

Part 4 Minerals

Name _____

Part 4 Lesson 1 Minerals

Rock – Mass or grouping of _____

The "Big 3" Primary Minerals that make up rocks.



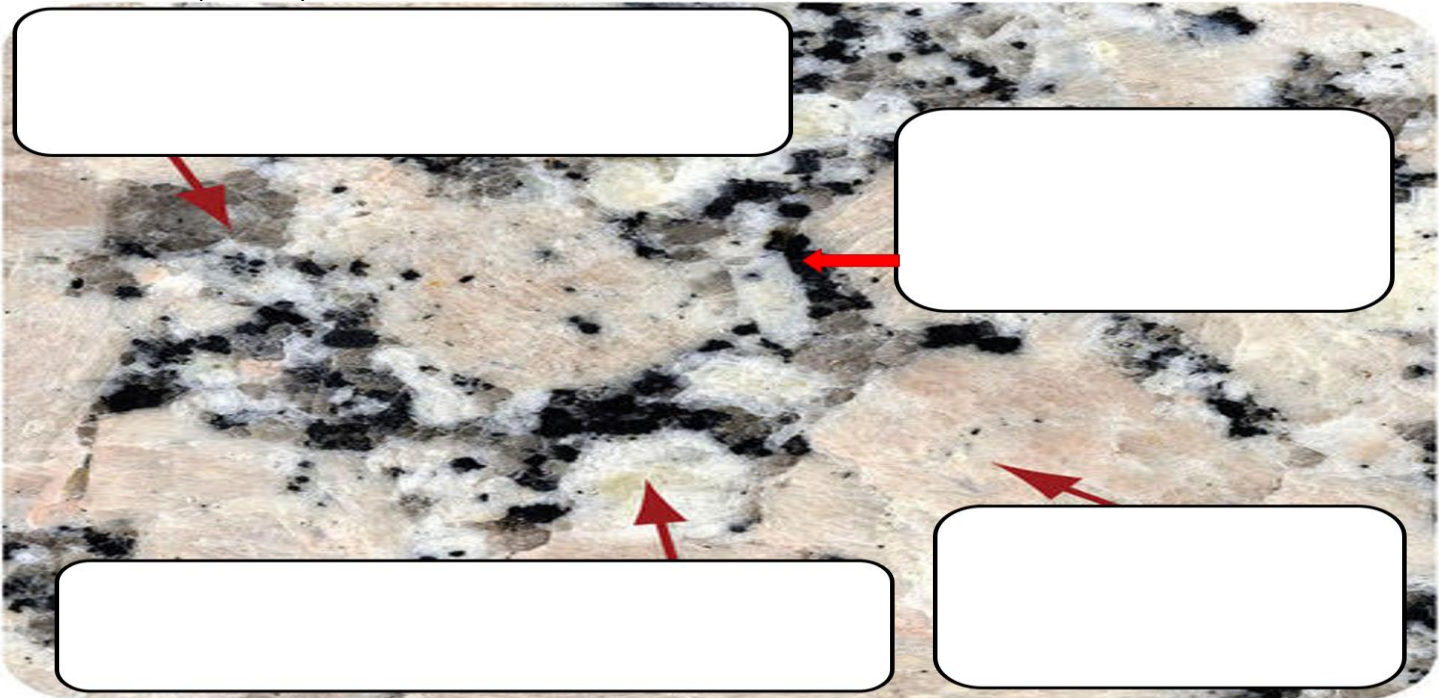
Minerals are _____, _____ (non-living), _____, that join together to make _____ and have unique compositions.

Must have a fixed _____ formula and specific _____ structure.

Which picture is a mineral? **Explain** why below each image.

Note: All mineral _____ are the result from the _____ of the minerals _____.

Name some primary minerals that are in the rock Granite below.



A crystal is a solid in which the _____ are arranged in a repeating pattern.

Part 4 Lesson 2 Crystals

Uses of minerals

_____ \$
_____, Mined for \$

Please describe a downside to valuable minerals below.

A collection of images illustrating the use and mining of minerals. On the left, a smartphone is shown, representing the use of minerals in technology. Below it is a circular inset showing various mineral samples. In the center, a circular inset shows hands holding a pile of dark mineral dust. On the right, a circular inset shows two children using tools to mine, representing the extraction of minerals.

Types of crystals.

Hex_____ (Four axes, three are equal in length and lie at an angle of 120° from each other).

Tri_____: (3 axis, all unequal and none at 90° angles).

O_____: (All axis unequal in length, and 90° degrees from each other).

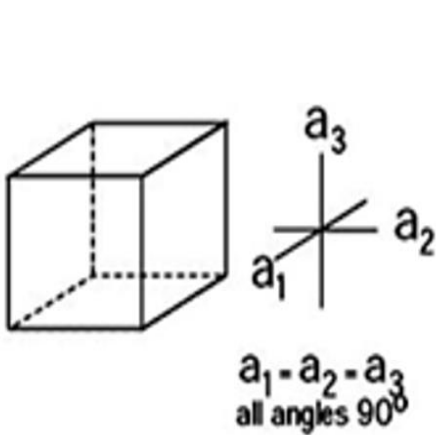
M_____: All axis unequal in length. Two of them are at right angles to each other, while the third is lies at an angle other than 90°.

Tetragonal. (Three axes, two are equal in length, one is unequal.)

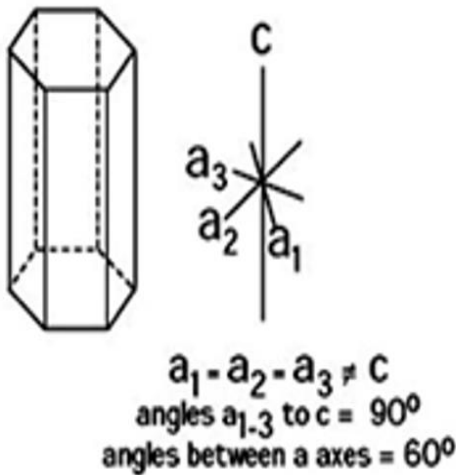
_____metric: (All three axes are equal in length an at 90° degrees from each other.)

Part 4 Lesson 3 start

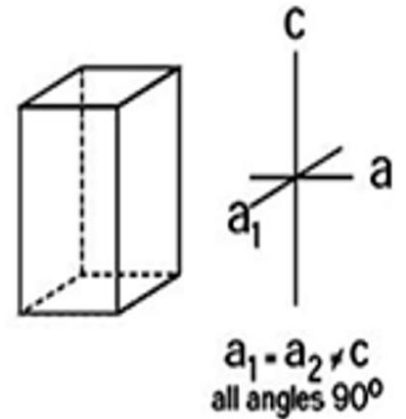
Name the type of Crystals below.



