

Minerals Study Guide

Modified True/False

Indicate whether the sentence or statement is true or false. If false, change the identified word or phrase to make the sentence or statement true.

- _____ 1. Although a few minerals are composed of single elements, most are made from compounds.

- _____ 2. Minerals can form when differences in density force magma upward into warmer layers of Earth's interior. _____
- _____ 3. Mineral crystals may begin to precipitate out of a solution that has become saturated.

- _____ 4. The most common minerals, feldspar and quartz, are carbonates. _____
- _____ 5. Gems are prized for their great availability and beauty. _____
- _____ 6. There are at least 3000 known minerals in Earth's crust. _____
- _____ 7. Minerals form from cooled magma and from elements in gases. _____
- _____ 8. Minerals can be identified based on their physical and chemical properties.

- _____ 9. The most reliable way to identify a mineral is by using a combination of several tests.

- _____ 10. The classification of a mineral as an ore does not change once it has been mined.

- _____ 11. Trace elements in a mineral do not affect the color or the value of mineral.

Multiple Choice

Identify the letter of the choice that best completes the statement or answers the question.

- _____ 12. Minerals always exist in a(n) _____ form.
 - a. liquid
 - b. gaseous
 - c. solid
 - d. organic
- _____ 13. The most abundant elements in Earth's crust are _____.
 - a. aluminum and potassium
 - b. halite and coal
 - c. oxides and carbonates
 - d. oxygen and silicon
- _____ 14. Silver, gold, and copper have shiny surfaces and thus are said to have _____.
 - a. dull luster
 - b. metallic luster
 - c. waxy luster
 - d. nonmetallic luster

- ____ 15. Ores near Earth's surface generally are obtained from ____.
- waste-removal facilities
 - underground mines
 - open-pit mines
 - bodies of water with high concentrations of dissolved minerals

Completion

Complete each sentence or statement.

- A mineral, such as salt, is naturally occurring but _____, in contrast to sugar, which comes from plants.
- A mineral can take the shape of one of the six major _____ systems.
- _____ make up the most common mineral group.
- When compounds in cooling _____ no longer move freely, they may interact chemically to form minerals.
- _____ is described as either metallic or nonmetallic.
- A mineral's _____ rarely changes, but sometimes does not match its external color.
- Mohs scale is used to compare the _____ of minerals.
- Mica has perfect _____ in one direction; it breaks in sheets.
- When flint and opals break, they have a unique _____ with arlike patterns.
- Geologists commonly use _____ as a measure of density for accurate identification of a mineral.

Matching

Match each item with the correct statement below.

- | | |
|-------------|---------------------|
| a. cleavage | d. luster |
| b. fracture | e. specific gravity |
| c. hardness | f. streak |

- Ratio of the weight of a substance to the weight of an equal volume of water
- Property of splitting along one or more flat planes evenly and easily
- Property of breaking with rough or jagged edges
- Measure of how easily a mineral can be scratched
- Color of a mineral when it is broken up and powdered
- The way a mineral reflects light from its surface

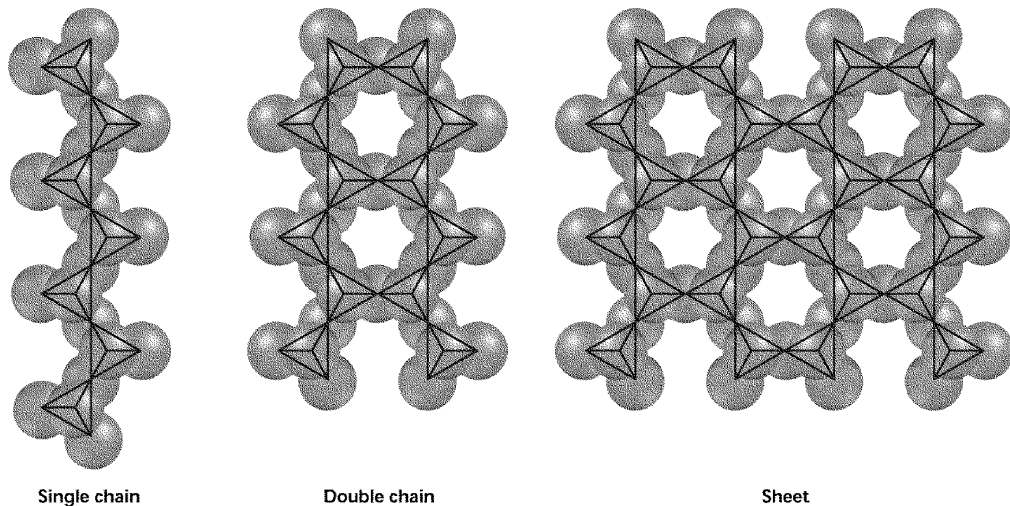
Match each item with the correct statement below.

