

Quadrant II – Notes

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Module No: 06
Name of the Presenter: Raghav R Gadgil

Notes:

Hardness

- **Hardness** is a mineral's resistance to abrasion or scratching.
- **Relative hardness** is determined by trying to scratch a surface of one mineral with an edge or corner of a second mineral.
- If a scratch or abrasion results, the first mineral is the softer.
- In 1872, a German mineralogist Frederich Mohs devised a simple way to determine the hardness of an unknown mineral by arranging 10 minerals in series according to their increasing hardness values giving Mohs scale of hardness
- **Absolute hardness** is the measure of a material's ability to resist permanent deformation
- The scale is Mohs scale of hardness, these standard minerals do not advance in any definite or regular ratio of hardness.

Mineral	H	H	Nonmineral
Talc	1		
Gypsum	2	2.5	Fingernail, aluminium
Calcite	3		
Fluorite	4		
Apatite	5	5.5	Pockeknife blade,
Feldspar	6	6.5	Metal file, streak

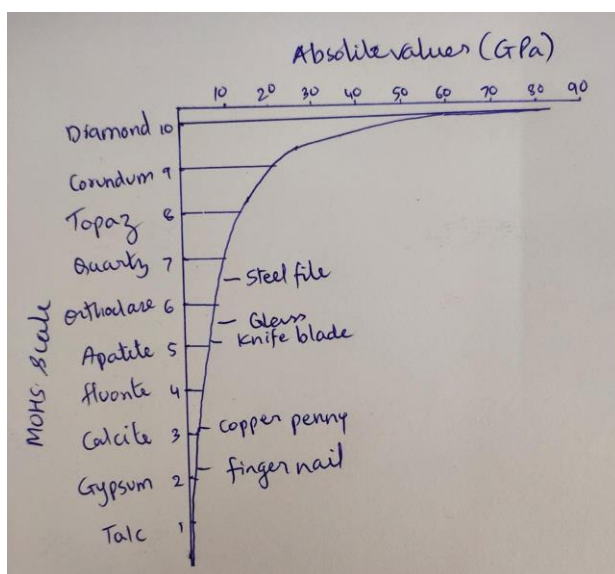
Quartz	7		
Topaz	8		
Corundum	9		
Diamond	10		

Determination of hardness:

- In actual practice, the hardness of an unknown mineral can be determined by observing the ease or difficulty with which a mineral can be scratched by the other.
- For this, the mineral under study should be scratched by the standard minerals from the Mohs scale of hardness.
- If the given mineral is scratched by Quartz and the same mineral in turn scratches orthoclase then the hardness of that particular mineral can be written as $H=6-7$ or 6.5.

Precautions while determining hardness:

1. Sometimes when one mineral is softer than other, portions of the first will leave a mark on the second that may be mistaken for a scratch. Such a mark can be rubbed off, whereas a true scratch will be permanent.
2. The surfaces of some minerals are frequently altered to material that is much softer than the original mineral. A *fresh surface* of the specimen to be tested must therefore be used.
3. The physical nature of a mineral may prevent a correct determination of its hardness. For instance, if the mineral is pulverulent or granular, it may be broken down and apparently scratched by the mineral much softer than itself. It is always advisable when making the hardness test to confirm it by reversing the order of procedure; i.e. do not only try to scratch mineral A by mineral B, but also try to scratch B by A.



- Mohs hardness scale is not linear and is close to being exponential.

- The hardnesses of the softest minerals are more similar than the hardnesses of the four hardest ones (quartz, topaz, corundum, diamond).
- Gypsum is only slightly harder than talc but diamond has a hardness five times greater than corundum
- Scratch hardness may vary substantially with direction and crystallographic plane in some minerals.
- Kyanite typically when scratched parallel to its length the hardness is 5 but at right angles it is 7.

Crystal form:

- Under favourable conditions the minerals attain certain definite geometrical forms by virtue of which they are bounded by flat surface and this is referred to as crystal. The general descriptive terms associated are:
 1. Crystallized: a term used to denote that the mineral occurs as well developed crystals with the terminations clearly marked and the faces sharply developed.
 2. Crystalline: a term used to denote that no definite flat surfaces or the faces are developed but a confused aggregate of imperfectly formed crystal grains that have interfered with one another during their growth.
 3. Crypto-crystalline: it actually refers to the microscopic examination of mineral specimen. The crypto-crystalline minerals do not have good form megascopically however under the microscope their partial crystallization and formation of mere traces of crystal structure is clearly revealed. E.g. bloodstone, chalcedony, jasper, agate etc.
 4. Amorphous: The minerals with total absence of crystalline structure are referred to as amorphous minerals. E.g. opal.