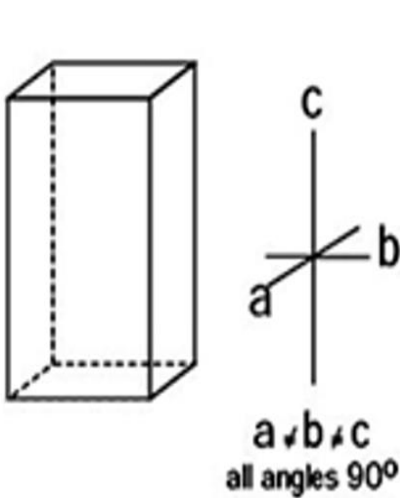
A



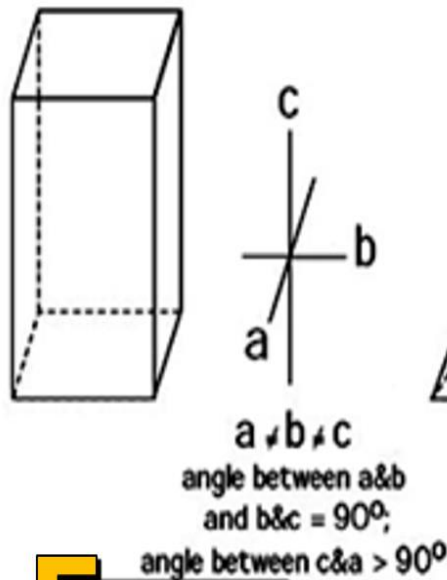
B



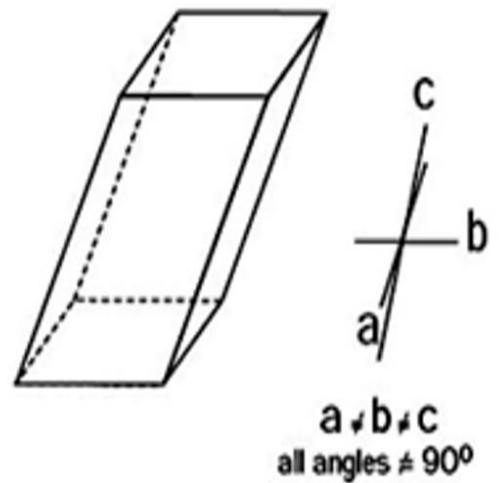
C



D



E



F

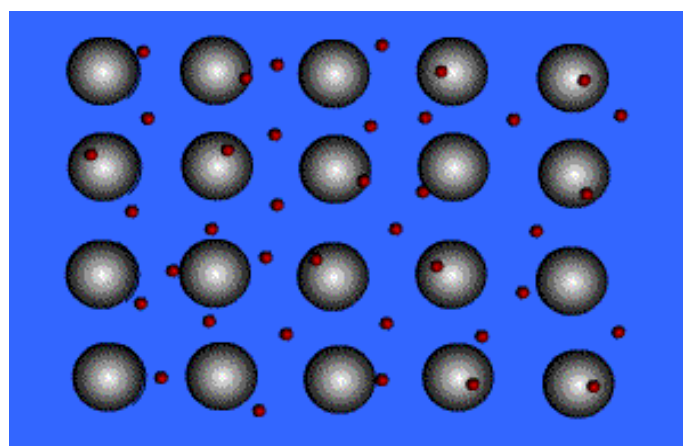
Part 4 Lesson 3 Crystals, Bonds, Quiz

Crystal Properties / Chemical Bonds

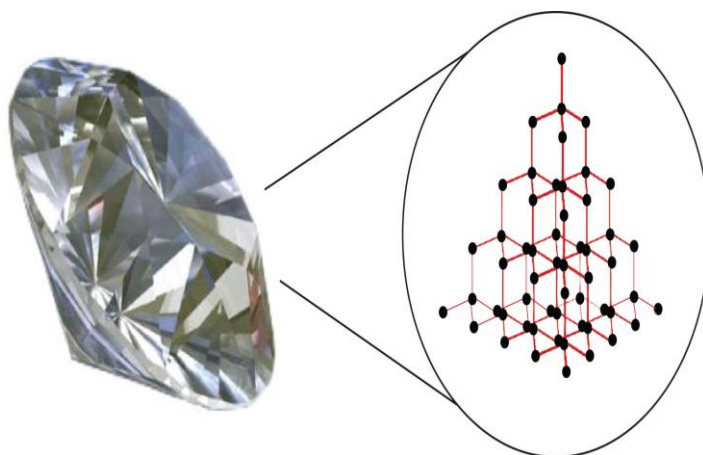
- **C** _____ **Crystals:** Covalent bonds between all of the atoms.
Example: Diamond, Zinc Sulfide crystals.
- **M** _____ **Crystals:** Individual metal atoms of metallic crystals sit on lattice sites.
• Many free electrons. High melting points.
- **I** _____ **Crystals:** The atoms are held together by electrostatic forces (ionic bonds).
• Ex: (NaCl) table salt
• Example – Sucrose in rock candy, ice cube

Name three types of crystals based on their properties / chemical bonds? Additional information and or examples are welcome.

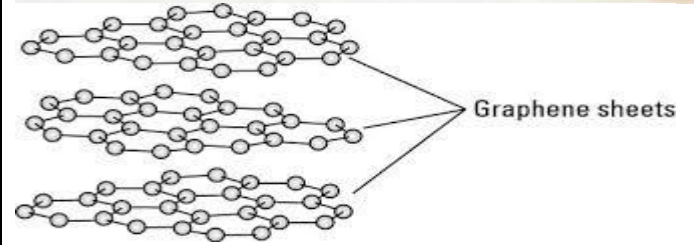
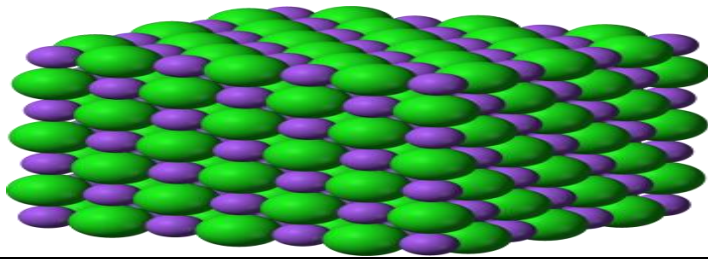
Answer=



Answer=

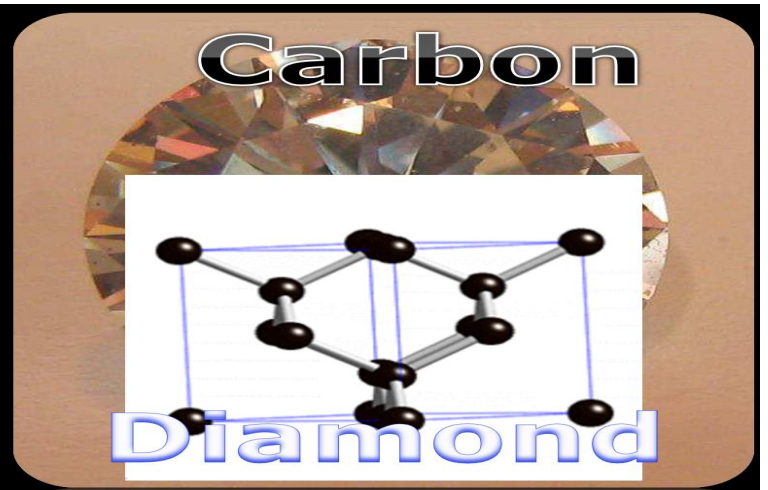
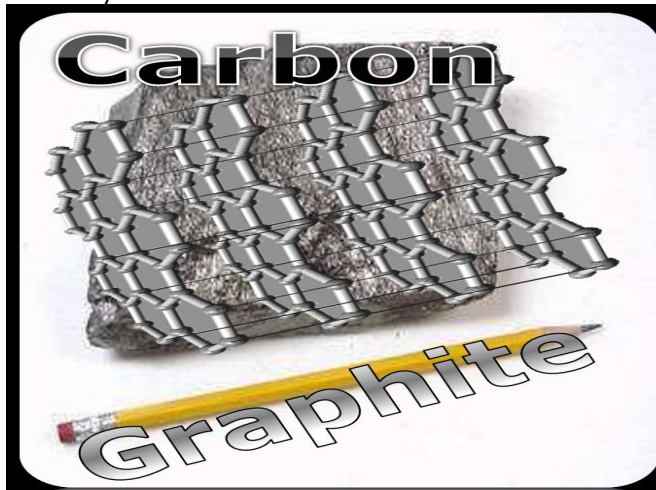


Answer=



Any guess for graphite in pencils?

A diamond (extremely hard) and the graphite in pencil (extremely soft) are both made entirely of Carbon? How can this be?



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

Part 4 Lesson 4 Primary Minerals

Use the common mineral properties scheme one the prior page to help you answer some of the questions below.

Name a few minerals that have metallic luster?	Name a few minerals that don't have metallic luster?
Name some minerals with hardness above 5 on the Moh's Hardness scale? Name one easily scratched mineral?	Name some minerals that exhibit cleavage?
What are some uses for Galena?	What's Pyroxene made of? Is it a silicate or non-silicate mineral?
What chemical elements is Pyrite made from? How about Olivine? Is it a silicate mineral?	What mineral has a double refractive property and rhombohedral cleavage?
I am an ore of Iron and Steel? I also have magnetic properties	I am used in drywall boards. Easily scratched by fingernail?
I am a primary mineral used in ceramics and glass?	My composition is $Fe_3Al_2Si_3O_{12}$ Dark red to Green hardness 6.5-7.5
I have both metallic and non-metallic luster?	Name four minerals that exhibit fracture instead of cleavage?

Two main types of minerals

Silicate Minerals – Contain _____ and _____. 75% of all minerals.

Non-silicate minerals

Non-silicate minerals: All others

◇ Mineral Identification Quiz			
1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16
17	18 A.) B.)	19	20
Bonus: * 21		*22	Grade:

Part 4 Lesson 5,6,7 Properties of Minerals

Note: All mineral properties are the result from the _____ of the minerals _____.

Physical Property of Minerals- a characteristic that can be observed or measured without changing the _____ of the substance.

Luster – How light is _____ from a mineral.

