Hydrogeology

Name_____
Date_____

Directions: Circle the correct answer. Each question is worth one point.

1) Which of these is the largest aquifer in America?
   a. Ogallala Aquifer
   b. Edwards Aquifer
   c. Mahomet Aquifer
   d. Kirkwood-Cohansey Aquifer
2) What percentage of water on Earth is potable?
   a. 5%
   b. Less than 1%
   c. 10%
   d. 15%
3) Which law is used to determine groundwater flow direction and velocity?
   a. Boyle's Law
   b. Boltzmann's Law
   c. Fourier's Law
   d. Darcy's Law
4) What kind of water originates from precipitation?
   a. Meteoric water
   b. Cognate water
   c. Fossil water
   d. Juvenile water
5) Which of these types of strata have porosity and a negligible permeability?
   a. Confined aquifer
   b. Unconfined aquifer
   c. Aquitard
   d. Aquiclude
6) Which of these drainage patterns occurs on an eroded dome?
   a. Dendritic drainage pattern
   b. Radial drainage pattern
   c. Rectangular drainage pattern
   d. Annular drainage pattern
7) What is the maximum contaminant level for nitrates in drinking water?
   a. 10 ppm
   b. 1 ppm
   c. 50 ppm
   d. 100 ppm
8) Which one of these rock types is not found in karst topography?
   a. Limestone
   b. Sandstone
   c. Dolomite
   d. Marble

9) Which one of these terms does not describe the zone beneath the surface that contains both water and air?
   a. Aeration zone
   b. Unsaturated zone
   c. Vadose zone
   d. Phreatic zone
10) Which of these well types are drilled into natural rock formations not prone to collapsing?
   a. Shallow well
   b. Rock well
   c. Sand well
   d. Artesian well

Directions: Write TRUE or FALSE on the line provided next to each statement. Each question is worth one point.

11) _____T_____ A watershed is the area drained by a single river system.
12) _____F_____ A losing stream is also called an effluent stream.
13) _____T_____ Backsiphonage occurs when there is a partial vacuum in a water supply system.
14) _____F_____ Artesian wells draw water from unconfined aquifers.
15) _____F_____ Perched aquifers occur below the water table.

Directions: Answer each question. Complete sentences are not required; bulletin answers are acceptable. Each question is worth three points.

16) What are the four types of wetlands?
   Marsh, Bog, Swamp, Fen

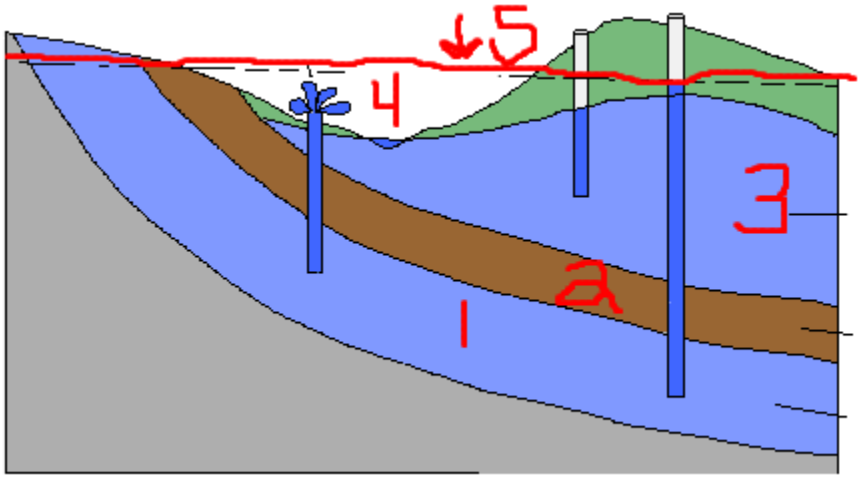
17) What is the difference between porosity and permeability?
   Porosity is a measurement of space between rocks whereas permeability is a measurement of how easy it is for fluids to flow between rocks.

18) What are the three components of hydraulic head?
   Pressure head, elevation head, and velocity head.

19) What is a cone of depression, and what is its main cause?
   The region, shaped like an inverted cone, in which the water table is drawn down, or depressed, in the vicinity of a borehole. The main cause is overpumping.

20)List three sources of groundwater contamination.
Possible answers: storage tanks, septic systems, hazardous waste, landfills, road salts, atmospheric contamination, etcetera.

Directions: Fill in the diagram. Each correct answer is worth one point.



1) ____Confined aquifer_____
2) ____Confining bed/Acquiclude/Aquitard_____
3) ____Unconfined aquifer_____
4) ____Artesian Well_____
5) ____Water Table_____

Directions: Answer each question according to the scenario provided. Each correct answer is worth three points.

A contaminant known as Trichloroethylene has been found at Well B, which is currently pumping. Pumping and static water table elevations have been provided for five wells in the same area, A, B, C, D, and E. All wells except for B are static currently.

Well	Pumping Elevation	Static Elevation
A	2500	2517
B	2551	2568
C	2499	2516
D	2565	2582
E	2547	2664

Geology and Hydrology Values Found at Well B

Depth (ft)	Lithology	K	Porosity (%)
0-4	Topsoil	2.68	52
4-46	Silt	4.02	46
46-56	Fine sand & gravel	88.40	39
56-82	Silty clay	1.34	44
82-151	Fine sand & gravel	88.40	39
151-163	Silt	4.02	46
163-255	Fine sand & gravel	88.40	39
255-280	Shale	0.00	6

1) What other wells are currently at risk? _____A and C_____
2) When calculating horizontal groundwater velocity for well B, what conductivity value would you use? _____88.40_____
3) When calculating horizontal groundwater velocity for well B, what porosity value would you use? _____.39 or 39%, not just 39_____
4) True or False: The measurement between the well with the highest water table elevation and the water table contour line is always parallel to the water table contour line. _____False_____
5) What three values are necessary to calculate horizontal velocity? _Conductivity, gradient, and porosity_____

Directions: Fill in the remediation techniques table. Each correct answer is worth half a point. The contaminant in question is the same one present in Well B.

Technique	In-situ / Ex-situ	Type (Biological, Chemical, Physical, Other, or any combinations)	Cost (Low, Medium, High)	Applicable to Contaminant? (Yes, No, Not alone)	Definition
Air sparging	In-situ	Physical	Medium	Yes	Injects air underground to help remove vapors from groundwater. The addition of air makes the chemicals evaporate faster, which makes them easier to extract using another technology.

Pump and Treat	Ex-situ	Physical	High	Not alone	Groundwater is pumped from wells to an above ground treatment system that removes the contaminants.
Phytoremediation	In-situ	Biological	Low	No	Uses plants to clean up contaminated environments.
Permeable Reactive Barrier	In-situ	Biolgical/Chemical	Medium	Yes	A zone created below ground which the polluted water must flow through to be treated. The reactive materials that make up the zone either trap harmful contaminants or make them less harmful.
Monitored Natural Attenuation	In	Other	Low	Process is less effective/No, yes is not acceptable	Relies on natural processes to decrease concentrations of contaminants in soil and groundwater.

Points: _____/62.5