Water Quality: Freshwater Ecology Test

Team Name		Team Number	

Part 1 – Freshwater Ecology	1 point for each correct, 72 total

1. What property of water is responsible for stratification of fresh water bodies
    A. Adhesion
    B. Cohesion
    C. Transpiration
    D. Osmosis
    E. Density
2. Wetland plants with leaves above the water surface also use this property of water to move moisture up their stems to their leaves
    A. Capillary action
    B. Solubility
    C. Solvency
    D. Transpiration
    E. Respiration
3. Coriolis effect can influence large lakes and is caused by
    A. Upper level westerly winds in the mid latitudes
    B. Circulation of ocean gyres
    C. Rotation of the earth
    D. Revolution of the earth
    E. Tilt of the earth with respect to the plane of the ecliptic
4. When pollen grains in water are viewed under a microscope they are seen to be constantly moving. This movement is called
    A. Evaporation
    B. Dissolving
    C. Diffusion
    D. Brownian motion
    E. Randomium motion
5. Water striders take advantage of this property of water to walk on the surface of water
    A. Specific heat
    B. Solvency
    C. Solubility
    D. Surface Tension
    E. Evaporation
6. This number helps predict flow patterns in different water flow situations, and is the ratio of inertia and viscosity of water
    A. Drag coefficient
    B. Reynold's Number
    C. Stokes Number
    D. Velocity
    E. Logistic growth
7. Coriolis effect causes _____ anticlockwise / counterclockwise directional currents in the Northern Hemisphere lakes and _____ clockwise directional currents in the Southern Hemisphere lakes
8. On larger spatial scales, water flow can be either _____ laminar, characterized by flow paths in the water that are unidirectional or _____ turbulent, characterized by eddies where the flow is not as unidirectional
9. What is the typical unit of compartments in the global hydrologic cycle
    A. Inches
    B. Km^3
    C. Km
    D. Yr
    E. Ft^3

10. Match water cycle keywords from the word bank to the definition provided

A. Evaporation	I. Suspensions
B. Transpiration	J. Compartments
C. Precipitation	K. Flux
D. Condensation	L. Hydrosphere
E. Percolation	M. Sublimation
F. Infiltration	N. Groundwater table
G. Runoff	O. Aquifer
H. Accumulation	

____B Water vapor released from Plants and soil

____C Any liquid or solid water that falls to Earth

____I Fog and mist are examples of this

____D Process of a gas changing to a liquid

____A Process of a liquid's surface changing to a gas

____G Describes a variety of ways liquid water moves across land

____F Process by which water soaks into subsurface soils and moves into rocks

____E Process by which liquid water flows through the soil due to the force of gravity

____H Process in which water pools in large bodies

____J Reservoirs where water may be found during its cycle

____N Upper level of an underground surface where the soil/rock is permanently saturated with water

____L Includes water that is on the surface of the planet, underground, and in the air

____K Inflows and outflows in a water cycle

____M Conversion of water to water vapor, with no intermediate liquid stage

____O An underground rock formation in which groundwater is stored

11. The amount of O_2 that can be dissolved in water is a function of temperature; the _____ the temperature, the _____ the concentration of O_2.

A. lower, higher

B. higher, lower

C. higher, higher

12. O_2 concentration in water _____ with increasing water pressure and _____ with increasing salinity

A. decreases; increases

B. increases; decreases

C. decreases; decreases

D. increases; increases

13. Classify the following reactions in nutrient cycles into Oxidation (O) or Reduction (R) reactions

Reaction	**O / R**
N_2 to Ammonia	R
Ammonia to Nitrite	O
Nitrite to Nitrate	O
Nitrate to N_2	R
Sulfide to Sulfate	O
Elemental Sulfur to H_2S	R

14. The addition (oversupply) of a limiting nutrient to an ecosystem may lead to an algal bloom. What is a likely effect of an algal bloom on the ecosystem?