Metallic (shiny)

or non-metallic (_____)

_____ – How easily a mineral can be scratched / it's resistance to being scratched. Moh's Hardness Scale goes from 1-10 (10 is the hardest)

Color – Tells what _____ make up the mineral.

Streak – The _____ of the mineral when it is broken up and powdered

Specific Gravity – How _____ the mineral is?



- ◇ Name _____
- ◇ Composition is (KAlSi_3O_8)
- ◇ Hardness _____
- ◇ Silicate Mineral Y/N
- ◇ Cleavage or Fracture?
- ◇ Luster _____
- ◇ Uses



- ◇ Name _____
- ◇ Composition $\text{KAl}_2(\text{Si}_3\text{AlO}_{10})(\text{OH})_2$
- ◇ Hardness _____
- ◇ Silicate Mineral Y/N
- ◇ Cleavage or Fracture?
- ◇ Luster _____
- ◇ Uses



- ◇ Name _____
- ◇ Composition SiO_2
- ◇ Hardness _____
- ◇ Silicate Mineral Y/N
- ◇ Cleavage/ Fracture?
- ◇ Luster _____
- ◇ Uses



- ◇ Name _____
- ◇ Composition CaF_2
- ◇ Hardness _____
- ◇ Silicate Mineral Y/N
- ◇ Cleavage or Fracture?
- ◇ Luster _____
- ◇ Uses



- ◇ Name _____
- ◇ Hardness _____
- ◇ Silicate Mineral Y/N
- ◇ Cleavage or Fracture?
- ◇ Luster _____
- ◇ Uses



- ◇ Name _____
- ◇ Composition _____
- ◇ Hardness _____
- ◇ Silicate Mineral Y/N
- ◇ Cleavage / Fracture?
- ◇ Luster _____
- ◇ Uses



- ◇ Name _____
- ◇ Composition is S
- ◇ Hardness _____
- ◇ Silicate Mineral Y/N
- ◇ Cleavage or Fracture?
- ◇ Does it smell?
- ◇ Uses



- ◇ Name _____
- ◇ Composition Fe_2O_3
- ◇ Hardness _____
- ◇ Silicate Mineral Y/N
- ◇ Cleavage or Fracture?
- ◇ Luster _____
- ◇ Uses



- ◇ Name _____
- ◇ Composition Fe_2S
- ◇ Hardness _____
- ◇ Silicate Mineral Y/N
- ◇ Cleavage/ Fracture?
- ◇ Luster _____
- ◇ Common Name?



- ◇ Name _____
- ◇ Composition NaCl
- ◇ Hardness _____
- ◇ Silicate Mineral Y/N
- ◇ Cleavage or Fracture?
- ◇ Luster _____
- ◇ Tastes like....



- ◇ Name _____
- ◇ Composition $CaCO_3$
- ◇ Hardness _____
- ◇ Silicate Mineral Y/N
- ◇ Cleavage or Fracture?
- ◇ Luster _____
- ◇ Uses



- ◇ Name _____
- ◇ Composition PbS
- ◇ Hardness _____
- ◇ Silicate Mineral Y/N
- ◇ Cleavage / Fracture?
- ◇ Luster _____
- ◇ Uses

Arrange the following minerals according to their Mohs hardness scale... 10= hardest , 1 = softest

Apatite, Gypsum, Quartz, Diamond, Calcite, Talc, Topaz, Corundum, Feldspar, Fluorite,

10.)	9.)	8.)	7.)	6.)
5.) Apatite	4.)	3.)	2.)	1.)

◇ Properties of Mineral Identification Quiz

1	2	3	4
5	6	7	8
9	10	*11	*Grade

◇ Properties of Mineral Identification Quiz – Actual Minerals, Teacher Choice, not in slideshow

1	2	3	4
5	6	7	8
9	10?	*11	*Grade

Use the pictures to describe some physical properties of minerals. Be specific and try and name the minerals.

Density, $D = \text{-----}$

I am...
 Clear Colorless Crystal (Squashed Box)
 Transparent (Double Refractive)
 Colorless to white
 Hardness of 5
 No smell
 Average to fast melting of ice
 Insoluble in water not acid
 Medium density
 Perfect cleavage

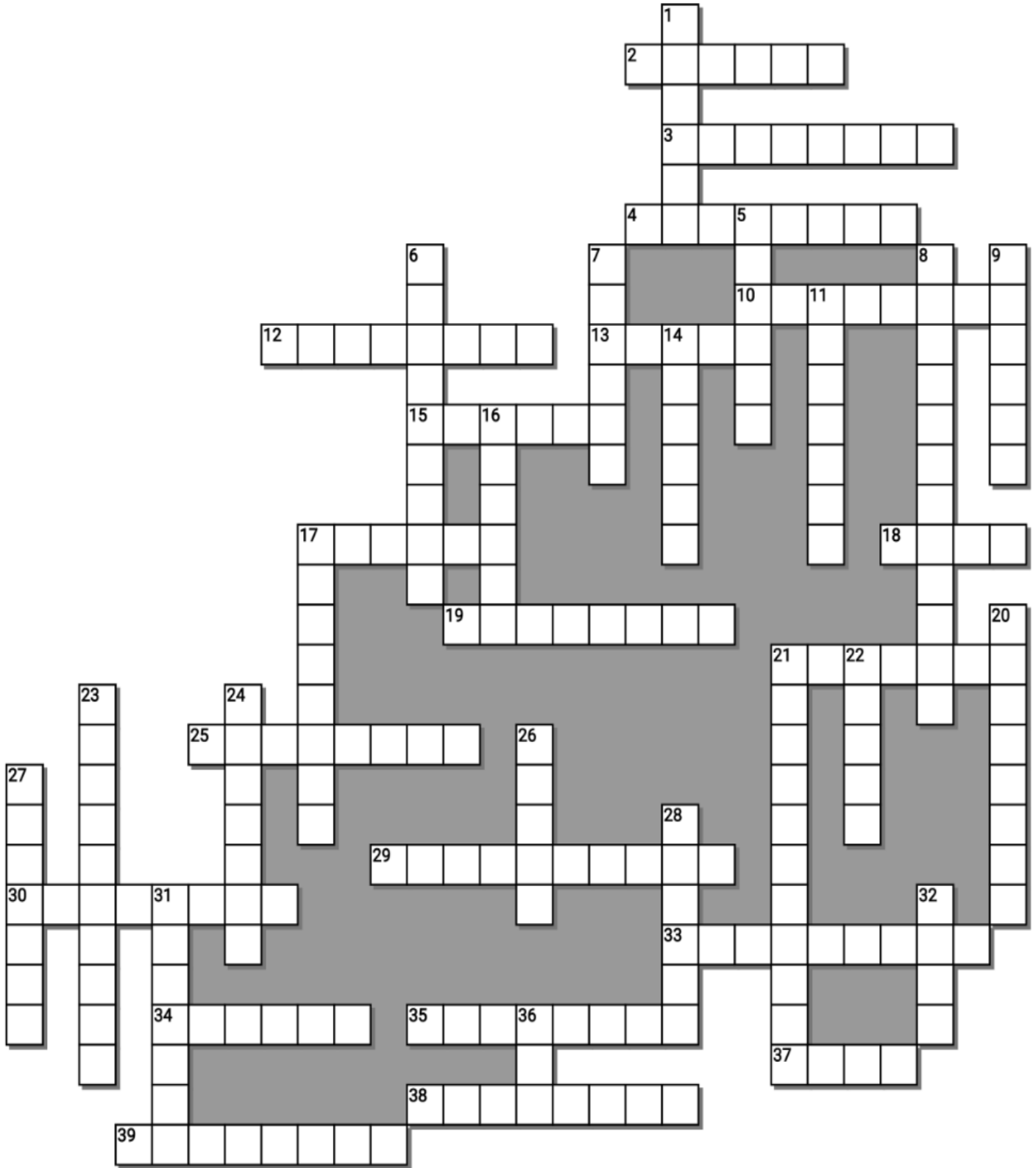
Melt Ice?

I am...
 Red to Black (Rust-like)
 Opaque
 Red to silver streak
 Hardness of 5
 No smell
 Average melting of ice
 Insoluble in water not acid
 Medium density
 No cleavage

I am...
 Brass yellow to gold
 Opaque
 Green to black
 Hardness of 6.5
 No smell
 Above average melting of ice
 Insoluble in water not acid
 High density
 No cleavage

Acid?

