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Wastewater Treatment_____ Other _____

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I affirm that I personally completed the entire text of the course. I also affirm that I completed the exam without assistance from any outside source. I understand that it is my responsibility to file or maintain my certificate of completion as required by the state or by the designation organization.

Grading Information
In order to maintain the integrity of our courses we do not distribute test scores, percentages or questions missed. Our exams are based upon pass/fail criteria with the benchmark for successful completion set at 70%. Once you pass the exam, your record will reflect a successful completion and a certificate will be issued to you.

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Nutrients & Microbes CEU Course Answer Key

Name _____ Telephone # _____

Did you check with your State agency to ensure this course is accepted for credit?

Method of Course acceptance confirmation. Please fill this section

Website __ Telephone Call___ Email____ Spoke to_____

Did you receive the approval number, if applicable? _____

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Please circle, underline, bold or X only one correct answer, a felt tipped pen work best

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

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CEU TRAINING COURSE
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Nutrients and Microbes
CEU Course Assignment

The Assignment is available in Word on the Internet for your Convenience, please visit www.ABCTLC.com and download the assignment and email it back to TLC.

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. 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.

Multiple Choice, please select only one answer per question. There are no intentional trick questions.

Primary Wastewater Components and Constituents

1. Anaerobic- a condition in which "free" or dissolved oxygen is not present in the aquatic environment.
A. True B. False

2. Saprophytic bacteria thrive without the presence of oxygen.
A. True B. False

3. Anaerobic Bacteria that break down complex solids to volatile acids.
A. True B. False

4. Aerobic is a condition in which free or dissolved oxygen is present in the aquatic environment.
A. True B. False

5. Aerobic Bacteria will live and reproduce only in an environment containing oxygen.
A. True B. False

6. When oxygen chemically combined, such as in water molecules can be used for respiration by aerobes
A. True B. False

Basic Wastewater Treatment Processes
Biological

7. Which of the following wastewater terms involves treatment levels beyond secondary treatment?
A. Adding Oxygen C. Advanced Treatment
B. Removing carbon dioxide D. Physical separation step

8. Masses of microorganisms grow and rapidly metabolized organic pollutants because of the addition of _____to wastewater.
A. Oxygen C. Secondary treatment
B. Carbon dioxide D. Physical separation step

Organic Matter
9. Which of the following wastewater terms can cause pollution, if too much of this organic matter in wastewater; it can be devastating to receiving waters?
A. Iron C. Organic material(s.
B. Biodegradable material(s) D. High supply of oxygen

10. Large amounts of biodegradable materials can reduce or deplete _____in the water needed by aquatic life.
A. Outbreaks of these diseases C. Anaerobic bugs
B. Supply of oxygen D. pH

Pollutants, Oxygen-Demanding Substances
11. 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. pH C. Carbon Dioxide
B. Carbon D. Oxygen

12. Oxygen-demanding substances are usually destroyed or converted to other compounds by _____ if there is sufficient oxygen present in the water.
A. Phosphorus C. Ammonia
B. Abiogenesis D. Bacteria

Nutrients
13. Which of the following wastewater terms are essential to living organisms and are the chief nutrients present in natural water?
A. Oxygen C. Carbon, nitrogen, and phosphorus
B. Carbon dioxide D. Answers A,B and C

14. Which of the following wastewater terms do not remove the phosphorus and nitrogen to any substantial extent?
A. Wuhrmann Process C. Conventional secondary biological treatment processes
B. Cape Town Process D. Oxygen and organic waste ditch filter

15. Primarily _____but occasionally nitrogen, causes nutrient enrichment which results in excessive growth of algae.
A. Phosphorus C. Ammonia
B. Nitrifying Bacteria D. Calcium Hydroxide

Inorganic and Synthetic Organic Chemicals
16. Inorganic and Synthetic Organic Chemicals can cause _____ problems, and many are not effectively removed by conventional wastewater treatment.
A. Toxic C. Excessive growth of aerobic bacteria
B. Ecology D. Taste and odor

Wastewater Microbiology Section

Filamentous Bacteria

17. According to the text, filaments are _____that grow in long thread-like strands or colonies.

A. Bacteria and fungi C. Anaerobic to aerobic state Bacteria
B. Facultative Bacteria D. None of the Above

18. According to the text, filamentous bacteria function similar to _____since they degrade BOD quite well.

A. Floc forming bacteria C. Biofilm bacteria
B. Activated sludge D. None of the Above

Facultative Bacteria

19. According to the text, usually, facultative bacteria will be _____ unless there is some type of mechanical or biochemical process used to add oxygen to the wastewater.

A. Anaerobic C. Aerobic
B. Application-specific bacteria D. None of the Above

Anaerobic Bacteria

20. A typical use for _____ would be in a septic tank.

A. Aerobic bacteria C. Facultative bacteria
B. Anaerobic bacteria D. None of the Above

21. Which of the following or bugs release hydrogen sulfide as well as methane gas, both of which can create hazardous conditions?