A. An algal bloom will cause rapid changes in dissolved solids

B. An algal bloom will result in rapid changes in pH

C. An algal bloom will cause oxygen content to drop, creating hypoxic conditions

D. An algal bloom produces better food sources for fish

E. All of the above

15. Match wastewater treatment keywords to the definition provided

A. Anaerobic Digestion	H. Effluent
B. Aeration	I. Chlorination
C. Screening	J. Sedimentation
D. Grit removal	K. Sludge
E. Biological Flocculation	L. Scum
F. Clarifiers	M. Disinfection
G. Filtration	N. Biosolids
	O. Composting

____K semi-solid residue that settles to the bottom in a settling tank

____F settling tanks built with continuous mechanical removal of solids deposits

____B physical process to increase dissolved oxygen in treated water

____H refers to discharge as the treatment's final product

____L particles that float to the surface of the liquid

____N primarily organic materials produced during treatment which may be put to beneficial use

____J process of using gravity to remove solids that settle from water

____M used to remove pathogenic micro-organisms

____O biological degradation of organic materials under controlled aerobic conditions

____A organic pollutants are converted by micro-organisms to a gaseous product

____C process in which large objects are removed

____D process in which fine material is removed

____G water flows through a filter designed to remove particles in the water

____E process of combining with organisms to reduce the organic content of the sewage

____I process of adding chlorine or chlorine compounds to kill bacteria

16. The Phosphorus cycle is important because phosphorus is necessary for life. Phosphorus is released in organic compounds from the death of plants and animals and is taken up again by plants. How is the phosphorus made useable again for plants?

A. It breaks down naturally into a useable form
B. It is turned into inorganic phosphorus by sunlight and water movement
C. Bacteria change phosphorus back to a form useable by plants
D. It is transformed with oxygen to make new compounds
E. All of the above

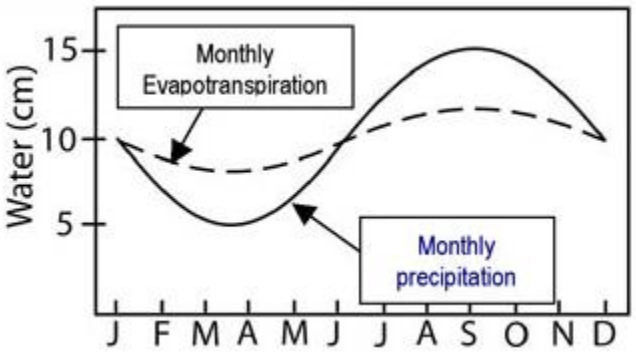
17. Which of the following best explains the difference between semelparous and iteroparous species?

A. Semelparous species generally have fewer offspring than iteroparous species
B. Semelparous species reproduce once in their lifetime, while iteroparous species reproduce multiple times
C. Iteroparous species generally die after reproduction, while semelparous species do not
D. Iteroparous species put all of their resources into a single reproductive event, and semelparous species do not

18. Which of the following organisms found in human waste that cause water pollution?

A. Coliform bacteria
B. Viruses
C. Protozoa
D. Parasitic worms
E. Fungus

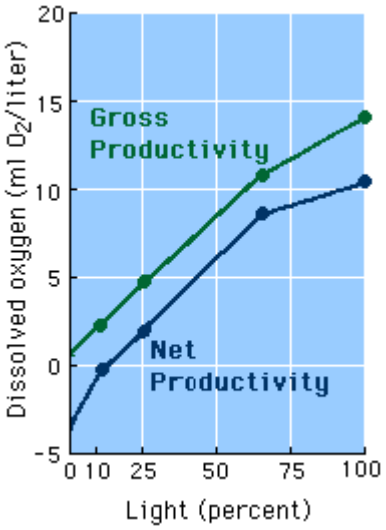
19. A population of minnows in a pond is growing under natural conditions with limited resources. As the minnow population increases in size, how will its rate of growth affect its population density?
    A. As the population grows, population density becomes unstable. As a result, population growth stops
    B. As the populations grows, population density increases. As a result, the rate of population growth eventually slows
    C. As the population grows, population density decreases. As a result, the rate of population growth eventually increases
    D. As the population grows, population density remains constant. As a result, population growth increases
20. According to the climate chart below, which months have the greatest potential for contaminating groundwater with pollutants in the soil?



