Station 1

1) Which of the following can be considered an ecosystem?
   a) Neuse River basin
   b) a small pond
   c) the entire planet
   d) all of the above

2) The majority of energy in aquatic ecosystems is made available via _____, except in the case of some bacteria which derive their energy from _____.
   a) photosynthesis, chemosynthesis
   b) photosynthesis, cellular respiration
   c) solar heating, photosynthesis
   d) solar heating, cellular respiration

3) Most of the biomass of an ecosystem consists of _____, which are organisms that _____ manufacture organic material from inorganic material.
   a) Autotrophs, can
   b) Autotrophs, cannot
   c) Heterotrophs, can
   d) Heterotrophs, cannot

4) Which location pictured below is most likely to support the greatest diversity of autotrophs?

River A

River B

River C

River D

(Images: https://www.nps.gov/buff/planyourvisit/upper-district-floating.htm, https://www.videoblocks.com/video/aerial-amazing-shot-of-rafting-boats-on-a-calm-desert-river-in-utah-ruwm_jvugiyvyes7r, https://www.shutterstock.com/image-photo/muddy-river-water-flow-surrounded-by-674318503, https://www.videoblocks.com/video/aerial-crystal-clear-river-with-kayakers-and-whitewater-rafters-in-patagonia-2k-s_ixizltitjg8cx9)

Station 1 – page 2

5) Incremental increase in biomass generated by organisms over a period of time is called _____.
   a) Accumulation
   b) Biomass buildup
   c) Production
   d) Assimilation

6) An ecologist identifies an aquatic organism with adaptations to low dissolved oxygen including large gill surface area and short distance between gills and the bloodstream. The organism is most likely native to which of the following locations?
   a) Lake
   b) River
   c) Estuary
   d) Tide Pool

7) The process by which atmospheric nitrogen (N2) is converted into a form useable by plants is called
   a) Nitrification
   b) Nitrogen fixation
   c) Ammonification
   d) None of the above; atmospheric nitrogen is useable by plants

8) What environmental phenomenon can convert N2 directly into NO3-?
   a) Lightning
   b) Volcanic eruptions
   c) Metabolism
   d) Oxidative cleavage

9) Which step(s) of the oxygen cycle occur(s) in plants?
   a) Cellular Respiration only
   b) Photosynthesis only
   c) Both Cellular Respiration and Photosynthesis
   d) Neither Cellular Respiration nor Photosynthesis

Station 2

10) A scientist testing water deemed to have "high quality" discovers that his sample contains several impurities. Is it possible for this water to truly be "high quality"?
   a) No, only completely pure water can be called "high quality"
   b) No, the scientist must have introduced the impurities by human error
   c) Yes, even high quality water contains other molecules
   d) Yes, the impurities were introduced by human error and therefore the original water is pure

11) Ecologists analyzing a lake notice that its pH changes very little in response to acidic runoff or acid rain. The lake is probably rich in which of the following molecules/ions, which act as buffers, preventing rainwater from becoming acidic?
   a) Carbonate and bicarbonate
   b) Hydroxide
   c) Nitrates and phosphates
   d) Carbon dioxide

12) Which of the following laws requires the EPA to periodically report a list of contaminants which are currently not subject to any restrictions but which may require regulations?
   a) Clean Water Act
   b) Safe Drinking Water Act
   c) Pollution Prevention Act
   d) Toxic Substances Control Act

