

Clements High School
HYDROGEOLOGY TEST



Name: _____ Date: _____ Team/School: _____

Total score: _____/100

Directions

- You will have 50 minutes to complete this test
- Part II will require computer access
- Part I is worth 30%, Part II is worth 10%, Part III is worth 60%
- All questions are worth 1 point, unless otherwise noted
- Good luck!

Part I: 58 points

1. Which definition of groundwater best suits the study of hydrogeology?
 - a. The fresh to slightly saline water, found in saturated geologic units near the surface
 - b. The moisture that is found in the pores between soil grains
 - c. The water found in the lower lithosphere and in the mantle
 - d. The extremely salty brines associated with petroleum deposits and deep sedimentary units

2. List and define the 3 basic types of aquifers. (4 points)

3. When estimating the density of rock-forming minerals, we can usually use a specific gravity of _____.

4. Express Darcy's law in a sentence. (2 points)

5. A _____ is a vertical tube in a pressurized water pipe used to measure pressure in a pipe. A

_____ is a vertical tube with an open or slotted interval inserted into the ground and used to measure hydraulic head in an aquifer. (2 points)

6. Below the water table, all pores are _____ filled with water. Above the water table, pores are _____ filled with water. (2 points)

7. Describe two impacts that pumping wells have on groundwater. (4 points)

8. What are three factors that affect whether a geologic unit may be considered an aquifer? (3 points)

9. Hydraulic head is a

- a. Vector Quantity
- b. Tensor Quantity
- c. Scalar Quantity
- d. Spinor Quantity

10. Primary porosity is a void space that forms _____ while secondary porosity is a void space that forms _____.

- a. After diagenesis; during diagenesis
- b. During diagenesis; after diagenesis
- c. After deposition; during deposition
- d. Before deposition; after deposition

11. Creosote and gasoline are both petroleum byproducts. Give one use of each, and identify each as DNAPL or LNAPL. (2 points)

12. Below what salinity is water considered fresh water?

13. Name the largest groundwater aquifer in the world, and its capacity. (2 points)

14. Describe a naturally occurring example of arsenic groundwater contamination. (3 points)

15. Name 4 biological groundwater remediation techniques. (2 points)

16. What is another name for the zone of aeration and how is it split up? (3 points)

17. What is the difference between point source pollution and nonpoint source pollution and give an example of each. (3 points)

18. What is the distinctive feature of the endorheic basin?

19. Define a septic system.

20. Which of the following is not an example of consumptive use?
- Intake of water by plants
 - Incorporation of water into products of food processing
 - Use of water for household purposes
 - Consumption of water by humans or livestock
21. What does the n in Darcy's law represent?
22. Name 2 advantages associated with xeriscaping. (2 points)
23. What is the unit for turbidity?
- Unitless
 - Formazin Turbidity Unit
 - Schlenk Degree of Turbidity
 - Secchi
24. Given 2 liters of pure water, what is the minimum mass of salt to be added to classify the solution as brackish water?
- 5 g
 - 10 g
 - 25 g
 - 50 g
25. Which of the following is NOT a rock susceptible to Karst topography?
- Limestone
 - Dolomite
 - Quartz
 - Gypsum

26. Which of the following has the highest permeability?

- a. Clay
- b. Sand
- c. Silt
- d. Gravel
- e. Sand mixed with gravel

27. What is the amount of time that groundwater remains in its aquifer called?

28. Explain what a losing stream is.

29. Where is the water table in a losing stream?

30. What are two causes of salination? (2 points)

31. What is the maximum safe PH of drinking water?

- a. 7.5
- b. 8.0
- c. 8.5
- d. 9.0

32. What is permeability and why is it an important factor into being an aquifer?
(2 points)

33. What is a strata?

34. About what percent of Earth's freshwater is in its icecaps?

- a. 1.5%
- b. 10%
- c. 57%
- d. 70%

35. What is juvenile water?

Part II: 15 points

Go to <http://groundwater.beehere.net/#practice> and select wells A, F, and G.

Answer the questions in the simulation, and fill in your answers on answer sheet.

Do NOT click check answer/show solution! Each blank is worth 1 point.

Flow Direction

Step 1:

Well with highest water table elevation: ____ / Elevation: ____

Well with lowest water table elevation: ____ / Elevation: ____

Remaining well: ____ / Elevation: ____

Difference in elevation between highest and lowest wells: ____

Difference in elevation between highest and middle wells: ____

Step 2:

Somewhere between the highest and lowest well the groundwater elevation will be equal to the middle well elevation. Distance from highest well to that position:

Step 3:

Direction groundwater will flow in: _____

Gradient

Step 1:

Distance Y: _____

Step 2:

Gradient (i): _____

Horizontal Velocity

Step 1:

K (conductivity): _____

n (porosity): _____ (in decimals; ex. a porosity of 45% would be .45)

Step 2:

Velocity: _____

Part III: 42 points

In the region from the Hydrogeology Challenge, there is a population concentrated around an important plastic factory. They discover that a leak has led to Polycyclic Aromatic Hydrocarbon (PAH) contamination at well F. They are currently pumping water from wells A and G, and are not pumping at well F. Point values are in parentheses after the questions.

1. Excluding well F, which well(s) is/are at risk of contamination, given current pumping conditions? (1 point)

2. What type of material will groundwater in this region flow through? What is the permeability constant of this lithology, in feet/day? (2 points)

3. Assuming that the Hydrogeology Challenge's assumptions are true, how many days will it take for the contamination plume to reach the well(s) in question 1 from well F? Show all work. (5 points)

4. Now, assuming that groundwater travels in straight paths throughout the entire aquifer, how many days will it take for the contamination plume to reach the well(s) in question 1 from well F? (Find the apparent velocity). Show all work. (5 points)

5. Can the risk of contamination to the well(s) from question 1 be decreased by pumping or stopping pumping at any of the wells? If so, which wells? Why? (3 points)

6. What are three assumptions that the Hydrogeology Challenge makes? (3 points)

7. Beyond use in plastics, what is another potential source for PAH contamination? (1 point)

8. The Hydrogeology Challenge guides you through a _____ _____ problem (two words), a common geology calculation used to find strike and dip. (1 point)

9. Fill out the remediation table below. (18 points)

10. Which remediation technique in the table should be employed to most efficiently remediate the contamination? Why? (3 points)

Remediation Technique	Definition	In-/Ex-Situ?	Type of Remediation (Physical, Biological, Other etc.)	Cost (Low, Medium, High)	Applicable to Contaminant? (y/n)
Activated Carbon Treatment					
Monitored Natural Attenuation					
Bioaugmentation					