Electron Diffraction & Imaging

Assignment No – 2

1. What is the type of Bravais lattice that can be generated from a rectangular 2-d lattice by keeping successive layers in such a way that the lattice points of adjacent layer are at positions that have only 1 - fold symmetry wrt to the present one?
   a) Tetragonal lattice
   b) Triclinic
   c) Hexagonal
   d) Orthorhombic

2. What type of Bravias lattice can be generated from a rectangular 2-d lattice by keeping successive layers such that lattice points of adjacent layer occupy positions above the centre of unit cell of the present layer in the 2-D lattice?
   a) Simple orthorhombic lattice
   b) Body centred orthorhombic lattice
   c) Simple tetragonal lattice
   d) Face centred orthorhombic lattice

3. (x,y,z) is a random point in the coordinate system. After 45º anticlockwise rotation about z axis the (x,y,z) point transferred to (x',y',z'). Choose the transformation matrix for this operation.

a) $\begin{bmatrix} 1/\sqrt{2} & 1/\sqrt{2} & 0 \\ -1/\sqrt{2} & 1/\sqrt{2} & 0 \\ 0 & 0 & 1 \end{bmatrix}$

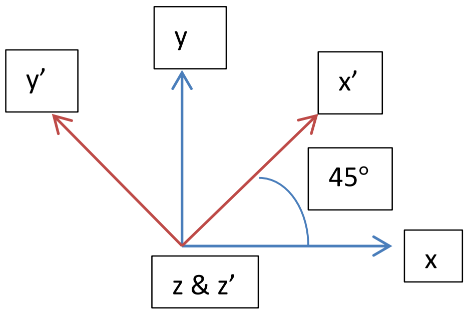
b) $\begin{bmatrix} 1/\sqrt{2} & -1/\sqrt{2} & 0 \\ 1/\sqrt{2} & 1/\sqrt{2} & 0 \\ 0 & 0 & 1 \end{bmatrix}$

c) $\begin{bmatrix} 1/\sqrt{2} & 1/\sqrt{2} & 0 \\ 1/\sqrt{2} & 1/\sqrt{2} & 0 \\ 0 & 0 & 1 \end{bmatrix}$

d $\begin{bmatrix} 1/\sqrt{2} & -1/\sqrt{2} & 0 \\ 1/\sqrt{2} & 1/\sqrt{2} & 0 \\ 0 & 0 & 1 \end{bmatrix}$

Answer: option (a)

$$\boxed{\begin{aligned} x' &= x\cos\alpha_{x'x} + y\cos\beta_{x'y} + z\cos\gamma_{x'z} \\ y' &= x\cos\alpha_{y'x} + y\cos\beta_{y'y} + z\cos\gamma_{y'z} \\ z' &= x\cos\alpha_{z'x} + y\cos\beta_{z'y} + z\cos\gamma_{z'z} \end{aligned}}$$



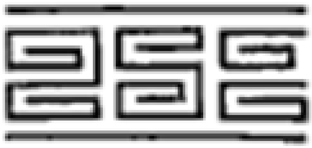
Therefore the transformation matrix can be obtained using above equations,

X' = x cos(45) + ycos(-45) + z cos(90) = x (1/√2) + y(1/√2) +z (0)
y' = x cos(135) + ycos(45) + z cos(90) = x (-1/√2) + y(1/√2) +z (0)
z' = x cos(90) + ycos(90) + z cos(0) = x (0) + y(0) +z (1)

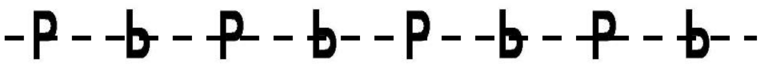
4. Unit cells of Bravais lattice are chosen so that they exhibit
   a) The highest rotational symmetry
   b) Smallest volume
   c) The highest screw axis symmetry
   d) Full symmetry of the lattice

5. The position of a point P(x, y, z) after reflection in mirror if the mirror plane is parallel to **yz** plane
   a) -x, y, z
   b) x, -y, z
   c) x, -y, -z
   d) -x, -y, z

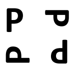
6. Find out the symmetry associated with the given pattern.



   a. P111
   b. P112
   c. P1b1
   d. Pa11

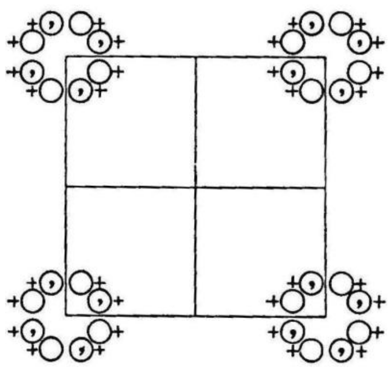
Answer:  Glid p1b1

7. The motif given below has 4 fold symmetry.



If the motif is placed around each lattice point of a crystal having 4mm symmetry at position having 1 fold symmetry, then how many motifs should be placed around each lattice point to satisfy the full symmetry of the crystal?

   a. 2
   b. 8
   c. 4
   d. 6



Answer:  = motif
= mirror image of the motif

8. The rectangular p-lattice has p2mm symmetry. If a motif containing 4mm symmetry is placed on each lattice point, then what is the minimum and the maximum symmetry the crystal can have?
   a. p2mm and p4mm
   b. p2 and p2mm
   c. p4 and p2mm
   d. p2 and p4mm

Answer: The crystal exhibits the symmetry which is common in both the planar lattice and the motif.

9. The maximum symmetry exhibited by 1-d crystal is
   a) p2mg
   b) p2mm
   c) p1b1
   d) p1m2

10. If a motif is kept at a lattice point, the condition for the lattice and the crystal to have the same symmetry is that
   a) motif and the crystal should have the same symmetry
   b) motif should have higher symmetry than the crystal
   c) symmetry axes of motif and the lattice should coincide and motifs and lattice should have the same symmetry elements
   d) none of these