

National Testing Agency

Question Paper Name :	X RAY CRYSTALLOGRAPHY 21st AUGUST 2021 Shift1
Subject Name :	X-RAY Crystallography
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Display Marks:	Yes

X-RAY CRYSTALLOGRAPHY

Group Number :	1
Group Id :	603489118
Group Maximum Duration :	0
Group Minimum Duration :	120
Show Attended Group? :	No
Edit Attended Group? :	No
Break time :	0
Group Marks :	100
Is this Group for Examiner? :	No

X-RAY CRYSTALLOGRAPHY-1

Section Id :	603489176
Section Number :	1
Section type :	Online
Mandatory or Optional :	Mandatory

Number of Questions :	50
Number of Questions to be attempted :	50
Section Marks :	100
Enable Mark as Answered Mark for Review and Clear Response :	Yes
Sub-Section Number :	1
Sub-Section Id :	603489328
Question Shuffling Allowed :	Yes

Question Number : 1 Question Id : 6034898769 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No

Correct Marks : 2 Wrong Marks : 0

From the following list of space groups, which space group can be uniquely determined from the systematic absences?

1. Pnc2
2. Pmma
3. Pbca
4. Pnma

Options :

60348933023. 1
60348933024. 2
60348933025. 3
60348933026. 4

Question Number : 2 Question Id : 6034898770 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No

Correct Marks : 2 Wrong Marks : 0

By the Euler's theorem, in the orthogonal system when two 2 folds are operated along the two vertical axes and when two mirrors are operated perpendicular to each other, the third axis generated by default respectively are

1. 2 fold and 2_1 screw
2. 2 fold and 2 fold
3. mirror and 2fold
4. inversion and mirror

Options :

60348933027. 1

60348933028. 2

60348933029. 3

60348933030. 4

Question Number : 3 Question Id : 6034898771 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No

Correct Marks : 2 Wrong Marks : 0

The lattice type A, B, C, F and I can be determined from which set of reflections?

1. Zonal reflections
2. Axial reflections
3. Hol reflections
4. General reflections

Options :

60348933031. 1

60348933032. 2

60348933033. 3

60348933034. 4

Question Number : 4 Question Id : 6034898772 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No

Correct Marks : 2 Wrong Marks : 0

In the construction of reciprocal lattice using the Bragg's law, what is the radius of Ewald sphere with a source of wavelength λ ?

1. $1/\lambda$
2. $2/\lambda$
3. λ
4. $\lambda/2$

Options :

60348933035. 1

60348933036. 2

60348933037. 3

60348933038. 4

Question Number : 5 Question Id : 6034898773 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No

Correct Marks : 2 Wrong Marks : 0

The smaller the Miller index,

1. The more nearly perpendicular the plane is to the axis
2. The more nearly parallel the plane is to the axis
3. The plane is inclined to another plane
4. None of the above

Options :

60348933039. 1

60348933040. 2

60348933041. 3

60348933042. 4

Question Number : 6 Question Id : 6034898774 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No

Correct Marks : 2 Wrong Marks : 0

Some space groups require the shifting of symmetry elements suitably to satisfy the point group conditions. Taking this into consideration, from the given list of space groups which one does not require shifting of symmetry elements for the point group mmm?

1. Pmmm
2. Pnnn
3. Pbca
4. Pnna

Options :

60348933043. 1

60348933044. 2

60348933045. 3

60348933046. 4

Question Number : 7 Question Id : 6034898775 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No

Correct Marks : 2 Wrong Marks : 0

In the space group Pnc2, the c glide is operated at

1. b/4
2. b/2
3. a/4
4. a/2

Options :

60348933047. 1

60348933048. 2

60348933049. 3

60348933050. 4

Question Number : 8 Question Id : 6034898776 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No

Correct Marks : 2 Wrong Marks : 0

What is the relation between 6_1 and 6_5 screws in the hexagonal system?

