

Properties of Common Minerals

	LUSTER	HARD- NESS	CLEAVAGE	FRACTURE	COMMON COLORS	DISTINGUISHING CHARACTERISTICS	USE(S)	COMPOSITION*	MINERAL NAME
Metallic luster		1-2	✓		silver to gray	black streak, greasy feel	pencil lead, lubricants	C	Graphite
		2.5	✓		metallic silver	gray-black streak, cubic cleavage, density = 7.6 g/cm ³	ore of lead, batteries	PbS	Galena
		5.5-6.5		✓	black to silver	black streak, magnetic	ore of iron, steel	Fe ₃ O ₄	Magnetite
		6.5		✓	brassy yellow	green-black streak, (fool's gold)	ore of sulfur	FeS ₂	Pyrite
Either		5.5-6.5 or 1		✓	metallic silver or earthy red	red-brown streak	ore of iron, jewelry	Fe ₂ O ₃	Hematite
Nonmetallic luster		1	✓		white to green	greasy feel	ceramics, paper	Mg ₃ Si ₄ O ₁₀ (OH) ₂	Talc
		2		✓	yellow to amber	white-yellow streak	sulfuric acid	S	Sulfur
		2	✓		white to pink or gray	easily scratched by fingernail	plaster of paris, drywall	CaSO ₄ •2H ₂ O	Selenite gypsum
		2-2.5	✓		colorless to yellow	flexible in thin sheets	paint, roofing	KAl ₃ Si ₃ O ₁₀ (OH) ₂	Muscovite mica
		2.5	✓		colorless to white	cubic cleavage, salty taste	food additive, melts ice	NaCl	Halite
		2.5-3	✓		black to dark brown	flexible in thin sheets	construction materials	K(Mg,Fe) ₃ AlSi ₃ O ₁₀ (OH) ₂	Biotite mica
		3	✓		colorless or variable	bubbles with acid, rhombohedral cleavage	cement, lime	CaCO ₃	Calcite
		3.5	✓		colorless or variable	bubbles with acid when powdered	building stones	CaMg(CO ₃) ₂	Dolomite
		4	✓		colorless or variable	cleaves in 4 directions	hydrofluoric acid	CaF ₂	Fluorite
		5-6	✓		black to dark green	cleaves in 2 directions at 90°	mineral collections, jewelry	(Ca,Na)(Mg,Fe,Al)(Si,Al) ₂ O ₆	Pyroxene (commonly augite)
		5.5	✓		black to dark green	cleaves at 56° and 124°	mineral collections, jewelry	CaNa(Mg,Fe) ₄ (Al,Fe,Ti) ₃ Si ₆ O ₂₂ (O,OH) ₂	Amphibole (commonly hornblende)
		6	✓		white to pink	cleaves in 2 directions at 90°	ceramics, glass	KAlSi ₃ O ₈	Potassium feldspar (commonly orthoclase)
		6	✓		white to gray	cleaves in 2 directions, striations visible	ceramics, glass	(Na,Ca)AlSi ₃ O ₈	Plagioclase feldspar
		6.5	✓		green to gray or brown	commonly light green and granular	furnace bricks, jewelry	(Fe,Mg) ₂ SiO ₄	Olivine
		7	✓		colorless or variable	glassy luster, may form hexagonal crystals	glass, jewelry, electronics	SiO ₂	Quartz
	6.5-7.5	✓		dark red to green	often seen as red glassy grains in NYS metamorphic rocks	jewelry (NYS gem), abrasives	Fe ₃ Al ₂ Si ₃ O ₁₂	Garnet	

*Chemical symbols: Al = aluminum Cl = chlorine H = hydrogen Na = sodium S = sulfur
 C = carbon F = fluorine K = potassium O = oxygen Si = silicon
 Ca = calcium Fe = iron Mg = magnesium Pb = lead Ti = titanium

✓ = dominant form of breakage

Overview:

Imagine if we didn't have minerals: say goodbye to your I-pod, your high definition TV, and to your future car. Even you would cease to exist without those precious dissolved minerals that are so vital for the proper functioning of your body. Our world depends on these solid, inorganic substances. Minerals can be an element, like gold or copper, or a simple compound like halite (NaCl), or as a more complex compound as found in the mineral hornblende. Mineral properties are controlled by the internal arrangement of the atoms, or simply, how the atoms are bonded together. For example, the composition of diamond and graphite is the same - only carbon atoms. But their internal atomic arrangements are different and produce two vastly different minerals. The beautiful diamond is the hardest mineral known, while graphite is a soft, greasy, dull mineral.