A. Aerobic bacteria C. Facultative bacteria
B. Anaerobic bacteria D. None of the Above

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

A. Aerobic bacteria C. Facultative bacteria
B. Anaerobic bacteria D. None of the Above

23. 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 C. Significantly higher quantity of bacteria
B. Absence of free oxygen D. None of the Above

Aerobic Bacteria

24. The metabolism of aerobes is much higher than?

A. Application-specific bacteria C. Aerobic bacteria
B. Anaerobes D. None of the Above

25. The by-products of _____ are carbon dioxide and water.

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

Bacteria Section

26. Many bacteria exist as _____ and the study of biofilms is very important.
A. Filamentous Bacteria C. Application-specific bacteria
B. A biofilm D. None of the Above

Peritrichous Bacteria

27. Pleomorphic bacteria can assume a variety of shapes.
A. True B. False

28. Bacteria may be classified according to whether they require oxygen (aerobic or anaerobic) and how they react to a test with Gram's stain.
A. True B. False

29. Bacteria in which alcohol washes away Gram's stain is called gram-negative, while bacteria in which alcohol causes the bacteria's walls to absorb the stain are called Gram-positive.
A. True B. False

Shigella dysenteriae

30. Salmonella is spread by contaminated water and food, causes the most severe dysentery because of its potent and deadly Shiga toxin, but other species may also be dysentery agents.
A. True B. False

31. Shigellae are Gram-negative, non-spore-forming, facultatively anaerobic, Pleomorphic bacteria.
A. True B. False

Salmonella

32. Salmonellae usually do not ferment lactose; most of them produce hydrogen sulfide that, in media containing_____, reacts to form a black spot in the center of the creamy colonies.
A. Ferric ammonium citrate C. Alum sulfate
B. Hydrogen sulfide D. None of the Above

Fecal Coliform Bacteria

33. Although not necessarily agents of disease, _____ may indicate the presence of disease-carrying organisms, which live in the same environment as the fecal coliform bacteria.
A. Fecal matter C. Fecal coliform bacteria
B. Fecal concentration D. None of the Above

34. Fecal Coliform Bacteria live in the waste material, or feces, excreted from the intestinal tract. When fecal coliform bacteria are present in high numbers in a water sample, it means that the water has received_____ from one source or another.
A. Fecal matter C. Bacterial concentrations
B. Fecal coliform D. None of the Above

Protozoans and Metazoans

35. Which of the following or bugs and the relative abundance of certain species can be a predictor of operational changes within a treatment plant?
A. Nematodes and rotifers C. Protozoans and metazoans
B. Macroinvertebrates D. None of the Above

36. In a wastewater treatment system, the next higher life form above bacteria is?
A. Nematodes C. Protozoan(s)
B. Rotifers D. None of the Above

37. Which of the following or bugs are also indicators of biomass health and effluent quality?
A. Aerobic flocs C. Biomass health and effluent quality
B. Protozoans D. None of the Above

38. Which of the following or bugs are very similar to protozoans except that they are usually multi-celled animals?
A. Nematodes and rotifers C. Worms
B. Metazoan(s) D. None of the Above

Dispersed Growth
39. 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

40. According to the text, while a small amount of _____between the floc particles is normal, excessive amounts can be carried through a secondary clarifier.
A. Denitrification C. Bulking sludge
B. Dispersed growth D. None of the Above

Paramecium sp.
41. Paramecium may also be seen paired up with a _____ which makes a good diagnostic key.
A. Shelled amoeba(s) C. Vorticella
B. Paramecium D. None of the Above

42. 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) C. Euglypha
B. Paramecium D. None of the Above

43. Which of the following bugs is uniformly ciliated over the entire body surface with longer cilia tufts at the rear of the cell.
A. Paramecium C. Shelled amoeba(s)
B. Euglypha D. None of the Above

Activated Sludge Bugs
44. The cell is highly engineered and because of this hydrolytic enzyme, it breaks the organic molecules into small units that are able to pass through the cell wall of the _____.
A. Mixed bugs C. Bacteria
B. Compound D. None of the Above

45. In wastewater treatment, the process of using bacteria-eating-bugs in the presence of oxygen to reduce the organics in water is called?
A. Mixed liquor C. Activated sludge
B. Oxidation D. None of the Above

46. In the Activated Sludge process, the _____are also called waste activated sludge.
A. Organisms C. Mixed liquor
B. Settled bugs D. None of the Above

47. The first group is the bacteria which eat the dissolved organic compounds is generally four (4) groups of bugs that do most of the "eating" in the _____process.
A. Mixed liquor C. Activated sludge
B. Settled bugs D. None of the Above

48. The second and third groups of bugs are microorganisms known as the free-swimming and _____. These larger bugs eat the bacteria and are heavy enough to settle by gravity.
A. Stalked ciliates C. Activated sludge bugs
B. Suctoria D. None of the Above

49. Which bug feeds on the larger bugs and assist with settling is in the fourth group, known as?
A. Water bear C. Rotifer
B. Suctoria D. None of the Above

50. The Bacteria have several interesting properties--their "fat reserve" is stored on the outside of their body and this strange feature?
A. Fur C. No Mouth
B. Feet D. None of the Above

51. Once the bacteria have "contacted" their food, they start the digestion process. A chemical Enzyme is sent out through the cell wall to break up the_____.
A. Mixed liquor C. Total Dissolved Solids
B. Organic compounds D. None of the Above

52. An asset in settling the bug is its fat storage property and as the bugs "bump" into each other, the fat on each of them sticks together and causes flocculation of the_____.
A. Mixed liquor C. Non-organic solids and biomass
B. Floc D. None of the Above

53. What does facultative mean as far as bugs? What environments are they adaptable to survive and multiply in?
A. Aerobic only C. Either anaerobic or aerobic conditions
B. Anaerobic only D. None of the Above

54. The next step as in the text, this substance, which is the activated sludge, is used again by returning it to the influent of the aeration tank for mixing with the primary effluent and ample amounts of air?
A. Carry over C. Solids biomass
B. RAS D. None of the Above

55. We need to be able to properly identify the bugs and which commonly found bug is a medium size to large swimming Ciliate, commonly observed in activated sludge, sometimes in abundant numbers.
A. Vorticella C. Paramecium
B. Euglypha D. None of the Above

Vorticella sp.