1. Different
2. Same in the opposite direction
3. Same
4. None of the above

Options :

60348933051. 1

60348933052. 2

60348933053. 3

60348933054. 4

Question Number : 9 Question Id : 6034898777 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No

Correct Marks : 2 Wrong Marks : 0

Which parameter will be present for the monoclinic system in the Braggs equation in reciprocal lattice?

1. $\cos \gamma^*$
2. $\cos \alpha^*$
3. $\cos \beta^*$
4. No $\alpha^* \gamma^* \beta^*$

Options :

60348933055. 1

60348933056. 2

60348933057. 3

60348933058. 4

Question Number : 10 Question Id : 6034898778 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No

Correct Marks : 2 Wrong Marks : 0

The set of unique inversion centres in triclinic system are

1. 0,0,0 and $1/2, 1/2, 1/2$
2. 000,100
3. 100,001
4. 010,001

Options :

60348933059. 1

60348933060. 2

60348933061. 3

60348933062. 4

Question Number : 11 Question Id : 6034898779 Question Type : MCQ Option Shuffling : No Is

Question Mandatory : No

Correct Marks : 2 Wrong Marks : 0

While operating a n glide perpendicular to a axis, identify the translation generated by a "n" glide perpendicular to a axis

1. $(a+b)/2$
2. $(a+c)/2$
3. $(b+c)/2$
4. $a/4+b/4$

Options :

60348933063. 1

60348933064. 2

60348933065. 3

60348933066. 4

Question Number : 12 Question Id : 6034898780 Question Type : MCQ Option Shuffling : No Is

Question Mandatory : No

Correct Marks : 2 Wrong Marks : 0

The symmetry operation involving a reflection perpendicular to an axis followed by a translation parallel to the plane of reflection is known as a glide operation. To determine the glide symmetry which set of reflection for the systematic absences should be considered?

1. Zonal reflections
2. Axial reflections
3. hol reflections
4. General reflections

Options :

60348933067. 1

60348933068. 2

60348933069. 3

60348933070. 4

Question Number : 13 Question Id : 6034898781 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No

Correct Marks : 2 Wrong Marks : 0

Which is the basic point group for the Monoclinic space group $P2_1$?

1. -1
2. m
3. 2
4. 2/m

Options :

60348933071. 1

60348933072. 2

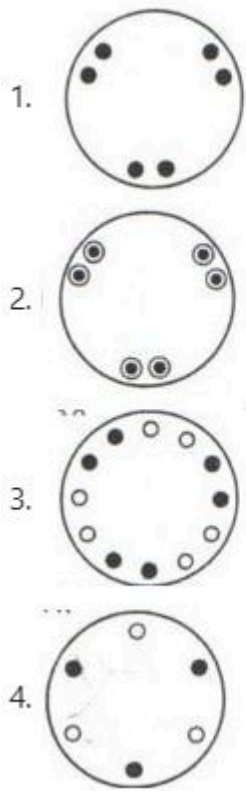
60348933073. 3

60348933074. 4

Question Number : 14 Question Id : 6034898782 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No

Correct Marks : 2 Wrong Marks : 0

Which point group is taken from the trigonal system to the hexagonal system?



Options :

60348933075. 1

60348933076. 2

60348933077. 3

60348933078. 4

Question Number : 15 Question Id : 6034898783 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No

Correct Marks : 2 Wrong Marks : 0

What are the symmetry operations involved in glide symmetry and screw axis?

