

2024-2007

GATE PYQ

Mineralogy



SP Geology

ADOPT IMPROVISE OVERCOME

2024

- Which one or more of the following minerals shows O: Si ratio of 4:1 in its silicate structure?
 - Olivine
 - Quartz
 - Diopside
 - Albite
- Match the minerals in Group-I with the corresponding cleavage types in Group-II.

Group-I		Group-II	
P.	Diopside	1.	Cubic
Q.	Galena	2.	Octahedral
R.	Calcite	3.	Prismatic
S.	Fluorite	4.	Rhombohedral

- P-3, Q-2, R-4, S-1
- P-4, Q-3, R-1, S-2
- P-3, Q-1, R-4, S-2
- P-4, Q-1, R-2, S-3

2023

- Which one of the following mineral pairs shows solid solubility through coupled substitution of elements?
 - Albite - Anorthite
 - Albite - Orthoclase
 - Grossular - Andradite
 - Jadeite - Aegirine
- Rhodocrosite in hand specimen is most likely to be confused with certain varieties of
 - Wollastonite
 - Orthoclase
 - Gypsum
 - Biotite
- Which of the following is NOT an essential property of a mineral?
 - Natural occurrence
 - Regular internal structure
 - Fixed composition
 - Solid state
- The number of lattice points in a face-centred cubic unit cell is
 - 1
 - 2
 - 3
 - 4

5. All the faces of an octahedron can be collectively symbolized by
 - A. 111
 - B. [111]
 - C. (111)
 - D. {111}
6. The total number of symmetry elements in the crystal class represented by the point group $4/m\bar{3}2/m$ is
 - A. 21
 - B. 22
 - C. 23
 - D. 24
7. The ratio of bridging to non-bridging oxygen atoms in the amphibole structure is
 - A. 4:11
 - B. 5:6
 - C. 2:7
 - D. 1:2
8. The minimum anion-to-cation radius ratio at which a 3-fold coordination becomes possible is _____. [*round off to 2 decimal places*]
9. The mole fraction of jadeite in the pyroxene of composition $(\text{Ca}_{0.667} \text{Na}_{0.333} \text{Fe}^{2+}_{0.121} \text{Fe}^{3+}_{0.125} \text{Mg}_{0.546} \text{Al}_{0.208}) \text{Si}_2\text{O}_6$ is _____. [*round off to 3 decimal places*]

2022

1. The intercepts of a crystal face on the crystallographic axes are ∞a , $2b$, $3c$. Which one of the following is its Miller Index?
 - A. (032)
 - B. (023)
 - C. (203)
 - D. (320)
2. A mineral of uniform composition is cut into a wedge shape. The birefringence of the wedge section is 0.012. The retardation at $40 \mu\text{m}$ thickness of the wedge is _____ nm. [*in integer*]
3. Which among the following space groups is/are non-compatible with glide plane?
 - A. $\text{Pab}2_1$
 - B. Pnma
 - C. $\text{P}6_3/\text{c}$
 - D. $\text{P}3\bar{1}\text{c}$

2021

1. Light passes through two media with refractive indices of 1.75 and 1.55, respectively. The thickness of both the media is $30 \mu\text{m}$. The resultant path difference of the yellow light component ($\lambda = 589 \text{ nm}$) is (Take $\pi = 3.141$) [*round off to one decimal place*].

- The symmetry elements of a point group are: 3 crystallographic axes of 2- fold symmetry and 3 mirror planes perpendicular to the crystallographic axes. The Hermann - Mauguin notation of the point group is
 - 2m2m2m
 - 2mm
 - 2/m2/m2/m
 - 2/m
- The mole percentages Of SiO₂, Al₂O₃ and K₂O in a granitic rock are 84.21, 7.89 and 7.89, respectively. The molar proportion (in of K-feldspar in the rock is _____ . [round off to one decimal place]

2020

- Which of the following is NOT a point group?
 - 222
 - 422
 - 432
 - 632
- The ratio of bridging to non-bridging oxygen atoms is zero in case of _____
 - Nesosilicate
 - Inosilicate
 - Phyllosilicate
 - Tectosilicate
- Point group in crystallography is characterized by a set of symmetry operations such that
 - All point in crystal is affected by it
 - No point in a crystal is affected by it
 - At least one point in a crystal is affected by it
 - At least one point in crystal is unaffected by it
- What are the miller indices of a plane that intercepts each of the crystallographic axis X, Y and Z at 20A⁰ ? (Assume a primitive unit cell with cell dimension a=5 A⁰ b=2 A⁰ and c=4 A⁰)
 - (111)
 - (524)
 - (425)
 - (542)
- The unit-cell of an orthorhombic mineral was compressed during deformation from 5 Å to 4.5 Å along the c-axis, with the other two dimensions remaining unaffected. The absolute value of the shift in the position of the (001) peak in its XRD pattern is _____⁰2θ. (Round off to 3 decimal places) (Wavelength of X-ray used = 1.5418 Å. For orthorhombic system: $1/d^2 = h^2/a^2 + k^2/b^2 + l^2/c^2$.)