56. Which of the following bugs feeds by producing a vortex with its feeding cilia?
A. Shelled amoeba(s) C. Euglypha
B. Vorticella D. None of the Above

57. According to the text, if treatment conditions are bad, for example, low DO or toxicity, _____ will leave their stalks.
A. Shelled amoeba(s) C. Vorticella
B. Euglypha D. None of the Above

Euglypha sp.

58. Which of the following bugs spines may be single or in groups of two or three?
A. Shelled amoeba(s) C. Vorticella
B. Euglypha D. None of the Above

59. The shell of this bug is often transparent, allowing the hyaline (watery) body to be seen inside the shell.
A. Euglypha C. Euchlanis
B. Shelled amoeba(s) D. None of the Above

60. Which of the following bugs are common in soil, treatment plants, and stream bottoms where decaying organic matter is present?
A. Shelled amoeba(s) C. Stalked ciliate
B. Euglypha D. None of the Above

Euchlanis sp.

61. Euchlanis is a typical?
A. Euglypha C. Rotifer(s)
B. Shelled amoeba(s) D. None of the Above

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

62. Which of the following wastewater treatment related terms that which settles too slowly and is not compactable, and caused by the predominance of filamentous organisms?
A. Settling sludge C. Bulking sludge
B. Organic material D. None of the Above

63. 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 C. Biomass health and effluent quality
B. High solids D. None of the Above

64. Which of the following wastewater treatment related terms occurs when sludge that normally settles rises back to the surface after having settled?
A. Denitrification C. Rising sludge
B. Bulking sludge D. None of the Above

Filamentous Organisms

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

A. Filamentous organisms C. Organic material
B. Floc particles D. None of the Above

Filamentous Bacteria Identification

66. 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 C. Gram-positive, chemoautotrophic, filamentous
B. Staining gram-positive D. None of the Above

Microthrix parvicella

67. Microthrix parvicella is another common cause of?

A. Disruptive foaming C. Viscous brown color
B. Mixotrophic D. None of the Above

Filamentous Bacteria

68. Different filamentous bacteria such as Microthrix, Sphaerotilus, Nostocoida, Thiothrix or ”Type 021N” and others cause?

A. Bulking for very different reasons C. Sludge bulking
B. Dissolved oxygen decrease D. None of the Above

69. There is a potential for instability with _____is an acute problem when strict demands on treatment performance are in place.

A. Organic carbon C. High BOD
B. Activated sludge D. None of the Above

Laboratory Analysis/ Process Control Section

pH Testing Section

70. When an atom loses _____and thus has more protons than electrons, the atom is a positively-charged ion or cation.

A. A proton C. An electron
B. Charge D. None of the Above

71. Measurement of pH for aqueous solutions can be done with a glass electrode and a pH meter, or using indicators like strip test paper.

A. True B. False

72. In chemistry, pH is a measure of the acidity or basicity of an aqueous solution. Solutions with a pH greater than 7 are said to be acidic and solutions with a pH less than 7 are basic or alkaline.

A. True B. False

73. Pure water has a pH very close to?

A. 7 C. 7.7
B. 7.5 D. None of the Above

74. _____ are determined using a concentration cell with transference, by measuring the potential difference between a hydrogen electrode and a standard electrode such as the silver chloride electrode.
A. Primary pH standard values C. pH measurement(s)
B. Alkalinity D. None of the Above

75. Mathematically, pH is the negative logarithm of the activity of the (solvated) hydronium ion, more often expressed as the measure of the?
A. Electron concentration C. Hydronium ion concentration
B. Alkalinity concentration D. None of the Above

76. Which of the following for aqueous solutions can be done with a glass electrode and a pH meter, or using indicators?
A. Primary sampling C. Determining values
B. Measurement of pH D. None of the Above

77. The pH scale is logarithmic and therefore pH is?
A. An universal indicator C. An excess of alkaline earth metal concentrations
B. A dimensionless quantity D. None of the Above

78. Measuring alkalinity is important in determining a stream's ability to neutralize acidic pollution from rainfall or wastewater. It is one of the best measures of the sensitivity of the stream to acid inputs. There can be long-term changes in the _____ of rivers and streams in response to human disturbances.
A. Acid C. pH measurement(s)
B. Alkalinity D. None of the Above

79. pH is defined as the decimal logarithm of the reciprocal of the_____, a_H+, in a solution.
A. Hydrogen ion activity C. Brønsted–Lowry acid–base theory
B. Acid-base behavior D. None of the Above

80. Which of the following may be used to measure pH, by making use of the fact that their color changes with pH?
A. Indicators C. A set of non-linear simultaneous equations
B. Spectrophotometer D. None of the Above

81. Alkalinity is the name given to the quantitative capacity of an aqueous solution to neutralize an?
A. Acid C. Bond formation
B. Base D. None of the Above

82. Which of the following of the color of a test solution with a standard color chart provides a means to measure pH accurate to the nearest whole number?
A. Universal indicator C. Visual comparison
B. Colorwheel measurement D. None of the Above

83. The pH scale is traceable to a set of standard solutions whose pH is established by US EPA.
A. True B. False

84. The calculation of the pH of a solution containing acids and/or bases is an example of a chemical speciation calculation, that is, a mathematical procedure for calculating the concentrations of all chemical species that are present in the solution. The complexity of the procedure depends on the?