    A. Jan–Feb
    B. Mar–April
    C. June–July
    D. Sep–Oct
    E. Nov-Dec
21. Inorganic carbon is found in the atmosphere, primarily in the form of _____ carbon dioxide (CO_2)
22. If a certain watershed received 1250 mm of rain during a year, stored 150 mm of water in its soil mantle, and lost 400 mm of water downstream, how much water was lost to the atmosphere (mainly through plants)?
    A. 550 mm
    B. 700 mm
    C. 1000 mm
    D. 625 mm
    E. 1800 mm
23. It is usually desirable to manage soils in ways that maintain a high infiltration rate because this results in
    A. more water becoming available to sustain plant productivity
    B. more water flowing in rivers, especially during rainy weather
    C. less leaching of chemicals applied to the soil surface
    D. all of the above
    E. none of the above
24. The biggest consumptive use of water in the U.S. and most other large developed countries is
    A. cooling fossil fuel and nuclear power plants
    B. municipal water supplies for household and commercial use
    C. heavy industries like steel and chemical factories
    D. ships and barges on the nation's major rivers and canals
    E. irrigation of agricultural cropland
25. List any two activities that can cause sediment pollution

    (any activity that causes human initiated erosion and runoff, example, logging, road construction, clearing land for agriculture)

26. Biochemical Oxygen Demand, (BOD) is a measure of organic material present in water. BOD value less than 5 ppm indicates a water sample to be
    A. rich in dissolved oxygen
    B. poor in dissolved oxygen
    C. highly polluted
    D. not suitable for aquatic life
27. In which aquatic environment would you expect dissolved oxygen to be highest?
    A. A mountain lake that is clear and cold
    B. A bog where the water is shallow and warm and there is a mat of aquatic plants
    C. A marine tide pool
    D. A cold mountain stream dropping over a series of small rock falls
    E. A coral reef in a still lagoon
28. Water with higher turbidity will tend to be
    A. more likely to become polluted
    B. higher pH than water with low turbidity
    C. cloudier than water with low turbidity
    D. more likely to contain phosphates
29. What is a watershed or drainage basin?
    A. a reservoir of water underground, containing a supply of groundwater.
    B. an area of land where water from rain or melting ice flows to lower elevations, converging into larger rivers, lakes or ocean.
    C. extensive wetlands leading to an estuary
    D. an area of land with a network of ponds, lakes and forest
30. List 2 Obligate Wetland Plants that occur in US wetlands more than 99% of the time
    ____Marsh Marigold, Royal Fern, Cardinal flower_____
31. At what light intensity do you expect there to be no net productivity?



    A. Any intensity below 100%
    B. Only at intensities of 0% and 2%
    C. Any intensity below 10%
    D. Any intensity above 25%
32. Calculate stream flow. Flow data collected at two transects A & B are given below.

Stream width @ A	2.5 m
Average Stream depth @ A	0.17 m
Stream width @ point B	3.0 m
Average Stream depth @ B	0.2 m
Distance between A & B	6.0 m
Flow time from A to B	15 sec
Coefficient for a rocky bottom stream	0.8

_____0.164_____ _____m^3/s_____
Value SI Unit

Average area = (((2.5*0.17)+(3.0*0.2))/2) = 0.5125 m^2
Flow = ALC/T = 0.5125 * 6 * 0.8 / 15 = 0.164 m^3/s

33. Thirty percent of invasive species in the Great Lakes have been introduced through__Ship ballast water
34. The top layer of a stratified lake is called
    A. Hypolimnion
    B. Metalimnion
    C. Epilimnion
    D. Thermocline

Part 2 – Macroflora and Fauna Identification	**50 points**

35. Identify organisms on color sheet provided.

- Enter common name below (2 points each)
- Enter weighting factor from the mapping table based on the class of the macroinvertebrate (0.5 point each)
- Calculate group score and enter (0.5 point each)
- Calculate water quality index (3 points)
- Lookup the Water Quality from the index range (2 points)

Macroinvertebrate	# of TAXA	Weighting Factor	Taxa score
A. Spiny water flea	0	0	0
B. Water scorpion	2	1	2
C. Stonefly nymph	3	1	3
D. Gilled snail	4	1	4
E. Dobsonfly	3	1	3
F. Midgefly bloodworm	2	4	8
G. Deer fly	0	4	0
H. Back swimmer	3	5	15
I. Predacious diving beetle	2	5	10
J. Midge	0	3	0
K. Whirligig beetle	0	5	0
L. Water boatman nymph	0	5	0
M. Mayfly	3	1	3
N. Cranefly	4	2	8
O. Giant water bug	0	5	0
Total Taxa Score	56		
Total # of TAXA	26		
Water Quality Index (total group score / total number of taxa)	2.15		
Water Quality	Good		