2019

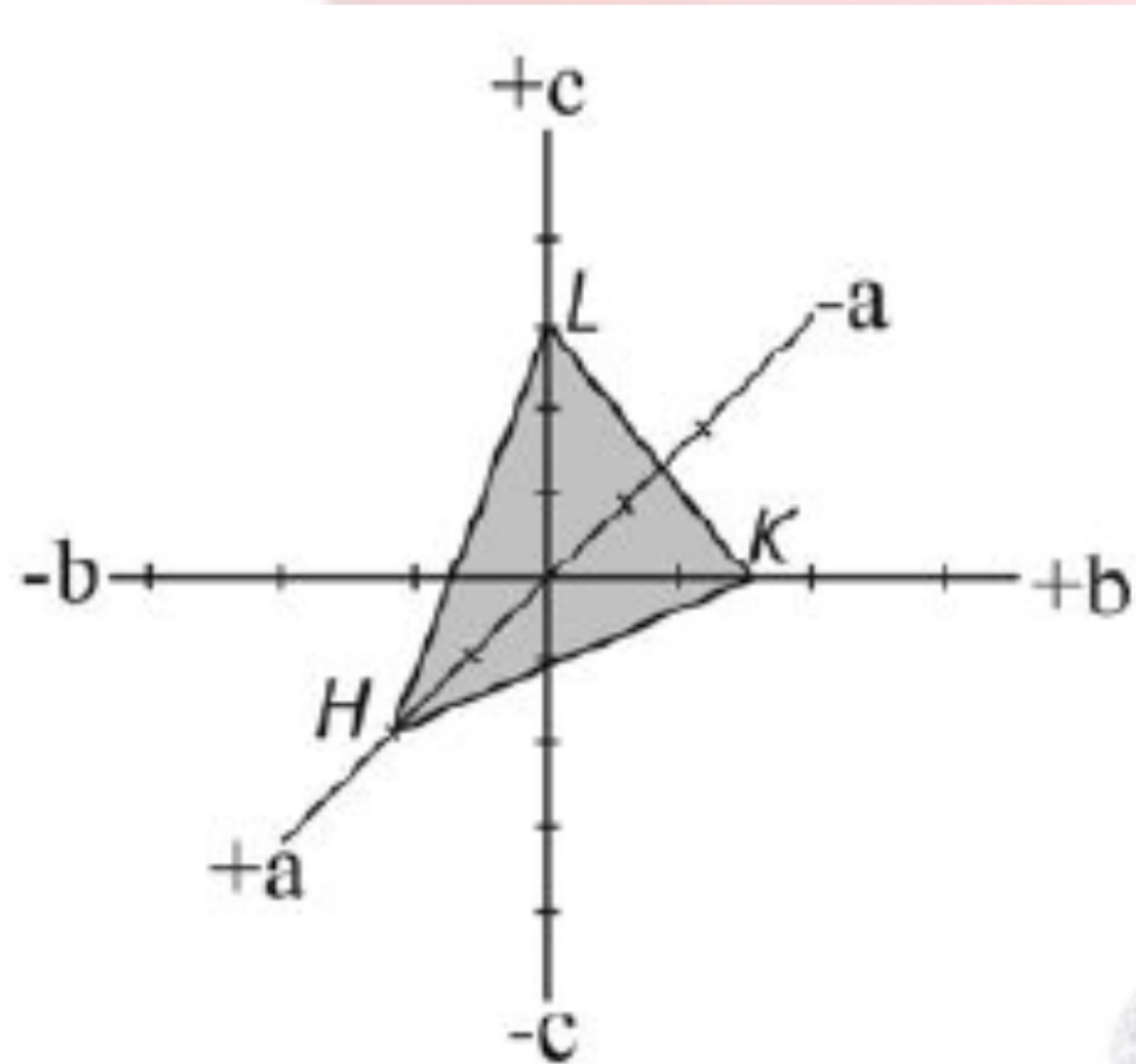
- Which of the following clay minerals contain potassium(K)
 - Illite
 - Kaolinite
 - Montmorillonite
 - Vermiculite

2018

2. The difference in the number of faces in forms $\{hkl\}$ and $\{111\}$ in the holosymmetric class of the isometric system is _____.

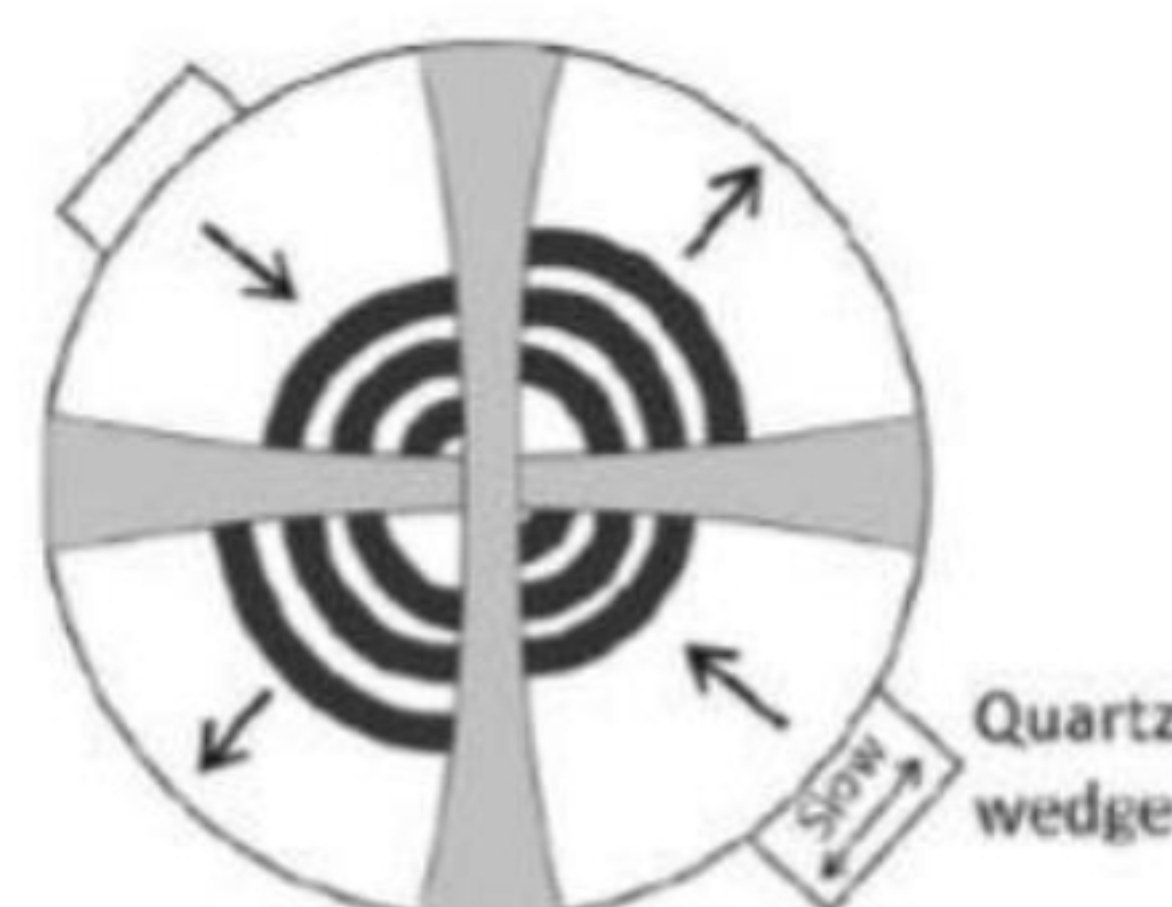
2017

1. Brightness temperature is a function of surface temperature
- Transmittance
 - Reflectance
 - Refractive index
 - Emissivity
2. Which of the following minerals has poor cleavage in all directions?
- Fluorite
 - Orthoclase
 - Quartz
 - Muscovite
3. The figure below shows the intercepts of the plane HKL with crystallographic axes a, b, c. The Miller index of the plane HKL is



