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NUTRIENT REMOVAL TRAINING COURSE \$100.00
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Collection ___ Wastewater Treatment ___ Pretreatment ___ Other _____

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Nutrient Removal Answer Key

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Multiple Choice. Pick only one answer per question. Select answer according to text. Circle, Mark off, underline or Bold the answer.

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This course contains general EPA's CWA federal rule requirements. Please be aware that each state implements wastewater/safety/environmental /building regulations that may be more stringent than EPA's regulations. Check with your state environmental/health agency for more information. These rules change frequently and are often difficult to interpret and follow. Be careful to be in full-compliance and do not follow this course for proper compliance.

Please e-mail or fax this survey with your final exam

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Nutrient Removal Training Course Assignment

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You will have 90 days from the start of this course to complete in order to receive your Professional Development Hours (**PDHs**) or Continuing Education Unit (**CEU**). A score of 70 % is necessary to pass this course. We prefer if this exam is proctored. No intentional trick questions. If you should need any assistance, please email all concerns and the completed manual to info@tlch2o.com.

We would prefer that you utilize the enclosed answer sheet in the front, but if you are unable to do so, type out your own answer key. Please include your name and address on your Answer Key and make copy for yourself. You can e-mail or fax your Answer Key along with the Registration Form to TLC. **(S) Means answer may be plural or singular. Multiple Choice Section - One answer per question and please use the answer key.**

Nutrients

- Which of the following wastewater terms have also been linked to ocean "red tides" that poison fish and cause illness in humans?
A. Nutrients from wastewater
B. Inorganic materials
C. Inorganic minerals
D. Excessive grease
E. Nitrogen and phosphorus
F. None of the Above
- Which of the following wastewater terms in drinking water may contribute to miscarriages and is the cause of a serious illness in infants called methemoglobinemia?
A. BOD
B. Most inorganic substances
C. Phosphorus
D. Pesticides and herbicide(s)
E. Nitrogen
F. None of the Above
- According to the text, wastewater often contains large amounts of which term in the form of nitrate and phosphate, which promote plant growth?
A. Nutrients from wastewater
B. Inorganic materials
C. Inorganic minerals
D. Nutrients nitrogen and phosphorus
E. Nitrogen and phosphorus
F. None of the Above
- Normally, excessive nutrients in receiving waters cause algae and other plants to grow quickly adding oxygen in the water, because of this additional of oxygen, fish and other aquatic life thrive.
A. True
B. False
- Organisms only require small amounts of _____ in biological treatment, so there normally is an excess available in treated wastewater.
A. BOD
B. Most inorganic substances
C. Nitrogen and phosphorus
D. Microorganisms
E. Nutrients
F. None of the Above

Solids

6. Which of the following terms must be treated, or they will clog soil absorption systems or reduce the effectiveness of disinfection systems?

- A. BOD
- B. Organic material
- C. The solids
- D. Microorganisms
- E. Suspended solids in wastewater
- F. None of the Above

7. Which of the following terms represents small particles of certain wastewater materials can dissolve, like salt in water?

- A. Suspended solids
- B. Organic material
- C. The solids
- D. Microorganisms
- E. Dissolved solids
- F. None of the Above

8. Solid materials in wastewater can consist of _____ and organisms.

- A. BOD
- B. Organic material
- C. The solids
- D. Microorganisms
- E. Organic and/or inorganic materials
- F. None of the Above

9. Settleable solids: Certain substances, such as sand, grit, and oxygen-demanding substances settle out from the rest of the wastewater stream during the preliminary stages of treatment.

- A. True
- B. False

10. On the bottom of settling tanks and ponds, _____ makes up a biologically active layer of sludge that aids in treatment.

- A. BOD
- B. Organic material
- C. The solids
- D. Heavier organic and inorganic materials
- E. Suspended solids in wastewater
- F. None of the Above

11. Which of the following terms represents materials that resist settling may remain suspended in wastewater?

- A. Suspended solids
- B. Organic material
- C. The solids
- D. Microorganisms
- E. Dissolved solids
- F. None of the Above

12. Some dissolved materials are consumed by _____ in wastewater.

- A. BOD
- B. Organic material
- C. The solids
- D. Microorganisms
- E. Suspended solids in wastewater
- F. None of the Above

13. Excessive amounts of dissolved solids in wastewater can have adverse effects on the environment.

- A. True
- B. False

Gases

14. Certain gases in wastewater can cause odors, affect treatment, or are potentially dangerous.

- A. True
- B. False

15. Methane gas is a byproduct of this wastewater term and is highly combustible.
- | | |
|------------------------|-------------------------------------|
| A. Dissolved oxygen | D. Biochemical oxygen demand or BOD |
| B. Oxygen-demanding | E. Anaerobic biological treatment |
| C. Magnesium hydroxide | F. None of the Above |

Hydrogen Sulfide and Ammonia

16. The gases hydrogen sulfide and along with _____ can be toxic and pose asphyxiation hazards.

- | | |
|--|-----------------------|
| A. Ammonia | D. The lack of oxygen |
| B. Wastewater odor(s) | E. Less oxygen |
| C. Hydrogen sulfide or H ₂ S problem(s) | F. None of the Above |

17. Which of the following terms will create conditions in the sewer system because of the lack of oxygen?

- | | |
|-----------------------|-----------------------|
| A. Slime bacteria | D. The lack of oxygen |
| B. Wastewater odor(s) | E. Less oxygen |
| C. Hydrogen sulfide | F. None of the Above |

18. Unless effectively contained or minimized by design and location, wastewater odors can affect the mental well-being and?

- | | |
|---------------------------------|-------------------------------------|
| A. Dissolved oxygen | D. Biochemical oxygen demand or BOD |
| B. Oxygen-demanding | E. Wastewater odor(s) |
| C. Quality of life of residents | F. None of the Above |

19. Which of the following terms - are very common in the collection and wastewater system?

- | | |
|--|----------------------|
| A. Slime bacteria | D. High DO |
| B. Wastewater odor(s) | E. Lack of turbidity |
| C. Hydrogen sulfide or H ₂ S problem(s) | F. None of the Above |

20. Ammonia as a dissolved gas in wastewater also is not dangerous to fish.

- A. True B. False

21. The best method of controlling hydrogen sulfide is to eliminate its habitat or growth area by keeping sewers cleaner, this will harbor?

- | | |
|--|-----------------------|
| A. Fewer slime bacteria | D. The lack of oxygen |
| B. Wastewater odor(s) | E. Less oxygen |
| C. Hydrogen sulfide or H ₂ S problem(s) | F. None of the Above |

22. Salts of zinc and iron may precipitate which term?

- | | |
|------------------------|-------------------------------------|
| A. Dissolved oxygen | D. Biochemical oxygen demand or BOD |
| B. Sulfides | E. Wastewater odor(s) |
| C. Magnesium hydroxide | F. None of the Above |

23. These chemicals or compounds are utilized in the treatment of hydrogen sulfide problems: Salts of zinc, lime, hydrogen peroxide, _____ and magnesium hydroxide.

- | | |
|---------------------|----------------------|
| A. Dissolved oxygen | D. Ammonia |
| B. Oxygen | E. Carbon dioxide |
| C. Chlorine | F. None of the Above |

24. Hydrogen dioxide production in collection systems can cause a number of problems such as corrosion of the pipes, manholes, and creation of hazardous atmospheres and foul odors.

