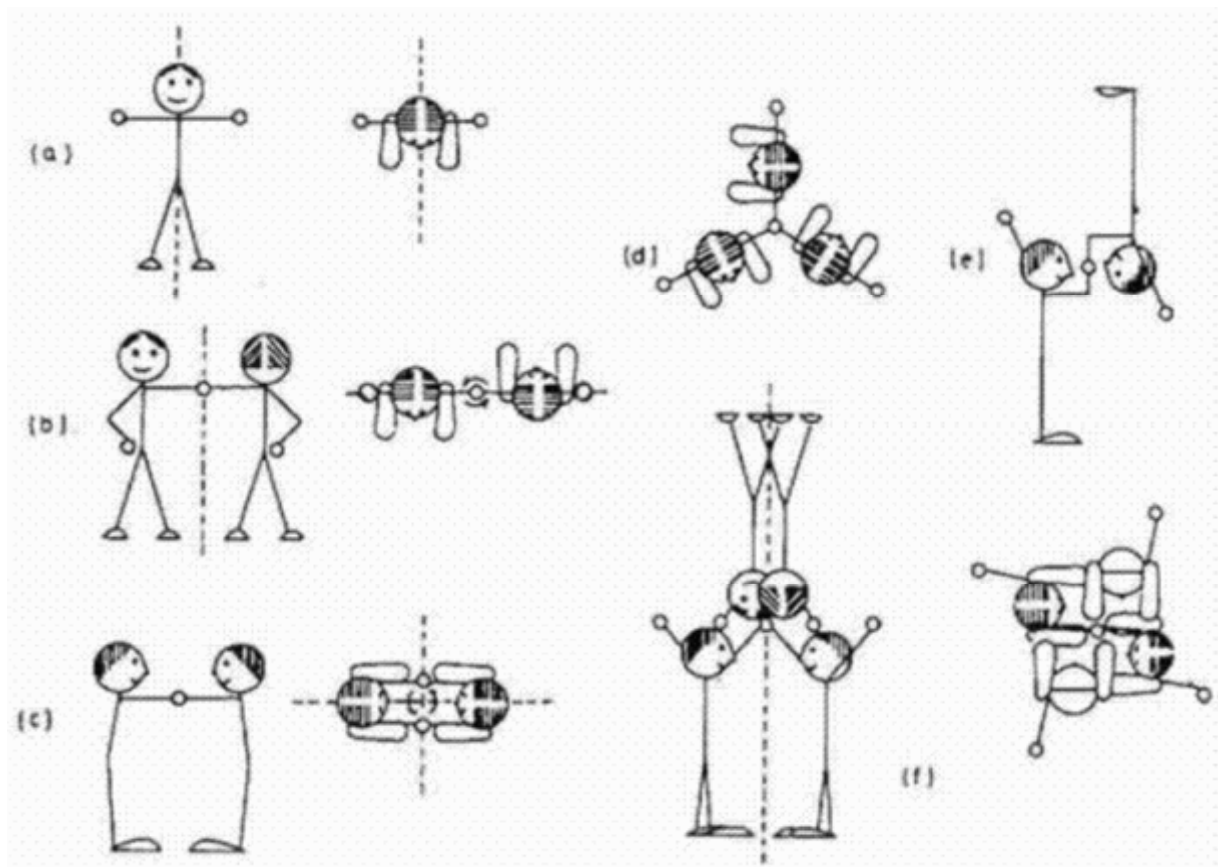## 5. Homework „Symmetry operations".

1. Find the symmetry elements for each of the pictures below:

2. An object has a *2-fold symmetry axis* (matrix *A2*) and an *inversion center* (matrix *A1*).
Prove that this object accepts the *mirror plane*, perpendicular to the rotation axis (matrix *A4*).

$$A_2 = \begin{pmatrix} 1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & -1 \end{pmatrix}, \quad A_1 = \begin{pmatrix} -1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & -1 \end{pmatrix}, \quad A_4 = \begin{pmatrix} -1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}$$

3. Find the matrices of the next transformations:

a) Rotating by 120^0 around the e_3 axis and mirroring in the plane perpendicular to e_1 axis.

b) Rotating by 90^0 around the e_2 axis and followed by inversion.

c) Mirroring in the plane that is parallel to e_2 axis and rotating by 60^0 around the e_1 axis.

d) Rotating by 90^0 around the e_1 axis and followed by rotation by 120^0 around the e_3 axis.

4. Find the transformation matrix describing a *6-fold* rotation *axis* $|| \mathbf{e}_3$. Show that this *6-fold axis* can be obtained by combining a *3-fold axis* and a *2-fold axis*.