1. Rotation and Translation
2. Reflection, Rotation and Translation
3. Rotation, Inversion and Translation
4. Reflection and Translation

Options :

60348933079. 1

60348933080. 2

60348933081. 3

60348933082. 4

Question Number : 16 Question Id : 6034898784 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No

Correct Marks : 2 Wrong Marks : 0

The point group $2/m$ belonging to the monoclinic system is

1. Centrosymmetric
2. Non- centrosymmetric
3. Asymmetric
4. Pseudosymmetric

Options :

60348933083. 1

60348933084. 2

60348933085. 3

60348933086. 4

Question Number : 17 Question Id : 6034898785 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No

Correct Marks : 2 Wrong Marks : 0

Symmetry operations involved in point group $3m$ belonging to the trigonal system are

1. 3 fold rotation, inversion
2. Inversion, mirror
3. 3 fold rotation, mirror
4. 3_1 screw and mirror

Options :

60348933087. 1

60348933088. 2

60348933089. 3

60348933090. 4

Question Number : 18 Question Id : 6034898786 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No

Correct Marks : 2 Wrong Marks : 0

The lattice type, screw axis and glide symmetries are determined from the systematic absences conditions. . Following this rule, the screw symmetry is determined from which set of reflections?

1. Zonal reflection
2. Axial reflection
3. hol reflections
4. hkl reflections

Options :

60348933091. 1

60348933092. 2

60348933093. 3

60348933094. 4

Question Number : 19 Question Id : 6034898787 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No

Correct Marks : 2 Wrong Marks : 0

Given the cell dimensions $a = 14.563$, $b = 18.376$, $c = 32.473 \text{ \AA}$ and $\alpha = \beta = \gamma = 90^\circ$ what is the volume of the unit cell?

1. $v = abc$
2. $v = abcsin\beta$
3. $v = 1/v^*$
4. $v = abc \cos\beta$

Options :

60348933095. 1

60348933096. 2

60348933097. 3

60348933098. 4

Question Number : 20 Question Id : 6034898788 Question Type : MCQ Option Shuffling : No Is

Question Mandatory : No

Correct Marks : 2 Wrong Marks : 0

Which set of systematic absent condition will be the same for the spacegroups C2, Cm and C2/m?

1. $hkl: h+k=2n+1$, and $h00: h=2n+1, 0k0: k=2n+1, hk0: h+k=2n+1$
2. $h0l: h=2n+1$ and $h0l: h+l=2n+1$
3. $0kl: k=2n+1$ and $0kl: k+l=2n+1$
4. $hk0: h+k=2n+1$ and $hk0: h=2n+1$

Options :

60348933099. 1

60348933100. 2

60348933101. 3

60348933102. 4

Question Number : 21 Question Id : 6034898789 Question Type : MCQ Option Shuffling : No Is

Question Mandatory : No

Correct Marks : 2 Wrong Marks : 0

In diffraction, while constructing the Ewald sphere and Limiting sphere, What is the sphere constructed using $2/\lambda$ as radius called?

1. Limiting sphere
2. Ewald sphere
3. Atomic sphere
4. Laue sphere

Options :

60348933103. 1

60348933104. 2

60348933105. 3

60348933106. 4

Question Number : 22 Question Id : 6034898790 Question Type : MCQ Option Shuffling : No Is

Question Mandatory : No

Correct Marks : 2 Wrong Marks : 0

In structure solution, in the light atom method for the centrosymmetric space group, what is the phase angle?

1. Zero to 360 deg
2. Zero and 180 deg
3. Can not be determined before solving the structure
4. None of the above

Options :

60348933107. 1

60348933108. 2

60348933109. 3

60348933110. 4

Question Number : 23 Question Id : 6034898791 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No

Correct Marks : 2 Wrong Marks : 0

The a^* b^* c^* and α^* β^* γ^* are called

1. a^* Axis and α^* Angles
2. Reciprocal lattice constants
3. Direct lattice constants
4. $\alpha^* = 1 - \alpha$, $\beta^* = 1 - \beta$, $\gamma^* = 1 - \gamma$

Options :

60348933111. 1

60348933112. 2

60348933113. 3

60348933114. 4

Question Number : 24 Question Id : 6034898792 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No

Correct Marks : 2 Wrong Marks : 0

When the 2_1 screw along b axis is operated in the permitted crystal system involving rotation and translation by $1/2$ unit, what is the transform for x,y,z?