When minerals are joined together, the solid mass is called a rock. The rock granite is composed of the minerals potassium feldspar, quartz, biotite and amphibole in various amounts. Mineralogists have identified over 3,000 minerals, but only 100 minerals are common and only about ten elements make up most minerals. So, how do we identify minerals? By testing their physical and chemical properties. These tests might include the mineral's appearance, the crystal shape, luster, hardness, streak, acid test, their form of breakage – cleavage or fracture, and at times how the mineral feels or smells. These properties and others, along with the mineral composition can be found in the Properties of Common Minerals chart.

The Chart:

The twenty-one given minerals are classified first by their luster – the way it reflects light. This classification, metallic or non-metallic, is given on the far left of this chart. The next identifying property is hardness, based on a scale of 1 to 10. Following this is whether the mineral shows cleavage or fracture. If the mineral shows at least one smooth face (side) it has cleavage. Common color is given, but we need to be careful since many minerals show more than one color due to different impurities within the mineral. Distinguishing Characteristics column gives additional information about the mineral. Look in this column for unusual properties. The Use(s) column is how man has found a use for a particular mineral. The Composition column shows the element or chemical formula for the mineral. Use the bottom of this chart to identify any chemical symbols you need help with. In the Mineral name column locate Potassium Feldspar, it also goes by the name orthoclase. Two other minerals are shown to be identified by other names.

Additional Information:

- Four minerals on this chart are considered to be ores. Ore deposits contain valuable substances that are mined for economic purposes. Most metals are found as ores.
- The common color of a mineral may not be the same as the powder of the mineral, which is its streak.
- The hardness scale goes from 1 to 10. A mineral can scratch any mineral with a hardness that is less than its rating.
- Calcite and dolomite will react by bubbling when in contact with hydrochloric acid.
- Limestone and marble will bubble with hydrochloric acid because both rocks have the mineral calcite in their composition.

Set 1 — Properties of Common Minerals

1. Part of a gemstone's value is based on the way a gemstone shines in reflected light. The way a mineral reflects light is described as the mineral's

- (1) fracture (3) luster
 (2) hardness (4) streak 1 _____

2. Which mineral will scratch glass (hardness = 5.5), but not pyrite?

- (1) gypsum (3) orthoclase
 (2) fluorite (4) quartz 2 _____

3. The table below shows the hardness of four common materials.

Hardness of Four Materials

Material	Hardness
human fingernail	2.5
copper penny	3.0
window glass	4.5
steel nail	6.5

Which statement best describes the hardness of the mineral dolomite?

- (1) Dolomite can scratch window glass, but cannot be scratched by a fingernail.
 (2) Dolomite can scratch window glass, but cannot be scratched by a steel nail.
 (3) Dolomite can scratch a copper penny, but cannot be scratched by a fingernail.
 (4) Dolomite can scratch a copper penny, but cannot be scratched by a steel nail. 3 _____

4. Which mineral leaves a green-black powder when rubbed against an unglazed porcelain plate?

- (1) galena (3) hematite
 (2) graphite (4) pyrite 4 _____

5. Which mineral scratches dolomite and is scratched by olivine?

- (1) galena (3) potassium feldspar
 (2) quartz (4) muscovite mica 5 _____

6. Which statement about the minerals plagioclase feldspar, gypsum, biotite mica, and talc can best be inferred from the chart?

- (1) These minerals have the same chemical and physical properties.
 (2) These minerals have different chemical properties, but they have similar physical properties.
 (3) These minerals have different physical and chemical properties, but they have identical uses.
 (4) The physical and chemical properties of these minerals determine how humans use them. 6 _____

7. Minerals from this chart are found in several different rocks. Which two rocks are primarily composed of a mineral that bubbles with acid?

- (1) limestone and marble
 (2) granite and dolostone
 (3) sandstone and quartzite
 (4) slate and conglomerate 7 _____

8. Which home-building material is made mostly from the mineral gypsum?

- (1) plastic pipes
- (2) window glass
- (3) drywall panels
- (4) iron nails

8 _____

9. The internal atomic structure of a mineral most likely determines the mineral's

- (1) hardness, cleavage, and crystal shape
- (2) origin, exposure, and fracture
- (3) size, location, and luster
- (4) color, streak, and age

9 _____

10. The accompanying table shows some observed physical properties of a mineral. Based on these observations, the elements that make up this mineral's composition are

Physical Property	Observation
color	white
hardness	scratched by the mineral calcite
distinguishing characteristic	feels greasy
cleavage/fracture	shows some definite flat surfaces

- (1) sulfur and lead
- (2) sulfur, oxygen, and hydrogen
- (3) oxygen, silicon, hydrogen, and magnesium
- (4) oxygen, silicon, aluminum, and iron

10 _____

"Herkimer Diamonds"

Gem-quality "Herkimer Diamonds" are hexagonal-shaped quartz crystals found in some of the surface bedrock of Herkimer, New York. The oldest of these gemstones are believed to be approximately 500 million years old. These quartz crystals are magnificent works of nature that have a natural diamond like geometric shape formed when the quartz crystallized. Natural "Herkimer Diamonds" were not cut or shaped by humans. Due to their appearance, "Herkimer Diamonds" are commonly used in jewelry. These quartz crystals are not true diamonds.

