SCIENCE OLYMPIAD
AT THE
UNIVERSITY OF FLORIDA

Northern Regional: January 19th, 2019

Water Quality B Test

Name(s): _____

Team Name: _____

School Name: _____

Team Number: _____

Rank: _____

Score: _____

Part 1: Freshwater Ecology (50 Points)

1. Mine drainage (turns pH of water to 2) is _____ times more acidic than neutral water **(1)**
2. The iron sulfide from a mine turns into _____, a strong acid, in water **(1)**
3. The Amazon River is acidic/basic **(1)**
4. Showing all work, calculate the pOH of a solution if the concentration of hydronium ions is 8.9×10^{-9} **(3)**
5. Showing all work, calculate the pH of a solution if the pKb of the solution is 12.4, the concentration of a base is 5.4×10^{-8} and the concentration of a conjugate base is 3.2×10^{-4} **(3)**
6. True or false: Volcanoes, geysers, and hot springs will cause the water in the surrounding area to become more alkaline **(1)**
7. True or false: A lentic body of water will have a higher productivity than a lotic body of water **(1)**

   The table below, which presents data from a river ecosystem, applies to questions 8-10

Species	Number (n)	n(n-1)
Water Penny	2	2
Dobsonfly	8	56
Asian Carp	1	0
Riffle Beetle	1	0
Water Scorpion	3	6
Total (N)	15	64

8. Calculate Simpson's Diversity Index **(2) (TIEBREAKER #2)**
9. Using your result from Question 8, calculate Simpson's Index of Diversity **(2)**
10. Using your result from Question 8, calculate Simpson's Reciprocal Index **(2)**
11. Wastewater treatment costs approximately _____ in the US each year **(1)**
12. The EPA creates a Contaminant Candidate List every _____ years **(1)**
13. Write the name of each keystone species in freshwater ecosystem on the answer sheet **(1)**
    a. River Otter
    b. Beaver
    c. Dobsonfly
    d. Salmon
    e. Fairy shrimp
    f. American alligator

A manager of a potable water treatment facility has to balance a variety of factors in order to minimize issues that occur during operations. Match the factor (answer choices) with the problems that arise from them (questions 14-23). Answers can be used once, more than once, or not at all. **(1 pt each)**

14. _____ Lowest pH
15. _____ Rising sludge
16. _____ Highest energy use
17. _____ Icing
18. _____ Filamentous bacteria
19. _____ Poorest effluent quality
20. _____ Plugging
21. _____ Highest Chlorine Demand
22. _____ Lowest DO levels
23. _____ Standing water

A. Poor primary classification
B. Hydraulic overload
C. Nitrification
D. Organic overload
E. Organic underload
F. Nutrient shortage
G. Cold weather

24. _____% of the biomass in activated sludge is composed of bacteria **(1)**

For Questions 25-27, identify whether the potable water treatment facility should use sulfate-reducing bacteria (SRB), oxidation ditches, or extended aeration

25. Located in an area with harsh weather conditions, able to denitrification waste, and able to continue operations when shock occurs **(1)**
26. Easy to operate and install, infrequent disposal of sludge, and a small ecological footprint **(1)**
27. The owner wants to be able to operate the facility remotely and treat toxic waste streams. She also want to deal with the removal of phosphorus **(1)**

28. General hardness measures the concentration of two ions in water. What are they? **(1)**
29. A high KH indicates a high presence of two polyatomic ions in water. What are they? **(1)**
30. Nitrification converts _____ into _____, which is subsequently transformed into _____ **(1)**
31. Denitrification converts nitrogenous wastes into _____ **(1)**
32. Freshwater has less than _____mg/L of dissolved salt **(1)**
33. If any of the compounds below are a salt, place them on the answer sheet **(1)**

LiCl $Fe_2(HPO_4)$ SiH_4 NH_4F $MgSO_4$ LiH H_3BO_3

34. The EPA lists _____ as the most common pollutant in rivers. The next two most common pollutants are _____ and _____ **(1)**

35. Phosphates will have more severe effects on an ecosystem in anaerobic/aerobic conditions **(1)**
36. Explain what occurred at Joint Base Water Treatment Facility in Cape Cod, Massachusetts, due to effluent release **(2)**
37. The hypolimnion is at the _____ of the lake and the epilimnion is at the _____ of the lake **(1)**
38. The most polluted river in Europe is the _____ **(1)**
39. What is the Ganga Action Plan and why did it fail? **(1)**
40. How did the Doce River in Brazil become the most polluted river in the Americas? **(1)**
41. How many 'dead rivers' does the Philippines have?_____ **(1)**
42. The most polluted river in the United States is the _____ **(1)**