YOUR NAME HERE: _____



Possible Answers

APATITE, ATOMS, BAUXITE, CALCITE, COBALT, COLTAN, COPPER, CORUNDUM, CRYSTAL, FELDSPAR, FLUORITE, GALENA, GRAPHITE, GYPSUM, HALITE, HARDNESS, HEMATITE, HEXAGONAL, ISOMETRIC, LUSTER, METALLIC, MICA, MINERALS, MOHS, MONOCLINIC, OLIVINE, ORE, ORTHORHOMBIC, PROPERTY, PYRITE, PYROXENE, QUARTZ, ROCKS, SILICATE, STREAK, SULFUR, TALC, TETRAGONAL, TOPAZ, TRIGONAL, ARRANGEMENT

Across

2. This is a primary mineral that exists in almost all rock types
3. Primary Mineral. Composition is (KAlSi₃O₈)
4. Type of Crystal with (3 axis, all unequal and none at 90° angles).
10. Physical _____ of Minerals- a characteristic that can be observed or measured without changing the identity of the substance.
12. An important rock forming mineral. A major mineral in the rock basalt.
13. Minerals make up r_____
15. Common mineral containing lead. May form cubes and has luster/shine.
17. C_____ : Another mineral that can cause conflict as its important in creating lithium ion batteries. The mining practices also used child labor.
18. M_____ hardness scale...
19. A high grade of coal. Made of carbon, found in pencils, conducts electricity. Has luster / shine. Can be a lubricant.
21. Common phosphate mineral helps plants get phosphorus. Bones and teeth are composed of calcium phosphate.
25. This describes how easily a mineral can be scratched.
29. Type of Crystal: (Three axes, two are equal in length, one is unequal.)
30. These minerals contain silicon and oxygen. 75% of all minerals.
33. Type of Crystal: (All three axes are equal in length an at 90° degrees from each other.)
34. C_____ for short is one of the world's most sought-after materials. Its heat resistant properties allow us to use our technology devices.
35. Colorful mineral in light. Well known and prized for its glassy luster and rich variety of colors.
37. Softest mineral in the world. Uses include paper, paints, plastics, ceramics, rubber, personal care and roofing.
38. These are natural inorganic (non-organic) solid that join together (crystals) to make unique compositions.
39. Type of Crystal / bonds where individual metal atoms of metallic crystals sit on lattice sites.

Down

1. Used in the manufacturing of acid, fertilizers, chemicals, explosives. Smells of rotten eggs. Yellow
5. Processed and used as prefabricated wallboard or an industrial or building plaster.
6. Type of Crystal: (Four axes, three are equal in length and lie at an angle of 120° from each other).
7. The color_ of the mineral when it is broken up and powdered
8. Type of Crystal with: (All axis unequal in length, and 90° degrees from each other).
9. An iron sulfide often called "Fools Gold". Used to create a spark in ancient times. Used in paper today and to create sulfuric acid.
11. This mineral is a magnesium iron silicate. Common mineral in the earth's surface. Olive in color
14. Important mineral in electric cables and wires, switches, plumbing, heating; roofing and building construction
16. How light is reflected from a mineral.
17. It is an exceptionally hard aluminum oxide that forms in igneous and metamorphic rocks. Makes rubies and sapphires.
20. Iron loxide - black colored or reddish brown (rust-like) Named for the Greek word blood.
21. All mineral properties are the result from the _____ of the minerals atoms.
22. All mineral properties are the result from the arrangement of the minerals _____.
23. Type of Crystal: All axis unequal in length. Two of them are at right angles to each other, while the third is lies at an angle other than 90°.
24. This ore is the main source of aluminum which the most abundant mineral in the Earth's crust.
26. A sought after crystal that is formed from a silicate mineral of aluminum and fluorine. Colorless
27. A _____ is a solid in which the atoms arranged in a repeating pattern.
28. Used in human and animal diet, food seasoning and food preservations. Helps to melt ice.
31. Double Refractive Property. Rhombohedral shape. Mineral that forms Limestone. This mineral is made of calcium carbonate. When I change forms I can become the rock marble.

Part 4 Minerals Review Game 10/11

Name:

Score ____ / 100

1-20 = 5 pts

*20-*25 * = Bonus + 1 pt,

(Secretly write owl in correct space +1 pt)

Final Question = 5 pt wager

MINERALS 101	SHAPE-UP	PRETTY COLORS	PRIVATE PROPERTY	Minerals in MOVIES Bonus round 1 pt each
1)	6)	11)	16)	*21)
2)	7)	12)	17)	*22)
3)	8)	13)	18)	*23)
4)	9)	14)	19)	*24)
5)	10)	15)	20)	*25)

Final Question Wager ____ /5 Answer

Part 4 Minerals

Name _____

Part 4 Lesson 1 Minerals

Rock – Mass or grouping of minerals

Minerals are natural inorganic (**non-organic**) **solid** that join together (**crystals**) to make unique compositions.

Which picture is a mineral? **Explain** why below each image.



This is not a mineral because it is a living creature that is organic.



This is not a mineral because it is not naturally occurring. Made by humans.



This is not a mineral because it is a liquid and not a solid

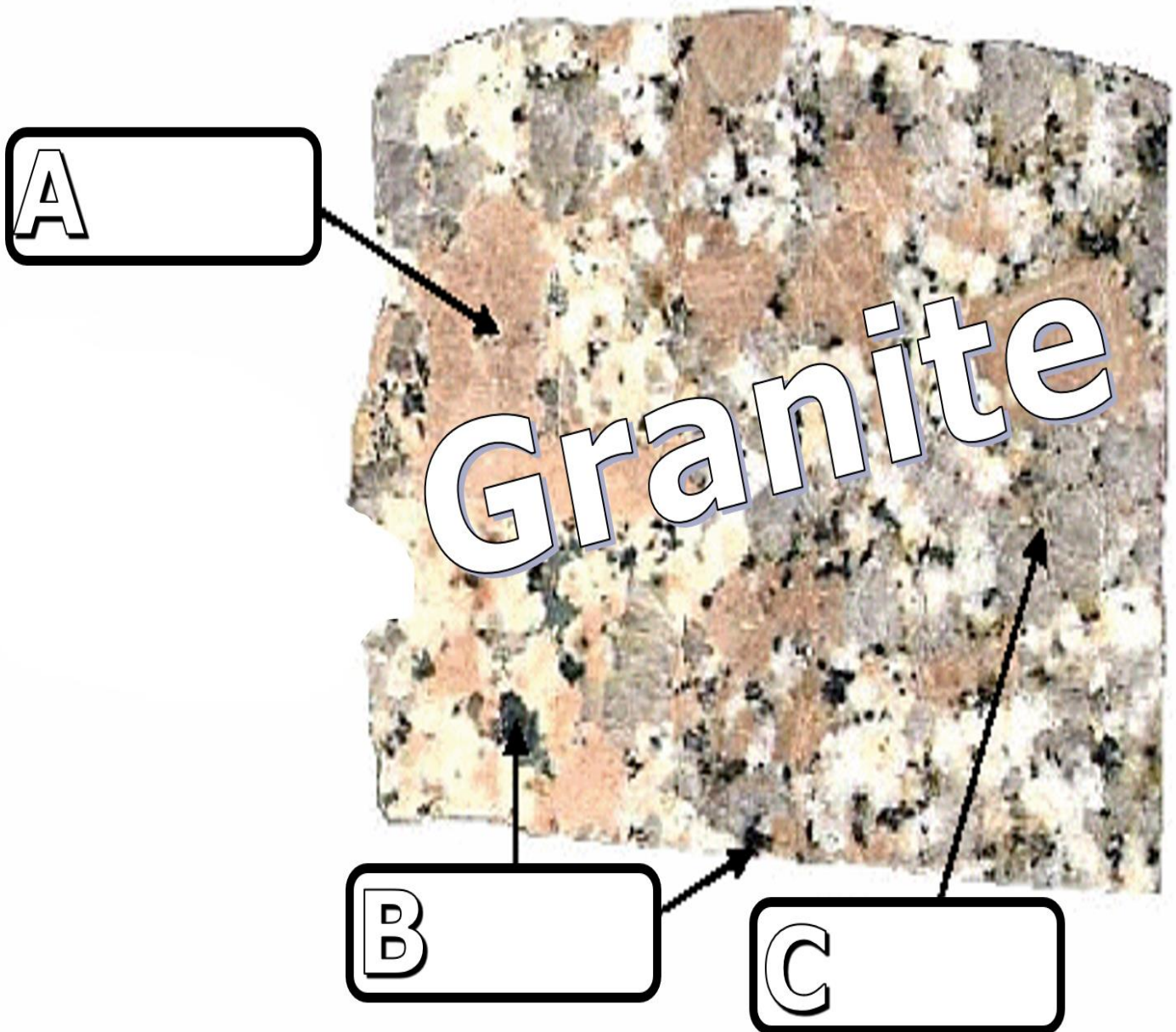


This is a mineral because it is a natural inorganic (non-living) solid that is joined together (crystals) to make unique compositions.

