

Weathering, Erosion and Soil 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. Frost wedging is an example of erosion. _____
- ____ 2. Water, carbon dioxide, and acids are significant agents of physical weathering.

- ____ 3. To some extent, the density of rocks determines the effects that chemical weathering will have on them. _____
- ____ 4. Without gravity, glaciers would not move downslope and streams would not flow.

- ____ 5. The parent bedrock determines what kinds of minerals a soil will contain.

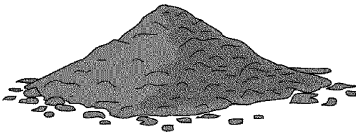
- ____ 6. The addition of compost, organic mulch, and peat moss to soil helps to maintain its acidity.

Multiple Choice

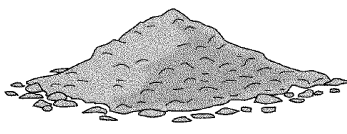
Identify the letter of the choice that best completes the statement or answers the question.

- ____ 7. Most of the weathering of Cleopatra's Needle is caused by ____.
- | | |
|------------------------|------------------|
| a. hydrolysis | c. oxidation |
| b. chemical weathering | d. frost wedging |
- ____ 8. In which of the following climates would chemical weathering most readily occur?
- | | |
|-----------------|-----------------|
| a. wet and warm | c. wet and cool |
| b. dry and warm | d. dry and cool |
- ____ 9. Barrier islands are formed when ____.
- | |
|---|
| a. the ocean floor is uplifted |
| b. the wind continuously blows sand out to sea |
| c. sand is repeatedly picked up, moved, and deposited by ocean currents |
| d. sand bars are worn away |
- ____ 10. Which of the following has the potential for the most erosion?
- | |
|--|
| a. water flowing across a flatland |
| b. wind blowing materials in the air, against the force of gravity |
| c. wind blowing materials down a slope |
| d. water flowing down a steep slope |
- ____ 11. What is one source of organic matter in soil?
- | | |
|---------------------------------------|----------------------|
| a. acid precipitation | c. weathered topsoil |
| b. dead fungi, bacteria, and protozoa | d. eroding bedrock |

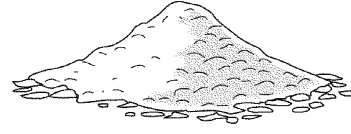
- ____ 12. Of the three soil samples shown below, Sample 1, the darkest and richest, would be found in ____ of a typical soil profile.



Sample 1



Sample 2



Sample 3

- a. horizon A
b. horizon B
c. horizon C
d. the hardpan
- ____ 13. Which of the following characteristics of water can be responsible for mechanical weathering?
- a. Water flows downstream under gravity.
b. Water expands when it freezes.
c. Water combines with atmospheric gases to form acid rain.
d. Water reacts with and can dissolve many kinds of minerals.
- ____ 14. In which of the following areas is wind a major erosional agent?
- a. grasslands
b. temperate forests
c. deserts
d. tropical rain forests
- ____ 15. Which of the following statements is NOT true of soil?
- a. It is a loose covering of broken rock particles and decaying organic matter.
b. There is one kind of soil in the United States.
c. Living organisms add nutrients to it.
d. It takes a long time to form.
- ____ 16. Which of the following could increase the rate of chemical weathering of a rock?
- a. moving it to a location with few plants and animals
b. moving it to a drier climate
c. increasing its total surface area
d. moving it to a colder climate
- ____ 17. Which of the following happens when a river enters a large body of water?
- a. The river water slows down and deposits large amounts of sediments.
b. The river water increases its speed and carries out gully erosion.
c. The river water flows over the delta, causing exfoliation.
d. The river water erodes the shoreline and deposits barrier islands.
- ____ 18. The color of a soil ____.
- a. is a reliable indicator of its fertility
b. is always dark brown or black
c. is not dependent on the amount of humus
d. is determined by its composition and climate

- _____ 19. Which of the following statements is NOT true about the deposition of eroded materials in bodies of water?
- It improves the quality of ecosystems.
 - It limits the availability of water for hydroelectric energy.
 - It reduces water supplies for personal consumption.
 - It can restrict navigation through the water bodies.
- _____ 20. Which of the following statements is NOT true of soils in sloped areas?
- Smaller particles remain on the slopes, while coarser particles move downslope.
 - Soils on slopes tend to be infertile.
 - Valley soils are usually thick.
 - South-facing slopes have somewhat thicker soils than slopes facing other directions.
- _____ 21. There can be no stream erosion or glacial erosion without _____.
- gravity
 - hydrolysis
 - wind
 - deposition

Completion

Complete each sentence or statement.