- A. True B. False

Pollutants, Oxygen-Demanding Substances

25. Which of the following terms is a key element in water quality that is necessary to support aquatic life?

- A. Dissolved oxygen D. Biochemical oxygen demand or BOD
B. Oxygen-demanding E. Wastewater odor(s)
C. Magnesium hydroxide F. None of the Above

26. Biochemical oxygen demand, or BOD, and is used to measure how well a sewage treatment plant is working, it is a demand placed on the unnatural supply of pollutants in wastewater.

- A. True B. False

27. If the effluent, the treated wastewater produced by a treatment plant, has a high content of organic pollutants or ammonia, it will demand more oxygen from the water and leave the water with less of _____ to support fish and other aquatic life.

- A. Slime bacteria D. The lack of oxygen
B. Wastewater odor(s) E. Oxygen
C. Hydrogen sulfide or H₂S problem(s) F. None of the Above

28. Organic matter and which term are “oxygen-demanding” substances?

- A. Dissolved oxygen D. Biochemical oxygen demand, or BOD
B. Ammonia E. Wastewater odor(s)
C. Magnesium hydroxide F. None of the Above

29. According to the text, oxygen-demanding substances are contributed by _____ and agricultural and industrial wastes.

- A. Slime bacteria D. The lack of oxygen
B. Wastewater odor(s) E. Domestic sewage
C. Hydrogen sulfide or H₂S problem(s) F. None of the Above

30. Oxygen-demanding substances are usually destroyed or converted to other compounds by _____ if there is sufficient oxygen present in the water.

- A. Dissolved oxygen D. Biochemical oxygen demand, or BOD
B. Oxygen-demanding E. Bacteria
C. Magnesium hydroxide F. None of the Above

31. According to the text, modern disinfection techniques have greatly reduced the danger of waterborne disease.

- A. True B. False

Nutrients

32. Which of the following wastewater terms - are essential to living organisms and are the chief nutrients present in natural water?

- A. Oxygen D. Carbon, nitrogen, and phosphorus
B. Ecology E. Phosphorus and nitrogen
C. Nutrient enrichment F. None of the Above

33. Uncontrolled algae growth blocks out sunlight and chokes aquatic plants and animals by depleting _____ in the water at night.

- A. Pathogen(s)
- B. Dissolved oxygen
- C. Nutrient enrichment
- D. Excessive growth of algae
- E. Phosphorus and nitrogen
- F. None of the Above

34. According to the text, the release of nutrients in quantities that exceed the affected waterbody's ability to assimilate them results in a condition called?

- A. Toxic
- B. Ecology
- C. Nutrient enrichment
- D. Eutrophication or cultural enrichment
- E. Oxygen and organic waste
- F. None of the Above

35. Which of the following wastewater terms do not remove the phosphorus and nitrogen to any substantial extent?

- A. Biofilm
- B. Some contaminants
- C. Secondary treatment
- D. Conventional secondary biological treatment processes
- E. Oxygen and organic waste
- F. None of the Above

36. According to the text, nutrients may convert the organic forms of phosphorus and nitrogen into mineral form, making them more usable by plant life.

- A. True
- B. False

37. An excess of these nutrients over-stimulates the growth of water plants, the result causes unsightly conditions, interferes with drinking water treatment processes, and causes unpleasant and disagreeable tastes and odors in drinking water.

- A. True
- B. False

38. Primarily _____ but occasionally nitrogen, causes nutrient enrichment which results in excessive growth of algae.

- A. Phosphorus
- B. Heavy metals
- C. Nutrient enrichment
- D. Excessive growth of algae
- E. Phosphorus and nitrogen
- F. None of the Above

Inorganic and Synthetic Organic Chemicals

39. Inorganic and Synthetic Organic Chemicals can cause _____ problems, and many are not effectively removed by conventional wastewater treatment.

- A. Toxic
- B. Ecology
- C. Nutrient enrichment
- D. Excessive growth of algae
- E. Taste and odor
- F. None of the Above

Thermal

40. Which of the following terms reduces the capacity of water to retain oxygen?

- A. Heat
- B. Heavy metals
- C. Nutrient enrichment
- D. Excessive growth of algae
- E. Phosphorus and nitrogen
- F. None of the Above

41. Unchecked discharges of which term can seriously alter the ecology of a lake, a stream, or estuary?

- A. Toxic
- B. Waste heat
- C. Nutrient enrichment
- D. Eutrophication or cultural enrichment
- E. Phosphorus and nitrogen
- F. None of the Above

42. According to the text, even discharges from wastewater treatment plants and storm water retention ponds affected by winter can be released at temperatures below that of the receiving water, and lower the stream temperature.
A. True B. False

Primary Treatment

43. The initial stage in the treatment of domestic wastewater is known as bar screens.
A. True B. False

44. Coarse solids are removed from the wastewater in the primary stage of treatment. In some treatment plants, _____ may be combined into one basic operation.
A. Solid(s) D. Suspended growth process(es)
B. Finer debris E. Primary and secondary stages
C. Grit and gravel F. None of the Above

45. There are two basic stages in the treatment of wastes, RAS and WAS.
A. True B. False

46. The secondary stage uses which term to further purify wastewater?
A. Very fine solids D. Primary sludge
B. Biological processes E. Grit and screenings
C. Pollutant(s) F. None of the Above

Preliminary Treatment

47. Especially in cities with combined sewer systems, removing the _____ that washes off streets or land during storms is very important.
A. Very fine solids D. Primary sludge
B. Grit and gravel E. Grit and screenings
C. Pollutant(s) F. None of the Above

48. Large amounts of _____ entering a treatment plant can cause serious operating problems, such as excessive wear of pumps and other equipment.
A. Solid(s) D. Grit and sand
B. Finer debris E. Dissolved organic and inorganic constituents
C. Grit and gravel F. None of the Above

49. In some plants, another finer screen is placed after the grit chamber to remove any additional material that might damage equipment or interfere with later processes.
A. True B. False

50. The preliminary treatment is purely physical stage consisting of Coarse Screening, Raw Influent Pumping, Static Fine Screening, Grit Removal, and Selector Tanks.
A. True B. False

51. The _____ enters from the collection system into the Coarse Screening process.
A. Solid(s) D. Raw wastewater
B. Finer debris E. Dissolved organic and inorganic constituents
C. Grit and gravel F. None of the Above

52. After the wastewater has been screened, it may flow into a grit chamber where sand, grit, cinders, and small stones settle to the bottom

A. True B. False

53. Which of the following terms passes into the Static Fine Screening process which consists of two stationary (or static) screens?

- A. Solid(s)
- B. Finer debris
- C. Grit and gravel
- D. Flow
- E. Dissolved organic and inorganic constituents
- F. None of the Above

54. The wastewater passes into the _____ process that consists of two vortex grit separators which produce a whirlpool action to force the finest debris to the outside perimeter.

- A. Very fine solids
- B. De-gritted wastewater
- C. Grit Removal
- D. Primary sludge
- E. Grit and screenings
- F. None of the Above

55. Which of the following terms once removed by these processes must be periodically collected and trucked to a landfill for disposal or are incinerated?

- A. Very fine solids
- B. Wastewater
- C. Pollutant(s)
- D. Primary sludge
- E. Grit and screenings
- F. None of the Above

56. The Coarse Screening consists of a basket shaped bar screen that collects larger debris (several inches in diameter) prior to the Raw Influent Pumping.

A. True B. False

57. Which of the following terms is removed and placed into a dumpster for disposal into the landfill?

- A. Liquids
- B. Finer debris
- C. Compounds
- D. Debris
- E. Dissolved organic and inorganic constituents
- F. None of the Above

58. Which of the following terms passes into the Raw Influent Pumping process that consists of submersible centrifugal pumps?