- | | |
|------------|-------------|
| a. crystal | d. mineral |
| b. gem | e. ore |
| c. magma | f. silicate |

- ___ 32. Naturally occurring, inorganic solid with specific chemical composition and crystalline structure
- ___ 33. Solid in which the atoms are arranged in repeating patterns
- ___ 34. Molten material found beneath Earth's crust
- ___ 35. Mineral that contains silicon and oxygen
- ___ 36. Mineral that contains a useful substance that can be mined for profit
- ___ 37. Valuable mineral prized for its rarity and beauty

Short Answer

38. Discuss the unique characteristic of silica that is represented in the diagram below.



39. Which is a more reliable method of identifying a mineral—streak or color? Explain.
40. How does the cost of removing waste material affect the classification of an ore?
41. Explain the meaning of the terms *naturally occurring* and *inorganic* as they relate to mineral characteristics.

Compare and contrast each pair of related terms or phrases.

42. cleavage, fracture
43. density, specific gravity
44. hardness, texture
45. luster, streak

46. What are three characteristics of a mineral?
47. If you took random samples of minerals from several locations, which type of mineral would you likely have more of—oxides, silicates, or carbonates. Why?
48. What accounts for the large diversity of silicates?
49. Why is color one of the least reliable tests for identifying minerals? Give an example to support your answer.
50. Why are some minerals classified as gems? Give three examples of gems.
51. A solution is nearly saturated with dissolved minerals. What will happen if 50 percent of the water in the solution evaporated?
52. What conditions typically result in the formation of large, well-shaped mineral crystals?
53. What can you conclude about the atomic bonds along a plane of cleavage?
54. Why do geologists usually use a combination of tests to identify a mineral?
55. What mineral would you use to polish a piece of corundum? Why?
56. Which mineral would react to iron filings—magnetite or graphite? What special property would that mineral have?
57. What three factors should be considered before mining a newly found mineral deposit?

Use this table for the six mineral samples to answer the following questions.

Mineral	Specific Gravity	Chemical Formula	Breakage Pattern
Gold	19.3	Au	Hackly
Apatite	5	$\text{Ca}_5(\text{PO}_4)_3(\text{F}, \text{OH}, \text{Cl})$	Uneven fracture
Pyrite	5.2	FeS_2	Uneven fracture
Garnet	3.5–4.3	$(\text{Mg}, \text{Fe}, \text{Ca})_3(\text{Al}_2\text{Si}_3\text{O}_{12})$	Conchoidal fracture
Beryl	2.75	$\text{Be}_3\text{Al}_2\text{Si}_6\text{O}_{18}$	Uneven fracture
Corundum	4	Al_2O_3	Fracture

58. If the volume of the sample of pyrite equals the volume of the sample of gold, how many times greater is the mass of the gold sample than the mass of the pyrite sample?
59. How can the breakage pattern be used to distinguish between gold and pyrite?
60. Which of the six minerals is a native element?
61. List the six minerals in order from most dense to least dense.

Problem

62. Your task is to determine the relative hardness on the Mohs' scale of two everyday objects—a penny and a steel pocketknife. You also have samples of gypsum, fluorite, and quartz. By experimentation, you determine the following: The penny scratches gypsum, but it doesn't scratch quartz, fluorite, or the knife blade. The knife scratches gypsum, fluorite, and the penny, but it doesn't scratch quartz. What is the hardness of the penny? What range of Mohs' values can the knife blade have?

Mohs Harness Scale		
	Hardness	Hardness of Common Objects
Talc	1 (softest)	
Gypsum	2	finger nail (2.5)
Calcite	3	piece of copper (3.5)
Fluorite	4	iron nail (4.5)
Apatite	5	glass (5.5)
Feldspar	6	steel file (6.5)
Quartz	7	streak plate (7)
Topaz	8	scratches quartz
Corundum	9	scratches topaz
Diamond	10 (hardest)	scratches all common materials

Three pairs of mineral samples are brought to you for testing. Both samples in one pair look like gold, but one is pyrite, or fool's gold. Both samples in the second pair look like emeralds, but one is nonprecious apatite. Both samples in the third pair look like rubies, but one is a less valuable garnet. Use the information in the table to complete the dichotomous key to identify each mineral.