- (243)
 - (342)
 - (436)
 - (634)
4. Fluorite crystal (CaF_2) adopts face-centered cubic structure with lattice parameter $a = 5.463 \text{ \AA}$. If the ionic radius of anion (F) is 1.71 \AA , the ionic radius of cation (Ca) is
5. The diagram below shows the interference figure of a mineral. The mineral is

- uniaxial positive.
- biaxial negative.
- uniaxial negative.
- biaxial positive



2016

1. Match the crystal forms (listed in Group I) with their corresponding number of faces (listed in Group II).

Group I	Group II
P. Cube	1. Two
Q. Tetrahedron	2. Four
R. Pinacoid	3. Six
S. Dodecahedron	4. Twelve

- a. P-4; Q-2; R-3; S-1
- b. P-3; Q-2; R-1; S-4
- c. P-3; Q-4; R-1; S-2
- d. P-1; Q-3; R-4; S-2

2. Which one of the following statements is CORRECT in all respects for the amphibole glaucophane, $\text{Na}_2\text{Mg}_3\text{Al}_2\text{Si}_8\text{O}_{22}(\text{OH})_2$?

- a. Na is in the M4-site, Al is in octahedral coordination and Si is in tetrahedral coordination.
- b. Na is in the A-site, both Al and Si are in tetrahedral coordination.
- c. Na is in the M4-site, Al is partly in octahedral and partly in tetrahedral coordination, Si is in tetrahedral coordination.
- d. Na is in the A-site, both Al and Si are in octahedral coordination.

3. Out of the following symmetry elements, which one is present in all classes of the cubic system?

- a. Four axes of 3-fold symmetry
- b. Three axes of 4-fold symmetry
- c. Six axes of 2-fold symmetry
- d. Three mirror planes

4. Match the minerals in Group-I with their optical properties in Group-I

Group I	Group II
P. Calcite	1. Uniaxial negative, low birefringence, high relief
Q. Nepheline	2. Uniaxial negative, high birefringence, moderately high relief
R. Apatite	3. Uniaxial positive, low birefringence, low relief
S. Quartz	4. Uniaxial negative, low birefringence, low relief

- a. P-4; Q-2; R-1; S-3
- b. P-3; Q-2; R-4; S-1
- c. P-2; Q-4; R-1; S-3
- d. P-1; Q-3; R-2; S-4

5. The ionic strength of a solution having 0.5 molal NaCl and 0.25 molal CaCl_2 is _____ molal

6. Which one of the following options is arranged in the CORRECT increasing order of Vicker's micro-hardness?

- a. galena < chalcopyrite < sphalerite < magnetite
- b. sphalerite < galena < magnetite < chalcopyrite
- c. galena < magnetite < chalcopyrite < sphalerite
- d. sphalerite < magnetite < chalcopyrite < galena

2015

1. In Triclinic crystal system, the three crystallographic axes a, b, c are of
 - a. equal lengths with angle between b and c as 90°
 - b. equal lengths with angle between a and c $\neq 90^\circ$
 - c. unequal lengths with angle between a and c $\neq 90^\circ$
 - d. unequal lengths with angle between b and c as 90°

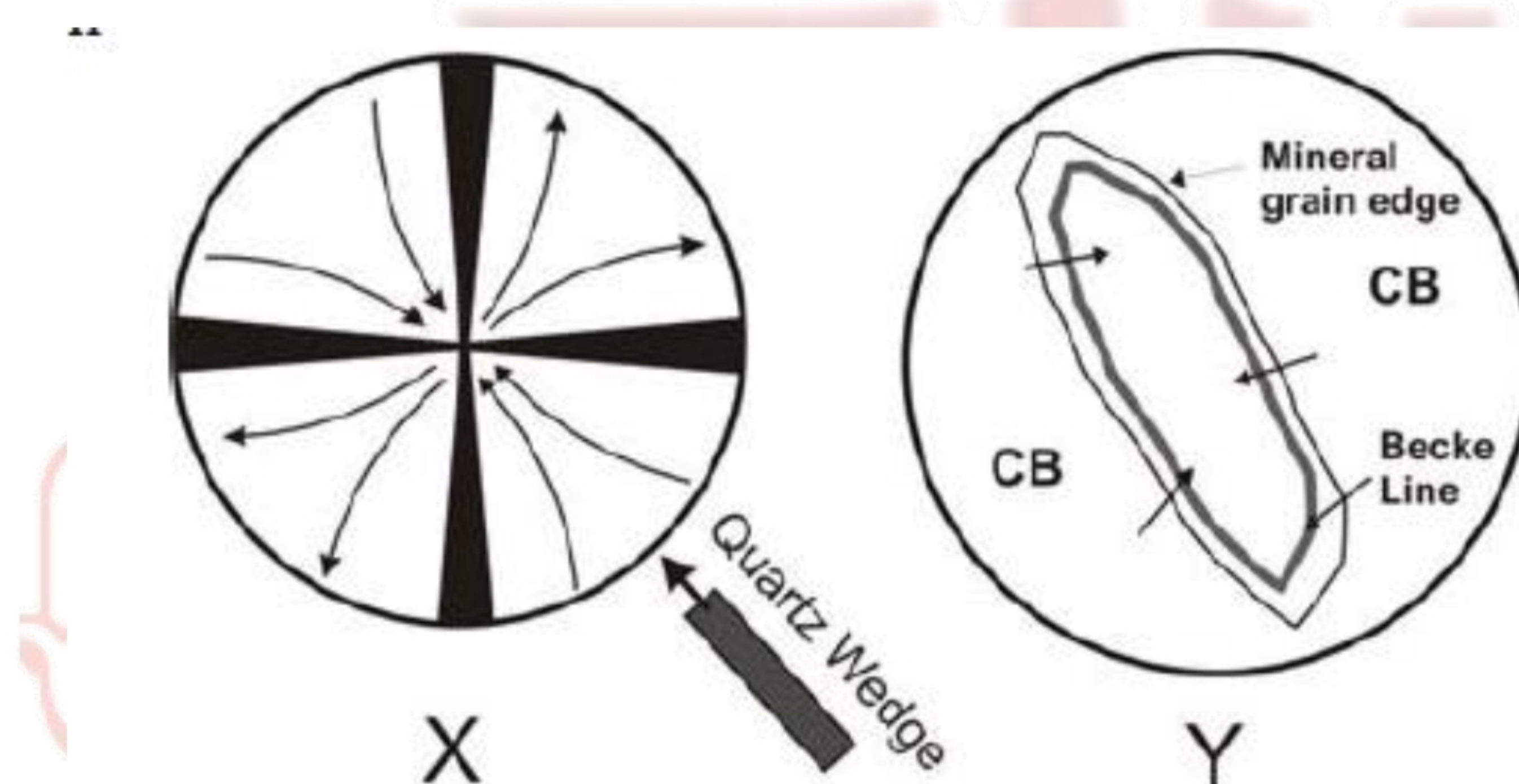
2. Which one of the following is NOT a set of polymorphous minerals?
 - a. calcite, aragonite, vaterite
 - b. quartz, coesite, tridymite
 - c. graphite, anthracite, diamond
 - d. kyanite, sillimanite, andalusite