Part 4 Lesson 2 Crystals

Name some primary minerals that are in the rock Granite below.

A=Feldspar	B=Quartz	C=Mica
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A crystal is a solid in which the **atoms** are arranged in a repeating pattern.

Uses of minerals

Gems \$

Ores, Mined for \$

Please describe a downside to valuable minerals below.

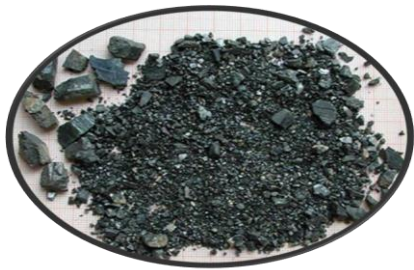
Columbite-tantalite (aka...coltan), or cobalt, and diamonds.

Response=

COLTAN – Columbite-tantalite (coltan) for short is one of the world's most sought-after materials. Its heat resistant properties allow us to use our technology devices. It is a conflict mineral that is mined and can fund military groups. Mostly in the DRC Democratic Republic of Congo

COBALT – Another mineral that can cause conflict as its important in creating lithium ion batteries. The mining practices also used child labor.

DIAMONDS - (especially in Africa) an uncut diamond mined in an area of armed conflict and traded illicitly to finance the fighting.



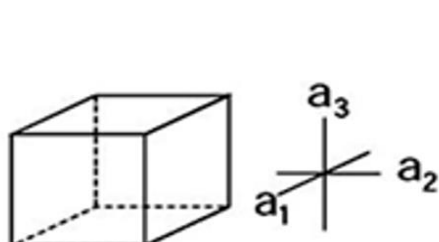
Types of crystals.

- **Hexagonal** (Four axes, three are equal in length and lie at an angle of 120° from each other).
- **Trigonal:** (3 axis, all unequal and none at 90° angles).
- **Orthorhombic:** (All axis unequal in length, and 90° degrees from each other).
- **Monoclinic:** All axis unequal in length. Two of them are at right angles to each other, while the third is lies at an angle other than 90° .
- Tetragonal. (Three axes, two are equal in length, one is unequal.)
- **Isometric:** (All three axes are equal in length an at 90° degrees from each other.)

Part 4 Lesson 3 start

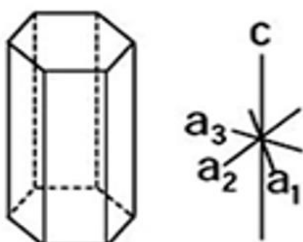
Name the type of Crystals below.

A=Isometric (Cubic)	B=Hexagonal	C=Tetragonal
D=Orthorhombic	E=Monoclinic	F=Triclinic



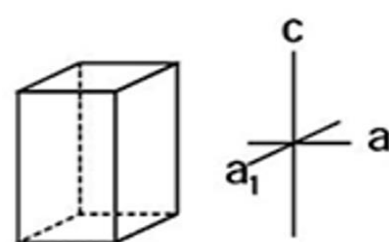
$a_1 = a_2 = a_3$
all angles 90°

A



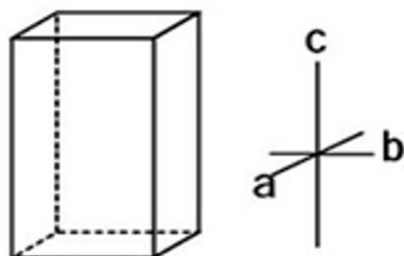
$a_1 = a_2 = a_3 \neq c$
angles $a_{1,3}$ to $c = 90^\circ$
angles between a axes = 60°

B



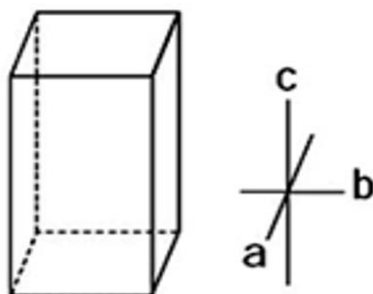
$a_1 = a_2 \neq c$
all angles 90°

C



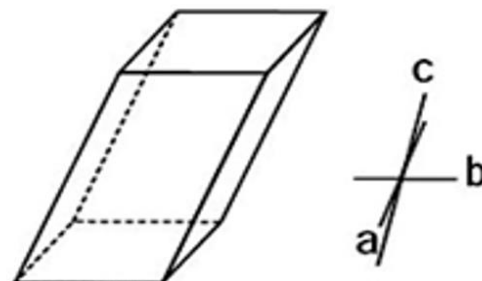
$a \neq b \neq c$
all angles 90°

D



$a \neq b \neq c$
angle between a & b
and b & $c = 90^\circ$;
angle between c & $a > 90^\circ$

E



$a \neq b \neq c$
all angles $\neq 90^\circ$

F

Part 4 Lesson 3 Crystals, Bonds, Quiz

Crystal Properties / Chemical Bonds

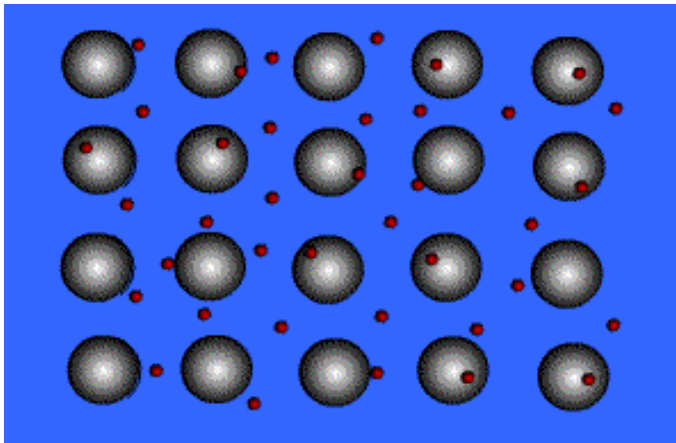
- **Covalent Crystals:** Covalent bonds between all of the atoms.
Example: Diamond, Zinc Sulfide crystals.
- **Metallic Crystals:** Individual metal atoms of metallic crystals sit on lattice sites.
 - Many free electrons. High melting points.
- **Ionic Crystals:** The atoms are held together by electrostatic forces (ionic bonds).
 - Ex: (NaCl) table salt
 - Example – Sucrose in rock candy, ice cube

Name three types of crystals based on their properties / chemical bonds?
Additional information and or examples are welcome.

Answer=

Metallic Crystals: Individual metal atoms of metallic crystals sit on lattice sites.

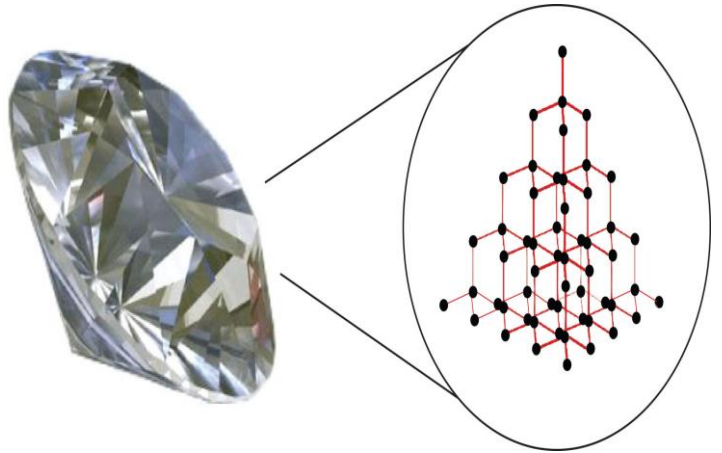
Many free electrons. High melting points.



Answer=

Covalent Crystals: Covalent bonds between all of the atoms.