Mineral	Color	Hardness
Gold	Metallic gold	2.5–3
Apatite	Blue, green	5
Pyrite	Metallic pale brass, gold	6–6.5
Garnet	Red, deep red, brown	6.5–7.5
Beryl	Bluish green, green	7.5–8
Corundum	Red, deep red	9

63. Which mineral can scratch at least one of the green stones?

Name: _____

ID: A

64. Which mineral can scratch neither green stone?
65. Which mineral can scratch at least one of the red stones?
66. Which mineral can scratch neither red stone?
67. Which mineral can scratch only one of the green stones?
68. Which mineral can scratch both green stones?

Minerals Study Guide Answer Section

MODIFIED TRUE/FALSE

1. T
2. F, cooler
3. T
4. F, silicates
5. F, rarity
6. T
7. F, solutions
8. T
9. T
10. F, can change
11. F, can affect

MULTIPLE CHOICE

12. C
13. D
14. B
15. C

COMPLETION

16. inorganic
17. crystal
18. Silicates
19. magma
20. Luster
21. streak
22. hardness
23. cleavage
24. fracture
25. specific gravity

MATCHING

26. E
27. A
28. B

- 29. C
- 30. F
- 31. D

- 32. D
- 33. A
- 34. C
- 35. F
- 36. E
- 37. B

SHORT ANSWER

- 38. One silicon attaches to four oxygen atoms to form one tetrahedron. A tetrahedron has the ability to share oxygen atoms with other tetrahedron molecules. This structure allows elements to combine chemically and structurally in a vast number of ways and accounts for the diversity in silicates. As shown in the diagram, silica tetrahedra can form single chains, double chains, or a tetrahedral sheet.
- 39. Streak; a mineral's streak rarely changes, even if it is weathered or its external color varies slightly.
- 40. If the cost of removing the waste material becomes higher than the value of the ore itself, the mineral will no longer be classified as an ore. It would no longer be economical to mine the ore.
- 41. A naturally occurring substance is one that is made by natural processes. Thus, a substance developed in a lab, such as a synthetic diamond, cannot be considered a mineral. An inorganic substance is one that is not alive nor has ever been alive. Therefore coal, formed by an organic process, is not a mineral.
- 42. Both describe how minerals split due to their atomic arrangements. Minerals with cleavage split easily and evenly along one or more planes, while minerals with fracture break unevenly along jagged edges.
- 43. Density is the ratio of the mass of a substance divided by its volume. Specific gravity is the most common measure of density. It is the ratio of the weight of a substance to the weight of an equal volume of water.
- 44. Both are tests used to identify a mineral. Hardness is a measure of how easily a mineral can be scratched, while texture describes how a mineral feels.
- 45. Both are tests used to identify a mineral. Luster is the way a mineral reflects light from its surface, while streak is the color of a mineral when it is broken up and powdered.
- 46. Answers should include any three of the following: naturally occurring, inorganic, solid, unique chemical composition, definite crystalline structure.
- 47. There likely would be more silicates than other types because 96 percent of the minerals in Earth's crust are silicates.
- 48. A silica tetrahedron has the ability to share oxygen atoms with other tetrahedrons. This allows elements to combine chemically and structurally in many ways.
- 49. Color is not a reliable test because a lot of minerals have the same color and can be mistaken for one another. Pyrite and gold, for example, cannot be distinguished by color alone.
- 50. Rare or exceptionally beautiful minerals that are considered to be valuable are called gems. Examples include diamonds, sapphires, emeralds, rubies, and amethyst.

51. Crystals may begin to form.
52. Large, well-shaped crystals tend to form from magmas that cool slowly in an unrestricted space.
53. The atomic bonds along a plane of cleavage are usually weak. That is why they break evenly into a cleavage plane.
54. Some minerals have characteristics similar to other minerals. Therefore, more than one test may be necessary to accurately identify the minerals.
55. Diamond could polish corundum because diamond is harder than corundum and is capable of scratching the surface of corundum instead of being scratched by it.
56. Magnetite would react to the iron filings. It is naturally magnetic.
57. Answers may vary. Students may say the cost of mining the mineral, the demand for the mineral, and the environmental impact of the mine. Accept all reasonable answers.
58. $19.3 \div 5.2 = 3.7$ times greater
59. Gold has a hackly breakage pattern, while pyrite has an uneven fracture.
60. gold
61. gold, pyrite, apatite, garnet, corundum, beryl

PROBLEM

62. The penny has a hardness of 3. The knife has a hardness of either 5 or 6.
63. pyrite
64. gold
65. beryl
66. apatite
67. garnet
68. corundum