22. In a process known as _____, eroded materials are dropped in another location.
23. A major problem in farming areas is _____, which is the deepening and widening of rill channels.
24. A(n) _____ is a distinct layer, or zone, within a soil profile.
25. _____ is the removal and transportation of weathered material from one location to another.
26. The process by which rocks on or near Earth's surface break down and change is _____.
27. _____ is the erosion by running water of a small channel on the side of a slope.

Matching

Match each item with the correct statement below.

- | | |
|--------------------|-----------------|
| a. temperate soils | c. polar soils |
| b. tropical soils | d. desert soils |
- _____ 28. These soils form at high latitudes and high elevations and have good drainage but no distinct horizons.
- _____ 29. With rainfall greater than 50 – 60 cm per year, these soils vary greatly and may contain large amounts of humus.
- _____ 30. These soils experience high temperatures and heavy rainfall, which leads them to become weathered and often infertile.

- _____ 31. These soils generally get less than 25 cm of rain per year, which results in high levels of accumulated salts.

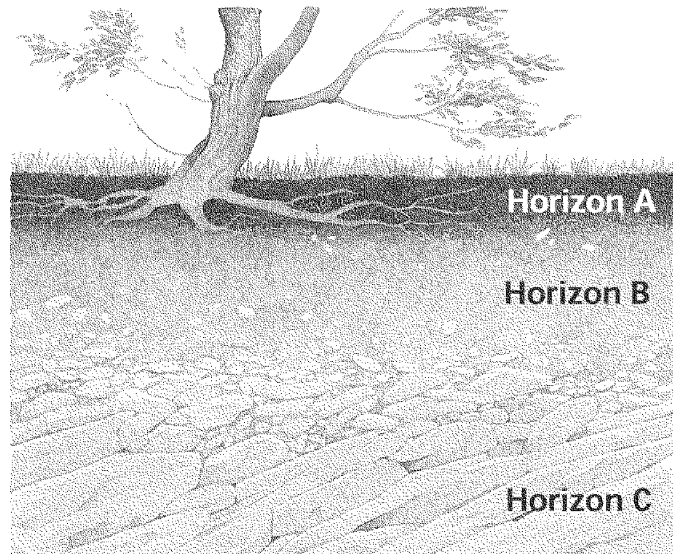
Match each item with the correct definition below.

- | | |
|---------------------|------------------------|
| a. residual soil | f. soil |
| b. transported soil | g. soil profile |
| c. exfoliation | h. chemical weathering |
| d. oxidation | i. frost wedging |
| e. hydrolysis | |
- _____ 32. The loose covering of broken rock particles and decaying organic matter overlying the bedrock of Earth's surface
- _____ 33. The repeated thawing and freezing of water in the cracks of rocks
- _____ 34. A vertical sequence of soil layers
- _____ 35. The process by which rocks and minerals undergo changes in their composition as the result of chemical reactions
- _____ 36. The chemical reaction of oxygen with other substances
- _____ 37. Soil that has been moved to a location away from its parent bedrock
- _____ 38. The reaction of water with other substances
- _____ 39. Soil located above its parent material
- _____ 40. The process by which outer layers of a rock are stripped away

Short Answer

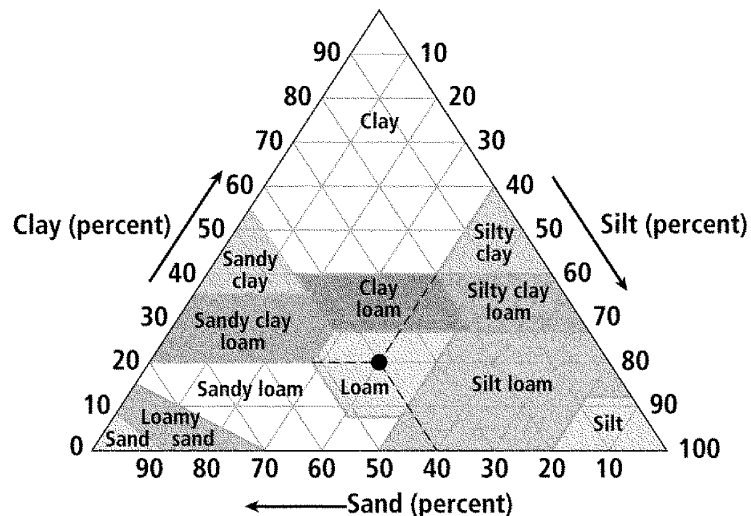
41. What is the difference between weathering and erosion?
42. What is acid precipitation and how does it affect the weathering process?
43. Give an example of how animals, including humans, affect the erosional process.
44. Describe how soils form layers.