- A. Wastewater
- B. Split samples
- C. Duplicate samples
- D. Dissolved organic and inorganic constituents
- E. Grit and gravel
- F. None of the Above

Primary Sedimentation

59. Pollutants that are dissolved or are very fine and remain suspended in the wastewater are easily removed effectively by gravity settling.

A. True B. False

60. When the wastewater enters a sedimentation tank, it slows down and the suspended solids gradually sink to the bottom, this mass of solids is called?

- A. Very fine solids
- B. Wastewater
- C. Pollutant(s)
- D. Primary sludge
- E. Grit and screenings
- F. None of the Above

61. When the screening completed and the grit removed, wastewater is clear of dissolved organic and inorganic constituents along with suspended solids.

- A. True B. False

62. Which of the following wastewater treatment terms consist of minute particles of matter that can be removed from the wastewater with further treatment such as sedimentation or gravity settling, chemical coagulation, or filtration?

- A. Solid(s) D. Suspended growth process(es)
B. Suspended solids E. Dissolved organic and inorganic constituents
C. Grit and gravel F. None of the Above

Secondary Treatment

63. The wastewater enters from Preliminary Treatment into the clarifier process which a biological process consisting of large oval shaped basins that are capable of removing these finer solids.

- A. True B. False

64. Maintaining a population of microorganisms within the oxidation basins that consumes the _____ and also adhere to the solids themselves.

- A. Total Solids D. Elevated Hardness, Salty Taste, or Corrosiveness
B. TDS E. Wastewater temperature
C. Very fine solids F. None of the Above

65. Which of the following terms form larger and heavier aggregates that can be physically separated?

- A. Solid(s) D. Finer solids
B. Finer debris E. Dissolved organic and inorganic constituents
C. Grit and gravel F. None of the Above

66. After which term has been through Primary Treatment processes, it flows into the next stage of treatment called secondary?

- A. Very fine solids D. Primary sludge
B. Wastewater E. Grit and screenings
C. Pollutant(s) F. None of the Above

67. The two most common conventional methods used to achieve secondary treatment are: _____ and suspended growth processes.

- A. Solid(s) D. Unsuspended growth process(es)
B. Finer debris E. Organic matter
C. Attached growth processes F. None of the Above

68. The Secondary Treatment stage consists of a biological process such as _____ and a physical process, Secondary Clarification.

- A. Wildlife habitat D. Phosphorus-reduction system(s)
B. Oxidation Ditches E. Excessive sludge production
C. Denitrification F. None of the Above

69. The Preliminary Treatment stage removes as much _____ as possible using physical processes.

- A. Solid(s)
- B. Finer debris
- C. Grit and gravel
- D. Suspended growth process(es)
- E. Dissolved organic and inorganic constituents
- F. None of the Above

Nutrient Removal Technologies

Fixed-film systems - Aerobic/anaerobic trickling filter package plant

70. Which of the following terms are biological treatment processes that employ a medium such as rock, plastic, wood, or other natural or synthetic solid material that will support biomass on its surface?

- A. Trickling filter(s)
- B. Fixed-film systems (FFSs)
- C. Nitrogen removal system(s)
- D. Aerobic nitrification processes
- E. Recirculating sand filters (RSFs)
- F. None of the Above

71. Which of the following terms are typically constructed as beds of media through which wastewater flows?

- A. A closed loop
- B. Nitrogen removal system(s)
- C. Optimal DO levels
- D. Trickling filter FFSs
- E. A portion of the denitrified effluent
- F. None of the Above

72. Which of the following terms represents removal typically varies from 0 to 35 percent although removal percentages as high as 65%?

- A. Nitrified effluent
- B. Nitrogen
- C. Total Nitrogen (TN)
- D. Nitrogen and phosphorus levels
- E. Activated sludge
- F. None of the Above

73. Phosphorus removal is typically 1 to 1.5 percent.

- A. True
- B. False

74. Multi-pass systems result in higher treatment quality and assist in removing _____ levels by promoting nitrification in the aerobic media bed and denitrification in the anaerobic septic tank.

- A. Total Solids
- B. TDS
- C. pH
- D. Elevated Hardness, Salty Taste, or Corrosiveness
- E. Total Nitrogen (TN)
- F. None of the Above

75. According to the text, some of the factors affecting performance include influent wastewater characteristics, hydraulic and organic loading, medium type, maintenance of optimal DO levels, and?

- A. Wildlife habitat
- B. Recirculation rates
- C. Denitrification
- D. Phosphorus-reduction system(s)
- E. Excessive sludge production
- F. None of the Above

76. Commercial on-site systems use synthetic media and receive wastewater from overlying sprayheads for anaerobic treatment and de-nitrification.

- A. True
- B. False

77. Which of the following terms returns to the anoxic zone to mix with either septic tank contents or incoming septic tank effluent for denitrification?

- A. Filamentous organisms
- B. Floc particles
- C. Organic material
- D. Nitrified effluent
- E. Biosurfactant trehalose
- F. None of the Above

78. Which of the following terms is discharged for disposal or further treatment?

- A. Ammonia oxidation
- B. Phosphorus removal
- C. Nitrate removal
- D. Denitrified effluent
- E. Oxygen demand of wastewater
- F. None of the Above

79. According to the text, currently typical trickling filters systems are capable of producing effluent _____ concentrations of 5 to 40 mg/L.

- A. Nitrified effluent
- B. Nitrogen
- C. Total Nitrogen (TN)
- D. Nitrogen and phosphorus levels
- E. BOD and TSS
- F. None of the Above

Sequencing batch reactor (SBR)

80. According to the text, the SBR process is a sequential suspended growth process in which all major steps occur in the same tank in sequential order.

- A. True
- B. False

81. Which of the following terms consists of a combination of level sensors, timers, and microprocessors which can be configured to meet the needs of the system?

- A. SBR process
- B. Underdrain system
- C. Sand filter(s)
- D. Cluster applications
- E. Process control timer(s)
- F. None of the Above

82. Which of the following terms can be designed and operated to enhance removal of nitrogen, phosphorus, and ammonia, in addition to removing TSS and BOD?

- A. Trickling filter(s)
- B. Oxidation Ditches
- C. Nitrogen removal system(s)
- D. SBRs
- E. Recirculating sand filters (RSFs)
- F. None of the Above

83. Which of the following terms are suitable for areas with little land, stringent treatment requirements, and small wastewater flows such as RV parks, and other small applications?

- A. Package plant SBRs
- B. Sand filter(s)
- C. Chemical adsorption
- D. Fixed-film bioreactor(s)
- E. Diffused air or mechanical devices
- F. None of the Above

84. The SBR system can typically be found in packaged configurations for onsite and small community or?

- A. Decanter
- B. Underdrain system
- C. Sand filter(s)
- D. Cluster applications
- E. Process control timer(s)
- F. None of the Above

85. Which of the following terms are often sized to provide mixing as well and are operated by the process control timers?

- A. Underdrain system
- B. Free water surface (FWS) systems
- C. SBRs
- D. Conventional recirculation tank
- E. Anaerobic septic tank effluent
- F. None of the Above

86. Several decanter configurations are available, including?

- A. Fixed and floating units
- B. Recirculating filter(s)
- C. Available adsorption sites
- D. Septic tank effluent
- E. Distribution network
- F. None of the Above

Intermittent Sand Filters (ISF)

87. Intermittent sand filters label is used to describe a variety of Packed-bed filters of sand or other granular materials available on the market.