Class – Water Quality Weighting Factor	
Class of invertebrate	**Weighting factor**
Class 1 (pollution Sensitive)	1
Class 2 (moderately sensitive)	2
Class 3 (moderately tolerant)	3
Class 4 (pollution tolerant)	4
Class 5 (air breathing)	5
Nuisance Animal	0

Water Quality	
Excellent	1.0 – 2.0
Good	2.1 – 2.5
Fair	2.6 – 3.5
Poor	> 3.6

36. Water quality parameters are properties of water that affect aquatic life. List 8 water quality parameters that are measurable and their effects on aquatic life processes when they are low and high (1 points each, total 24)

Water Quality Parameter	Low	High
Temperature	Slows bio processes	Lowers dissolved oxygen
Transparency	Less producers, less photosynthesis	Growth of algae, eutrophication
Turbidity/water currents	Lower nutrient mixing, affects movement of phytoplankton	Sunlight does not reach plants, low DO, high temps
Dissolved Oxygen	Does not support life, consumers die off	Sustains life, a highly productive environment
Carbon Dioxide	Affects acid-base balance in the blood and tissues of fish, alkalosis	Excessive algal growth, eutrophication, fish has trouble with taking in oxygen, temperature rises, carbonic acid may alter pH
Nutrient levels	Limited plant growth, oligotrophic	Excessive algal growth, eutrophic
Salinity	Sustains freshwater organisms	Low DO, Harmful to freshwater organisms
pH	Physical damage to gills, exoskeleton, fins	Physical damage to gills, exoskeleton, fins
Biochemical Oxygen Demand (BOD)	Low nutrient levels, high DO	High nutrient levels, depletion of oxygen, low DO
Water conductivity	Low nutrient levels	High nutrient levels, possible water pollution
Total suspended solids (see turbidity), The term Total Solids includes both TSS and Total dissolved solids. And since TSS alone does not adversely affect water quality, TSS becomes the primary focus for water quality.		

37. The Michigan Department of Health and Human Services extended a 'Do Not Eat' fish advisory for the Huron River watershed due to a contaminant.

    A. What is this contaminant? _____Per- and polyfluoroalkyl substances (PFAS)_____

    B. List one other ways (besides food) people are exposed to this contaminant

    Food packages with PFAS-containing materials, processed with equipment that used PFAS, or grown in PFAS-contaminated soil or water, Commercial household products, including stain- and water-repellent fabrics, nonstick products (e.g., Teflon), polishes, waxes, paints, cleaning products, and fire-fighting foams, Production facilities or industries that use PFAS, Drinking water

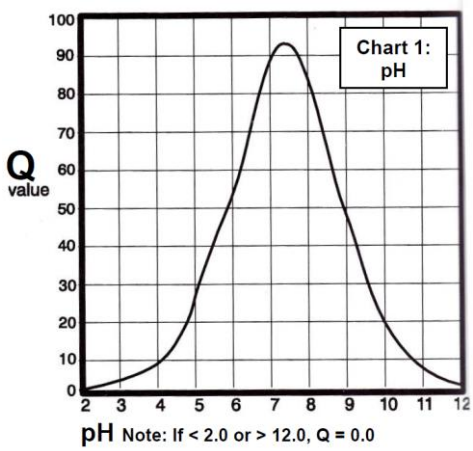
    C. List one adverse health effect from exposure to this contaminant

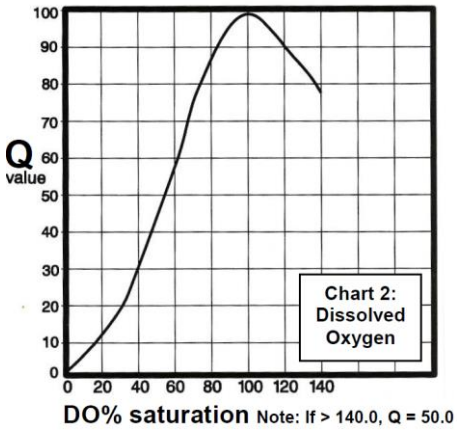
    Infant birth weights,, Effects on the immune system, cancer (for PFOA), and thyroid hormone disruption (for PFOS)

