Name: _____ Class: _____ Date: _____ ID: A

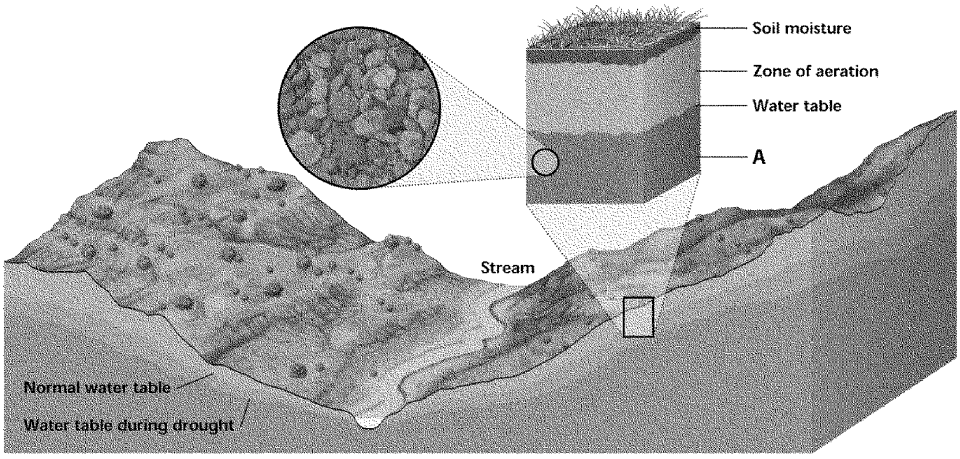
Groundwater Short Study Guide

Multiple Choice

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

____ 1. Much of the water that falls on the ground as precipitation ____.
a. enters the ground through the process of infiltration
b. evaporates back into the atmosphere
c. becomes runoff and finds its way back to the ocean
d. forms small pools

____ 2. In the diagram below, the area labeled A is called the ____.



a. zone of infiltration
b. recharge zone
c. zone of saturation
d. zone of permeability

____ 3. What is responsible for the production of most ions in groundwater?
a. precipitation of calcium carbonate
b. groundwater surges
c. dissolution of carbonic acid and calcium carbonate
d. geyserite reacting with carbonic acid

____ 4. What two materials are necessary for the formation of most caves?
a. water and carbon dioxide
b. carbonic acid and groundwater
c. soft water and travertine
d. acidic groundwater and limestone

Matching

Match each item with the correct statement below.

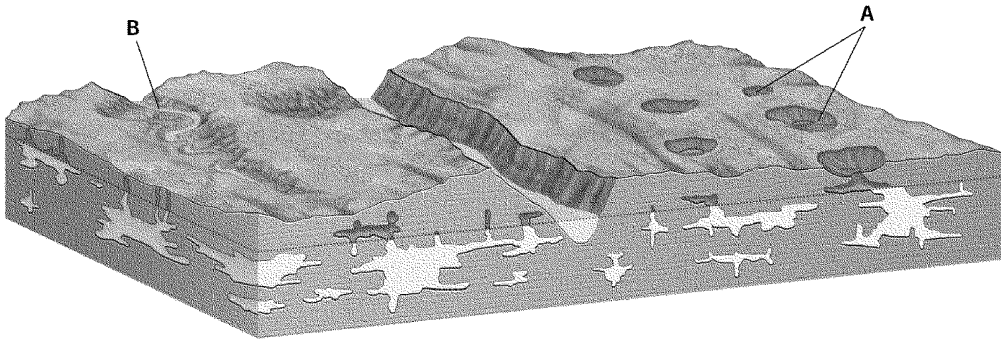
a. subsidence
b. geyser
c. drawdown
d. recharge zone
e. spring

____ 5. Where groundwater discharges a volume of water at the Earth's surface

____ 6. The land surface above an aquifer sinks because of excessive groundwater withdrawal
____ 7. Explosive hot springs that erupt at regular intervals
____ 8. The process that adds water from precipitation to the zone of saturation
____ 9. The difference between the original water-table level and the water level in a pumped well