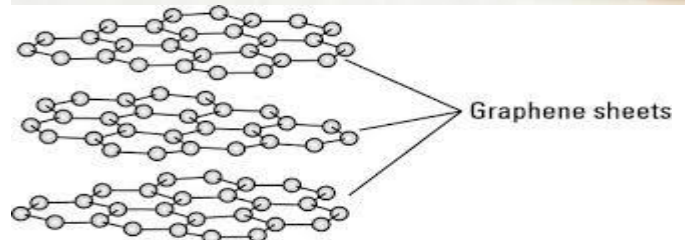
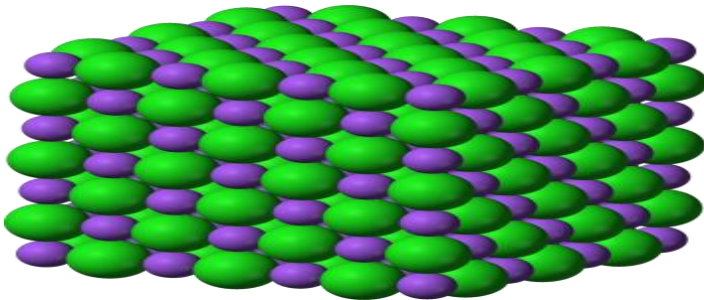
Example: Diamond, Zinc Sulfide crystals.



Answer=

Ionic Crystals: The atoms are held together by electrostatic forces (ionic bonds).

Ex: (NaCl) table salt

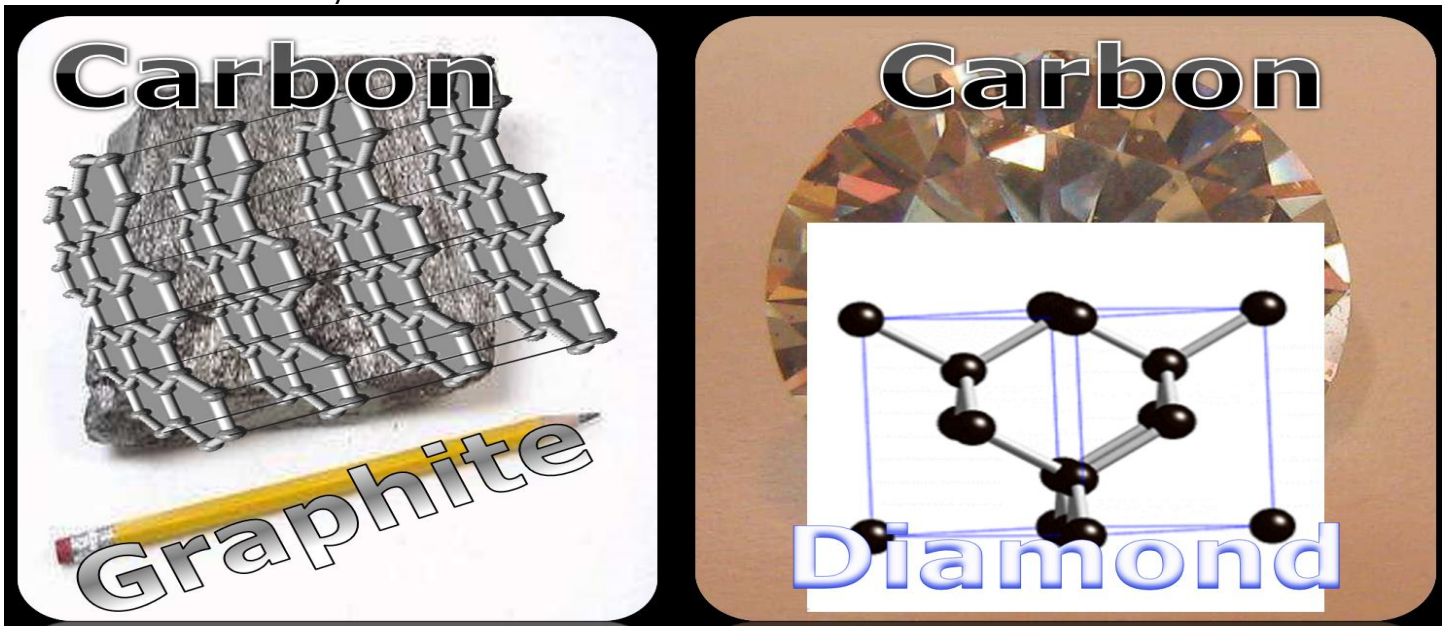


Covalent Crystals: Covalent bonds between all of the atoms.

Example: Diamond, Zinc Sulfide crystals.

Any guess for graphite in pencils?

A diamond (extremely hard) and the graphite in pencil (extremely soft) are both made entirely of Carbon? How can this be?



- Note: All mineral properties are the result from the arrangement of the minerals atoms.

Both graphite and diamonds are both made of carbon atoms. Graphite is a soft mineral and we use it in pencils. When we write with a pencil, sheets of carbon break away and bond with your paper. A diamond, which is also made of carbon has different arrangement of atoms. Instead of being arranged in a sheet, they are arranged tetrahedrally and as a result diamonds are extremely hard. Both graphite and diamonds are made of the same atom but have extremely different properties.

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

Part 4 Lesson 4 Primary Minerals

Use the common mineral properties scheme on the prior page to help you answer some of the questions below.

<p>Name a few minerals that have metallic luster?</p> <p>PYRITE, GRAPHITE, HEMATITE, GALENA, MAGNETITE,</p>	<p>Name a few minerals that don't have metallic luster?</p> <p>SULFUR, FELDSPAR, FLOURITE, CALCITE, HALITE, not the ones to the left with metallic luster</p>
<p>Name some minerals with hardness above 5 on the Moh's Hardness scale?</p> <p>PYRITE, HEMATITE, QUARTZ, PYROXENE, AMPHIBOLE, FELDSPAR, OLIVINE, QUARTZ, TOPAZ, GARNET</p> <p>Name one easily scratched mineral? GRAPHITE, CALCITE, HALITE, anything with low hardness</p>	<p>Name two minerals that exhibit cleavage, and two that exhibit fracture?</p> <p>FRACTURE – PYRITE, MAGNETITE, SULFUR, OLIVINE, QUARTZ, GARNET</p> <p>CLEAVAGE- All of the others</p>
<p>What is one use for Galena?</p> <p>Batteries, Ore of Lead</p>	<p>What's Pyroxene made of? Is it a silicate or non-silicate mineral?</p> <p>(NaCa)(Mg,Fe,Al)(Al,Si)2O6– It is a silicate mineral</p>
<p>What chemical elements is Pyrite made from?</p> <p>Iron and Sulfur - FeS₂</p> <p>How about Olivine? Is it a silicate</p>	<p>What mineral has a double refractive property and rhombohedral cleavage?</p> <p>Calcite</p>

mineral? $(\text{Mg}^{2+}, \text{Fe}^{2+})_2\text{SiO}_4$	
I am an ore of Iron and Steel? I also have magnetic properties Magnetite	I am used in drywall boards. Easily scratched by fingernail? GYPSUM
I am a primary mineral used in ceramics and glass? Feldspar	My composition is $\text{Fe}_3\text{Al}_2(\text{SiO}_4)_3$ Garnet
I have both metallic and non-metallic luster? Hematite	Name four minerals that exhibit fracture instead of cleavage? FRACTURE – PYRITE, MAGNETITE, SULFUR, OLIVINE, QUARTZ, GARNET

Two main types of minerals

Silicate Minerals – Contain **silicon** and **oxygen**. 75% of all minerals.
Non-silicate minerals

Non-silicate minerals: All others.

◇ Mineral Identification Quiz

1 GYPSUM	2 QUARTZ	3 SULFUR	4 HEMATITE
5 GRAPHITE	6 MICA	7 FLUORITE	8 PYRITE
9 FELDSPAR	10 HALITE	11 BAUXITE	12 CALCITE
13 AMPHIBOLE	14 COPPER	15 TALC	16 TOPAZ
17 APATITE	18 A.) PYROXENE B.) OLIVINE	19 GALENA	20 CORUNDUM
Bonus: * 21 SONIC		*22 GANDALF	Grade:

Part 4 Lesson 5,6,7 Properties of Minerals

Note: All mineral properties are the result from the **arrangement** of the minerals **atoms**.

Physical Property of Minerals- a characteristic that can be observed or measured without changing the **identity** of the substance.

Luster – How light is **reflected** from a mineral.

- Metallic (shiny)
- or non-metallic (dull)

Hardness – How easily a mineral can be scratched.

Color – Tells what **atoms** make up the mineral.

Streak – The **color** of the mineral when it is broken up and powdered

Specific Gravity – How **dense** the mineral is?



