Answer Key 00063766

Note: Draw neat diagrams where necessary.

Max. Marks 100
Duration 3 Hrs

1 a **Fill in the blanks** 10

i) The minerals with metallic bonding are goos conductors of electricity.
ii) The sheets in Graphite are loosely bonded together by Van der Waal's forces.
iii) Clacite shows 3 sets of cleavages while gypsum shows one set of cleavage.
iv) Natrolite show accicular habit of mineral.
v) Resistance of mineral to scratching or abrasion is defined as hardness.
vi) All crystals have been classified into 6 crystal systems and 32 crystal classes.
vii) Pyroxenes are are divided into _________and ___________based on their crystal structure
viii) Cube is a form bounded by six similar faces, each of which is parallel to the three crystallographic axes and intersects the third axis at unit distance.
ix) Basal pinacoid (0001) is form present in hexagonal system.
x) In Monoclinic system the b axis is called as the ortho axis.

b **Define the following** 10

i) Cleavage and fracture: Cleavage is the tendency of a mineral to break along smooth planes parallel to zones of weak bonding. Fracture is the characteristic mark left when a mineral chips or breaks.

ii) Face and solid angle: crystal is bounded by flat plane surfecs these are called as face. Crystal may have like faces or unlike faces.

Solid angle: Soild angle is formed by intersection of three or more faces. (Diagram expected)

iii) Mammillary and botryoidal habit of mineral
Larger mammary gland like rounded forms resembling botryoidal (e.g. malachite).

Botryoidal:"Grape-like" rounded forms (e.g.. malachite

iv) Planes of symmetry: Any two dimensional surface that pass through the center of crystal and divides the crystal into two symmetrical parts that are mirror images of each other is called as plane of symmetry.

v) Pyramid and dome:
A pyramid is a 3, 4, 6, 8 or 12 faced open form where all faces in the form meet, or could meet if extended, at a point. Domes are 2- faced open forms where the 2 faces are related to one another by a mirror plane.

2 Answer any two of the following-(unit 1

a Describe the covalent bonding. Use example of Diamond and graphite to explain role of bonding in hardness of these two minerals. 10

Covalent bond: In this type of bonding, electrons are shared between two atoms, with the outermost shells of the atoms overlapping. Example- Diamond has a covalent structure composed entirely of carbon atoms. The carbon has four electrons in its outer shell and thus can for four covalent bonds with other carbon atoms. This is basis of the diamond structure in which each carbon atom is surrounded by four others. Atoms are located at the corners and the face centers of the cube, and also at points ¼ or ¾ along a diagonal. Such structure has great strength, which is reflected in the extreme hardness of diamond. The other crystalline form of carbon, graphite has a totally different structure with carbon atoms arranged in layers at the corners of regular, planes, hexagons, each carbon atom being linked to three others. There is covalent bond between each pair of atoms and the planes or layers of atoms, which are mutually displaced, are held together by Van der Waals bonding. The atomic structure accounts for the well developed cleavage which graphite possess, parallel to the sheets of atoms.

b What is polymorphism and pseudomorphism? Explain in detail with examples. 10

Polymorphism: Compound or elements that can exist in more than one crystallographic structure are called polymorphs and the phenomenon is termed as polymorphism. Each polymorph has its own physical properties and a distinct atomic or ionic configuration. Isomorphic substances are classified as dimorphic, trimorphic etc. depending upon the number of crystalline forms developed. The same substance may form different polymorphs under differing conditions. Example- diamond and graphite are polymorphs of carbon. In diamond the carbon atoms are held together by covalent bond. It results on great hardness. On the other hand graphite has carbon atoms which are held together by covalent and van der waals bonds which results in lower hardness.

Pseudomorphism: If a mineral is replaced by another mineral without any change in the external form then they are termed as pseudomorphs and the phenomenon is called as pseudomorphism. PSeudomorphs are formed in several ways such as by incrustation, infiltration, replacement and by alteration.

c List various physical properties observed in minerals. Explain the forms of minerals with examples. 10

Colour
Streak
Lusture
Test, odour and feel
Form
Habit
Clevage and partings
Fracture
Hardness
Specific gravity

Mineral Forms

i) The following general descriptive terms are associated with crystal characters of minerals:

Crystallized- The mineral occurs as well developed crystals.
Crystalline- No definite crystals are developed
Cryptocrystalline- The mineral possesses traces of crystalline structure.
Amorphous- Complete absence of crystalline structure.

d Define mineral. Explain various processes that results in formation of minerals in nature. 10

"A mineral is a body produced by the processes of inorganic nature, having usually a definite chemical composition and, if formed under favorable conditions, a certain characteristic atomic structure which is expressed in its crystalline form and other physical properties”.

