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Hardness scale mineralogist crossword

Hardness scale mineralogist is a crossword puzzle clue that we have spotted 2 times. There are related clues (shown below). Referring crossword puzzle answersNewsday - Sept. 27, 2020Newsday - Jan. 15, 2017 The Mohs' hardness scale was developed in 1822 by Frederich Mohs. This scale is a chart of relative hardness of the various minerals (1 - softest to 10 - hardest). Since hardness depends upon the crystallographic direction (ultimately on the strength of the bonds between atoms in a crystal), there can be variations in hardness depending upon the direction in which one measures this property. One of the most striking examples of this is kyanite, which has a hardness of 5.5 parallel to the 1 direction (c-axis), while it has a hardness of 7.0 parallel to the 100 direction (a-axis). Talc (1), the softest mineral on the Mohs scale has a hardness greater than gypsum (2) in the direction that is perpendicular to the cleavage. Diamonds (10) also show a variation in hardness (the octahedral faces are harder than the cube faces). For further information see articles from the American Mineralogist on microhardness, the Knoop tester, and diamonds. Mohs' hardness is a measure of the relative hardness and resistance to scratching between minerals. Other hardness scales rely on the ability to create an indentation into the tested mineral (such as the Rockwell, Vickers, and Brinell hardness - these are used mainly to determine hardness in metals and metal alloys). The scratch hardness is related to the breaking of the chemical bonds in the material, creation of microfractures on the surface, or displacing atoms (in metals) of the mineral. Generally, minerals with covalent bonds are the hardest while minerals with ionic, metallic, or van der Waals bonding are much softer. When doing the tests of the minerals it is necessary to determine which mineral was scratched. The powder can be rubbed or blown off and surface scratches can usually be felt by running the fingernail over the surface. One can also get a relative feel for the hardness difference between two minerals. For instance quartz will be able to scratch calcite with much greater ease than you can scratch calcite with fluorite. One must also use enough force to create the scratch (if you don't use enough force even diamond will not be able to scratch quartz - this is an area where practice is important). You also have to be careful to test the material that you think you are testing and not some small inclusion in the sample. This is where using a small hand lens can be very useful to determine if the test area is homogenous. One of the most famous identification methods in the study of mineralogy is the Mohs Scale of Hardness. A comparative scale, based on the hardness of each mineral, it is a way geoscientists can compare minerals to each other and organise them based upon an easily testable physical characteristic. Each level of hardness has a value, from 1 (the softest) to 10 (the hardest) and each number is associated with a mineral example. The hardest, with a Mohs scale of 10 is diamond! But why do we organise minerals in this way, and who was Friedrich Mohs – the person who invented the whole system? Born in Germany in 1773 Friedrich Mohs trained as a geologist with a specialism in mining. In 1801 he moved to Austria to work as a mining foreman and was also hired by a wealthy Austrian banker, J.F. van der Null, to curate and identify his vast collection of minerals. He later continued this work at the Joanneum Museum, in Graz, Austria. At the time minerals were mostly classified by their chemical composition, but this wasn't very consistent, and Friedrich wondered if there wasn't a better way. He decided to follow the example of botanists and group minerals together according to their physical characteristics – starting with how hard they were. He was not the first to do so; Pliny the Elder had first compared the hardness of the minerals diamond and quartz to each other in his book Naturalis Historia written in 77AD, and Friedrich decided to continue Pliny the Elder's ordinal ranking system. Eventually he came up with a set of 10 values of hardness that could all be determined relative to each other using the now-famous scratch test. Although Mohs' method of classifying minerals based on their physical properties was not widely accepted at the time, he had a long and successful career in mineralogy, mining and geoscience. He died at age 66, 181 years ago this week, but not without fundamentally changing the way we study minerals to this very day. The Mohs Illustrated Scale of Hardness by Hazel Gibson Qualitative ordinal scale from 1 to 10, characterizing scratch resistance of various minerals Mohs hardness kit, containing one specimen of each mineral on the ten-point hardness scale The Mohs scale of mineral hardness (/moʊz/) is a qualitative ordinal scale, from 1 to 10, characterizing scratch resistance of various minerals through the ability of harder material to scratch softer material. The scale was created in 1822 by German geologist and mineralogist Friedrich Mohs; it is one of several definitions of hardness in materials science, some of which are more quantitative.[1][2] The method of comparing hardness by observing which minerals can scratch others is of great antiquity, having been mentioned by Theophrastus in his treatise On Stones, c. 300 BC, followed by Pliny the Elder in his Naturalis Historia, c. AD 77.[3][4][5] The Mohs scale is extremely useful for identification of minerals in the field, but is not an accurate predictor of how well materials endure in an industrial setting – toughness.