- ◇ Name **FELDSPAR**
- ◇ Composition is **(KAlSi₃O₈)**
- ◇ Hardness **6**
- ◇ Silicate Mineral **Y/N**
- ◇ Cleavage or **Fracture**?
- ◇ Luster **Non-metallic**
- ◇ Uses **–Glass, Ceramics**



- ◇ Name **MICA**
- ◇ Composition **KAl₂(Si₃AlO₁₀)(OH)₂**
- ◇ Hardness **2.5**
- ◇ Silicate Mineral **Y/N**
- ◇ **Cleavage** or Fracture?
- ◇ Luster **Non-metallic**
- ◇ Uses **–Construction Materials**



- ◇ Name **QUARTZ**
- ◇ Composition **SiO₄**
- ◇ Hardness **7**
- ◇ Silicate Mineral **Y/N**
- ◇ Cleavage/ **Fracture**?
- ◇ Luster **Non-metallic**
- ◇ Uses **–Glass Jewelry Electronics**



- ◇ Name **Fluorite**
- ◇ Composition **CaF₂**
- ◇ Hardness **4**
- ◇ Silicate Mineral **Y/N**
- ◇ **Cleavage** or Fracture?
- ◇ Luster **Non-metallic**
- ◇ Uses **HYDROFLUORIC ACID**



- ◇ Name **PYROXENE**
- ◇ Hardness **5-6**
- ◇ Silicate Mineral **Y/N**
- ◇ Cleavage or **Fracture?**
- ◇ Luster **Non-metallic**
- ◇ Uses **JEWELRY, Rock forming mineals**



- ◇ Name **GRAPHITE**
- ◇ Composition **Carbon**
- ◇ Hardness **1-2**
- ◇ Silicate Mineral **Y/N**
- ◇ **Cleavage** / Fracture?
- ◇ Luster **Metallic**
- ◇ Uses **Pencils, Lubricant**



- ◇ Name **Sulfur**
- ◇ Composition is S
- ◇ Hardness **2**
- ◇ Silicate Mineral **Y(N)**
- ◇ Cleavage or **Fracture?**
- ◇ Does it smell? **Rotten Eggs**
- ◇ Uses **Fertilizers, Biologically Important**



- ◇ Name **Hematite**
- ◇ Composition **Fe₂O₃**
- ◇ Hardness _____
- ◇ Silicate Mineral **Y(N)**
- ◇ Cleavage or **Fracture?**
- ◇ Luster **Sometimes**
- ◇ Uses **Ore of Iron,**



- ◇ Name **Pyrite**
- ◇ Composition **Fe₂S**
- ◇ Hardness **6.5**
- ◇ Silicate Mineral **Y(N)**
- ◇ Cleavage or **Fracture?**
- ◇ Luster **Metallic**
- ◇ Common Name? **Fools Gold**

 <p> ◇ Name <u>Halite</u> ◇ Composition <u>NaCl</u> ◇ Hardness <u>2.5</u> ◇ Silicate Mineral <u>Y/N</u> ◇ Cleavage or Fracture? <u>Non-metallic</u> ◇ Luster <u>Non-metallic</u> ◇ Tastes like.... <u>Salt</u> </p>	 <p> ◇ Name <u>Calcite</u> ◇ Composition <u>CaCO₃</u> ◇ Hardness <u>3</u> ◇ Silicate Mineral <u>Y/N</u> ◇ Cleavage or Fracture? <u>Non-metallic</u> ◇ Luster <u>Non-metallic</u> ◇ Uses <u>Building uses</u> </p>	 <p> ◇ Name <u>Galena</u> ◇ Composition <u>PbS</u> ◇ Hardness <u>2.5+</u> ◇ Silicate Mineral <u>Y/N</u> ◇ Cleavage or Fracture? <u>Metallic</u> ◇ Luster <u>Metallic</u> ◇ Uses <u>Ore of lead</u> </p>
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Arrange the following minerals according to their Mohs hardness scale... 10= hardest , 1 = softest

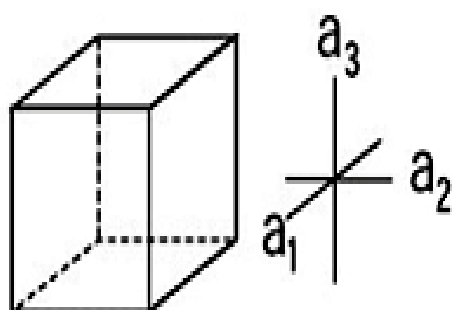
Apatite, Gypsum, Quartz, Diamond, Calcite, Talc, Topaz, Corundum, Feldspar, Fluorite,

10.) Diamond	9.) Topaz	8.) Corundum	7.) Quartz	6.) Feldspar
5.) Apatite	4.) Flourite	3.) Calcite	2.) Gypsum	1.) Talc

Use the pictures to describe some physical properties of minerals. Be specific and try and name the minerals.

◇ Properties of Mineral Identification Quiz

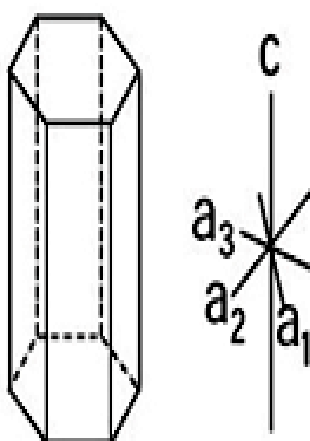
1 Rose Quartz	2 Calcite	3 Feldspar	4 Pyrite
5 Mica	6 Halite	7 Hematite	8 Sulfur
9 Mica	10 ? Choice	*11 Dragon	*Grade



$$a_1 = a_2 = a_3$$

$$\text{all angles } 90^\circ$$

ISOMETRIC
(CUBIC)