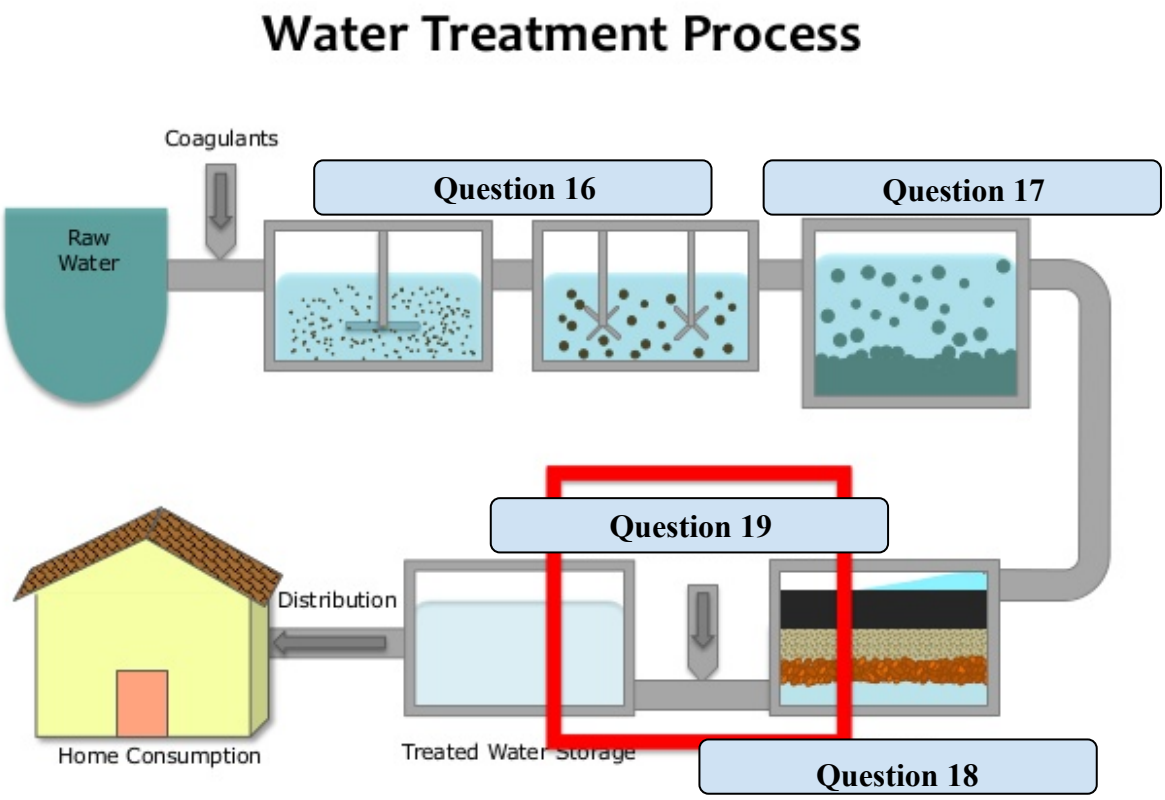
13) Why are watersheds a natural unit of biophysical and economic analysis?
   a) Movement of water and soil is multidirectional
   b) Human activities made outside a watershed rarely affect water quality inside the watershed
   c) Most physical effects and interactions are contained within watersheds
   d) Organisms rarely move from watershed to watershed

14) If 0.10 g of a pollutant are found in 2.0 kg of freshwater, what is the concentration of the pollutant in g/ml?
   a) 5.0×10^{-5}
   b) 5.0×10^{-2}
   c) 2.0×10^{1}
   d) 2.0×10^{4}

15) An increase in temperature usually causes dissolved oxygen to _____.
   a) Increase
   b) Decrease
   c) Stay the same
   d) Not enough information

Station 3

For Questions 16-19, use the diagram below.



(https://www.slideshare.net/commgroup/drinking-water-treatment-process)

16) This stage combines small particles into large particles. Which step in the water treatment process is this?
    a) Coagulation/Flocculation
    b) Disinfection
    c) Filtration
    d) Sedimentation

17) In this stage, large particles settle on the bottom of the tank. What step in the water treatment process is this?
    a) Coagulation/Flocculation
    b) Disinfection
    c) Filtration
    d) Sedimentation

Station 3 – page 2

18) This stage uses sand and gravel to remove fine particles. What step in the water treatment process is this?
    a) Coagulation/Flocculation
    b) Disinfection
    c) Filtration
    d) Sedimentation

19) In this stage, pathogens are destroyed or neutralized. What step in the water treatment process is this?
    a) Coagulation/Flocculation
    b) Disinfection
    c) Filtration
    d) Sedimentation

20) A North Carolina town wants to reduce the cost of drinking water treatment for their residents. They plan to switch from using a local river as a source of water to an underground aquifer, and ask you to review their plans. Is this change likely to reduce cost in the long run?
    a) Yes; groundwater tends to require less treatment than surface water
    b) No; groundwater tends to require more treatment than surface water
    c) No; water from almost any source requires the same amount of treatment
    d) Not enough information

21) Which of the following is NOT a reason to use a home drinking water treatment?
    a) Remove a specific contaminant
    b) Family member has a compromised immune system
    c) Remove fluoride
    d) Improve taste

22) A chemical plant treating water to remove contaminants before discharge is an example of point of _____ filtration.