3. Match the point group (HM symbol) in Group I with its corresponding general form in Group II

Group I	Group II
P. $\bar{6}2m$	1. Ditrigonal Dipyramid
Q. $3/m$	2. Tetragonal Scalenohedron
R. 422	3. Trigonal Dipyramid
S. $\bar{4}2m$	4. Tetragonal Trapezohedron
	5. Hexagonal Dipyramid

- a. P-5; Q-1; R-2; S-4
- b. P-1; Q-3; R-4; S-2
- c. P-1; Q-3; R-2; S-5
- d. P-3; Q-5; R-2; S-4

4. Identify the CORRECT pair of minerals both of which show optical properties as shown in figures X (optic axis figure) and Y (with increasing free working distance between objective and stage). CB – Canada Balsam



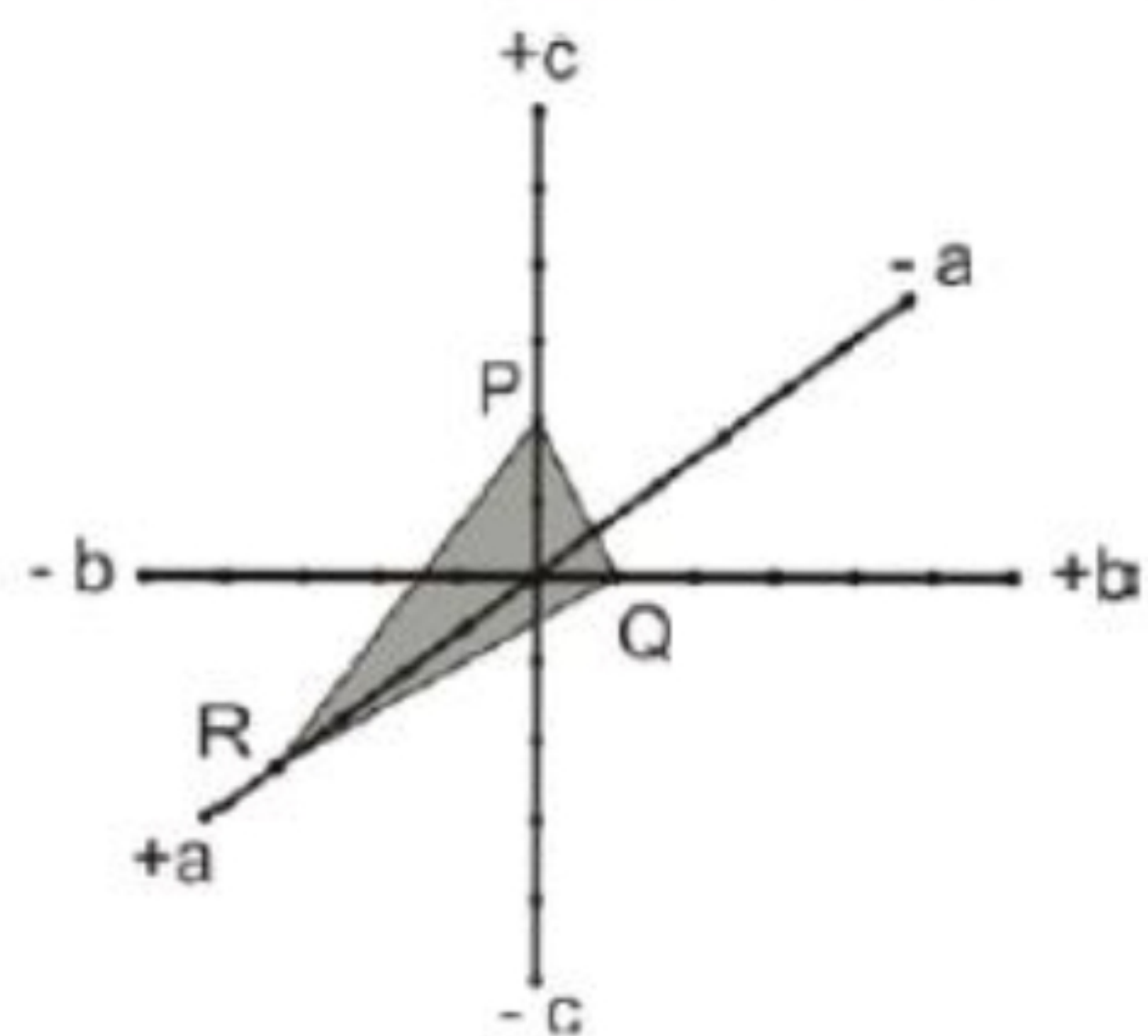
- a. Quartz, Stishovite
- b. Cordierite, Chlorite
- c. Apatite, Tourmaline
- d. Nosean, Halite