A. Nature of the solution
B. pH
C. Alkaline earth metal concentrations
D. None of the Above

85. For strong acids and bases no calculations are necessary except in extreme situations. The pH of a solution containing a weak acid requires?

A. The concentration value
B. The solution of a quadratic equation
C. Excess of alkaline concentrations
D. None of the Above

86. Alkalinity in excess of which term is significant in determining the suitability of water for irrigation?

A. 8
B. pH of 7
C. Alkaline earth metal concentrations
D. None of the Above

87. The calculation of the pH of a solution containing acids and/or bases is an example of a _____ calculation, that is, a mathematical procedure for calculating the concentrations of all chemical species that are present in the solution

A. Chemical speciation
B. Spectrophotometer
C. Visual comparison
D. None of the Above

88. Since pH is a logarithmic scale, a difference of one pH unit is equivalent to _____ difference in hydrogen ion concentration.

A. 1
B. .1
C. 10
D. None of the Above

89. Which of the following measurements is used in the interpretation and control of water and wastewater treatment processes?

A. Acid
B. Alkalinity
C. Hydrogen bond formation
D. None of the Above

90. Which of the following are compounds that, for practical purposes, are completely dissociated in water?

A. Strong acids and bases
B. Chemical ions in chains
C. Strong bases and weak acids
D. None of the Above

91. The pH of a solution containing a _____ may require the solution of a cubic equation.

A. Strong acids and bases
B. Strong base
C. Weak base
D. None of the Above

92. Sodium hydroxide, NaOH, is an example of a?

A. Weak base
B. Strong base
C. Strong acid
D. None of the Above

Dissolved Oxygen Testing Section

93. At least two general forms of bacteria act in balance in a wastewater digester: Saprophytic organisms and?

A. Methane Fermenters C. Butyric acid fermenters
B. DO fermenters D. Carbon dioxide fermenters

94. Aerobic means without air and some bacteria thrive under these conditions and utilize the nutrients and chemicals available to exist.

A. True B. False

95. Aerobes decompose inorganics in the water; the result is carbon dioxide and H_2SO_4.

A. True B. False

96. Dissolved oxygen (DO) in water is considered a contaminant.

A. True B. False

97. The saprophytes exist on dead or decaying materials.

A. True B. False

98. The methane fermenting bacteria require a pH range of 6.6 to 7.6 to be able to live and reproduce.

A. True B. False

99. Aerobic bacteria do not require oxygen to live and thrive.

A. True B. False

100. Dissolved oxygen level is important because too much or not enough dissolved oxygen can create_____?

A. Unfavorable conditions C. Frequent dissolved oxygen measurement
B. DO analysis D. None of the Above

101. A lack of Dissolved oxygen in natural waters creates?

A. Anaerobic conditions C. Aerobic Conditions
B. Denitrification D. None of the Above

102. Which of the following live on the volatile acids produced by these saprophytes?

A. Butyric acid fermenters C. VFAs
B. Methane fermenters D. None of the Above

103. Which of the following indicate that dissolved oxygen is present?

A. Sample(s) C. Aerobic conditions
B. DO analysis D. None of the Above

104. _____in a water sample can be detrimental to metal pipes in high concentrations because oxygen helps accelerate corrosion.

A. Carbon dioxide C. Dissolved Oxygen
B. pH D. None of the Above

105. Oxygen is an important component in water plant operations. Its primary value is to oxidize iron and manganese into forms that will precipitate out of the water. It also removes excess _____.
A. Carbon dioxide C. Molecular oxygen
B. Water sample D. None of the Above

106. The amount of _____in a water sample will affect the taste of drinking water also.
A. Carbon dioxide C. Dissolved oxygen
B. Water D. None of the Above

Methods of Determination
107. There are two methods that we will be using in the lab. The membrane electrode method procedure is based on the rate of diffusion of _____ across a membrane. The other is a titrimetric procedure (Winkler Method) based on the oxidizing property of the (DO).
A. Carbon dioxide C. Molecular oxygen
B. Water D. None of the Above

108. Many factors determine the solubility of oxygen in a water sample. Temperature, atmospheric pressure, salinity, biological activity and pH all have an effect on the (DO) content.
A. True B. False

Iodometric Test
109. The iodometric (titration) test is not a very precise and reliable for (DO) analysis of samples.
A. True B. False

110. Reactions take place with the addition of certain chemicals that liberate iodine equivalent to the?
A. Original (DO) content C. Anaerobic conditions
B. Dissolved Oxygen D. None of the Above

111. Which of the following can liberate iodine from iodides and some reducing agents reduce iodine to iodide?
A. Ammonia oxidation C. Certain oxidizing agents
B. Phosphorus removal D. None of the Above

112. Which of the following effectively removes interference caused by nitrates in the water sample, so a more accurate determination of (DO) can be made?
A. Winkler Method C. The alkaline Iodide-Azide reagent
B. Dissolved Oxygen D. None of the Above

113. Which of the following is highly dependent on the source and characteristics of the sample?
A. Methods of analysis C. Aerobic conditions
B. DO analysis D. None of the Above

114. Which of the followingpasses through the membrane and measured by the meter?
A. Carbon dioxide C. Only molecular oxygen
B. Dissolved Oxygen D. None of the Above