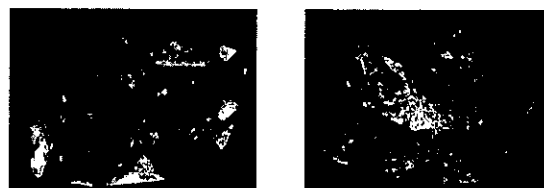
Mineral Characteristics of "Herkimer Diamonds" (Quartz) and True Diamonds

Mineral	Color	Chemical Composition	Luster	Hardness	Dominant Form of Breakage
"Herkimer Diamond" (quartz)	Colorless or variable	SiO ₂	Glassy	7	Fracture
True diamond	Colorless or variable	C	Glassy	10	Cleavage

11. List two mineral characteristics that differ between "Herkimer Diamonds" and true diamonds.

- 1) _____
- 2) _____

Photographs of "Herkimer Diamonds" (Quartz)



12. State one use for "Herkimer Diamonds" (quartz), other than their use in jewelry.

Set 2 — Properties of Common Minerals

13. A human fingernail has a hardness of approximately 2.5. Which two minerals are softer than a human fingernail?

- (1) calcite and halite
- (2) sulfur and fluorite
- (3) graphite and talc
- (4) pyrite and magnetite

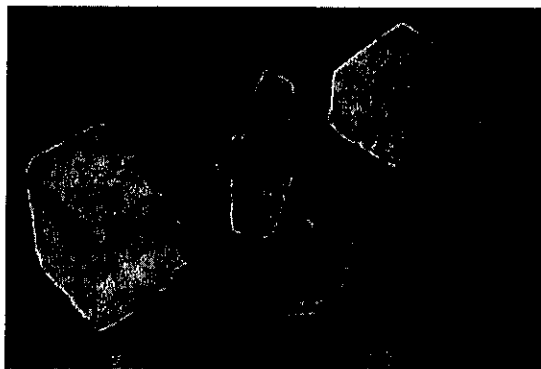
13 _____

14. How are the minerals biotite mica and muscovite mica different?

- (1) Biotite mica is colorless, but muscovite mica is not.
- (2) Biotite mica contains iron and/or magnesium, but muscovite mica does not.
- (3) Muscovite mica scratches quartz, but biotite mica does not.
- (4) Muscovite mica cleaves into thin sheets, but biotite mica does not.

14 _____

15. The photograph below shows a piece of halite that has been recently broken.



Which physical property of halite is demonstrated by this pattern of breakage?

- (1) hardness
- (2) streak
- (3) cleavage
- (4) luster

15 _____

16. Mohs mineral hardness scale and the chart below showing the approximate hardness of some common objects.

Moh's Mineral Hardness Scale	Approximate Hardness of Common Objects
Talc	Fingernail (2.5)
Gypsum	Copper penny (3.5)
Calcite	Iron nail (4.5)
Fluortie	Glass (5.5)
Apatite	Steel file (6.5)
Feldspar	Streak plate (7.0)
Quartz	
Topaz	
Corundum	
Diamond	

Which statement is best supported by this scale?

- (1) A fingernail will scratch calcite, but not quartz.
- (2) A fingernail will scratch quartz, but not calcite.
- (3) A piece of glass can be scratched by quartz, but not by calcite.
- (4) A piece of glass can be scratched by calcite, but not by quartz.

16 _____

17. The mineral graphite is often used as

- (1) a lubricant
- (2) an abrasive
- (3) a source of iron
- (4) a cementing material

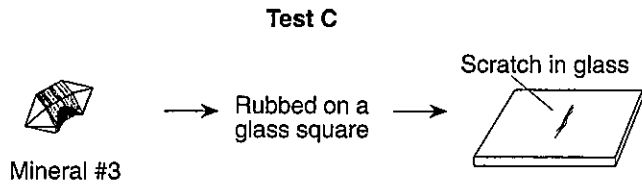
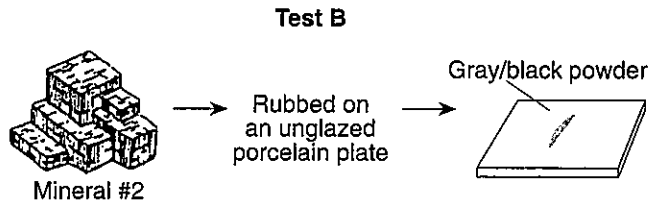
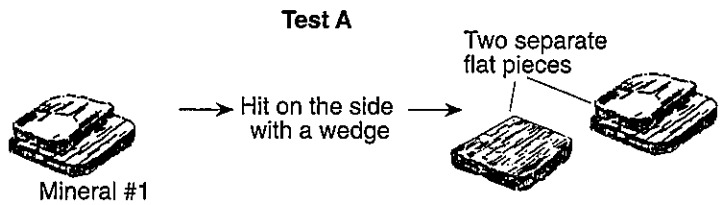
17 _____