1. $-x, -y, \frac{1}{2} + z$
2. $x, \frac{1}{2} + y, z$
3. $-x, \frac{1}{2} + y, -z$
4. $x, \frac{1}{2} + y, -z$

Options :

60348933115. 1

60348933116. 2

60348933117. 3

60348933118. 4

Question Number : 25 Question Id : 6034898793 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No

Correct Marks : 2 Wrong Marks : 0

When considering the axial, zonal and general reflection, What is the systematic absence condition for a 2_1 screw along c axis?

1. $0k0 : k=2n+1$ absent
2. $h00 : h=2n+1$ absent
3. $hkl : h=2n+1$ absent
4. $00l : l=2n+1$ absent

Options :

60348933119. 1

60348933120. 2

60348933121. 3

60348933122. 4

Question Number : 26 Question Id : 6034898794 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No

Correct Marks : 2 Wrong Marks : 0

Which is the correct systematic absences condition used to determine B centered lattice?

1. $hkl : h+l=2n+1$ absent
2. $hkl : k+l=2n+1$ absent
3. $hkl : h+k+l=2n+1$ absent
4. $hkl : h+k=2n+1$ absent

Options :

60348933123. 1

60348933124. 2

60348933125. 3

60348933126. 4

Question Number : 27 Question Id : 6034898795 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No

Correct Marks : 2 Wrong Marks : 0

In direct methods what is the basic assumption?

1. The atom is considered as equal scatterers and point atoms
2. The atoms are treated as they scatter
3. The heavier the atom larger the scattering
4. All of the above

Options :

60348933127. 1

60348933128. 2

60348933129. 3

60348933130. 4

Question Number : 28 Question Id : 6034898796 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No

Correct Marks : 2 Wrong Marks : 0

Find out the resultant amplitude ' F_r ' and resultant phase angle α_r when five waves with different amplitudes f_1, f_2, f_3, f_4 and f_5 with phase angles $\alpha_1, \alpha_2, \alpha_3, \alpha_4$ and α_5 are superimposed.

1. $|F_r| = \sqrt{x^2 + y^2} = \sqrt{(\sum f_j \cos \alpha_j)^2 + (\sum f_j \sin \alpha_j)^2}, \alpha_r = \tan^{-1}(\sum f_j \sin \alpha_j / \sum f_j \cos \alpha_j)$
2. $|F_r| = (\sum f_j \cos \alpha_j) / (\sum \cos \alpha_j)$
3. $|F_r| = (\sum f_j \cos \alpha_j) / (\sum \sin \alpha_j)$
4. $|F_r| = (\sum f_j)$

Options :

60348933131. 1

60348933132. 2

60348933133. 3

60348933134. 4

Question Number : 29 Question Id : 6034898797 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No

Correct Marks : 2 Wrong Marks : 0

Which pair of symmetry equivalents will give the Harker section for the Monoclinic Space group $P2_1/c$?

1. x, y, z and $x, \frac{1}{2} - y, \frac{1}{2} + z$
2. $-x, -y, -z$ and $-x, \frac{1}{2} + y, \frac{1}{2} - z$
3. x, y, z and $-x, \frac{1}{2} + y, \frac{1}{2} - z$
4. All of the above

Options :

60348933135. 1

60348933136. 2

60348933137. 3

60348933138. 4

Question Number : 30 Question Id : 6034898798 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No

Correct Marks : 2 Wrong Marks : 0

In the structure factor equation, the electron density $\rho(xyz)$ in terms of Fourier synthesis of structure factor, the summation is carried over which?

