

3. Space Groups

Problems

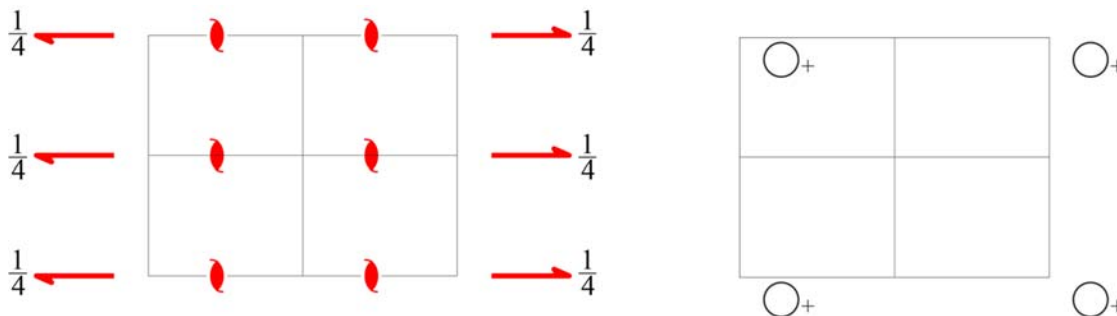
3.1. Each of the diagrams below showing space-group symmetry elements is incomplete.

- Graphically indicate the missing symmetry elements;
- Complete the corresponding general-position diagram.

a)



b)



3.2. The transformation matrix and translation vector associated with a symmetry operation of the type $\rho(X) = \rho(R \cdot X + T)$ are shown. Identify the symmetry operation, including the location of the symmetry element.

a) $R = \begin{pmatrix} -1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & -1 \end{pmatrix}, T = \begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix}$

b) $R = \begin{pmatrix} 1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & 1 \end{pmatrix}, T = \begin{pmatrix} 0 \\ 0 \\ \frac{1}{2} \end{pmatrix}$

c) $R = \begin{pmatrix} -1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & 1 \end{pmatrix}, T = \begin{pmatrix} 0 \\ \frac{1}{2} \\ \frac{1}{2} \end{pmatrix}$

d) $R = \begin{pmatrix} -1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}, T = \begin{pmatrix} \frac{1}{2} \\ \frac{1}{2} \\ 0 \end{pmatrix}$

e) $R = \begin{pmatrix} 1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & 1 \end{pmatrix}, T = \begin{pmatrix} 0 \\ \frac{1}{2} \\ 0 \end{pmatrix}$

f) $R = \begin{pmatrix} 0 & -1 & 0 \\ 1 & 0 & 0 \\ 0 & 0 & 1 \end{pmatrix}, T = \begin{pmatrix} \frac{1}{2} \\ 0 \\ 0 \end{pmatrix}$