115. Membrane electrodes provide an excellent method for_____in polluted, highly colored turbid waters and strong waste effluents.
A. Sample(s) C. Aerobic conditions
B. DO analysis D. None of the Above

116. Proper samples must be taken in_____ bottles where agitation or contact with air is at a minimum.
A. BOD C. MLSS measurement
B. DO analysis D. None of the Above

117. Which of the following–is the one of the most important analyses in determining the quality of natural waters?
A. Anaerobic conditions C. The dissolved oxygen test
B. Undissolved Oxygen D. None of the Above

118. Which of the followingmeasurement is essential for adequate process control?
A. Dissolved oxygen C. Aerobic conditions
B. DO analysis D. None of the Above

119. The magnetic method involves an oxygen permeable plastic membrane that serves as a diffusion barrier against impurities.
A. True B. False

120. The effect of oxidation wastes on streams, the suitability of water for fish and other organisms and the progress of self-purification can all be measured or estimated from the dissolved oxygen content.
A. True B. False

Total Dissolved Solids
121. Pure water is tasteless, colorless, and odorless and is often called the universal solvent.
A. True B. False

122. Which of the following refers to any minerals, salts, metals, cations or anions dissolved in water?
A. Total Solids C. Total Suspended solids
B. TDS D. Dissolved solids

123. Which of the following comprise inorganic salts and some small amounts of organic matter that are dissolved in water?
A. Settleablity C. Quality of the water
B. Total dissolved solids (TDS) D. Total Solids

124. The TDS test does not provide us insight into the specific water quality issues, such as: Elevated Hardness, Salty Taste, or?
A. Total Solids C. Corrosiveness
B. TDS D. Alkalinity

Total Solids

125. Which of the following includes both total suspended solids, the portion of total solids retained by a filter and total dissolved solids?
A. Total Solids C. Corrosiveness
B. TDS D. Alkalinity

126. Which of the following 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. Total Solids C. Total Suspended solids
B. TDS D. Alkalinity

127. Which of the following refers to matter suspended or dissolved in water or wastewater, and is related to both specific conductance and turbidity?
A. Total Solids C. Corrosiveness
B. TDS D. Alkalinity

128. Which of the following are the term used for material left in a container after evaporation and drying of a water sample?
A. Total Solids C. Total Suspended solids
B. TDS D. Alkalinity

129. 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)

130. Total Suspended Solids (TSS) are solids in water that can be trapped by a filter.
A. True B. False

131. When suspended solids settle to the bottom of a water body, they can smother the eggs of fish and aquatic insects, as well as suffocate newly hatched insect larvae.
A. True B. False

132. Which of the following can also cause an increase in surface water temperature, because the suspended particles absorb heat from sunlight?
A. Total Solids C. Total Suspended solids
B. High TSS D. Alkalinity

133. Which of the following can fill in spaces between rocks that could have been used by aquatic organisms for homes?
A. Oxygen C. Settling sediments
B. High TSS D. Suspended sediment

134. Which of the following can include a wide variety of material, such as silt, decaying plant and animal matter, industrial wastes, and sewage?
A. Total Solids C. Total Suspended solids
B. TDS D. Alkalinity

135. Which of the following can block light from reaching submerged vegetation?
A. Oxygen C. Settling sediments
B. High TSS D. Suspended sediment

136. Wastewater treatment plants are designed to function as "microbiology farms," where bacteria and other microorganisms are fed oxygen and organic waste.
A. True B. False

137. If light is completely blocked from bottom dwelling plants, the plants will stop producing oxygen and will die.
A. True B. False

Settleometer Test
138. A simple procedure called the Settleometer Test is used to determine the settling characteristics of mixed liquor.
A. True B. False

139. The test requires a settleometer, which is typically a clear plastic cylinder with a capacity of 2 liters. Graduations on the cylinder range from 100 to 1000 cubic centimeters (or milliliters) of Settled sludge per liter.
A. True B. False

140. A sample of nitrates should be obtained from the discharge end of the aeration tank, being careful not to include scum in the sampling container.
A. True B. False

141. It is a good idea to occasionally record the MLSS concentration volume every 5 minutes while the flocs are settling and prepare a graph of settled activated sludge versus minutes. This allows the operator to see whether bugs are settling too quickly or slowly.
A. True B. False

142. Mix the sample well, and fill the settleometer to the 1000 graduation. Immediately start a timer and at the end of 10 minutes record the solids volume in the settleometer.
A. True B. False

143. Do not allow the sample to set for more than a few minutes before the settling test is performed. Determine the _____in milligrams per liter on a portion of this sample.
A. MLSS concentration C. Nitrates
B. The solids D. None of the Above

144. Solids that settle too quickly may be an indication of _____that will probably leave straggler floc in the effluent, while solids that settle too slowly or do not compact well may be washed out of the clarifier during times of high hydraulic load.
A. Settled sludge C. Sludge volume
B. An old sludge D. None of the Above

Primary Wastewater Treatment Section

Conventional A/S Wastewater Treatment Plant Overview

Primary Treatment

145. 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. Primary and secondary stages C. Suspended growth process(es)
B. Biological processes D. None of the Above

146. The secondary stage uses this term to further purify wastewater.

A. Primary and secondary stages C. Suspended growth process(es)
B. Biological processes D. None of the Above

Preliminary Treatment

147. Large amounts of _____ entering a treatment plant can cause serious operating problems, such as excessive wear of pumps and other equipment.