1. Atomic position, $x\ y\ z$
2. Structure factor f_o
3. Scattering factor
4. hkl

Options :

60348933139. 1

60348933140. 2

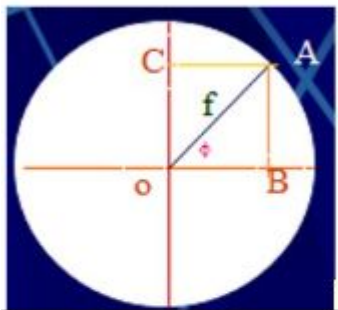
60348933141. 3

60348933142. 4

Question Number : 31 Question Id : 6034898799 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No

Correct Marks : 2 Wrong Marks : 0

The amplitude of the wave in SHM, Which one is correct?



1. $\theta = OC$
2. $f = \sqrt{(OB)^2 + (OC)^2}$
3. $f = AB$
4. $f = OC/OB$

Options :

60348933143. 1

60348933144. 2

60348933145. 3

60348933146. 4

Question Number : 32 Question Id : 6034898800 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No

Correct Marks : 2 Wrong Marks : 0

In powder diffraction, for a hexagonal system, what is the relation between the miller indices and the Bragg angle?

1. Same hkl more than one θ
2. More than one hkl has same θ
3. θ and hkl are not related
4. Intensity depends on hkl

Options :

60348933147. 1

60348933148. 2

60348933149. 3

60348933150. 4

Question Number : 33 Question Id : 6034898801 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No

Correct Marks : 2 Wrong Marks : 0

In Patterson method which is not a Harker section?

1. $\frac{1}{2}$ 0 w
2. 0 v w
3. u 0 w
4. u $\frac{1}{2}$ w

Options :

60348933151. 1

60348933152. 2

60348933153. 3

60348933154. 4

Question Number : 34 Question Id : 6034898802 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No

Correct Marks : 2 Wrong Marks : 0

What does the miller indices 221 mean?

1. $a/2, b/2$, intercept in c at 1
2. Half in a , twice in b , twice in c
3. Twice the intercept in abc
4. Parallel to abc

Options :

60348933155. 1

60348933156. 2

60348933157. 3

60348933158. 4

Question Number : 35 Question Id : 6034898803 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No

Correct Marks : 2 Wrong Marks : 0

Which pair of the following are ambiguous space groups?

1. $Pca2_1$, $Pcam$
2. $Pca2_1$, $Pcc2$
3. $Pna2_1$, $Pna2$
4. All of the above

Options :

60348933159. 1

60348933160. 2

60348933161. 3

60348933162. 4

Question Number : 36 Question Id : 6034898804 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No

Correct Marks : 2 Wrong Marks : 0

The Friedel equivalent for the cubic system, which holds good?

1. $hkl=h0l$
2. $hkl=0kl$
3. $hkl=khl$
4. $hkl=hk0$

Options :

60348933163. 1

60348933164. 2

60348933165. 3

60348933166. 4

Question Number : 37 Question Id : 6034898805 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No

Correct Marks : 2 Wrong Marks : 0

In tetragonal system, How are the reciprocal lattice units a^* b^* c^* related?

1. Orthogonal to each other
2. a^* and b^* are orthogonal
3. a^* b^* are parallel and c^* is orthogonal
4. a^* b^* c^* are coplanar

Options :

60348933167. 1

60348933168. 2

60348933169. 3

60348933170. 4

Question Number : 38 Question Id : 6034898806 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No

Correct Marks : 2 Wrong Marks : 0

What are the permitted Bravais lattice types in monoclinic?

1. P,A,B,C,F,I
2. P,C,F,I
3. P,C,A,B
4. P,C

Options :

60348933171. 1

60348933172. 2

60348933173. 3

60348933174. 4

Question Number : 39 Question Id : 6034898807 Question Type : MCQ Option Shuffling : No Is

Question Mandatory : No

Correct Marks : 2 Wrong Marks : 0

X-rays are have a wavelength of the range

1. $< 0.1 \text{ \AA}$
2. $10 - 100 \text{ \AA}$
3. $0.1 - 10 \text{ \AA}$
4. Micro wave

Options :

60348933175. 1

60348933176. 2

60348933177. 3

60348933178. 4

Question Number : 40 Question Id : 6034898808 Question Type : MCQ Option Shuffling : No Is

