(2) of Bandstructure

Fourier transform general form: $x - na \to \vec{r}$ ?

$$\psi(\vec{k}) = \frac{1}{(2\pi)^{3/2}} \int d\vec{r}\, \psi(\vec{r})\, e^{-i\vec{k}\cdot\vec{r}}$$

applied to (1): because

$$\psi_{kl}(x) = \frac{1}{\sqrt{N}} \sum_n e^{ikna}\, \phi_l(x - na)$$

because of result of summation by n

(8) substituting $|\psi_{kl}\rangle$ will change $l \to m$

(14)
$$\langle \psi_{kl} | \hat{H} | \psi_{km} \rangle = \sum_n e^{ikna} \langle \phi(0) | \hat{H} | \phi(na) \rangle \quad \text{from (12)}$$

$$= \underbrace{\sum_n e^{ikna} \left( \varepsilon_s \delta_{n,0} - t\, \delta_{n,\pm 1} \right)}_{A}$$

$$\langle \psi_{kl} | \psi_{km} \rangle = \sum_n e^{ikna} \langle \phi_l(0) | \phi_m(na) \rangle \quad \text{from (11)}$$

$$= \underbrace{\sum_n e^{ikna} \delta_{n,0}}_{B}$$

$$\sum_{kl} \left[ \langle \psi_{km} | \hat{H} | \psi_{kl} \rangle - \varepsilon_k \langle \psi_{km} | \psi_{kl} \rangle \right] c_{kl} = 0 \quad \text{from (7)}$$

$$A = B$$

$$\sum_n e^{ikna} \left( \varepsilon_s \delta_{n,0} - t\, \delta_{n,\pm 1} \right) = \varepsilon_k \sum_n e^{ikna} \delta_{n,0}$$