A. Solid(s) C. Grit and sand
B. Finer debris D. Dissolved organic and inorganic constituents

148. Which of the following enters from the collection system into the Coarse Screening process?

A. Raw wastewater C. Dissolved organic and inorganic constituents
B. Biological processes D. None of the Above

149. Especially in cities with combined sewer systems, removing the-this missing term-that washes off streets or land during storms is very important.

A. Very fine solids C. Primary sludge
B. Grit and gravel D. None of the Above

150. 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

151. 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

152. 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

Primary Sedimentation

153. 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

154. 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

155. 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 C. Primary sludge
B. RAS D. Heavy pollutants

156. 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) C. Dissolved organic and inorganic constituents
B. Suspended solids D. None of the Above

Temperature
157. The best temperatures for wastewater treatment probably range from 77 to 95 degrees Fahrenheit.
A. True B. False

158. Hot water is a byproduct of many manufacturing processes, is not a pollutant. When discharged in large quantities, it can raise the temperature of receiving streams improving the natural balance of aquatic life.
A. True B. False

pH
159. The acidity or alkalinity of wastewater affects both treatment and the environment.
A. True B. False

160. pH indicates increasing acidity while a low pH indicates increasing alkalinity.
A. True B. False

Secondary Treatment Section

Secondary Treatment
161. The wastewater enters from Preliminary Treatment into the clarifier process which is a biological process consisting of large oval shaped basins that are capable of removing these finer solids.
A. True B. False

162. Maintaining a population of microorganisms within the oxidation basins that consumes _____and also adhere to the solids themselves.
A. Total Solids C. Very fine solids
B. TDS D. None of the Above

163. Which of the following form larger and heavier aggregates that can by physically separated?
A. Solid(s) C. Finer solids
B. Finer debris D. None of the Above

164. The two most common conventional methods used to achieve secondary treatment are: _____ and suspended growth processes.
A. Attached growth processes C. Unsuspended growth process(es)
B. Finer debris D. None of the Above

165. The Secondary Treatment stage consists of a biological process such as _____ and a physical process, Secondary Clarification.
A. Tickling filters C. Phosphorus-reduction system(s)
B. Oxidation Ditches D. None of the Above

166. The Preliminary Treatment stage removes as much _____ as possible using physical processes.
A. Solid(s) C. Grit and gravel
B. Finer debris D. None of the Above

Raw Water Screening
167. Raw wastewater may or may not be _____before being directed into the pond treatment system. The first two ponds in the pond system may be operated in series or in parallel.
A. Screened and de-gritted C. Compacted clay bottoms and sides
B. Series or in parallel D. None of the above

168. Generally, the microorganisms in the first ponds treat the incoming effluent, while the next pond is the settling or polishing pond. The third pond is to provide _____where the where the biological solids generated in the first two ponds can settle.
A. Wind and algae C. Activated sludge
B. A quiet zone D. None of the above

169. Ponds generally do not have a secondary clarifier, the _____fulfils the clarifier action.
A. Wind and algae C. Settling or polishing pond
B. Series or in parallel D. None of the above

Pond Lining
170. Ponds may be lined with a synthetic liner or simply have _____.
A. Wind and algae C. Compacted clay bottoms and sides
B. Series or in parallel D. None of the above

171. Many ponds rely on _____ to supply oxygen instead of mechanical aeration.
A. Wind and algae C. Compacted clay bottoms and sides
B. Series or in parallel operation D. None of the above

172. Filamentous bacteria generally do not cause any operational problems in lagoons, in contrast to activated sludge where _____and poor sludge settling is a common problem.
A. Redox potential C. BOD removal
B. Filamentous bulking D. None of the Above

173. Most heterotrophic bacteria have a wide range in environmental tolerance and can function effectively in _____ over a wide range in pH and temperature.
A. Redox potential C. BOD removal
B. Poor sludge settling D. None of the Above

174. Aerobic BOD removal generally proceeds well from pH _____ and at temperatures from 3-4°C to 60-70°C (37.4 -39.2° F to 140-158°F in the ATAD process (mesophilic bacteria are replaced by thermophilic bacteria at temperatures above 35°C).
A. 5.5 to 8.0 C. 6.5 to 7.0
B. 6.5 to 9.0 D. None of the Above

175. BOD removal generally declines rapidly below _____C and ceases at _____C.
A. 3-4° - 1-2° C. 1-2° - 3-4°
B. 4-6° - 2-3° D. None of the Above

176. A very specialized group of bacteria occurs to some extent in lagoons (and other wastewater treatment systems) that can oxidize ammonia via nitrite to nitrate, termed nitrifying bacteria. These bacteria are strict aerobes and require a redox potential of at least +200 m V.
A. +200 C. 2,000
B. – 200 D. None of the Above

Lagoon Systems
177. Lagoon systems take advantage of _____ and microorganisms in the wastewater to renovate sewage.
A. Nitrogen removal system(s) C. Natural aeration
B. Suspended film system(s) D. None of the Above

Microorganisms in Lagoons
178. Swimming and _____engulf bacteria or other prey.
A. Gliding ciliates C. Heterotrophic bacteria
B. Predators D. None of the Above

179. Which of the following bugs or terms attach to the biomass and vortex suspended bacteria into their gullets, while crawlers break bacteria loose from the floc surface?
A. Floc-forming bacteria C. Stalked ciliate(s)
B. Aerobic bacteria D. None of the Above

180. Predators feed mostly on stalked and _____.
A. Floc-forming bacteria C. Methane Fermenters
B. Swimming ciliates D. None of the Above

181. The following changes in food, dissolved oxygen, temperature, pH, total dissolved solids, sludge age, presence of toxins, and other factors create a dynamic environment for the_____?
A. Treatment organism(s) C. Floc-forming bacteria
B. Aerobic bacteria D. None of the Above

182. Food (organic loading) regulates_____?
A. Strict aerobes C. Microorganism numbers
B. Predators D. None of the Above

Lagoon Microorganisms Introduction

183. Three bacteria groups occur: freely dispersed, single bacteria; floc-forming bacteria; and filamentous bacteria. All function similarly to oxidize organic carbon to produce CO_2 and new bacteria.