3 Answer any two of the following- (unit 2)

a Define crystal. Explain the elements of crystal symmetry. 10

A crystal is any solid material in which the component atoms are arranged in a definite patter and whose surface regularity reflects its internal symmetry.
There are three elements of symmetry
Axes of symmetry
Plane of symmetry
Centre of symmetry

b Describe the principle and working of contact goniometer. 10

A contact goniometer consists of two metal rules pivoted together at the centre of a graduated semicircle. The instrument is placed with its plane perpendicular to an edge between two faces of the crystal to be measured, and the rules are brought into contact with the faces. The angle between the rules, as read on the graduated semicircle, then gives the angle between the two faces. The rules are slotted, so that they may be shortened and their tips applied to a crystal partly embedded in its matrix. The instrument illustrated is employed for the approximate measurement of large crystals.

c Define parameters and indices of a crystal face. Explain Index system of Miller. 10

Crystal faces can be defined by their intercepts on the crystallographic axes. Two very important points about intercepts of faces:
The intercepts or parameters are relative values, and do not indicate any actual cutting lengths.
Since they are relative, a face can be moved parallel to itself without changing its relative intercepts or parameters.
Because one does usually not know the dimensions of the unit cell, it is difficult to know what number to give the intercept of a face, unless one face is chosen arbitrarily to have intercepts of 1. Thus, the convention is to assign the largest face that intersects all 3 crystallographic axes the parameters - 1a, 1b, 1c. This face is called the unit face.
By specifying the intercepts or parameters of a crystal face, we now have a way to

uniquely identify each face of a crystal. But, the notation is cumbersome, so crystallographers have developed another way of identifying or indexing faces. This conventional notation called the Miller Index.
Miller Indices
The Miller Index for a crystal face is found by
first determining the parameters
second inverting the parameters, and
third clearing the fractions.
For example, if the face has the parameters 1 a, 1 b, ¥ c
inverting the parameters would be 1/1, 1/1, 1/ ¥
this would become 1, 1, 0
the Miller Index is written inside parentheses with no commas - thus (110)

d Describe elements of symmetry of Triclinic systems. Add note on pinacoid forms of Triclinic system 10

This Crystal System let themselves refer, consists of three non-equivalent axes, intersecting each other at oblique angles, i.e. angles that are not (necessarily) equal to 900. Of these axes, for (the set-up of) which one chooses appropriate (existing) crystal edges, one sets -- analogously to the Orthorhombic System -- one axis vertically (the c axis, or vertical axis), the longer of the other two -- the macro axis -- transversely, and the other, i.e. the shorter axis -- the brachy axis -- obliquely to the beholder. The angle obtaining between the vertical axis and the macro axis is denoted by the greek letter alpha.
The angle obtaining between the vertical axis and the brachy axis is denoted by the greek letter beta.
The angle obtaining between the brachy axis and the macro axis is denoted by the greek letter gamma.

4 Answer any two of the following-(unit 3) 10

a Draw and describe in detail Sorosilicates and Nesosilicates structures.

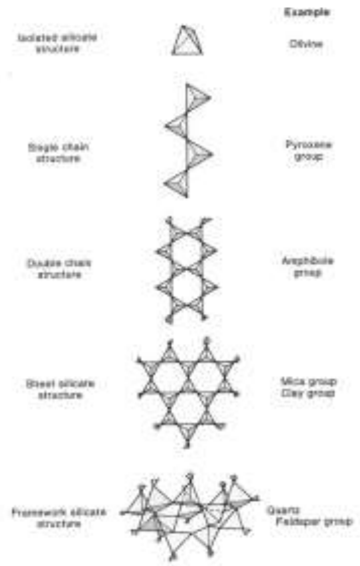
Sorosilicate

The silicon: oygen ration is 2:7
Greek term Soro= group
The Si_2O_7 units are arranged on a regular pattern and linked together by other cations like Ca, Na, Al^{+3}
Example- Epidote