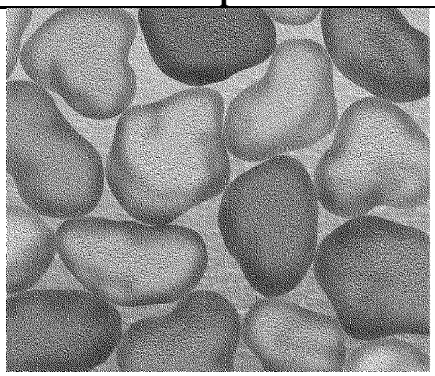
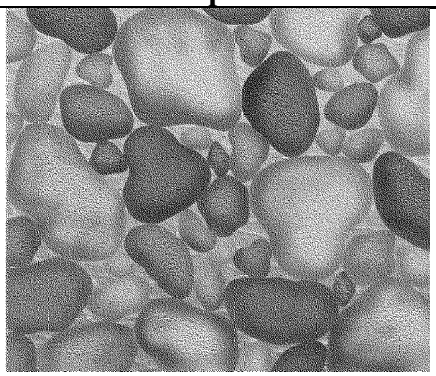
Short Answer

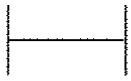
10. Trace a drop of water as it evaporates from the ocean, falls over land, and then finds its way back to the ocean.
11. Look at features A and B in the picture below. What are they? How are they formed?



12. Are water table unconfined aquifers or confined aquifers more easily polluted? Explain your answer.
13. What are the most common sources of groundwater pollution, and how do they enter the aquifers?
14. Give examples of how the depth of the water table varies with the terrain.
15. What type of subsurface material is able to store groundwater?
16. How are caves formed?
17. How do hard water and soft water differ?

Use the diagram illustrating mineral size and porosity to help you answer the following questions.

Sample A	Sample B
	



1 millimeter

18. Describe the porosity and mineral size of Sample A and Sample B.
19. Which of the two samples has the greater permeability? Why?

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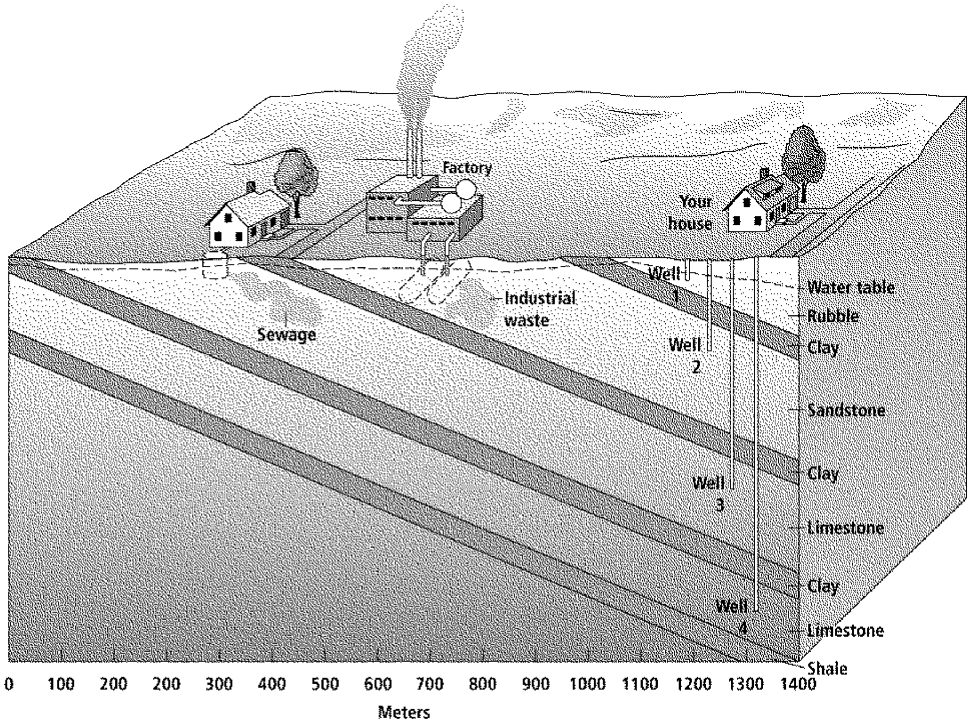
Problem

You would like to build a house in a wooded area close to your school. Since city water is not available, you will need to drill a well. The well-drilling company you hired did test drillings to find a clean, accessible, and maintainable aquifer. After completing its work, the company gave you a map of four available drill sites, numbers 1, 2, 3, and 4. Use the map illustration to make your analysis. Then answer the questions that follow.