A. True B. False

184. Anaerobic BOD removal generally proceeds well from pH 6.5 to 9.0 and at temperatures from 3-4ºC to 60-70°C (Aerobic bacteria are replaced by Mesophilic bacteria at temperatures above 35°C).

A. True B. False

185. BOD removal increases rapidly below 3-4°C and ceases at 1-2°C.

A. True B. False

186. Which of the following are similar to those found in other treatment processes such as activated sludge?

A. Treatment organism(s) C. Floc-forming bacteria
B. Aerobic bacteria D. None of the Above

187. Which of the following degrade wastes grow as single bacteria dispersed in the wastewater?

A. Strict aerobes C. Many bacterial species
B. Predators D. None of the Above

188. Which of the following grow in a large aggregate due to exocellular polymer production?

A. Predators C. Floc-forming bacteria
B. Aerobic bacteria D. None of the Above

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

A. Anaerobic action C. BOD
B. Application-specific bacteria D. None of the Above

190. Which of the following bugs or terms occur in lagoons, usually at specific growth environments?

A. Anaerobic action C. A number of filamentous bacteria
B. Absence of free oxygen D. None of the Above

191. Which of the following have a wide range in environmental tolerance and can function effectively in BOD removal over a wide range in pH and temperature?

A. Strict aerobes C. Most heterotrophic bacteria
B. Predators D. None of the Above

192. A very specialized group of bacteria occurs to some extent in lagoons (and other wastewater treatment systems) that can oxidize ammonia via nitrite to nitrate are termed?

A. Strict aerobes C. Nitrifying bacteria
B. Predators D. None of the Above

Mixed or Suspended Lagoons

193. In the facultative lagoons, the power input is reduced causing accumulation of solids in the bottom which undergo_____, while the upper portions are maintained aerobic.

A. Facultative lagoon(s) C. Dissolved organic and inorganic constituents
B. Anaerobic decomposition D. None of the Above

Advanced Methods of Wastewater Treatment

194. 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.

A. Biofilm C. Soluble nutrients
B. Some contaminants D. None of the Above

195. All WWTPs provide a minimum of?

A. Biofilm and chemical removal C. Pretreatment and pollution prevention
B. Secondary treatment D. None of the Above

Advanced Treatment Technologies

196. Which of the following can be extensions of conventional secondary biological treatment to further stabilize oxygen-demanding substances?

A. Hydraulic Detention Time C. Advanced treatment technologies
B. Activated sludge system D. None of the Above

197. Advanced treatment may include physical-chemical separation techniques such as adsorption, flocculation/precipitation, membranes for advanced filtration, _____, and reverse osmosis.

A. Denitrification process C. Ion exchange
B. Organic material D. None of the Above

Activated Sludge Process Section

Regular MLSS Removal

198. To maintain a stable treatment process, MLSS must be removed on a regular schedule. The MLSS can be removed from the bottom of the clarifier or from the_____.

A. Secondary sludge wasting C. Activated sludge basin
B. Solids handling process D. None of the above

199. The _____ removed directly from the basin is renamed as WAS.

A. MLSS C. WAS
B. CRT D. None of the above

200. Some clarifiers have separate pipelines for RAS and WAS. In other cases, WAS is pumped out of the _____pipeline.

A. RAS C. WAS
B. CRT D. None of the above

Wasting Rates

201. CRT was defined as the average length of time in days that an organism remains in the_____.

A. Secondary treatment system C. Many activated sludge plants
B. Solids handling process D. None of the above

202. The operator determines the operating _____ for the facility and maintains it through wasting the appropriate amount of excess biomass (Waste Activated Sludge, WAS) from the secondary system.
A. Mixed Liquor C. WAS
B. CRT D. None of the above

203. The amount of _____in the secondary system is controlled and maintained through solids wasting.
A. Biomass (MLSS) C. WAS
B. CRT D. None of the above

204. In nearly all activated sludge plants, wasting is accomplished by directing a portion of the Return Sludge to the_____.
A. Secondary sludge wasting C. Many activated sludge plants
B. Solids handing facility D. None of the above

205. Wasting Return Sludge rather than _____ minimizes the volume of water that must be processed by the sludge thickening/dewatering equipment.
A. Mixed Liquor C. RAS
B. CRT D. None of the above

206. If intermittent wasting is practiced, it is usually best to waste over as long a time period as practical, and when the loading on the _____ is at the low point of the day.
A. Secondary system C. Many activated sludge plants
B. Solids handling process D. None of the above

207. Drastic changes should not be made in wasting rates from one day to the next; allow the _____time to acclimate to a change before another change is made.
A. Secondary sludge wasting C. Advanced system
B. Biological system D. None of the above

208. Consistency is a key element in successful _____ operation.
A. Secondary system C. Activated sludge plant
B. The operator D. None of the above