Part 2: Macroflora and Fauna Identification (50 Points)

43. The table from questions 8-10 has been redisplayed below. Based on the given information, is this river polluted? Why or why not? **(1)**

Species	Number (n)	n(n-1)
Water Penny	2	2
Dobsonfly	8	56
Asian Carp	1	0
Riffle Beetle	1	0
Water Scorpion	3	6
Total (**N**)	15	64

Questions 44-49 refer to Figure 1 in the picture packet

44. What is the common name of this organism? **(1)**
45. How was this organism likely introduced into ecosystems in the United States? **(1)**
46. Besides competition with native organisms, what is the main issue regarding these organisms? **(1)**
47. Where was this organism originally introduced in the United States? **(1)**
48. Circle the correct answers: The presence of this organism would increase/decrease phytoplankton concentration, increase/decrease water clarity, increase/decrease nutrient concentration, and increase/decrease dissolved oxygen **(2)**
49. Would this organism prefer a rocky or sandy river floor? **(1)**

Questions 50-51 refer to Figure 2 in the picture packet

50. What is the common name of this organism? **(1)**
51. At this stage of life, can these organisms survive in highly acidic water? **(1)**

Questions 51-55 refer to Figure 3 in the picture packet

52. What is the common name of this organism? **(1)**
53. Would the larvae of this organism be able to survive in oxygen-depleted water? **(1)**
54. What are the larvae of this organism called? **(1)**
55. What do adult organisms do in order to breathe underwater? **(1)**

Questions 56-57 refer to Figure 4 in the picture packet

56. What is the common name of the organism? **(1)**
57. Would this organism be considered a good indicator of water quality? **(1)**

Questions 58-61 refer to Figure 5 in the picture packet

58. What is the common name of this organism? **(1)**
59. Would these organisms live in fast-moving or slow-moving rivers? **(1)**
60. Is this organism resistant to pollution? **(1)**
61. What anthropomorphic pollution source has the most adverse impact on this organism? **(1)**

Questions 62-65 refer to Figure 6 in the picture packet

62. What is the common name of this organism? **(1)**
63. What color is the abdomen of this organism? **(1)**
64. This air-breathing organism got trapped underwater when a lake froze over! How does it survive? **(1)**
65. What happens to the nitrogen levels of the river when this organism comes up to to breathe? **(1)**

Questions 66-72 refer to Figure 7 in the picture packet

66. What is the common name of this organism? **(1)**
67. How is light penetration impacted by the presence of this organism? **(1)**
68. What happens to oxygen levels when this organism is present? **(1)**
69. What happens to fish populations when this organism is present? **(1)**
70. What river speed does this organism prefer? **(1)**
71. What US state was this organism originally introduced into? **(1)**
72. Is this organism invasive in Florida? **(1)**

Questions 73-77 refer to Figure 8 in the picture packet

73. What is the common name of this organism? **(1)**
74. What kind of plankton is this organism? **(1)**
75. Why is this organism so hard to naturally control? **(1)**
76. How was this organism introduced into the US? **(1)**
77. Which Great Lake was this organism originally discovered in? **(1)**

Questions 78-86 refer to Figure 9 in the picture packet

78. What is the common name of this organism? **(1)**
79. Would this organism prefer to live in turbid water? **(1)**
80. Would this organism prefer to live in an environment where a lot of sunlight is available? **(1)**
81. What temperature range, in Celsius, can this organism live in? **(1)**
82. State one reason why this organism may **NOT** be a good indicator of water quality **(1)**
83. How does genetic drift play a role in this species' ability to be an good indicator of water quality in a river ecosystem? **(1)**
84. Rank the toxicity of the following metals (with 1 being the most toxic and 5 being the least toxic) in relationship the the above organism **(1) (TIEBREAKER #3)**
    _____ Zinc
    _____ Manganese
    _____ Copper
    _____ Iron
    _____ Lead
85. Should hsp60 protein concentration in this organism be used to measure copper levels in a body of water? **(1)**

86. Should catalase activity in this organism be used to measure copper levels in a body of water? **(1)**

Questions 87-91 refer to Figure 10 in the picture packet

87. What is the common name of this organism? **(1)**

88. Which two abiotic factors have the largest impact on the number of these organisms present in an ecosystem? **(1)**

89. If this organism is found in a stream, it is also likely that _____ (a fish species) also exist in the lake **(1)**

90. What other two organisms are used alongside this organism as the basis for determining if a stream is polluted? **(1)**

91. How do these organisms increase dissolved oxygen content in their immediate area? **(1)**

Part 3: Water Monitoring and Analysis (50 Points)