45. Below is a picture of a soil profile. Compare the characteristics of soil in Horizon A with soil in Horizon B.



46. How does climate influence the rate of weathering of earth materials?
 47. Describe how soil forms.
 48. How do living things impact weathering and erosion?
 49. Contrast mechanical and chemical weathering, and give examples of each.

Study the diagram. Then answer the following questions.



50. What property of soil does the diagram illustrate?
 51. Name the three sizes of soil particles, from largest to smallest.
 52. How would you classify a soil that contains 60 percent sand, 30 percent silt, and 10 percent clay?

Name: _____

ID: A

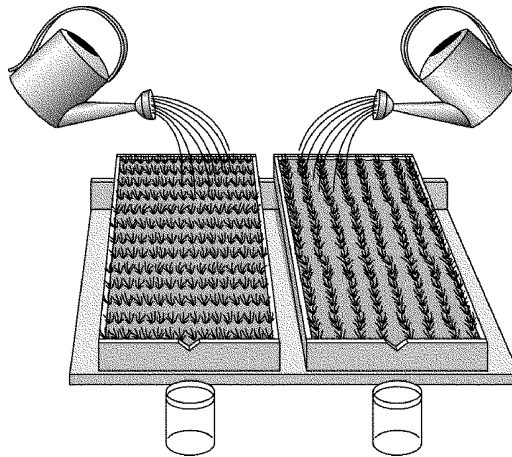
53. How would you classify a soil that contains equal percentages of all three sizes of soil particles?
54. About what proportion of sand/silt/clay makes up sandy clay?
55. In general, soil drainage is determined by particle size: the larger the particle size, the better the drainage. Compare the drainage of sand, sandy clay, and clay soils.

Problem

A golf course designer, who is about to build a championship golf course, has come to you with a problem. He tells you that parts of his developing course cannot grow grass and tend to flood. After testing the soil, you decide that the reason it drains poorly and doesn't retain adequate moisture is because it has too much nonporous clay. You tell him that by adding soil conditioners, the new soil will improve its drainage and retain more water. You mention that water retention is important because water supplies are low in the hot summer months, and grasses need water to stay green. Improved drainage will also allow more rainfall to be soaked into the soil, thus lessening runoff and water erosion.

You develop a simple setup to test various soil combinations for drainage and water retention. You will add dry soil, which was heated to expel all moisture, to a beaker. The beaker has a drain hole in the bottom to allow the drainage of excess water to a measuring cylinder. You add 200 ml of water to the beakers with the various soil combinations. After one hour, you then reweigh the soil and measure the drainage water.

The clay is the unsuitable soil from the golf course. Humus and sand were picked up from a local nursery, and soils A and B are higher priced synthetic soils produced by a chemical company. Most of the soil combinations drained in less than 30 minutes. When the drain time is greater than 60 minutes, this indicates poor drainage and some of the water will remain on top of the soil, where it either evaporates or runs off. All water weights are given in grams. One gram of water is approximately equal to one milliliter.



| | Clay | Clay + Humus | Clay + Sand | Clay + Soil A | Clay + Soil B |
|-----------------|-------------|-------------------------|------------------------|--------------------------|--------------------------|
| Dry soil weight | 600 g | 600 g | 600 g | 600 g | 600 g |
| Water added | 200 g | 200 g | 200 g | 200 g | 200 g |
| Wet soil weight | 690 g | 730 g | 640 g | 730 g | 760 g |
| Water drainage | 20 g | 70 g | 160 g | 70 g | 35 g |
| Time to drain | >60 min | 30 min | 20 min | 30 min | >60 min |

56. The water added to the dry soil should equal the weight of the wet soil plus the drainage weight. If it doesn't, it's because some of the water evaporated or ran off. Using the data from the chart provided above, complete the table below by indicating the amount of water that either evaporated or ran off.

| | Clay | Clay + Humus | Clay + Sand | Clay + Soil A | Clay + Soil B |
|-------------------------|-------------|-------------------------|------------------------|--------------------------|--------------------------|
| Water evaporated/runoff | | | | | |

57. Compare the use of sand and humus as far as their ability to retain water and improve drainage.
58. How does Soil A and B compare to humus as far as their ability to retain water and improve drainage.
59. Why do you suppose clay has such a high evaporation rate?
60. Why is sand not a good soil conditioner?
61. What soil combination would you recommend to the golf course designer? What are some other factors that might influence the selection of the best soil conditioner?