2014

1. Match the mineral habits (listed in Group I) with the minerals (listed in Group II)

Group I	Group II
(P) Acicular	(1) Kyanite
(Q) Fibrous	(2) Beryl
(R) Bladed	(3) Sillimanite
(S) Columnar	(4) Chrysotile
	(5) Olivine

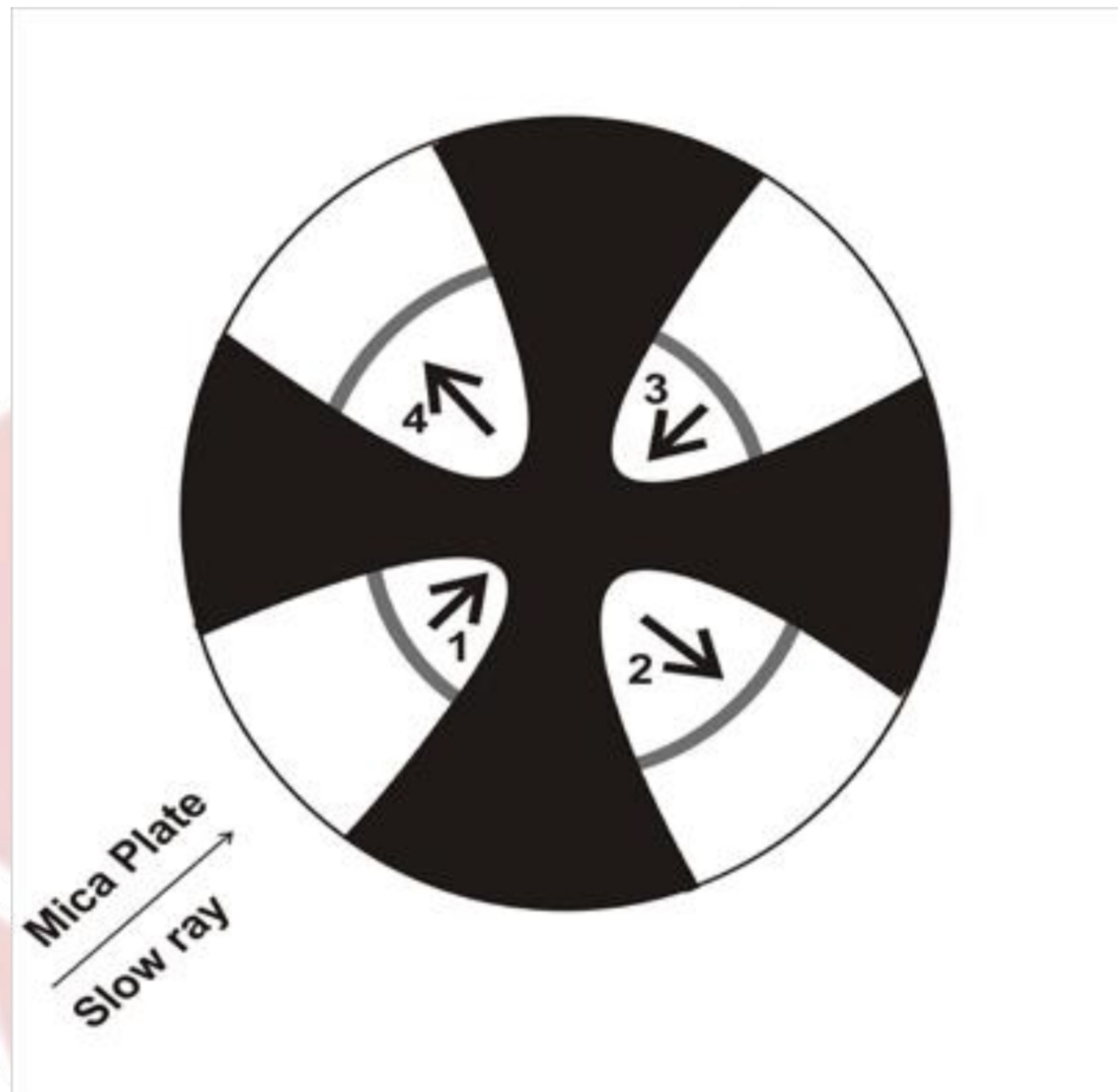
- a. P-3; Q-2; R-5; S-1
 - b. P-4; Q-5; R-1; S-2
 - c. P-2; Q-3; R-4; S-1
 - d. P-3; Q-4; R-1; S-2
2. Which one of the following represents a closed crystallographic form?
- a. Hexagonal prism
 - b. Hexagonal dipyramid
 - c. Tetragonal pyramid
 - d. Ditetragonal prism
3. In the figure given below a, b and c are the crystallographic axes of a crystal. The Miller Index of the crystal face PQR is:



- a. (421)
 - b. (124)
 - c. (142)
 - d. (214)
4. Match the items in Group I with those in Group II

Group I	Group II
(P) Interference colour	(1) Property of a single grain seen under microscope in polarized light
(Q) Twinkling	(2) Property of a single grain seen under microscope under crossed Nicol's
(R) Pleochroism	(3) Property seen when several grains are viewed collectively under microscope in polarized light
(S) Play of colours	4. Property of a mineral seen in hand specimen

- a. P-2; Q-3; R-1; S-4
 - b. P-2; Q-3; R-4; S-1
 - c. P-3; Q-4; R-1; S-2
 - d. P-1; Q-4; R-2; S-3
5. The uniaxial interference figure of a mineral given below shows the changes in the position of color bands when a mica plate is inserted in the accessory slot of the microscope as shown. The changes in the interference figure are due to



- a. increase in retardation along the quadrants 1 and 3
- b. increase in retardation along the quadrants 2 and 4
- c. decrease in retardation along the quadrants 1 and 3
- d. increase in retardation in all quadrants

2013

1. The number of hydrous minerals in the Moh's scale of hardness is _____
2. Match the minerals in Group I with its corresponding industrial application in Group II.