- A. True
- B. False

88. Which of the following terms provide advanced secondary treatment of settled wastewater or septic tank effluent?

- A. Trickling filter(s)
- B. Oxidation Ditches
- C. Sand filters
- D. Aerobic nitrification filters
- E. Recirculating sand filters (RSFs)
- F. None of the Above

89. Which of the following terms collects the filter effluent for further processing or discharge?

- A. SBR process
- B. Underdrain system
- C. Sand filter(s)
- D. Distribution network
- E. Process control timer(s)
- F. None of the Above

90. Which of the following terms are aerobic, fixed-film bioreactors?

- A. Decanter
- B. Sand filter(s)
- C. Chemical adsorption
- D. Fixed-film bioreactor(s)
- E. Diffused air or mechanical devices
- F. None of the Above

91. Bioslimes from the growth of microorganisms develop as films on the sand particle surfaces. The microorganisms in the slimes capture soluble and colloidal waste materials in the wastewater as it percolates over the sand surfaces.

- A. True
- B. False

92. Which of the following terms are strained out at the filter surface?

- A. Total Solids
- B. TDS
- C. Most suspended solids
- D. Elevated Hardness, Salty Taste, or Corrosiveness
- E. Wastewater temperature
- F. None of the Above

93. Which of the following terms are usually limited, the capacity of the media to retain ions depends on the target constituent, the pH, and the mineralogy of the media?

- A. Decanter
- B. Sand filter(s)
- C. Chemical adsorption
- D. Fixed-film bioreactor(s)
- E. Adsorption sites in the media
- F. None of the Above

94. Phosphorous is one element of concern in wastewater that can be removed in this manner, but the number of available adsorption sites is limited by the?

- A. Characteristics of the media
- B. Recirculating filter(s)
- C. Available adsorption sites
- D. Septic tank effluent
- E. Distribution network
- F. None of the Above

95. Which of the following terms can be used for a broad range of applications, including single-family residences, large commercial establishments, and small communities?

- A. Decanter
- B. Sand filter(s)
- C. Chemical adsorption
- D. Fixed-film bioreactor(s)
- E. Diffused air or mechanical devices
- F. None of the Above

96. Sand filters are frequently used to pretreat septic tank effluent prior to _____ where the soil has insufficient unsaturated depth.

- A. Surface water
- B. Recirculating filter(s)
- C. Available adsorption sites
- D. Septic tank effluent
- E. Subsurface infiltration onsite
- F. None of the Above

97. Which of the following terms are used primarily to treat domestic wastewater, but they have been used successfully in treatment trains to treat wastewaters high in organic materials?

- A. Decanter
- B. Sand filter(s)
- C. Chemical adsorption
- D. Fixed-film bioreactor(s)
- E. Diffused air or mechanical devices
- F. None of the Above

Recirculating Sand Filters (RSF)

98. Recirculating filters using _____ provide advanced secondary treatment of settled wastewater or septic tank effluent.

- A. Sand, gravel, or other media
- B. Wastewater
- C. Denitrification
- D. Phosphorus-reduction system(s)
- E. Excessive sludge production
- F. None of the Above

99. Which of the following terms collects and recycles the filter effluent to the recirculation tank for further processing or discharge?

- A. Underdrain system
- B. Free water surface (FWS) systems
- C. Oxygen
- D. Conventional recirculation tank
- E. Anaerobic septic tank effluent
- F. None of the Above

100. The basic components of recirculating filters include a recirculation/dosing tank, pump and controls, distribution network, filter bed with an underdrain system, and a return line.

- A. True
- B. False

101. The returned aerobic filtrate in the recirculation tank, mixes with the anaerobic septic tank effluent before being reapplied to the?

- A. Underdrain system
- B. Free water surface (FWS) systems
- C. Filter
- D. Conventional recirculation tank
- E. Anaerobic septic tank effluent
- F. None of the Above

102. Which of the following terms can be used for a broad range of applications, including single-family residences, large commercial establishments, and small communities?

- A. Trickling filter(s)
- B. Oxidation Ditches
- C. Nitrogen removal system(s)
- D. Aerobic nitrification processes
- E. RSFs
- F. None of the Above

103. Denitrification also has not been shown to occur in RSFs.

- A. True
- B. False

Natural Systems

104. According to the text, wetland systems are typically described in terms of the position of the water surface and/or the type of vegetation grown.

A. True B. False

105. As with tank designs, in the natural system, bacteria break down organic matter in the wastewater, aerobically, anoxically and anaerobically.

A. True B. False

106. Which of the following terms treat wastewater by bacterial decomposition, settling, and filtering?

A. Underdrain system D. Conventional recirculation tank
B. Free water surface (FWS) systems E. Anaerobic septic tank effluent
C. Wetlands F. None of the Above

107. Oxygen for _____ is supplied by the plants growing in the wetland.

A. Ammonia oxidation D. An aerobic wastewater treatment facility
B. Phosphorus removal E. Aerobic decomposition
C. Nitrate removal F. None of the Above

108. FWS wetlands with long detention times can remove minor amounts of _____ through plant uptake, adsorption, complexation, and precipitation.

A. Total Solids D. Elevated Hardness, Salty Taste, or Corrosiveness
B. TDS E. Phosphorus
C. pH F. None of the Above

109. Which of the following terms is typically greater in the first year or two because of soil absorption?

A. Ammonia oxidation D. An aerobic wastewater treatment facility
B. Phosphorus removal E. Oxygen demand of wastewater
C. Nitrate removal F. None of the Above

110. Which of the following terms is also possible with the use of an addition process, such as chemical addition and mixing prior to a final deep settling pond?

A. Ammonia oxidation D. An aerobic wastewater treatment facility
B. Phosphorus removal E. Oxygen demand of wastewater
C. Nitrate removal F. None of the Above

111. Subsurface flow (SF) wetlands are specifically designed to treat or polish which missing term and are typically constructed as a bed or channel containing appropriate media?

A. Ammonia oxidation D. Wastewater
B. Phosphorus removal E. Oxygen demand of wastewater
C. Nitrate removal F. None of the Above

112. Duckweed are floating macrophytes.

A. True B. False

113. Duckweed fronds can double their mass in two days under ideal conditions of nutrient availability, sunlight, and temperature.

A. True B. False

122. A disadvantage of duckweed systems is the large amount of biomass produced by the rapidly growing plants, which creates a _____ requirement.

- A. Ammonia oxidation
- B. Phosphorus removal
- C. Nitrate removal
- D. Solids handling
- E. Oxygen demand of wastewater
- F. None of the Above

Sustainable Nutrient Recovery

123. Studies have shown that about 80 percent of the _____ and 50 percent of the phosphorus in wastewater are derived from urine?

- A. Total Solids
- B. TDS
- C. pH
- D. Nitrogen
- E. Wastewater temperature
- F. None of the Above

124. _____ and pollution, nutrients could be recycled for agricultural use, and could be removed before being mixed with wastewater and released to the environment.

- A. Total Solids
- B. TDS
- C. pH
- D. Nitrogen
- E. Nitrogen and phosphorus
- F. None of the Above

125. If you could separate 50 to 60 percent of urine, this could reduce in-plant carbon dioxide gas discharges and result in fewer impurities in methane captured from sludge digestion.

- A. True
- B. False

126. According to the text, one benefit would be reduced energy consumption at WWTPs as a result of reduced treatment requirements for?

- A. Total Solids
- B. TDS
- C. pH
- D. Nitrogen
- E. Nitrogen and phosphorus
- F. None of the Above

Nutrient Removal for Small Communities

127. Which of the following wastewater terms treat and dispose of effluent on the same property that produces the wastewater?

- A. Groundwater recharge
- B. Community drainfield(s)
- C. High-aluminum mud(s)
- D. Onsite septic systems
- E. Small volumes of wastewater
- F. None of the Above

128. According to the text, wastewater from several homes is pretreated onsite by individual septic tanks before being transported through alternative sewers to _____ treatment unit that is relatively simple to operate and maintain.