92. Write all conditions below associated with fecal coliform on the answer sheet **(1)**

Typhoid fever   Dysentery   Gastroenteritis   Hepatitis

93. The three ways to treat fecal coliform are **(1)**

94. True or false: A stream would typically have more dissolved oxygen than a lake **(1)**

95. True or false: In freshwater ecosystems, phosphates are more likely to be a limiting nutrient than nitrates **(1)**

96. Untreated municipal solid waste has a BOD of around _____mg/L **(1)**

97. Dissolved oxygen is likely to be lower upstream/downstream **(1)**

98. The Jackson Candle Method and a Secchi dish both measure the same thing in a sample of water. What is it? **(1)**

99. At what temperature, in Kelvin, is water most dense? **(2) (TIEBREAKER #4)**

100.   Define the term 'xenobiotic' **(1)**

Use the graph below to answer questions 101 and 102
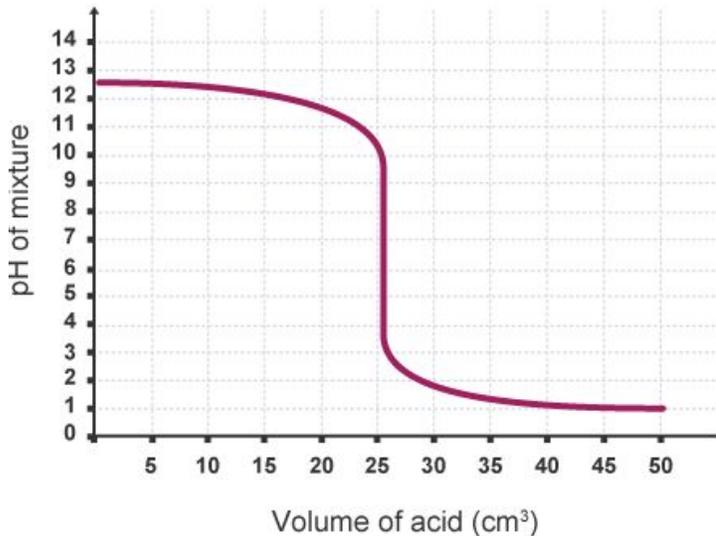
101.   Write the pH of the equivalence point on the space provided in the answer sheet **(1)**

102.   Based on the graph, a _____ is being titrated with a _____ **(1)**
    a. Strong acid; strong base
    b. Strong acid; weak base
    c. Weak acid; weak base
    d. Weak acid; strong base
    e. Weak base; weak acid
    f. Strong acid; weak acid

103.   An influx of fecal coliform into the Mississippi River is likely a point/nonpoint source of pollution **(1)**

104.   Homiohaline solutions have a _____ salinity while polyhaline solutions have a _____ salinity. **(1)**

105. State whether the dissolved oxygen is high or low during these times of year **(2)**
    a. Winter
    b. Spring
    c. Summer
    d. Fall
106. Name the six strong acids. <u>DO NOT</u> state their chemical formulas. You <u>must</u> state their full name **(3)**
107. Name the six strong bases. <u>DO NOT</u> state their chemical formulas. You <u>must</u> state their full name **(3)**
108. What does ROWPU stand for? **(1)**
109. What does NPDES stand for? **(1)**
110. What does JTU stand for? **(1)**
111. What does TDS stand for? **(1)**
112. What does FTU stand for? **(1)**
113. What does TSS stand for? **(1)**
114. What does NTU stand for? **(1)**
115. The piece of U.S. legislation that sets wastewater standards is the _____ **(1)**
116. State whether the body of water would be fresh, brackish, saline, or a brine <u>(ppt= parts per thousand, not parts per trillion)</u> **(3)**
    a. 45 ppt
    b. 5 ppt
    c. 890 ppt
    d. 2 ppm
    e. .1 ppt
    f. .7 ppt
117. Due to the high quantity of limestone, Florida's freshwater ecosystems have a higher/lower pH than other freshwater ecosystems **(1)**
118. Define the term 'alkalinity' **(1)**
119. _____ is the term used to describe when thermal pollution increases the overall health of an ecosystem **(1)**
120. An increase in total solids in a river will increase/decrease the temperature of the river **(1)**
121. The average phosphate levels in a lake is approximately _____µg/L **(1)**
122. The average phosphate levels in an impoundment is approximately _____µg/L **(1)**
123. As temperature increases, dissolved oxygen increases/decreases **(1)**
124. What does the Winkler method measure? **(1)**
125. **WRITE YOUR SALINITY ESTIMATE ON THE ANSWER SHEET. THIS WILL BE USED AS TIEBREAKER #1. (10)**