Group I	Group II
P. Kaolinite	1. Pigment
Q. Rutile	2. Asbestos
R. Graphite	3. Cement
S. Serpentine	4. Lubricant
	5. Abrasive

- a. P-1, Q-3, R-4, S-2
- b. P-3, Q-1, R-2, S-4
- c. P-3, Q-1, R-4, S-3
- d. P-1, Q-5, R-3, S-2

3. Match the Hermann-Mauguin symbol in Group I with its corresponding general form in Group II.

Group I	Group II
P. $6/m$	1. Trigonal Dipyramid
Q. $3m$	2. Ditrigonal Dipyramid
R. $\bar{6}m2$	3. Dihexagonal Pyramid
S. $\bar{6}$	4. Ditrigonal Pyramid
	5. Hexagonal dipyramid

- a. P-5, Q-4, R-2, S-1
- b. P-5, Q-4, R-1, S-2
- c. P-5, Q-4, R-1, S-3
- d. P-3, Q-4, R-2, S-1

4. Match the mineral habits (listed in Group I) with the minerals (listed in Group II)

Group I	Group II
(P) Acicular	(1) Kyanite
(Q) Fibrous	(2) Beryl
(R) Bladed	(3) Sillimanite
(S) Columnar	(4) Chrysotile
	(5) Olivine

- a. P-3; Q-2; R-5; S-1
- b. P-4; Q-5; R-1; S-2
- c. P-2; Q-3; R-4; S-1
- d. P-3; Q-4; R-1; S-2

5. Choose the diamagnetic mineral from the following

- a. Calcite
- b. Enstatite
- c. Pyrite
- d. Ilmenite

2012

1. In Moh's scale hardness, how many minerals are of silicate composition?

- a. 4
- b. 5
- c. 6
- d. 7

2. Which of the following is not a variety of silica?

- a. Jasper
- b. Coesite
- c. Stishovite
- d. Flinkite

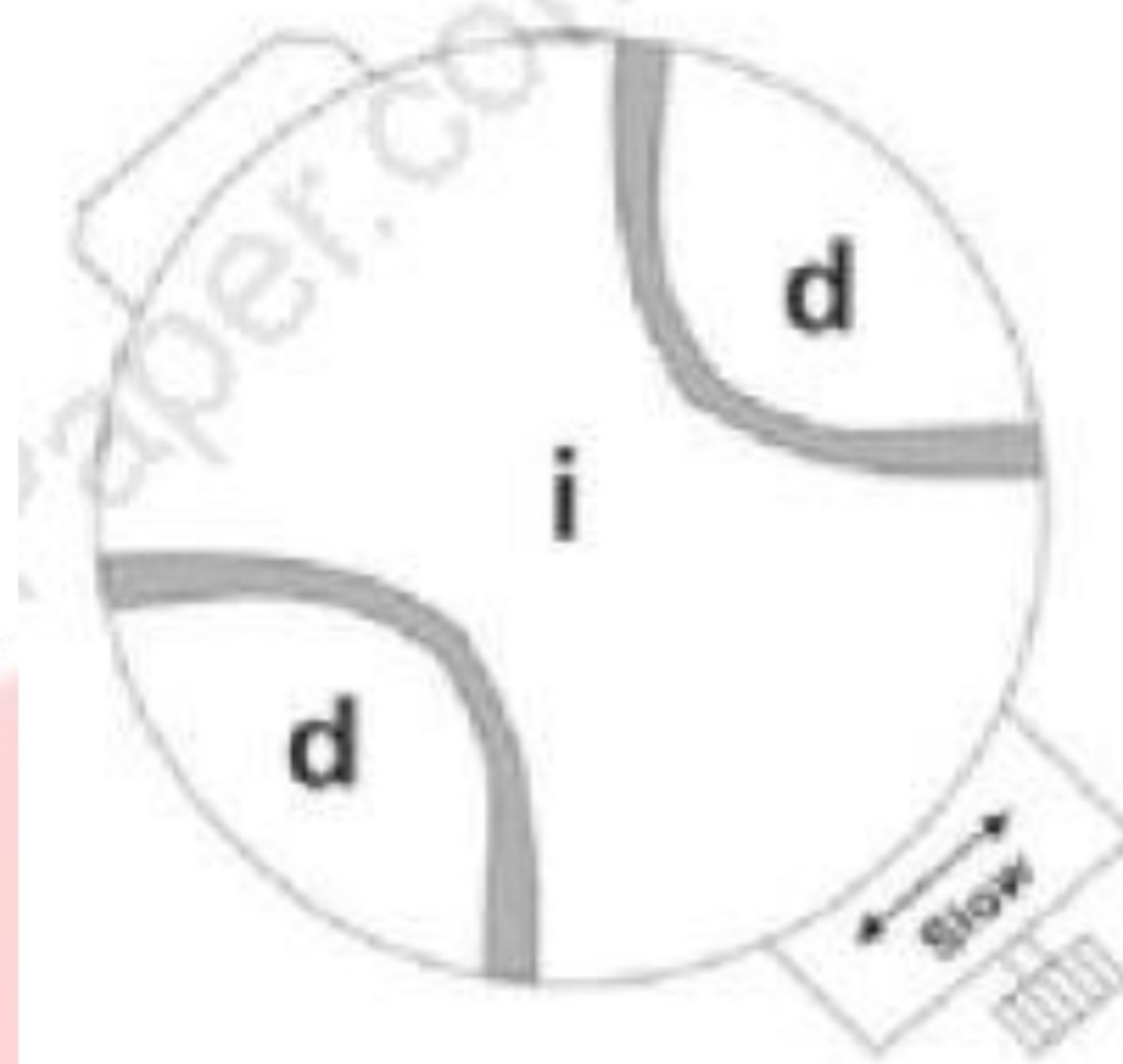
3. Which one of the following mineral constituents exhibits strong absorption in the UV-blue band of the EM spectrum due to charge transfer effect leading to colouration?
 - a. Fe-O
 - b. Si-O
 - c. Al-OH
 - d. Mg-OH
4. An analysis of augite yields 3 silicon atoms calculated on the basis of 12 oxygen atoms. If only Al replaces Si, calculate the number tetrahedral-Al in the mineral
 - a. 1
 - b. 2
 - c. 3
 - d. 4
5. In which of the following crystal systems, the characteristic symmetry elements "a two-fold axis of rotation and at least two planes of symmetry" are possible?
 - a. Tetragonal
 - b. Hexagonal
 - c. Orthorhombic
 - d. Monoclinic
6. Determine the correctness or otherwise of the following Assertion [a] and reason [r]
Assertion: Biaxial minerals can be pleochroic in three shades
Reason: Biaxial minerals have three refractive indices.
 - a. Both [a] and [r] are true and [r] is the correct reason for [a]
 - b. [a] is true but [r] is false
 - c. [a] is false but [r] is true
 - d. Both [a] and [r] are true but [r] is not the correct reason for [a]