- A. An offsite decentralized
- B. Wastewater
- C. Denitrification
- D. Phosphorus-reduction system(s)
- E. Excessive sludge production
- F. None of the Above

129. Wastewater systems such as community drainfields, irrigation systems, and _____ are being installed to reduce infrastructure investment and minimize adverse environmental impacts.

- A. Wildlife habitat
- B. Package plants
- C. Denitrification
- D. Phosphorus-reduction system(s)
- E. Excessive sludge production
- F. None of the Above

130. Additional alternatives that include _____, sand filters, and constructed wetlands can be used to reduce nutrient pollution?
- A. Groundwater recharge
 - B. Community drainfield(s)
 - C. High-aluminum mud(s)
 - D. Aerobic tanks
 - E. Small volumes of wastewater
 - F. None of the Above

Phosphorus Removal

131. Few phosphorus removal processes are well developed for _____ application.
- A. Onsite wastewater systems
 - B. Wastewater
 - C. Denitrification
 - D. Phosphorus-reduction system(s)
 - E. Excessive sludge production
 - F. None of the Above

132. The controlled addition of chemicals such as aluminum, iron, and calcium compounds with subsequent flocculation and sedimentation has limited success.
- A. True
 - B. False

133. Studies of high-iron sands and _____ indicate that 50 to 95 percent of the phosphorus can be removed?
- A. Groundwater recharge
 - B. Community drainfield(s)
 - C. High-aluminum mud(s)
 - D. Nitrogen and phosphorus pollution
 - E. Small volumes of wastewater
 - F. None of the Above

Nitrogen Removal

134. Processes that remove 75 to 100 percent of total nitrogen include aerobic biological systems and media filters, especially recirculating filters.
- A. True
 - B. False

135. The vast majority of on-site and cluster nitrogen-removal systems employ nitrification and?
- A. Groundwater recharge
 - B. Community drainfield(s)
 - C. High-aluminum mud(s)
 - D. Denitrification biological reactions
 - E. Small volumes of wastewater
 - F. None of the Above

136. SBRs, and an array of _____ combined with an anoxic/anaerobic process to perform denitrification.
- A. Trickling filter(s)
 - B. Oxidation Ditches
 - C. Nitrogen removal system(s)
 - D. Aerobic nitrification processes
 - E. Recirculating sand filters (RSFs)
 - F. None of the Above

137. There are systems that utilize membrane solids separation following _____ are capable of removing total nitrogen down to very low concentrations (i.e. 3 – 4 mg/L TN).
- A. Nitrogen removal system(s)
 - B. Tertiary process
 - C. Biological nitrification and denitrification
 - D. Suspended film system(s)
 - E. Recirculating sand filters (RSFs)
 - F. None of the Above

138. Which of the following terms are located last in the treatment train prior to subsurface wastewater infiltration system (SWIS) disposal or surface water disposal?
- A. Trickling filter(s)
 - B. Oxidation Ditches
 - C. Nitrogen removal system(s)
 - D. Aerobic nitrification processes
 - E. Recirculating sand filters (RSFs)
 - F. None of the Above

Secondary Clarification Process

139. The SCP provides quiescent conditions that allow the larger aggregates of solids and microorganisms to settle out for collection.

- A. True B. False

140. In the SCP, the majority of microorganism-rich underflow is re-circulated to Tanks as Return Sludge to help sustain the microorganism population in the?

- A. Trickling filter(s) D. Aerobic nitrification processes
B. Oxidation Ditches E. Recirculating sand filters (RSFs)
C. Nitrogen removal system(s) F. None of the Above

Fixed Film Systems

141. Which of the following wastewater terms grow microorganisms on substrates such as rocks, sand or plastic?

- A. Mature biofilm D. Application-specific microbiology
B. Activated sludge system E. Fixed film systems
C. Advanced treatment technologies F. None of the Above

142. The wastewater is spread over the substrate, allowing the wastewater to flow past the film of microorganisms fixed to the substrate.

- A. True B. False

143. Which of the following wastewater terms and rotating biological contactors, and sand filters are examples of fixed film systems?

- A. Trickling filter(s) D. Aerobic nitrification processes
B. Oxidation Ditches E. Recirculating sand filters (RSFs)
C. Nitrogen removal system(s) F. None of the Above

Suspended Film Systems

144. As the microorganisms absorb organic matter and nutrients from the wastewater, they grow in size and number. After the microorganisms have been suspended in the wastewater for several hours, they are settled out as sludge.

- A. True B. False

145. Which of the following wastewater terms stir and suspend microorganisms in wastewater?

- A. Nitrogen removal system(s) D. Suspended film system(s)
B. Tertiary process E. Recirculating sand filters (RSFs)
C. Microorganism(s) F. None of the Above

146. Activated sludge, _____, oxidation ditch, and sequential batch reactor systems are all examples of suspended film systems.

- A. Trickling filter(s) D. Aerobic nitrification processes
B. Extended aeration E. Recirculating sand filters (RSFs)
C. Nitrogen removal system(s) F. None of the Above

Lagoon Systems

147. Lagoon systems are shallow basins which hold the waste-water for several months to allow for the natural degradation of sewage.

- A. True B. False

148. Lagoon systems take advantage of _____ and microorganisms in the wastewater to renovate sewage.

- A. Nitrogen removal system(s)
- B. Tertiary process
- C. Natural aeration
- D. Suspended film system(s)
- E. Recirculating sand filters (RSFs)
- F. None of the Above

Other Important Wastewater Characteristics

149. One important wastewater characteristic that can affect public health and the environment, as well as the design, cost, and?

- A. Treatment processes
- B. Total dissolved solids (TDS)
- C. Quality of the water
- D. The environment
- E. Effectiveness of treatment
- F. None of the Above

Temperature

150. The best temperatures for wastewater treatment probably range from 77 to 95 degrees Fahrenheit.

- A. True
- B. False

151. Biological treatment activity accelerates in warm temperatures and slows in cool temperatures, but _____ can stop treatment processes altogether.

- A. Oxygen
- B. High TSS
- C. Settling sediments
- D. Total Suspended Solids (TSS)
- E. Extreme hot or cold
- F. None of the Above

pH

152. The acidity or alkalinity of wastewater affects both treatment and the environment. Low

- A. True
- B. False

153. pH indicates increasing acidity while a low pH indicates increasing alkalinity.

- A. True
- B. False

154. Which of the following terms of wastewater needs to remain between 6 and 9 to protect organism?

- A. Total Solids
- B. TDS
- C. pH
- D. Elevated Hardness, Salty Taste, or Corrosiveness
- E. Wastewater temperature
- F. None of the Above

155. Other substances and some acids can alter _____ can inactivate treatment processes when they enter wastewater from industrial or commercial sources.

- A. Total Solids
- B. TDS
- C. pH
- D. Elevated Hardness, Salty Taste, or Corrosiveness
- E. Wastewater temperature
- F. None of the Above

Total Dissolved Solids

156. Pure water is tasteless, colorless, and odorless and is often called the universal solvent.

- A. True
- B. False

157. Which of the following wastewater terms is a good solvent and picks up impurities easily?

- A. Treatment processes
- B. Total dissolved solids (TDS)
- C. Quality of the water
- D. Wastewater
- E. Water
- F. None of the Above

158. Which of the following wastewater terms refer to any minerals, salts, metals, cations or anions dissolved in water?

- A. Total Solids
- B. TDS
- C. pH
- D. Elevated Hardness, Salty Taste, or Corrosiveness
- E. Dissolved solids
- F. None of the Above

159. Which of the following wastewater terms comprise inorganic salts and some small amounts of organic matter that are dissolved in water?