Nesosilicate

Name has been coined from greek Neso= island. These are constituted of individual or independent tetrahedral units.Si:O ratio is 1:4
Example: Forsterite (Olivine)

b Briefly explain structural classification of the silicates. Use chemical formula, Si:O ratio as key points. 10



c What are Cyclosilicates? Explain the structure, chemical formula and minerals of this group. 10

1. Cyclosilicates

This group consist of tetrahedral rings which have Si:O ratio 1:3
The name is from greek Cyclo= ring
Minerals of cyclosilicate group:

d Draw neat diagrams to illustrate Sorosilicate and Inosilicate structures. Explain the properties of minerals of Pyroxene group. 10

Refer to diagram used in Q.4b
Properties of minerals of pyroxene group

Chemical Composition	
Color	Usually dark green, dark brown or bla varieties are white t
Cleavage	Two directions, that meet at nearly right ang 93°), un
Hardness	5 to 6 (hard
Specific Gravity	3.2 to 3.5 (average), increases with
Luster	Vitreous (glass-like), in dark colored sa mistake
Streak	White, greenish

5 Write notes on any four of the following (all units) 20

i) Axial conventions used in crystallography

Three crystallographic axes namely a,b and c
Axes a and b are horizontal
Axis c is vertical
Top end a c front end of a and right end of b are positive.
angle between these three axes is termed as α,β and γ

ii) Nonmetallic lustures of minerals

Non-metallic: not looking like a metal at all. Nonmetallic luster is divided into several sub-types:

Adamantine, having the hard, sparkly look of a diamond; Resinous, having the look of amber – not quite glassy; Glassy/Vitreous, having the look of glass Pearly, having the iridescent look of mother-of-pearl (though usually just barely); often found on the cleavage face of a mineral having perfect cleavage Greasy/Oily, having the look of an oil-coated substance; Silky, having the look of silk, fine parallel fibers of mineral – such as chrysotile "asbestos"; Dull, having a plain looking surface that is not submetallic; Earthy, having the look of soil or clay.

iii) Colour and streak of Minerals

The minerals absorb certain wavelengths of the natural light and reflects others, this is how to a human eye the mineral appears coloured. The colour is related to major atomic constitution of that mineral. Colour of mineral can also be due to presence of certain anions or anionic groups like CO3-2, Cl-1etc.

The color of a mineral's powder is often a very important property for identifying the mineral. The streak test is done by scraping a specimen of the mineral across a piece of unglazed porcelain known as a "streak plate."

iv) Moh's Scale of hardness

Hardness is a measure of a mineral's resistant to abrasion. This property is easily de-termined and is used widely for field identification of minerals. More than a century ago. Friedrich Mohs (1773-1839), a German mineralogist, assigned arbitrary relative numbers to ten common minerals in order of their hardness.

1 Talc Fingernail (2.5)
2 Gypsum
3 Calcite Cooper coin (3)
4 Flourite Knife blade (5.5)
5 ApatiteGlass plate (5.5+)
6 K-feldspar
7 Quartz Streak plate (7)
8 Topaz
9 Corundum
10 Diamond

A simpler version of the Moho's scale can be established using three

types of hardness:
Soft - Minerals that can be scratched with a fingernail
Intermediate - Minerals that cannot be scratched with a fingernail but can be scratched with a steel nail.

v) Forms of Isometric system (type Galena)
Isometric system, also called cubic system. A cube has six square faces, but many of the crystal forms in the isometric system display more complex configurations; among the most symmetrical forms of the isometric (or cubic) system are the octahedron (8 faces), trisoctahedron (24 faces), and hexoctahedron (48 faces).

vi) Body-centred Cubic packing in metals.
The metallic ions are arranged at the centers and the corners of a series of cubes. It is not tightly packed model each sphere touches eight other ionic spheres. This arrangement is reflected in the properties, these metals are harder and more brittle. Example: Iron, Tungsten.
Hexagonal close-packing- In this type of packing the centre of ionic spheres lie at the corners of an equilateral triangles. This ionic structure is repeated after every second layer and the repetition occurs only in one direction gliding planes are rare and hence that results in properties such as hardness and less ductility. Example: Magnesium, Titanium.

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