Question Mandatory : No

Correct Marks : 2 Wrong Marks : 0

For the space group $P2_1/c$, what kind of interaction will be observed in Patterson map

1. Only Harker vector
2. Only Harker plane
3. Both Harker vector and plane
4. Only inversion

Options :

60348933179. 1

60348933180. 2

60348933181. 3

60348933182. 4

Question Number : 41 Question Id : 6034898809 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No

Correct Marks : 2 Wrong Marks : 0

In electromagnetic spectrum, what is the property of the X-rays?

1. Unaffected by the Electric and Magnetic Fields
2. Carries negative charge
3. Having longer wave length and high energy
4. The wavelength is square of the energy

Options :

60348933183. 1

60348933184. 2

60348933185. 3

60348933186. 4

Question Number : 42 Question Id : 6034898810 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No

Correct Marks : 2 Wrong Marks : 0

In neutron diffraction which is diffracting?

1. The Neutrons
2. The Electrons
3. The Nucleus
4. The atom as a whole

Options :

60348933187. 1

60348933188. 2

60348933189. 3

60348933190. 4

Question Number : 43 Question Id : 6034898811 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No

Correct Marks : 2 Wrong Marks : 0

In cubic system, hkl, klh, lkh reflections are

1. indistinguishable
2. distinguishable
3. does not have same Θ
4. not unique

Options :

60348933191. 1

60348933192. 2

60348933193. 3

60348933194. 4

Question Number : 44 Question Id : 6034898812 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No

Correct Marks : 2 Wrong Marks : 0

The screw axis that does not exist is

1. 3_1
2. 4_1
3. 5_1
4. 6_1

Options :

60348933195. 1

60348933196. 2

60348933197. 3

60348933198. 4

Question Number : 45 Question Id : 6034898813 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No

Correct Marks : 2 Wrong Marks : 0

The Patterson method is used to locate

1. Light atom
2. Heavy atom
3. Medium atom
4. None of the above

Options :

60348933199. 1

60348933200. 2

60348933201. 3

60348933202. 4

Question Number : 46 Question Id : 6034898814 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No

Correct Marks : 2 Wrong Marks : 0

Two parameters are non zeros or $\frac{1}{2}$ and having $U \cdot V, U \cdot W, V \cdot W$ are called

1. Harker section
2. Harker line
3. Harker vector
4. None of the above

Options :

60348933203. 1

60348933204. 2

60348933205. 3

60348933206. 4

Question Number : 47 Question Id : 6034898815 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No

Correct Marks : 2 Wrong Marks : 0

The value of slope in Wilson plot is

1. $-2B$
2. $-B$
3. $2B$
4. $3B$

Options :

60348933207. 1

60348933208. 2

60348933209. 3

60348933210. 4

Question Number : 48 Question Id : 6034898816 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No

Correct Marks : 2 Wrong Marks : 0

Diffraction phenomena is explained using

1. Newton's Corpuscular theory
2. Huygens' wave theory
3. Electromagnetic theory
4. All of the above

Options :

60348933211. 1

60348933212. 2

60348933213. 3

60348933214. 4

Question Number : 49 Question Id : 6034898817 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No

Correct Marks : 2 Wrong Marks : 0

The reflections $h\ 0\ 0$, $0\ k\ 0$, $0\ 0\ l$ are called

1. Pinacoidal reflections
2. Zonal reflections
3. General reflections
4. Special reflections

Options :

60348933215. 1

60348933216. 2

60348933217. 3

60348933218. 4

Sub-Section Number : 2

Sub-Section Id : 603489329

Question Shuffling Allowed : Yes

Question Number : 50 Question Id : 6034898818 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No

Correct Marks : 2 Wrong Marks : 0

F centered lattice cannot be determined by systematic absences

1. True
2. False

Options :

60348933219. 1

60348933220. 2