- A. Treatment processes
- B. Total dissolved solids (TDS)
- C. Quality of the water
- D. Both treatment and the environment
- E. Universal solvent
- F. None of the Above

160. TDS in drinking water originate from natural sources, sewage, urban run-off, industrial wastewater, and chemicals used in the water treatment process.

- A. True
- B. False

161. The total dissolved solids test provides a qualitative measure of the amount of dissolved ions, but does not tell us the nature or ion relationships.

- A. True
- B. False

162. Which of the following wastewater terms has been due to natural environmental features such as: mineral springs, carbonate deposits, salt deposits, and sea water intrusion?

- A. Total Solids
- B. TDS
- C. pH
- D. Elevated Hardness, Salty Taste, or Corrosiveness
- E. Wastewater temperature
- F. None of the Above

163. Which of the following wastewater terms is the concentration is the sum of the cations (positively charged) and anions (negatively charged) ions in the water?

- A. Treatment processes
- B. Total dissolved solids (TDS)
- C. Quality of the water
- D. Both treatment and the environment
- E. Universal solvent
- F. None of the Above

164. The TDS test does not provide us insight into the specific water quality issues, such as: Elevated Hardness, Salty Taste, or?

- A. Total Solids
- B. TDS
- C. pH
- D. Corrosiveness
- E. Wastewater temperature
- F. None of the Above

Total Solids

165. Which of the following wastewater terms refers to matter suspended or dissolved in water or wastewater, and is related to both specific conductance and turbidity?

- A. Total Solids
- B. TDS
- C. pH
- D. Elevated Hardness, Salty Taste, or Corrosiveness
- E. Wastewater temperature
- F. None of the Above

166. Which of the following wastewater terms are used for material left inside a container after evaporation and drying of a water sample?

- A. Treatment processes
- B. Total dissolved solids (TDS)
- C. Quality of the water
- D. Total solids
- E. pH
- F. None of the Above

167. Which of the following wastewater terms includes both total suspended solids, the portion of total solids retained by a filter and total dissolved solids?

- A. Total Solids
- B. TDS
- C. pH
- D. Elevated Hardness, Salty Taste, or Corrosiveness
- E. Wastewater
- F. None of the Above

168. Which of the following wastewater terms can be measured by evaporating a water sample in a weighed dish, and then drying the residue in an oven at 103 to 105° C?

- A. Treatment processes
- B. Total dissolved solids (TDS)
- C. Quality of the water
- D. Total Suspended solids
- E. Wastewater
- F. None of the Above

169. The increase in weight of the dish represents the total solids. Instead of total solids, laboratories often measure total suspended solids and/or total dissolved solids.

- A. True
- B. False

Total Suspended Solids (TSS)

170. Total Suspended Solids (TSS) are solids in water that can be trapped by a filter.

- A. True
- B. False

171. Which of the following wastewater terms can also cause an increase in surface water temperature, because the suspended particles absorb heat from sunlight?

- A. Oxygen
- B. High TSS
- C. Settling sediments
- D. Total Suspended Solids (TSS)
- E. Suspended sediment
- F. None of the Above

172. Which of the following wastewater terms can include a wide variety of material, such as silt, decaying plant and animal matter, industrial wastes, and sewage?

- A. Total Solids
- B. TDS
- C. pH
- D. TSS
- E. Wastewater
- F. None of the Above

173. Estimating which term for centralized treatment systems is a complicated task, especially when designing a new treatment plant in a community where one has never existed previously?

- A. Peak flow(s)
- B. Flow volume(s)
- C. Additional flows
- D. This can increase flow(s)
- E. Original design load
- F. None of the Above

174. The focus of wastewater treatment plants is to reduce _____ in the effluent discharged to natural waters, meeting state and federal discharge criteria.

- A. BOD and COD
- B. Some contaminants
- C. Secondary treatment effluent
- D. Soluble nutrients
- E. Oxygen and organic waste
- F. None of the Above

175. Treatment of wastewater usually involves _____ such as the activated sludge system in the secondary stage after preliminary screening.

- A. Biological processes
- B. Activated sludge system
- C. Advanced treatment technologies
- D. Application-specific microbiology
- E. Pretreatment and pollution prevention
- F. None of the Above

176. These secondary treatment steps that harness natural self-purification processes contained in bioreactors for the biodegradation of organic matter and bioconversion of _____ in the wastewater.

- A. Biofilm
- B. Some contaminants
- C. Secondary treatment effluent
- D. Soluble nutrients
- E. Oxygen and organic waste
- F. None of the Above

Application Specific Microbiology

177. Which of the following terms is the preferred methodology in wastewater treatment affecting the efficiency of biological nutrient removal?

- A. Mature biofilm
- B. Activated sludge system
- C. Advanced treatment technologies
- D. Application-specific microbiology
- E. Pretreatment and pollution prevention
- F. None of the Above

Advanced Methods of Wastewater Treatment

178. As our country and the demand for clean water have grown, it has become more important to produce cleaner wastewater effluents, yet _____ are more difficult to remove than others are.

- A. Biofilm
- B. Some contaminants
- C. Secondary treatment effluent
- D. Soluble nutrients
- E. Oxygen and organic waste
- F. None of the Above

179. Pretreatment and pollution prevention which helps limit _____ discharged to the sanitary sewer system.

- A. Types of wastes
- B. Activated sludge system
- C. Advanced treatment technologies
- D. Application-specific microbiology
- E. Pretreatment and pollution prevention
- F. None of the Above

180. All WWTPs provide a minimum of?

- A. Biofilm
- B. Secondary treatment
- C. Secondary treatment effluent
- D. Pretreatment and pollution prevention
- E. Oxygen and organic waste
- F. None of the Above

Advanced Treatment Technologies

181. Treatment levels beyond secondary are called advanced treatment.

- A. True
- B. False

Nitrogen Control

182. Nitrogen in one form or another is present in municipal wastewater and is usually not removed by secondary treatment.

- A. True
- B. False

183. Ammonia in wastewater effluent is safe to aquatic life.

- A. True
- B. False

184. Nitrogen in the form of _____ can exert a direct demand on oxygen or stimulate the excessive growth of algae.

- A. Nitrification
- B. Ammonia
- C. Nitrogen
- D. Nitrogen in the nitrate form
- E. Ammonia to the non-toxic nitrate
- F. None of the Above

185. Which of the following wastewater treatment terms beyond the secondary stage, nitrifying bacteria present in wastewater treatment can biologically convert ammonia to the non-toxic nitrate through a process known as nitrification?

- A. Nitrification
- B. Denitrification
- C. Nitrogen
- D. Nitrogen in the nitrate form
- E. Biological treatment
- F. None of the Above

186. Which of the following wastewater treatment terms process can be added to the system to convert the nitrate to nitrogen gas?

- A. Nitrification
- B. Denitrification
- C. Nitrogen
- D. Nitrogen in the nitrate form
- E. Additional biological
- F. None of the Above

Conversion of Nitrate to Nitrogen Gas

187. The conversion of nitrate to _____ is accomplished by bacteria in a process known as denitrification.

- A. Nitrogen gas
- B. Phosphorus
- C. Nitrogen
- D. Nitrate nitrogen
- E. Methanol
- F. None of the Above

188. Which of the following wastewater treatment terms are added or a small stream of raw wastewater is mixed in with the nitrified effluent?