2011

1. The hardest oxide mineral in the Moh's scale hardness is
 - a. Corundum
 - b. Topaz
 - c. Quartz
 - d. Diamond
2. Choose the correct sets of crystal faces for which c crystallography axis is the zone axis
 - a. (100), (001), ($\bar{1}00$)
 - b. (010), (001), ($0\bar{1}0$)
 - c. (010), ($\bar{1}10$), ($\bar{1}00$)
 - d. (110), (001), ($\bar{1}\bar{1}0$)
3. The twin plane in the Manebach law is
 - a. (010)
 - b. (001)
 - c. (100)

d. (021)

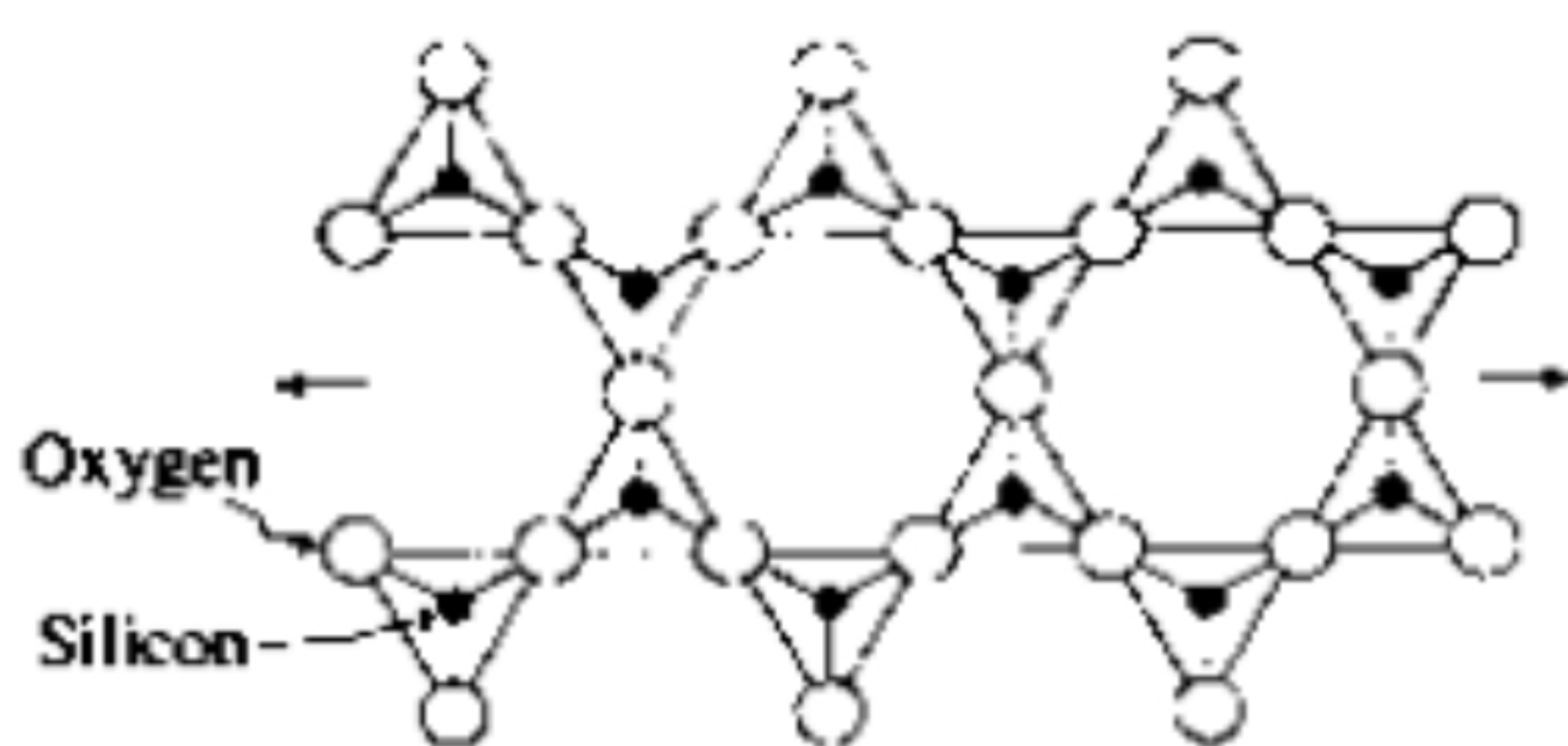
4. The figure below shows the pattern of increase (i) and decrease (d) in the interference colors of a mineral after intersection of mica plate. The optic sign of the mineral is



- a. Uniaxial Positive
 - b. Uniaxial negative
 - c. Biaxial positive
 - d. Biaxial negative
5. Which of the following is TRUE for the coordination number (n) of aluminium?
- a. n=4 in both plagioclase and garnet
 - b. n=6 in both plagioclase and garnet
 - c. n=4 in plagioclase and n=6 in garnet
 - d. n=6 in plagioclase and n=4 in garnet

