

## 9. Diffraction

### **Problems**

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9.1. The basis lattice vectors in direct space for a particular crystal are given (in Cartesian coordinates) by:

$$\mathbf{a}_1 = (0.40\hat{\mathbf{x}}) \text{ nm} \quad \mathbf{a}_2 = (0.20\hat{\mathbf{x}} + 0.30\hat{\mathbf{y}}) \text{ nm} \quad \mathbf{a}_3 = (0.60\hat{\mathbf{z}}) \text{ nm}$$

Find the following:

- The volume of the unit cell.
  - The three lattice constants  $a_1$ ,  $a_2$ , and  $a_3$  (in nm) and the three angles  $\alpha_1$ ,  $\alpha_2$ , and  $\alpha_3$  (in  $^\circ$ ) between the basis vectors ( $\mathbf{a}_i \cdot \mathbf{a}_j = a_i a_j \cos \alpha_k$ , for  $i \neq j \neq k \neq i$ ).
  - The reciprocal-lattice basis vectors  $\mathbf{b}_1$ ,  $\mathbf{b}_2$ , and  $\mathbf{b}_3$ .
  - The lengths of the following vectors: i)  $[3\bar{3}1]$  and ii)  $(3\bar{3}1)$  (with appropriate units).
  - The angle between the vectors in d).
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