23) Which step of wastewater treatment prevents clogging of treatment machines by debris?
    a) Primary treatment
    b) Secondary treatment
    c) Tertiary treatment
    d) Screening

24) Which step of wastewater treatment involves separation of macrobiotic solid matter?
    a) Primary treatment
    b) Secondary treatment
    c) Tertiary treatment
    d) Screening

25) Which step of wastewater treatment most closely resembles drinking water treatment procedures?
    a) Primary treatment
    b) Secondary treatment

c) Tertiary treatment
d) Screening

Station 4

Source: (https://nas.er.usgs.gov/queries/greatlakes/FactSheet.aspx?SpeciesID=56&Potential=Y&Type=2&HUCNumber=)
Credit: Trent Henry & Gabrielle Habeeb

26) Identify the organism in the image above

27) If an abundance of these organisms is found, what does this indicate about water quality?

28) True or False: Water bodies in which an abundance of this organism is found may contain large quantities of heavy metals

Photo: Michigan Sea Grant

29) Identify the organism in the image above
30) How did this organism arrive in North America?

Station 5

Source: https://nature.mdc.mo.gov/discover-nature/field-guide

31) Identify the organism in the image above.

32) True or False: These organisms are indicators of good water quality

33) True or False: These organisms are known to transmit harmful viruses like Zika and West Nile

Source: http://www.invadingspecies.com

34) Identify the organism in the image above.

35) How did this organism arrive in the U.S.?

36) What is one way this organism is detrimental to U.S. lakes?

Station 6

37) Identify the organism who makes the case shown in the image above.

38) If this organism is making a silk case, what does that indicate about the water quality?

39) This is a leech. How can you distinguish juveniles from adults for this organism?

40) True or False: If you find the organism in the water, it is considered low quality polluted water with low oxygen.

41) Do leeches live in:
   a) Freshwater ecosystems only
   b) Marine ecosystems only
   c) Both marine and freshwater ecosystems

Source: http://somethingscrawlinginmyhair.com

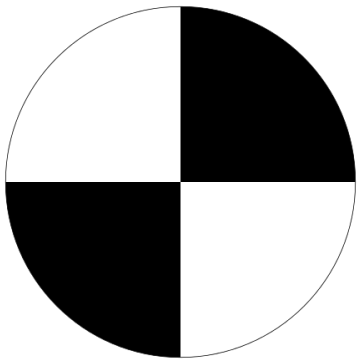
42) Identify the organism in the image above

43) T/F: This organism is indicative of an acidic pH

Station 7

44) Which of the following is the NOT a common source of phosphate pollution?.
   a) Poor agricultural practices
   b) Septic leakage
   c) Fertilizer runoff
   d) Algal blooms

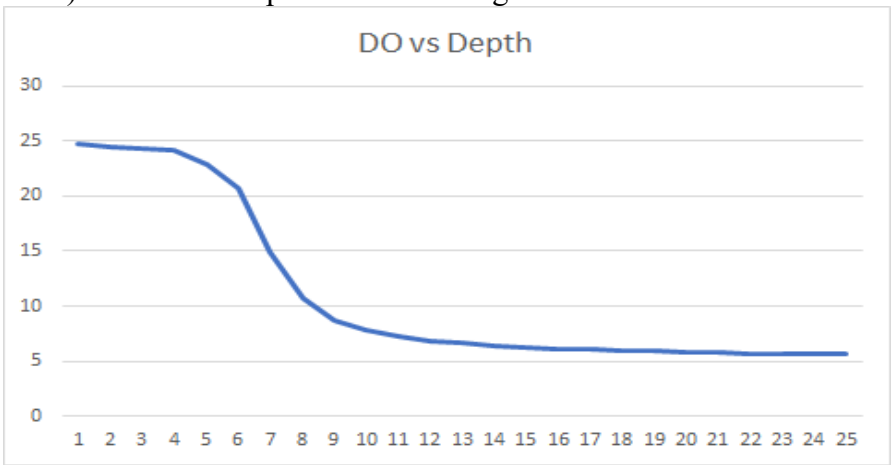
45) Examine the pictures below.