[6] Use Despite its lack of precision, the Mohs scale is relevant for field geologists, who use the scale to roughly identify minerals using scratch kits. The Mohs scale hardness of minerals can be commonly found in reference sheets. Mohs hardness is useful in milling. It allows assessment of which kind of mill will best reduce a given product whose hardness is known.[7] The scale is used at electronic manufacturers for testing the resilience of flat panel display components (such as cover glass for LCDs or encapsulation for OLEDs). The Mohs scale has been used to evaluate the hardness of smartphone screens. Most modern smartphone displays use Gorilla Glass that scratches at level 6 with deeper grooves at level 7 on the Mohs scale of hardness.[8][9] Minerals The Mohs scale of mineral hardness is based on the ability of one natural sample of mineral to scratch another mineral visibly. The samples of matter used by Mohs are all different minerals. Minerals are chemically pure solids found in nature. Rocks are made up of one or more minerals. As the hardest known naturally occurring substance when the scale was designed, diamonds are at the top of the scale. The hardness of a material is measured against the scale by finding the hardest material that the given material can scratch, or the softest material that can scratch the given material. For example, if some material is scratched by apatite but not by fluorite, its hardness on the Mohs scale would fall between 4 and 5.[10] "Scratching" a material for the purposes of the Mohs scale means creating non-elastic dislocations visible to the naked eye. Frequently, materials that are lower on the Mohs scale can create microscopic, non-elastic dislocations on materials that have a higher Mohs number. While these microscopic dislocations are permanent and sometimes detrimental to the harder material's structural integrity, they are not considered "scratches" for the determination of a Mohs scale number.[11] The Mohs scale is a purely ordinal scale. For example, corundum (9) is twice as hard as topaz (8), but diamond (10) is four times as hard as corundum. The table below shows the comparison with the absolute hardness measured by a sclerometer, with pictorial examples.[12][13] Mohs hardness Mineral Chemical formula Absolute hardness[14] Image 1 Talc $Mg_3Si_4O_{10}(OH)_2$ 1 2 Gypsum $CaSO_4·2H_2O$ 2 3 Calcite $CaCO_3$ 14 4 Fluorite CaF_2 21 5 Apatite $Ca_5(PO_4)_3(OH^−,Cl^−,F^−)$ 48 6 Orthoclase feldspar $KAlSi_3O_8$ 72 7 Quartz SiO_2 100 8 Topaz $Al_2SiO_4(OH^−,F^−)_2$ 200 9 Corundum Al_2O_3 400 10 Diamond C 1500 On the Mohs scale, a streak plate (unglazed porcelain) has a hardness of approximately 7.0. Using these ordinary materials of known hardness can be a simple way to approximate the position of a mineral on the scale.[15] Intermediate hardness The table below incorporates additional substances that may fall between levels:[16] Hardness Substance or mineral 0.2–0.3 caesium, rubidium 0.5–0.6 lithium, sodium, potassium, candle wax 1 talc 1.5 gallium, strontium, indium, tin, barium, thallium, lead, graphite, ice[17] 2 hexagonal boron nitride,[18] calcium, selenium, cadmium, sulfur, tellurium, bismuth, gypsum 2–2.5 halite (rock salt), fingernail[19] 2.5–3 gold, silver, aluminium, zinc, lanthanum, cerium, jet 3 calcite, copper, arsenic, antimony, thorium, dentin 3.5 platinum 4 fluorite, iron, nickel 4–4.5 ordinary steel 5 apatite (tooth enamel), zirconium, palladium, obsidian (volcanic glass) 5.5 beryllium, molybdenum, hafnium, glass, cobalt 6 orthoclase, titanium, manganese, germanium, niobium, uranium 6–7 fused quartz, iron pyrite, silicon, ruthenium, iridium, tantalum, opal, peridot, tanzanite, rhodium, jade 7 osmium, quartz, rhenium, vanadium 7.5–8 emerald, beryl, zircon, tungsten, spinel 8 topaz, cubic zirconia, hardened steel 8.5 chrysoberyl, chromium, silicon nitride, tantalum carbide 9 corundum (includes sapphire and ruby), tungsten carbide, titanium nitride 9–9.5 silicon carbide (carborundum), tantalum carbide, zirconium carbide, alumina, beryllium carbide, titanium carbide, aluminum boride, boron carbide.[a][20][21] 9.5–near 10 boron, boron nitride, rhenium diboride (a-axis),[22] stishovite, titanium diboride, moissanite (crystal form of silicon carbide) 10 diamond, carbonado Comparison with Vickers scale This list is incomplete; you can help by adding missing items with reliable sources. Comparison between Mohs hardness and Vickers hardness:[23] Mineralname Hardness (Mohs) Hardness (Vickers)(kg/mm2) Graphite 1–2 VHN10 = 7–11 Tin 1.5 VHN10 = 7–9 Bismuth 2–2.5 VHN100 = 16–18 Gold 2.5 VHN10 = 30–34 Silver 2.5 VHN100 = 61–65 Chalcocite 2.5–3 VHN100 = 84–87 Copper 2.5–3 VHN100 = 77–99 Galena 2.5 VHN100 = 79–104 Sphalerite 3.5–4 VHN100 = 208–224 Heazlewoodite 4 VHN100 = 230–254 Carrollite 4.5–5.5 VHN100 = 507–586 Goethite 5–5.5 VHN100 = 667 Hematite 5–6 VHN100 = 1,000–1,100 Chromite 5.5 VHN100 = 1,278–1,456 Anatase 5.5–6 VHN100 = 616–698 Rutile 6–6.5 VHN100 = 894–974 Pyrite 6–6.5 VHN100 = 1,505–1,520 Bowieite 7 VHN100 = 858–1,288 Euclase 7.5 VHN100 = 1,310 Chromium 8.5 VHN100 = 1,875–2,000 See also Brinell scale Geological Strength Index Hardnesses of the elements (data page) Knoop hardness test Meyer hardness test Pencil hardness Rockwell scale Rosiwal scale Scratch hardness Notes ^ Carbides of some metals and semi-metals are quite hard (as well as brittle); carbides of tungsten (WC), tantalum (TaC), zirconium (ZrC), beryllium (Be2C), titanium (TiC), silicon (SiC), and boron (B4C) all have Mohs hardness levels between 9 and 10.[20][21] References ^ "Mineral gemstones". 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