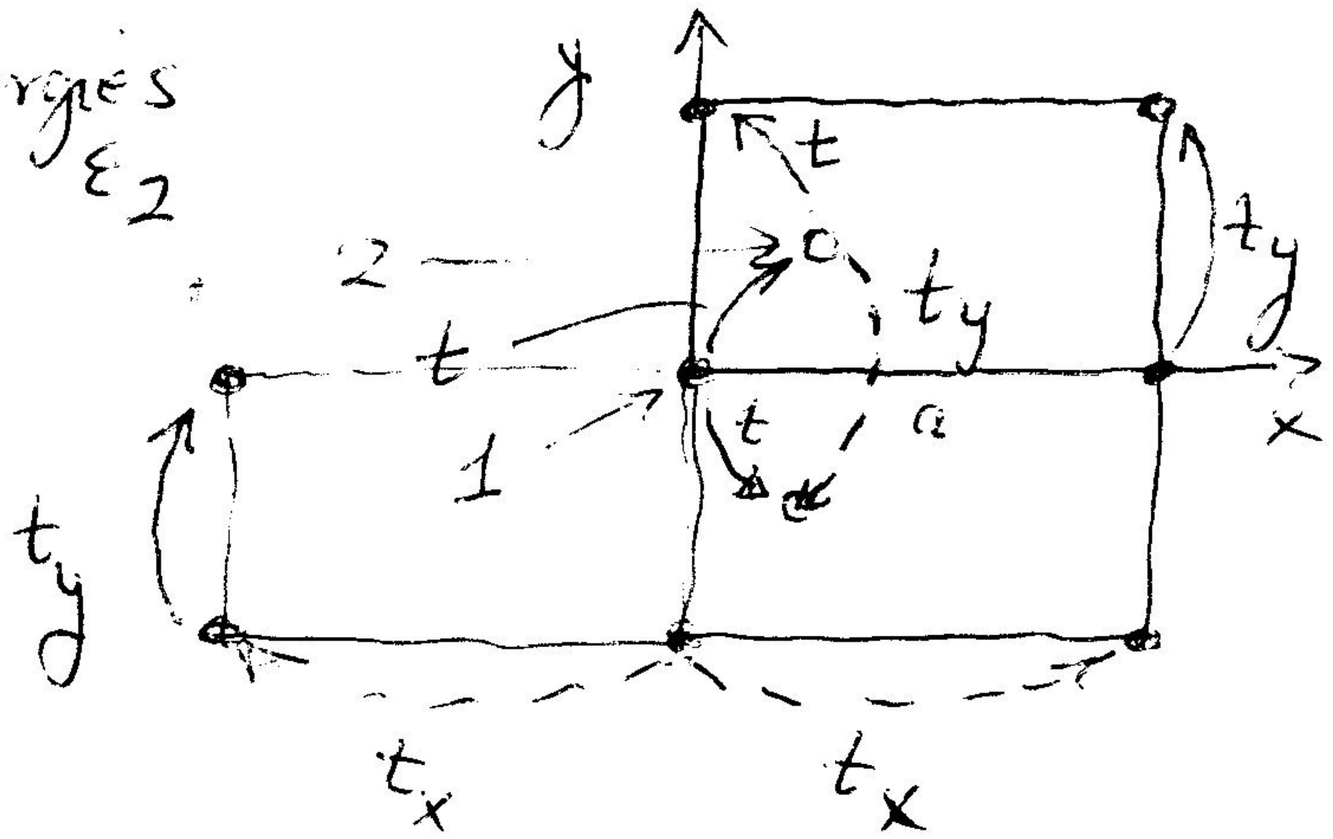
PHY 240A Homework #4 Due Oct 31, 2007

1. Tight Binding: Diatomic Lattice in 2D.

Rectangular lattice a, b.

Site energies $\varepsilon_1, \varepsilon_2$



1-1 hopping t_x along x-direction
1-1 hopping t_y along y-direction
2-2 hopping t_y along y-direction
1-2 hopping t between near neighbor 1-2 pairs.

$\begin{cases} t_x = 1/3 \\ t_y = 1/2 \\ t = 1 \end{cases}$

(a) Construct the TB Hamiltonian matrix $\underset{\approx}{H}(\underset{\sim}{k})$.

(b) Plot the bands along the k_y axis, to $(0, \frac{\pi}{b})$

for $\begin{cases} \varepsilon_1 = \varepsilon_2 = 0 \\ \varepsilon_1 = 4, \varepsilon_2 = -4 \end{cases}$

(c) For $\varepsilon_1 = \varepsilon_2 = 0$, plot the bands along k_x ~~(0,0)~~ $(0,0) \to (\frac{\pi}{a}$

2. For free electrons in two dimensions, calculate the density of states $D(\varepsilon)$. Show all work, and give your units & exactly what $D(\varepsilon)$ is.