The person in the image above is working on a global citizen science project using the instrument depicted on the right. This instrument is called a __(A)__ and it is used to measure __(B)___.

46) Examine the chart below, why is this trend observed?

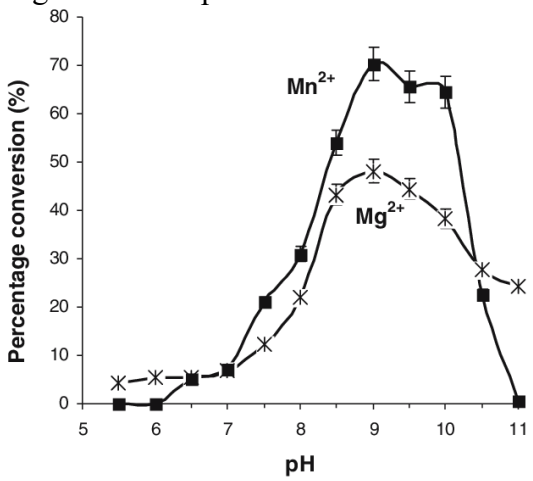
   a) Dissolved oxygen tends to dissipate over time
   b) Deeper water tends to be colder, resulting in lower dissolved oxygen levels
   c) Organisms deeper in the water column tend to consume more oxygen
   d) Shallower depths tend to have greater aeration



(NLA 2007 Water Chemistry Profile)

Station 7 – page 2

For Questions 46-47, examine the graph below, which shows the activity of CMP-sialic acid synthetase, an enzyme involved in producing the outer layers of animal cells, at different pH ranges an in the presence of different ions.



47) What is the pH that causes the peak activity of the enzyme in the presence of Mn^{2+} ?

48) Based on the graph above, which of the following is true?

a) A high concentration of Mn^{2+} ions is effective in mitigating the effects of a low pH
b) Water acidification can harm aquatic organisms by lowering the activity of critical enzymes
c) Most rivers and streams have a pH of 8 or above due to the presence of Mn^{2+} and Mn^{2+} ions
d) At high pH levels, outer layers of animal cells are rapidly converted into their constituent ions

Station 8


Images: https://www.nytimes.com/2018/09/19/climate/florence-hog-farms.html https://www.newsweek.com/pollution-hurricane-florence-so-bad-you-can-see-it-space-1137656

The image on the left shows a North Carolina hog farm's waste lagoon overflowing due to flooding during Hurricane Florence. Hurricanes such as Florence have the potential to cause major environmental damage by releasing contaminants from agriculture and industry into water systems; such release is shown in the image on the right.

49) Waste from livestock often contains large quantities of nitrates and other nutrients. When these nutrients enter the water supply and cause rapid growth of bacteria and algal blooms, this situation is known as _____.

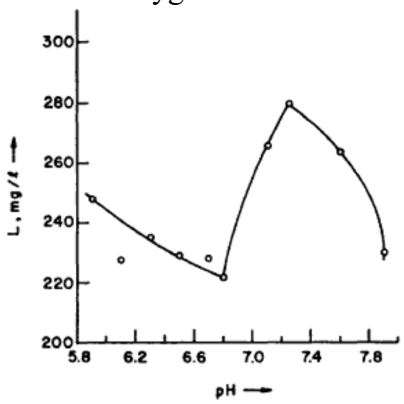
50) On the axes on your answer sheet, sketch the general trend you would expect for dissolved oxygen over time in this scenario. Be sure to label the axes, but no numbers are needed.

51) Which of the following environmental conditions would minimize fecal coliform contamination of surface water resulting from overflow?
   a) Aeration
   b) Cloud cover
   c) Cold front
   d) High salinity

52) Organic debris from the lagoons would be classified in what category of total solids?
   a) Dissolved
   b) Suspended
   c) Settleable
   d) Precipitate

Station 8- page 2

For Questions 53-54, examine the graph below, which depicts the relationship between pH and biochemical oxygen demand at room temperature.