- A. Nitrogen gas
- B. Phosphorus
- C. Nitrogen
- D. Nitrate nitrogen
- E. Methanol
- F. None of the Above

189. Which of the following wastewater treatment terms - comprises almost 80 percent of the air in the earth's atmosphere?

- A. Phosphorus
- B. Phosphorus
- C. Nitrogen
- D. Nitrate nitrogen
- E. Methanol
- F. None of the Above

Biological Phosphorus Control

190. Some biological treatment processes called biological nutrient removal can also achieve nutrient reduction, removing?

- A. Both nitrogen and phosphorus
- B. Phosphorus
- C. Nitrogen
- D. Nitrate nitrogen
- E. Oxygen
- F. None of the Above

191. BNR processes involve modifications of suspended growth treatment systems in that the bacteria in these systems also convert _____ to inert nitrogen gas.

- A. Both nitrogen and phosphorus
- B. Phosphorus
- C. Nitrogen
- D. Nitrate nitrogen
- E. Oxygen
- F. None of the Above

Coagulation-Sedimentation Process

192. Solids heavier than water settle out of wastewater by gravity. With the addition of specific chemicals, solids can become heavier than water and will settle.

A. True B. False

193. Which of the following wastewater treatment terms is used to increase the removal of solids from effluent after primary and secondary treatment?

- A. Carbon adsorption
- B. An advanced process
- C. A form of stabilization
- D. Chemical coagulation-sedimentation
- E. Processed wastewater solids ("sewage sludge")
- F. None of the Above

194. Which of the following wastewater treatment terms can be added to the wastewater to remove phosphorus?

- A. Other alkaline materials
- B. A form of stabilization
- C. Sewage solids, or sludge
- D. Alum, lime, or iron salts are chemicals
- E. Phosphate
- F. None of the Above

Carbon Adsorption

195. Carbon adsorption technology can remove organic materials from wastewater that resist removal by?

- A. Denitrification process
- B. Biological treatment
- C. Bulking sludge
- D. Insufficient aeration in the reactor
- E. Anaerobic sludge
- F. None of the Above

Water Quality Criteria

196. The Clean Water Act directs the EPA to develop criteria for water quality that accurately reflect the latest scientific knowledge about the effects of pollutants on aquatic life and human health.

A. True B. False

197. The Clean Water Act and the EPA includes specific information on the concentration and dispersal of pollutants through biological, physical, and chemical processes as well as the effects of pollutants on biological communities as a whole.

A. True B. False

Aerobic Processes

198. The most common aerobic processes are: activated sludge systems, lagoons, trickling filters and rotating disk contactors.

A. True B. False

199. Which of the following terms are used to degrade carbonaceous BOD?

- A. Carbonaceous BOD
- B. Attached growth processes
- C. Activated sludge processes
- D. Suspended growth processes
- E. Food-to-microorganism ratio, F/M
- F. None of the Above

200. Food (organic loading) regulates?

- A. Strict aerobes
- B. Predators
- C. Microorganism numbers
- D. Heterotrophic bacteria
- E. Many bacterial species
- F. None of the Above

Aerobic Bacteria

201. Three bacteria groups occur: freely dispersed, single bacteria; floc-forming bacteria; and filamentous bacteria. All function similarly to oxidize organic carbon to produce CO₂ and new bacteria.

A. True B. False

202. Growth form is important as these flocs degrade _____ and settle at the end of the process, producing a low TSS effluent.

- A. Anaerobic action
- B. Absence of free oxygen
- C. BOD
- D. Aerobic bacteria
- E. Application-specific bacteria
- F. None of the Above

Nitrification

203. Which of the following bugs require a neutral pH and substantial alkalinity?

- A. Nitrifying bacteria
- B. Methane forming bacteria
- C. Two bacteria
- D. Aerobic bacteria
- E. Anaerobic, heterotrophic bacteria
- F. None of the Above

Anaerobic Bacteria

204. Which of the following bugs or related terms commonly occur in lagoons are involved in methane formation and in sulfate reduction?

- A. Nitrifying bacteria
- B. Methane forming bacteria
- C. Only two bacteria
- D. Aerobic bacteria
- E. Anaerobic, heterotrophic bacteria
- F. None of the Above

205. Anaerobic methane formation involves _____ bacteria.

- A. Three different groups of anaerobic
- B. Methane fermentation
- C. Methane bacteria
- D. Organic overloading conditions
- E. Acid-forming bacteria
- F. None of the Above

Photosynthetic Organisms

206. Which of the following bugs or related terms these bacteria convert formic acid, methanol, methylamine, and acetic acid under anaerobic conditions to methane?

- A. Nitrifying bacteria
- B. Methane forming bacteria
- C. General anaerobic degraders
- D. Aerobic bacteria
- E. Anaerobic, heterotrophic bacteria
- F. None of the Above

Protozoans and Microinvertebrates

207. Which of the following bugs or related terms best describe relatively slow growing and only occur in systems with a detention time of >10 days?

- A. Mosquitoes
- B. Bacteria and algae
- C. Protozoans
- D. Rotifers and daphnia
- E. Microinvertebrates
- F. None of the Above

208. The requirement for a minimum lagoon bank slope and removal of shoreline vegetation by most regulatory agencies is based on the public health need to reduce mosquito vectors.

A. True B. False

Activated Sludge Methods - Organic Load

209. The organic load enters the reactor where the active microbial population is present. The reactor must be continuously aerated.

- A. True B. False

Common Types

210. The most common types of activated sludge are the conventional and the continuous flow stirred tank, in which the contents are completely mixed. In the conventional process, the wastewater is circulated along the aeration tank, with the flow being arranged by baffles in plug flow mode.

- A. True B. False

Paramecium sp.

211. Which of the following bugs is a medium to large size (100-300 μm) swimming ciliate, commonly observed in activated sludge, sometimes in abundant numbers?

- A. Shelled amoeba(s) D. Stalked ciliate
B. Euglypha E. Paramecium
C. Vorticella F. None of the Above

212. Which of the following bugs is described as a filter-feeding ciliate because its cilia move and filter bacteria from the water?

- A. Shelled amoeba(s) D. Stalked ciliate
B. Euglypha E. Paramecium
C. Vorticella F. None of the Above

213. According to the text, Vorticella are oval to round shaped, have a contractile stalk, a domed feeding zone, and a water vacuole located near the terminal end of the false foot.

- A. True B. False

214. After reproducing, the offspring develops a band of swimming cilia and goes off to form its own stalk, the evicted organism is called a?

- A. Shelled amoeba(s) D. Swarmer
B. Euglypha E. Paramecium
C. Vorticella F. None of the Above

215. Which of the following bugs spines may be single or in groups of two or three?

- A. Shelled amoeba(s) D. Stalked ciliate
B. Euglypha E. Paramecium
C. Vorticella F. None of the Above

216. Euchlanis is a swimmer, using its foot and cilia for locomotion. In common with other rotifers, it has a head rimmed with cilia, a transparent body, and a foot with two strong swimming toes.

- A. True B. False

217. According to the text, Euchlanis is commonly found in?

- A. Biofilm bacteria D. Activated sludge
B. Filamentous bacteria E. An omnivore
C. Some bacteria F. None of the Above

218. Which of the following terms secrete sticky substances that form a sort of gel in which they live?

- A. Biofilm bacteria
- B. Filamentous bacteria
- C. Some bacteria
- D. Activated sludge
- E. An omnivore
- F. None of the Above

Filamentous Bacteria

219. Which of the following terms are a type of bacteria that can be found in a wastewater treatment system?

- A. Filamentous Bacteria
- B. Facultative
- C. Application-specific bacteria
- D. Either anaerobic or aerobic conditions
- E. Anaerobic to aerobic state
- F. None of the Above

Site Specific Bacteria

220. Aeration and biofilm building are the key operational parameters that contribute to the efficient degradation of organic matter (BOD/COD removal).