Flow Rate in Meters Per Year					
Material	Shale	Clay	Limestone	Sandstone	Rubble
Flow Rate	0.5	0.0	100	50	200

20. Compare and contrast wells 1, 2, and 3. Analyze the potential of each well for a clean, accessible, and maintainable water supply.

21. What is the potential for a clean, accessible, and maintainable water supply from well 4? Could there be a problem with the water?

22. Use the flow rate table to determine when the sewage from the broken septic tank will contaminate the water in well 3.

23. Use the flow rate table to determine when the industrial waste will contaminate the water in well 2. Is it possible that the waste could be made harmless before it reaches the well?

24. Which site has the best potential for your well? Explain your decision.

Groundwater Short Study Guide
Answer Section

MULTIPLE CHOICE

1. A
2. C
3. C
4. D

MATCHING

5. E
6. A
7. B
8. D
9. C

SHORT ANSWER

10. Answers may vary. The water evaporates from the ocean and becomes invisible water vapor and visible clouds. Winds move this atmospheric moisture over Earth. The atmospheric moisture returns to Earth's surface as precipitation. Some precipitation falls directly back into the ocean; some falls on land and eventually returns to the oceans.
11. Label A indicates sinkholes, which are depressions in the ground caused by the collapse of a cave or by the direct dissolution of bedrock by acidic rain or soil moisture. Label B indicates a sinking stream. These form when a surface stream drains into a cave system and continues underground, leaving a dry valley above.
12. Water table unconfined aquifers, because they are unprotected, and so close to the surface, are more easily polluted. Confined aquifers are usually sandwiched between aquicludes. Because they are relatively sealed by the aquicludes, confined aquifers are more difficult to pollute. Also, because the groundwater in a confined aquifer comes from a distant recharge area, the water is exceptionally pure by the time it reaches the aquifer.
13. The most common sources of groundwater pollution are sewage, industrial waste, landfills, and agricultural chemicals. They enter the ground above the water table but are eventually flushed downward by precipitation.
14. In stream valleys, the water table is only a few meters deep, while in swampy areas, the water table is close to or at the surface. On hilltops, the water table can be tens of meters or more below the surface.
15. Subsurface material that is porous, so the water is stored in the pore spaces of soil and various rocks.
16. Most caves are formed in limestone by the dissolving activity of carbonic acid in groundwater. As groundwater percolates through the cracks and joints of limestone formations, it gradually dissolves adjacent rock and enlarges passages to form an interconnected network of openings called caves.

17. Hard water contains high concentrations of calcium, magnesium, or iron. Soft water does not contain high concentrations of these elements. Soft water commonly has been treated with a water softener to remove many of the dissolved ions.
18. Sample A shows large pores between large particle sizes. Sample B shows small pore sizes between various sized particles.
19. Sample A; its larger, connected pores allow more water to pass through at a higher flow velocity.

PROBLEM

20. Well 1 would be a shallow well with a clean water supply, but is close to the water table and may not be able to sustain a large withdrawal of water. Well 2 would be a medium well with a good supply of water, but may soon be polluted by industrial wastes. Well 3 is a deep well with a good supply of water, but might be polluted in the future by the sewage from the leaking septic tank.
21. Well 4 is a deep well with a good supply of water. It is close to a shale aquiclude that could protect it from pollution. One problem could be the cost of a deep well.
22. Well 3 is approximately 800 meters from the sewage. If the flow in limestone is 100 meters per year, it would take 8 years to reach well 3.
23. The industrial waste is approximately 400 meters from well 2. If the flow in the sandstone is 50 meters per year, it would take 8 years to reach well 2. If the industrial waste is in an ionic form, it is highly unlikely that it could be removed from the water.
24. Well 4 is the best choice. Its depth has the best potential for a good supply of water. Its location has the least potential for existing harmful pollution. Its location between aquicludes should help protect it from future pollution.