(Effect of pH on the Rate of BOD of Wastewater, S. K. Mukherjee, A. K. Chatterji and I. P. Saraswat)

53) The greatest dissolved oxygen will be present in wastewater with a pH of _____.
   a) 5.8-6.0
   b) 6.7-6.9
   c) 7.2-7.4
   d) 7.6-7.8

54) Assume the water was initially at a pH of 6.8 before it was contaminated with acidic fertilizer runoff. How will fertilizer contamination affect the rate of decomposition of organic matter in the floodwaters?
   a) Increase the rate
   b) Decrease the rate
   c) The rate will stay the same
   d) Not enough information

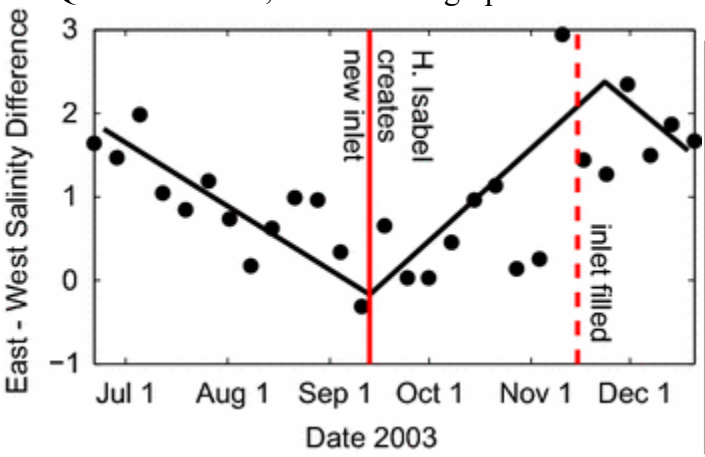
Station 9

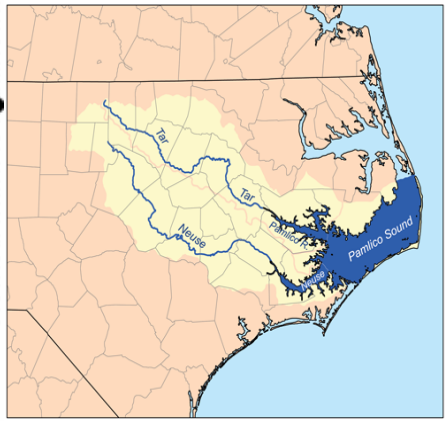
55) Use your salinometer to measure the salinity of the sample given. Record this value on your answer sheet.

56) The salinity value you measured is most characteristic of an _____.
   a) Ocean
   b) Estuary
   c) Lake
   d) Bog

Station 9 – page 2

For Questions 57-58, examine the graph below.





(Paerl et. al, Journal of Biochemistry)
(map: https://en.wikipedia.org/wiki/Pamlico_Sound#/media/File:Pamlicorivermap.png)

The graph above shows the relative difference in salinity between the eastern and western basins of the Pamlico Sound. Prior to the impact of Hurricane Isabel in September 2003, the salinity of the eastern basin was decreasing relative to the western basin because of unusually high freshwater discharge into the eastern basin.

57) When Hurricane Isabel hit North Carolina, it created a inlet resulting in the increase in East - West Salinity Difference shown on the graph. Based on the resulting trend shown in the graph, where was this inlet created and why did it result in the trend shown on the graph?
    a) Between the eastern and western basin, because exchange between the basins will increase the salinity of the eastern basin
    b) Between the eastern and western basin, because exchange between the basins will decrease the salinity of the eastern basin
    c) Between the eastern basin and the Atlantic Ocean, because exchange with ocean water will increase salinity of the eastern basin
    d) Between the eastern basin and the Atlantic Ocean, because exchange with ocean water will decrease salinity of the eastern basin

58) The inlet was filled by the NC Department of Transportation in November 2003. If the inlet remains filled, what do you predict will happen to the East - West Salinity Difference in the Pamlico Sound following 2003?
    a) It will increase
    b) It will decrease
    c) It will remain the same
    d) It is impossible to predict

Page 1 Total: _____ + Page 2 Total: _____ = _____
Tiebreakers: _____. Final Score: _____

2019 Regional Water Quality Division B - Student Answer Sheet

School: _____ V JV1 JV2 JV3

Student Names_____

Station 1

1. A B C D
2. A B C D
3. A B C D
4. A B C D
5. A B C D
6. A B C D
7. A B C D
8. A B C D
9. A B C D

Station 2

10. A B C D
11. A B C D
12. A B C D
13. A B C D
14. A B C D
15. A B C D

Station 3

16. A B C D
17. A B C D
18. A B C D
19. A B C D
20. A B C D
21. A B C D
22. (2pts) _____
23. A B C D
24. A B C D
25. A B C D