- A. True
- B. False

221. Which of the following terms become site-specific as the biofilm develops and matures and is even more efficient in treating the site-specific waste stream?

- A. Anaerobic action
- B. Absence of free oxygen
- C. Facultative bacteria
- D. Aerobic bacteria
- E. Application-specific bacteria
- F. None of the Above

Facultative Bacteria

222. Most of the bacteria absorbing the organic material in a wastewater treatment system are facultative in nature, meaning they are adaptable to survive and multiply in either anaerobic or aerobic conditions.

- A. True
- B. False

Anaerobic Bacteria

223. Which of the following terms live and reproduce in the absence of free oxygen?

- A. Anaerobic action
- B. Anaerobic bacteria
- C. Facultative bacteria
- D. Aerobic bacteria
- E. Application-specific bacteria
- F. None of the Above

224. In order to remove a given amount of organic material in an anaerobic treatment system, the organic material must be exposed to a _____ and/or detained for a much longer period of time.

- A. Anaerobic action
- B. Absence of free oxygen
- C. Facultative bacteria
- D. Aerobic bacteria
- E. Significantly higher quantity of bacteria
- F. None of the Above

Aerobic Bacteria

225. Aerobic bacteria live and multiply in the presence of free oxygen.

- A. True
- B. False

226. Facultative bacteria always achieve an aerobic state when oxygen is present.

- A. True
- B. False

227. The metabolism of aerobes is much higher than?
- A. Anaerobic action
 - B. Anaerobes
 - C. Facultative bacteria
 - D. Aerobic bacteria
 - E. Application-specific bacteria
 - F. None of the Above

Protozoans and Metazoans

228. In a wastewater treatment system, the next higher life form above bacteria is?
- A. Nematodes and rotifers
 - B. Metazoan(s)
 - C. Protozoan(s)
 - D. Protozoan and metazoan
 - E. Aerobic floc
 - F. None of the Above
229. Which of the following terms or bugs are also indicators of biomass health and effluent quality?
- A. Organic material
 - B. Protozoans
 - C. Macroinvertebrates
 - D. Biomass health and effluent quality
 - E. Aerobic flocs
 - F. None of the Above

Dispersed Growth

230. Dispersed growth is material suspended within the activated sludge process that has not been adsorbed into the floc particles. This material consists of very small quantities of colloidal (too small to settle out) bacteria as well as organic and inorganic particulate material.
- A. True
 - B. False

Activated Sludge Aerobic Flocs

231. Aerobic flocs in a healthy state are referred to as activated sludge. While aerobic floc has a metabolic rate approximately 10 times higher than anaerobic sludge, it can be increased even further by exposing the bacteria to an abundance of oxygen.
- A. True
 - B. False
232. Wastewater treatment efficiencies and removal levels are so much improved that additional downstream treatment components are?
- A. Denitrification process
 - B. Organic material
 - C. Bulking sludge
 - D. Insufficient aeration in the reactor
 - E. Dramatically reduced or totally eliminated
 - F. None of the Above

Problems may appear during the operation of activated sludge systems, including:

233. Which of the following terms' content in clarified effluent, which may be due to too high or too low solids retention time and to growth of filamentous microorganisms?
- A. Organic material
 - B. High solids
 - C. Macroinvertebrates
 - D. Biomass health and effluent quality
 - E. Aerobic flocs
 - F. None of the Above
234. Odors, caused by _____ in the settling tanks or insufficient aeration in the reactor.
- A. Denitrification process
 - B. Organic material
 - C. Bulking sludge
 - D. Insufficient aeration in the reactor
 - E. Anaerobic conditions
 - F. None of the Above

Filamentous Organisms

235. Which of the following wastewater treatment related terms reach too high a concentration, they can extend dramatically from the floc particles?

- A. Filamentous organisms
- B. Floc particles
- C. Organic material
- D. Process control variation
- E. Biosurfactant trehalose
- F. None of the Above

236. _____ because of the increased surface area and without a corresponding increase in mass, this will not settle well.

- A. Larger floc particles
- B. Activated sludge
- C. Floating scum mat
- D. Biomass
- E. Filaments
- F. None of the Above

237. Which of the following wastewater treatment related terms, due to the high surface area of this term will reach an excess concentration?

- A. Filamentous organisms
- B. Floc particles
- C. Organic material
- D. Process control variation
- E. Filamentous bacteria
- F. None of the Above

Filamentous Bacteria Identification

238. Filamentous Identification should be used as a tool to monitor the health of the biomass when a floating scum mat is suspected.

- A. True
- B. False

239. Filamentous Identification is used to determine the type of filaments present so that a cause can be found and corrections can be made to the system to alleviate future problems.

- A. True
- B. False

240. *Nocardia amarae*, a common cause of Gram-positive, chemoautotrophic, filamentous in waste treatment plants, is a slow growing, usually gram-positive, chemoautotrophic, filamentous, strict aerobe that produces the biosurfactant trehalose.

- A. True
- B. False

241. The foam from *Nocardia amarae* is usually a _____ unless algae are entrapped in it, in which case it appears green and brown.

- A. Viscous brown color
- B. Staining gram-positive
- C. Mixotrophic
- D. Gram-positive, chemoautotrophic, filamentous
- E. Disruptive foaming
- F. None of the Above

242. *Nostocoida limicola* is yet another common cause of disruptive foaming in waste treatment plants, motile in its Hormogonia and sometimes Trichome phases. This oxygenic phototrophic species often forms multicellular rigid filaments, forming non-symbiotic relationships with other species.

- A. True
- B. False

243. *Nostocoida* can also be identified by their starburst effect formations using phase contrast microscopy at 400 to 1000x magnification. After chlorination, a few dead cells sticking out identify stress to this species.

- A. True
- B. False

244. Thiothrix spp., the primary cause of disruptive foaming in wastewater treatment plants appears as straight to slightly curved cells with rectangular shape form filaments up to 1000 microns in length, in multicellular rigid filaments staining gram-positive, with obligately aerobic respiration.

A. True B. False

245. Microthrix parvicella is another common cause of?

- A. Viscous brown color
- B. Staining gram-positive
- C. Mixotrophic
- D. Gram-positive, chemoautotrophic, filamentous
- E. Disruptive foaming
- F. None of the Above

246. Sphaeroliticus natans is another filamentous species, and yet it is reputed to increase settleability by branching between flocs, increasing surface area.

A. True B. False

Filamentous Bacteria

247. A problem that often frustrates the performance of activated sludge is bulking sludge due to the growth of filamentous bacteria. Sludge bulking can often be solved by careful process modifications.

A. True B. False

Other Wastewater Treatment Components

Biochemical Oxygen Demand

248. Which of the following terms reflects high concentrations of substances that can be biologically degraded, thereby consuming oxygen?

- A. Organic carbon
- B. Human sources
- C. Domestic wastewater
- D. High BOD
- E. Growth of filamentous bacteria
- F. None of the Above

Nutrient Constituents in Wastewater and Measurement Methods

Nitrogen

249. The per capita contribution of nitrogen in domestic wastewater is about 1/10th of that for BOD.

A. True B. False

250. Influent concentration varies during the day and can vary significantly during rainfall events because of?

- A. An essential nutrient
- B. Dissolved oxygen decrease
- C. Sludge bulking
- D. Inflow and infiltration to the collection system
- E. Oxygen-demanding pollutants
- F. None of the Above