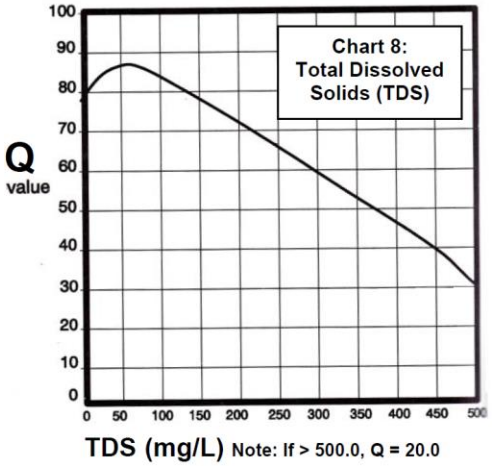
    https://www.epa.gov/pfas/basic-information-pfas#exposed

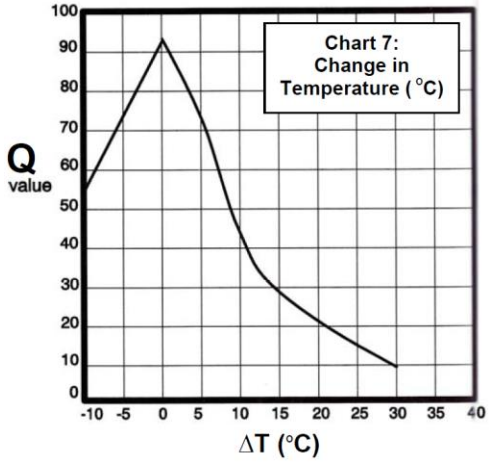
38. Calculate NSF Water Quality Index. Use the graphs and index table to determine missing Q-values (2 points each, total 30)

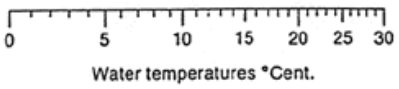
Water Quality - Index Ranges	
Excellent	90 – 100
Good	70 – 89
Medium	50 – 69
Bad	25 – 49
Very Bad	0 - 24

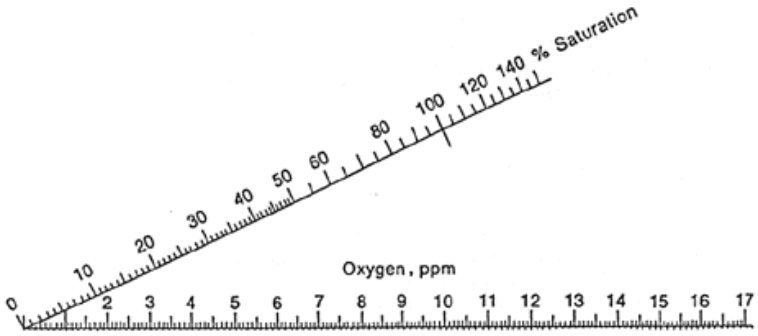












To convert DO in ppm or mg/L, find the value in the lower horizontal line, then draw a line from there to the temperature value in Celsius on the temperature ruler above. Wherever the line intersects the saturation line is the saturation %, then find the Q-value in the DO Sat% graph. Convert units appropriately whenever necessary

[Q – Value] * [WQ Weight] = [WQ Index] Sum the [WQ Index], then lookup the number against the range table to find WQ.

Water Quality Factor	Monitoring results	Q – Value	WQ weight	WQ Index
Dissolved oxygen	14.3 mg/L = 98%	98 (+-2)	0.17	16.66
Fecal coliform	1700 CFU/100ml	23	0.16	3.68
pH	7	89 (+-2)	0.11	9.79
Biochemical oxygen demand	6 mg/L	36	0.11	3.96
Temperature change	0 deg C	93 (+-2)	0.10	9.30
Total phosphate	0.2 mg/L	50	0.10	5.00
Nitrates	0.4 mg/L	91	0.10	9.10
Turbidity	10 NTU	79	0.08	6.32
Total solids	10 ml/L	82(+-2)	0.07	5.74
			Overall WQ Index	69.41
			Water Quality	Medium

Part 3B – Salinity Testing	**2 points each, total 10 points**

39. What is the salinity of sample A?

7%

40. What is the salinity of sample B?

4%

41. Which of these samples matches closest to the salinity of the ocean?

B

42. At what salinity is water considered slightly saline?

1000 ppm or mg/L (ref: https://water.usgs.gov/edu/saline.html)

43. How does an increase in salinity of freshwater affect flora and fauna?

increased salinity decreases a plant's ability to intake water by changing the water

potential and balance of a plant. An increase in salinity decreases water's ability to hold dissolved oxygen, greatly affecting aquatic life.

Part 2 Question 35

A

B

C

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