

Eðlisfræði þéttfnis I

Dæmablað 2

Skilafrestur 13. September 2016 kl. 15:00

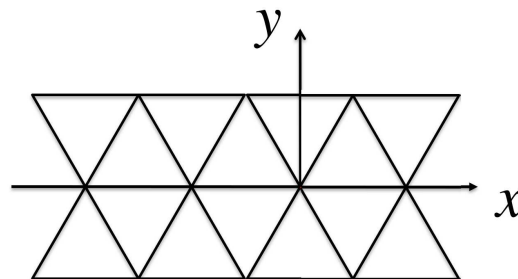
1. Bravais grind – Bravais lattice (10)

Ef gefið er að grunnvigrar grindar séu $\mathbf{a}(a/2)(\mathbf{i} + \mathbf{j})$, $\mathbf{b}(a/2)(\mathbf{j} + \mathbf{k})$, og $\mathbf{c}(a/2)(\mathbf{k} + \mathbf{i})$, þar sem \mathbf{i} , \mathbf{j} og \mathbf{k} eru þessir venjulegu einingavigrar í Kartesíusarhnitum, hver er þá Bravais grindin ?

Given that the primitive basis vectors of a lattice are $\mathbf{a}(a/2)(\mathbf{i} + \mathbf{j})$, $\mathbf{b}(a/2)(\mathbf{j} + \mathbf{k})$, and $\mathbf{c}(a/2)(\mathbf{k} + \mathbf{i})$, where \mathbf{i} , \mathbf{j} and \mathbf{k} are the usual three unit vectors along cartesian coordinates, what is the Bravais lattice ?

(Próf Maí 2016)

2. Two-dimensional triangular lattice – reciprocal lattice (10)



(a) Merkið inn grunngrindareiningu í þessari tvívíðu þríhyrningsgrind. Finnið grunn vigranna.

(b) Finnið grunn vigra nykurgrindarinnar.

(a) Identify the primitive unit cell of a two-dimensional triangular lattice. Find the basis vectors.

(b) Construct the basis vectors of the reciprocal unit cell.

(Próf Maí 2016)

3. Linear ionic crystal (15)

Consider a line of $2N$ ions of alternating charge $\pm q$ with a repulsive potential energy A/R^n between nearest neighbors.

(a) Show that at the equilibrium separation

$$U(R_0) = -\frac{2Nq^2 \ln 2}{4\pi\epsilon_0 R_0} \left(1 - \frac{1}{n}\right)$$

(b) Let the crystal be compressed so that $R_0 \rightarrow R_0(1 - \delta)$. Show that the work done in compressing a unit length of the crystal has the leading term $\frac{1}{2}C\delta^2$, where

$$C = \frac{(n-1)q^2 \ln 2}{4\pi\epsilon_0 R_0}$$

Note that we would not expect to obtain this result from the expression for $U(R_0)$, but we must use the complete expression for $U(R)$.