Column total: _____/26

26. (2pts) _____
27. (2pts) _____
_____
28. TRUE or FALSE
29. (2pts) _____
30. (2pts) _____
_____

Station 5

31. (2pts) _____
32. TRUE or FALSE
33. TRUE or FALSE
34. (2pts) _____
35. (2pts) _____
_____
36. (2pts) _____
_____

Station 6

37. (2pts) _____
38. (2pts) _____
39. (2pts) _____
40. A B C

41. TRUE or FALSE

42. (2pts) _____

43. TRUE or FALSE

Column total: _____/26

Column total: _____/30

Page total: _____

B.(2 pts)_____

46. A B C D

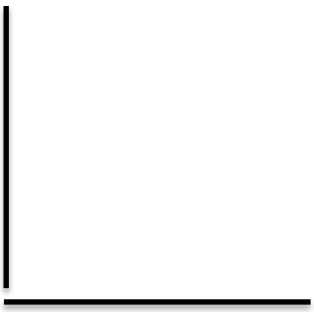
47. (2pts) _____

48. A B C D

Station 8

49. (2pts) _____

50. (4 pts)



51. A B C D

52. A B C D

53. A B C D

54. A B C D

Station 9

55. (4 pts)_____

56. A B C D

57. A B C D

58. A B C D

Tiebreakers: Best at Stations in reverse order: ie, best at station 9, then 8, then 7 etc.

Page total: _____/26

Station 1

1. A B C D
2. A B C D
3. A B C D
4. A B C D
5. A B C D
6. A B C D
7. A B C D
8. A B C D
9. A B C D

Station 2

10. A B C D
11. A B C D
12. A B C D
13. A B C D
14. A B C D
15. A B C D

Station 3

16. A B C D
17. A B C D
18. A B C D
19. A B C D
20. A B C D
21. A B C D
22. (2pts) ___ENTRY_____
23. A B C D
24. A B C D
25. A B C D

Station 4

Column total: _____/26

accept "not high levels of heavy metals or pesticides"

28. TRUE or FALSE
29. (2pts) _ Purple loosestrife
30. (2pts) _ Ship's ballasts and/or ornamental planting

Station 5

31. (2pts) _ Horse Fly or Deer Fly
32. TRUE or FALSE
33. TRUE or FALSE
34. (2pts) __ZEBRA MUSSEL_
35. (2pts) __ Ship's ballasts ___
36. (2pts) Any one: Filter out algae native species need, attach to and incapacitate native mussels, clog water intakes and outflows

Station 6

37. (2pts) __Caddisfly_____
38. (2pts) __low dissolved oxygen____
39. (2pts) No metamorphosis, so just size

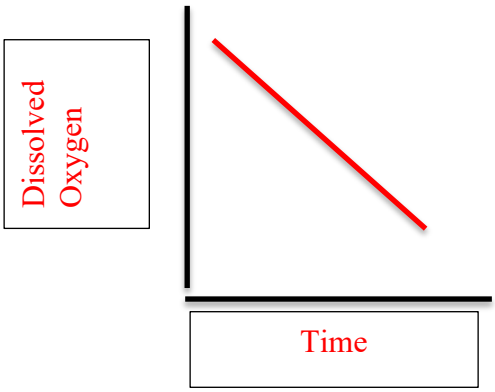
40. A B C
41. TRUE or FALSE
42. (2pts) _Common Backswimmer or Water Boatman__
43. TRUE or FALSE

Station 7

44. A B C D
45. A.(2pts) __Secchi Disk_____
    B.(2 pts)__turbidity_____
46. A B C D
47. (2pts) _Accept 8.5 – 9.5_____
48. A B C D

Station 8

49. (2pts) __Eutophication___
50. (4 pts)



2 pts for a diagonal line down to the right
1 point for each correctly labeled axis.

51. A B C D
52. A B C D
53. A B C D
54. A B C D

Station 9

55. (4 pts)__1-3% for full credit, 0 or 5% for 1 pt

56. A B C D

57. A B C D

58. A B C D

Page total: _____/26