2010

1. Silicon to oxygen ratio in the following silicate structure is



- a. 1:2
 - b. 2:5
 - c. 4:11
 - d. 1:3
2. Match the optical properties in Group I with appropriate minerals in Group II

Group I	Group II
P. Twinkling	1. Quartz
Q. Pleochroic haloes	2. Nepheline
R. Anomalous interference colour	3. Calcite
S. Uniaxial positive	4. Chlorite
	5. Biotite

- a. P-4. Q-5, R-3. S-2
- b. P 3, Q-4. R-5. S-2
- c. P 3. Q-5. R-4. S-1
- d. P-3, Q-4, R-5, S-1

3. Match the gemstones in Group I with corresponding minerals in Group II.

Group I	Group II
P. Peridot	1. Beryl
Q. Emerald	2. Feldspar
R. Amazonite	3. Corundum
S. Ruby	4. Olivine

- a. P-4. Q-1, R-2. S-3
- b. P-1, Q-3, R-2, S-4
- c. P-2, Q-4, R-1, S-3
- d. P-3, Q-4, R-1, S-2

4. Silica-undersaturated minerals are

- a. nepheline and albite
- b. olivine and enstatite
- c. leucite and orthoclase
- d. olivine and leucite

5. The Hermann-Mauguin symbols of crystallographic notation for the correct minerals in ABOVE question

- a. $2/m2/m2/m$ and $4/m$
- b. $4/m$ and $2/m$
- c. $2/m2/m2/m$ for both
- d. 6 and $\bar{1}$

2009

1. Match the minerals in Group-I with their characteristic optical properties in group II

Group-I	Group-II
P. Biotite	1. Uniaxial negative
Q. Sodalite	2. Mottled extinction
R. Nepheline	3. Uniaxial positive
S. Quartz	4. Isotropic, Low relief
	5. Isotropic, High relief
	6. biaxial negative

- a. P-5, Q-1 R-3 S-6
- b. P-6, Q-2 R-5 S-1
- c. P-3, Q-2 R-4 S-5
- d. P-2, Q-4 R-1 S-3

2. Plagioclase feldspar belongs to the _____ crystal system
 - a. Triclinic
 - b. Monoclinic
 - c. Orthorhombic
 - d. Rhombic
3. The plane by which twinned crystals are united is called the
 - a. Mirror plane
 - b. Twin plane
 - c. Glide plane
 - d. Composition plane

2008

1. Which of the following mineral is harder than a knife blade?
 - a. Calcite
 - b. Fluorite
 - c. Gypsum
 - d. Quartzite
2. If a horizontal mirror plane is added to a pyramid having three-fold symmetry, the resultant symmetry of the c-axis will be
 - a. $3m$
 - b. $\bar{3}$
 - c. $\bar{6}$
 - d. $6/m$
3. Dodecahedron and trapezohedron faces are observed in
 - a. Beryl
 - b. Chalcopyrite
 - c. Fluorite
 - d. Garnet
4. The crystal system of biotite is
 - a. Hexagonal
 - b. Monoclinic
 - c. Orthorhombic
 - d. Tetragonal
5. The [0001] section of a uniaxial mineral can be distinguished from an anisotropic mineral in thin section by
 - a. Extinction angle
 - b. Pleochroism
 - c. Relief
 - d. Interference figure
6. An X ray beam of wavelength $\lambda = 1.541 \text{ \AA}$ is incident on a cubic crystal having lattice spacing of 4 \AA . What will be its 2θ values (where θ is the glancing angle) on X-ray diffractogram?

- a. 11.10^0
- b. 20.10^0
- c. 22.20^0
- d. 44.20^0

7. The Fe-O bond length in hematite is 2.05 \AA and the ionic radius of anion is 1.32 \AA

- a. The correct pair of radius ratio and coordination number is
 - i. 0.220 and 3
 - ii. 0.380 and 4
 - iii. 0.553 and 6
 - iv. 0.770 and 8
- b. The electrostatic valency of the cation is
 - i. 0.25
 - ii. 0.5
 - iii. 1.0
 - iv. 3.0

2007

1. Glaucophane is a dense mineral because

- a. Na occurs in the 'A' site while Al is in the octahedral site
- b. Na occurs in the 'A' site while Al is in the tetrahedral site
- c. Na occurs in the 'M4' site while Al is in the octahedral site
- d. Na occurs in the 'M4' site while Al is in the tetrahedral site

2. Match the minerals in Group I with their respective silicate structures in Group

Group I	Group II
P. Olivine	1. Nesosilicate
Q. Quartz	2. Sorosilicate
R. Epidote	3. Inosilicate
S. Biotite	4. Phyllosilicate
	5. Cyclosilicate
	6. Tectosilicate

- a. P-1, Q-2, R-5, S-4
- b. P-1, Q-6, R-2, S-4
- c. P-3, Q-6, R-4, S-2
- d. P-3, Q-6, R-4, S-2

3. Quartz can be optically distinguished from nepheline based on

- a. Relief
- b. Birefringence
- c. Optic sign
- d. Extinction angle

Year	Question no	Answer	Year	Question no	Answer
2024	1	a	2015	1	c
	2	a		2	c
2023	1	a		3	b
	2	b		4	c
	3	c	2014	1	d
	4	d		2	b
	5	d		3	c
	6	c		4	a
	7	b		5	a
	8	4.42 to 4.46	2013	1	4
	9	0.208		2	c
2022	1	a		3	a
	2	480		4	d
	3	a,c		5	a
2021	1	64		5	c
	2	c		6	a
	3	1.55 to 1.65	2011	1	a
2020	1	d		2	c
	2	a		3	b
	3	d		4	d
	4	b		5	c
	5	1.98 to 2.00	2010	1	c
2019	1	a		2	c
2018	2			3	a
2017	1	d		4	d
	2	c		5	a
	3	b	2009	1	d
	4	2.1 to 2.2		2	a
	5	c		3	d
2016	1	b	2008	1	d
	2	a		2	c
	3	a		3	d
	4	c		4	b
	5	1.25		5	b
	6	a		6	c
				7(a)	C
				(b)	b
			2007	1	c
				2	b
				3	c