18. Quartz and halite have different crystal shapes primarily because

- (1) light reflects from crystal surfaces
- (2) energy is released during crystallization
- (3) of impurities that produce surface variations
- (4) of the internal arrangement of the atoms

18 _____

Base your answers to questions 19 and 20 on the accompanying diagram, which shows three minerals with three different physical tests, *A*, *B*, and *C*, being performed on them.



19. Which sequence correctly matches each test, *A*, *B*, and *C*, with the mineral property tested?

- (1) *A*—cleavage; *B*—streak; *C*—hardness
- (2) *A*—cleavage; *B*—hardness; *C*—streak
- (3) *A*—streak; *B*—cleavage; *C*—hardness
- (4) *A*—streak; *B*—hardness; *C*—cleavage

19 _____

20. The results of all three physical tests shown are most useful for determining the

- (1) rate of weathering of the minerals
- (2) identity of the minerals
- (3) environment where the minerals formed
- (4) geologic period when the minerals formed

20 _____

21. Explain the difference between luster and streak.

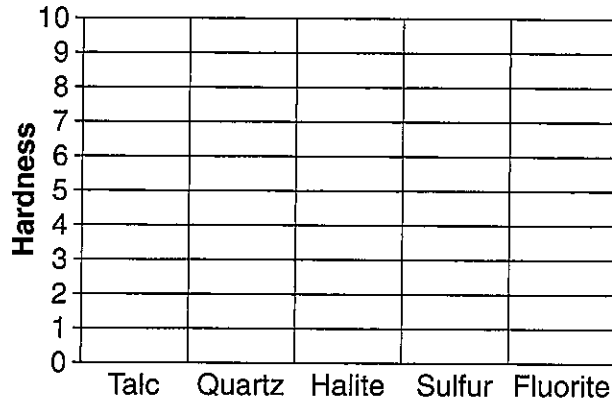
22. How can you tell the difference between calcite and halite.

23. What is an ore?

24. What element is present in biotite mica that is not present in muscovite mica? _____

Base your answers to questions 25a and b on the hardness of the minerals talc, quartz, halite, sulfur, and fluorite.

25. a) On the grid below, construct a bar graph to represent the hardness of these minerals.



b) Which mineral shown on the grid would be the best abrasive? State one reason for your choice.

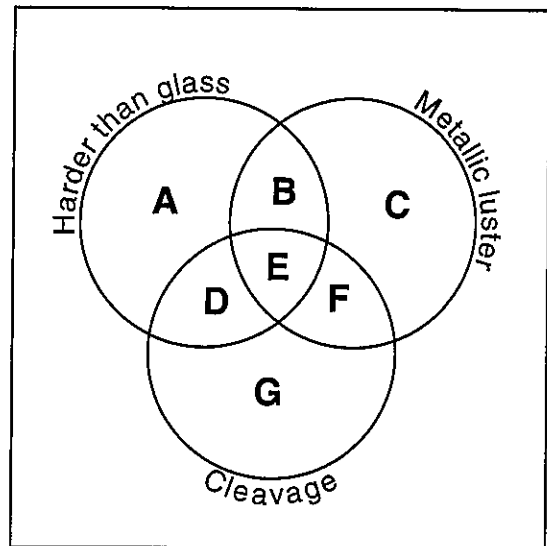
Mineral: _____

Reason: _____

26. A student created the accompanying table by classifying six minerals into two groups, A and B, based on a single property. Which property was used to classify these minerals?

Group A	Group B
olivine	pyrite
garnet	galena
calcite	graphite

Base your answers to questions 27a and b on the accompanying diagram of a mineral classification scheme that shows the properties of certain minerals. Letters A through G represent mineral property zones. Zone E represents the presence of all three properties. For example, a mineral that is harder than glass, has a metallic luster, but does not have cleavage, would be placed in zone B. Assume that glass has a hardness of 5.5.



27. a) In which zone would the mineral potassium feldspar be placed? _____

b) State the name of one mineral listed on the Properties of Common Minerals Table that could not be placed in any of the zones. _____