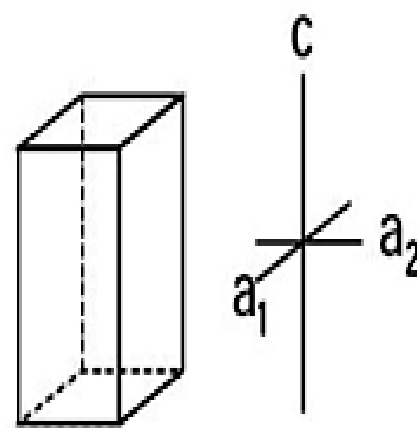


$$a_1 = a_2 = a_3 \neq c$$

$$\text{angles } a_{1,3} \text{ to } c = 90^\circ$$

$$\text{angles between } a \text{ axes} = 60^\circ$$

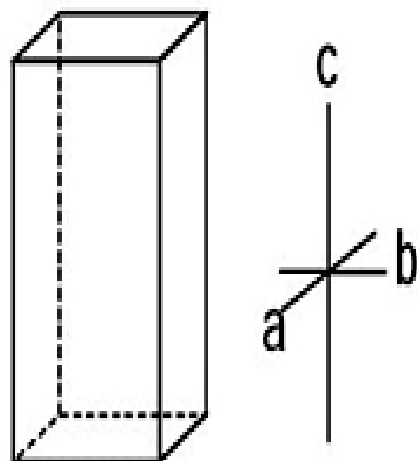
HEXAGONAL



$$a_1 = a_2 \neq c$$

$$\text{all angles } 90^\circ$$

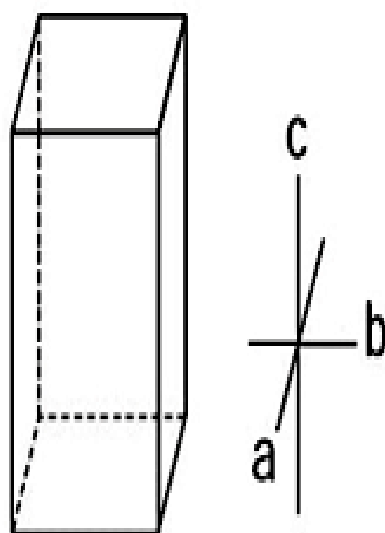
TETRAGONAL



$$a \neq b \neq c$$

$$\text{all angles } 90^\circ$$

ORTHORHOMBIC



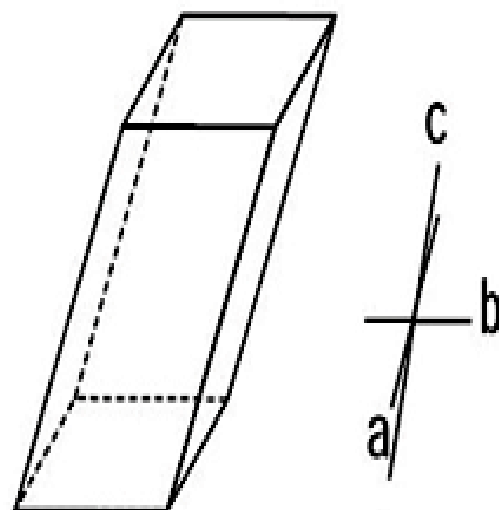
$$a \neq b \neq c$$

$$\text{angle between } a \& b$$

$$\text{and } b \& c = 90^\circ,$$

$$\text{angle between } c \& a > 90^\circ$$

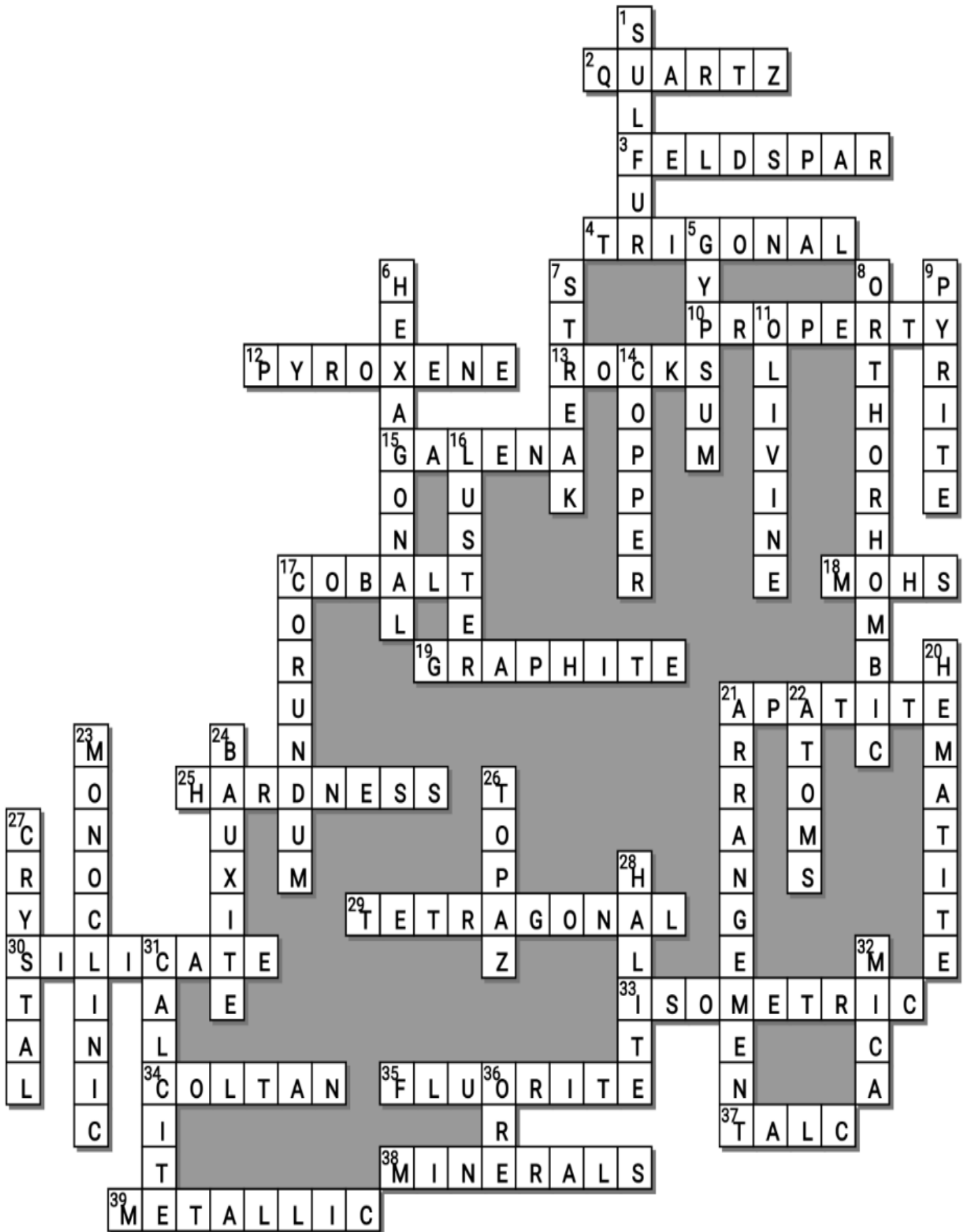
MONOCLINIC



$$a \neq b \neq c$$

$$\text{all angles } \neq 90^\circ$$

TRICLINIC



Across

2. This is a primary mineral that exists in almost all rock types
3. Primary Mineral. Composition is (KAlSi₃O₈)
4. Type of Crystal with (3 axis, all unequal and none at 90° angles).
10. Physical _____ of Minerals- a characteristic that can be observed or measured without changing the identity of the substance.
12. An important rock forming mineral. A major mineral in the rock basalt.
13. Minerals make up r_____
15. Common mineral containing lead. May form cubes and has luster/shine.
17. C_____ : Another mineral that can cause conflict as its important in creating lithium ion batteries. The mining practices also used child labor.
18. M_____ hardness scale...
19. A high grade of coal. Made of carbon, found in pencils, conducts electricity. Has luster / shine. Can be a lubricant.
21. Common phosphate mineral helps plants get phosphorus. Bones and teeth are composed of calcium phosphate.
25. This describes how easily a mineral can be scratched.
29. Type of Crystal: (Three axes, two are equal in length, one is unequal.)
30. These minerals contain silicon and oxygen. 75% of all minerals.
33. Type of Crystal: (All three axes are equal in length an at 90° degrees from each other.)
34. C_____ for short is one of the world's most sought-after materials. Its heat resistant properties allow us to use our technology devices.
35. Colorful mineral in light. Well known and prized for its glassy luster and rich variety of colors.
37. Softest mineral in the world. Uses include paper, paints, plastics, ceramics, rubber, personal care and roofing.
38. These are natural inorganic (non-organic) solid that join together (crystals) to make unique compositions.
39. Type of Crystal / bonds where individual metal atoms of metallic crystals sit on lattice sites.

Down

1. Used in the manufacturing of acid, fertilizers, chemicals, explosives. Smells of rotten eggs. Yellow
5. Processed and used as prefabricated wallboard or an industrial or building plaster.
6. Type of Crystal: (Four axes, three are equal in length and lie at an angle of 120° from each other).
7. The color_ of the mineral when it is broken up and powdered
8. Type of Crystal with: (All axis unequal in length, and 90° degrees from each other).
9. An iron sulfide often called "Fools Gold". Used to create a spark in ancient times. Used in paper today and to create sulfuric acid.
11. This mineral is a magnesium iron silicate. Common mineral in the earth's surface. Olive in color
14. Important mineral in electric cables and wires, switches, plumbing, heating; roofing and building construction
16. How light is reflected from a mineral.
17. It is an exceptionally hard aluminum oxide that forms in igneous and metamorphic rocks. Makes rubies and sapphires.
20. Iron loxide - black colored or reddish brown (rust-like) Named for the Greek word blood.
21. All mineral properties are the result from the _____ of the minerals atoms.
22. All mineral properties are the result from the arrangement of the minerals _____.
23. Type of Crystal: All axis unequal in length. Two of them are at right angles to each other, while the third is lies at an angle other than 90°.
24. This ore is the main source of aluminum which the most abundant mineral in the Earth's crust.
26. A sought after crystal that is formed from a silicate mineral of aluminum and fluorine. Colorless
27. A _____ is a solid in which the atoms arranged in a repeating pattern.
28. Used in human and animal diet, food seasoning and food preservations. Helps to melt ice.
31. Double Refractive Property. Rhombohedral shape. Mineral that forms Limestone. This mineral is made of calcium carbonate. When I change forms I can become the rock marble.

Part 4 Minerals Review Game 10/11

Name: _____

Score ____ / 100

1-20 = 5 pts

*20-*25* = Bonus + 1 pt,

(Secretly write owl in correct space +1 pt)

Final Question = 5 pt wager

MINERALS 101	SHAPE-UP	PRETTY COLORS	PRIVATE PROPERTY	Minerals in MOVIES Bonus round 1 pt each
1) INORGANIC & CRYSTALS	6) TRICLINIC	11) A and D Feldspar & QUARTZ	16) HARDNESS SCALE (Mohs Hardness Scale)	*21) MOVIE ALADDIN
2) Letter G	7) HEXAGONAL	12) QUARTZ	17) LUSTER	*22) DOPEY
3) ATOMS	8) ISOMETRIC	13) MUSCOVITE MICA	18) STREAK	*23) EMERALD CITY WIZARD OF OZ
4) ORES	9) LETTER A	14) FELDSPAR	19) FRACTURE CLEAVAGE	*24) ONWARD
5) GEMS	10) SILICATE MINERALS	15) FLUORITE	20) HALITE	*25) MALEFICENT

Final Question Wager ____/5 Answer

Answer: Galena **Isometric Crystal**