**Weathering, Erosion and Soil Study Guide
Answer Section**

MODIFIED TRUE/FALSE

1. F, weathering
2. F, chemical weathering
3. F, composition
4. T
5. T
6. F, fertility

MULTIPLE CHOICE

7. B
8. A
9. C
10. D
11. B
12. A
13. B
14. C
15. B
16. C
17. A
18. D
19. A
20. A
21. A

COMPLETION

22. deposition
23. gully erosion
24. soil horizon
25. Erosion
26. weathering
27. Rill erosion

MATCHING

28. C
29. A

- 30. B
- 31. D
- 32. F
- 33. I
- 34. G
- 35. H
- 36. D
- 37. B
- 38. E
- 39. A
- 40. C

SHORT ANSWER

- 41. Weathering is the process that involves the breaking down and changing of rocks and material on or near the Earth's surface. Erosion is the removal and movement of weathered materials from one location to another.
- 42. Acid precipitation is produced when sulfur dioxide and nitrogen oxides emissions combine with oxygen and water in the atmosphere to form sulfuric acid and nitric acid. These two acids can dissolve certain materials like limestone, which results in chemical weathering.
- 43. Many animals that burrow move surface material from one location to another. Humans excavate areas and move soil from one area to another.
- 44. Small pieces of weathered bedrock break off and rest on top of the parent rock layer. The pieces of rock continue to weather and the smaller pieces, along with living and dead organisms, form the top layer. Larger pieces form the underlying layers. Rainwater carries dissolved mineral to the lower layers of the soil.
- 45. Horizon A is the surface layer containing topsoil, which is usually dark-colored and rich in humus. Horizon B is the subsoil, is less-developed than Horizon A soil, and often contains soluble minerals that have been washed out from the topsoil. Horizon B soil may be red or brown in color due to the presence of iron oxides.
- 46. The interaction between temperature and precipitation has a great effect on rates of weathering. Chemical weathering occurs most readily in warm climates where rainfall is abundant and vegetation is lush. In contrast, physical weathering occurs most readily in cool, dry climates where water freezes and thaws.
- 47. Soil formation begins when weathering breaks bedrock into smaller and smaller pieces. Over time, tiny organisms living in the weathered material add nutrients to form soil. The processes of weathering and nutrient addition continue, and soil texture improves. As soil continues to develop, soil horizons form.

48. Possible response: Plants contribute to weathering when their roots exert pressure on rocks, and decaying organic matter contributes carbonic acid for chemical weathering. Organisms move Earth's surface materials from one place to another as they carry on their life processes. Animals burrow into the soil and shovel it to another place. Humans excavate when building structures or highways. Humans move soil while planting a garden. Human activities, such as the burning of fossil fuels, is responsible for some chemical weathering through acid precipitation.
49. Mechanical weathering is the process by which rocks and minerals break down into smaller pieces. In the process of chemical weathering, rocks and minerals undergo changes in their composition as a result of chemical reactions. Examples of mechanical weathering include frost wedging, exfoliation, and weathering as a result of pressure exerted by plant roots. Examples of chemical weathering include hydrolysis, oxidation, and the dissolving of minerals by carbonic acid and acid precipitation.
50. soil texture
51. clay, silt, sand
52. sandy loam
53. clay loam
54. 50 percent sand, 10 percent silt, 40 percent clay
55. Since sand has the largest percentage of large particle sizes, it should drain the best. Clay has the largest percentage of small particle sizes, so it should drain the worst. Sandy clay has a mixture of particle sizes, so it should drain somewhere between clay and sand.

PROBLEM

56. Clay = 90, Clay + Humus = 0, Clay + Sand = 0, Clay + Soil A = 10, Clay + Soil B = 5
57. Sand in a soil will increase the drainage rate substantially, and also increase the water retention by a small amount. Humus not only increases the drainage rate of the soil, but also adds an organic component that retains a lot of moisture.
58. Soil A has the same drainage and water retention as humus. Soil B has more water retention than humus, but does not drain as well.
59. Clay soil has small particle sizes that compact easily. Once compacted, it does not allow the easy penetration of water. The water that cannot enter the soil usually evaporates or runs off.
60. Sand has good drainage, but retains very little water.
61. The soil that has the best combinations of water retention and drainage is the clay/humus mixture and the clay/Soil A mixture. Answers may vary. The availability of either soil conditioner, its cost, and the long term effects of synthetic soil might be factors that would influence a decision.