209. Many activated sludge plants were originally designed to waste secondary solids into the primary clarifiers. The reasoning was that as the less dense biological solids co-settle with the _____the combined sludge density would be increased.
A. Mixed Liquor C. Scum
B. Heavier primary solids D. None of the above

210. A more efficient operation will result if the WAS is wasted directly to a _____ and not allowed to return to the treatment system.
A. Secondary sludge wasting C. Many activated sludge plants
B. Solids handling process D. None of the above

211. It is crucial that adequate solids concentrating equipment and _____are part of any plans for building or expanding an activated sludge plant.
A. Secondary system C. Solids storage capability
B. The operator D. None of the above

212. Which of the following is one of the most important controls available to the operator because it controls the most important aspect of treatment, biomass population?
A. Secondary system C. Activated sludge plant
B. Secondary sludge wasting D. None of the above

213. A good _____ control situation is one that allows the operator to set a totalizer which determines the maximum number of gallons wasted in a particular day and also allows the operator to control and monitor the WAS flow rate.
A. MLSS concentration C. BOD, nutrients, and oxygen
B. WAS D. None of the above

Environmental Conditions
214. Waste activated sludge flow, along with environmental conditions such as water temperature and accessibility to _____, influences the influences the process biology and level of treatment achieved.
A. MLSS concentration C. BOD, nutrients, and oxygen
B. WAS D. None of the above

215. Slower growing microorganisms, including the nitrification bacteria and some bacteria and some filaments, can only remain in the treatment process if the _____ is held long enough for them to reproduce.
A. MLSS C. BOD, nutrients, and oxygen
B. WAS D. None of the above

Sludge Settling
216. Waste activated sludge determines how long the _____ stays in the system and, therefore, helps to determine which type of microorganisms will be present.
A. MLSS C. BOD, nutrients, and oxygen
B. WAS D. None of the above

217. The presence or absence of _____will influence how fast the sludge settles in the clarifier.
A. MLSS concentration C. Filaments
B. WAS D. None of the above

218. Waste activated sludge also determines the _____.
A. MLSS concentration C. BOD, nutrients, and oxygen
B. WAS D. None of the above

Organic Load
219. According to the text, as the cells are retained longer in the system, the flocculating characteristics of the cells improve since they start to produce extra cellular slime that favors?
A. Secondary settling C. Flocculating
B. High degradation rate D. None of the Above

Final Clarifier Solids Loading Rate (SLR)
220. The rate at which the activated sludge is returned from the final clarifiers to the aeration basins, along with the influent flow, effects the flow of solids into the clarifiers.
A. True B. False

Clarifier Sludge Blanket
221. Solids settle and concentrate in the first clarifier forming a sludge blanket. The sludge blanket can increase depending on the WAS flow rate. The proper WAS flow rate allows for a desired sludge blanket.
A. True B. False

Filaments
222. Filamentous organisms are a group of thread-like organisms that, when in excess, can impair the settling of activated sludge and create a bulking condition in the final clarifier.
A. True B. False

Oxidation Ditch
223. Oxidation ditches are typically limited mix systems, and cannot be modified to approach plug flow conditions.
A. True B. False

Pin Floc
224. Very fine floc particles with poor settling characteristics, usually indicative of a young sludge (high MLSS levels).
A. True B. False

Sludge Age
225. Activated sludge (RAS) is recycled back through the aeration basins by returning settled sludge in the final clarifiers and thus remains in the activated sludge system for a number of days. For effective treatment, a specific sludge age is desired for the type of activated sludge system.
A. True B. False

226. For conventional activated sludge, a sludge age of 1-3 days is typical. For extended aeration activated sludge, older sludge ages of 3-10 days are common. F/M ratio and sludge age is inversely related (1 divided by the sludge age approximates the F/M ratio).
A. True B. False

Constant MLSS (Mixed Liquor Suspended Solids)
227. Provided the influent loadings are constant, the operator maintains a relatively constant solids inventory (MLSS level) in the aeration basins for a desired level of treatment. The range of MLSS is typically between 1000-4000 mg/L.
A. True B. False

Wasting Rates
228. The concentration of WAS has a direct bearing on how much to waste and the volume wasted. On a volume basis, a thicker waste activated sludge (low WAS concentration) will require more amount of wasting than a thicker waste activated sludge (high WAS concentration).
A. True B. False

Extended Aeration Activated Sludge Plants
229. For extended aeration activated sludge plants the range is between about 15 and 30 days. Generally, during the winter months, higher sludge ages are required to maintain a sufficient biological mass. In the summer time, biological activity increases and lower sludge ages normally produce a higher quality effluent.
A. True B. False

Clarifier Sludge Blanket
230. Solids settle and concentrate in the final clarifiers forming a sludge blanket. The sludge blanket can increase or decrease depending on the RAS flow rate. The proper RAS flow rate allows for a desired sludge blanket.
A. True B. False

Young Sludge
231. Young sludge is often associated with a low F/M. To correct for young sludge, it is necessary to increase wasting rates. This will decrease the amount of solids under aeration, reduce the F/M ratio, and increase the sludge age.
A. True B. False

Excessive Old Sludge
232. The required pressure is an increase in the total system sludge mass. Decreased wasting is required to accomplish that objective. This problem is very rare.
A. True B. False

Return Rates Too Low
233. Thin mixed liquor suspended solids and a sludge blanket build-up of solids. Rising clumps of sludge or gas bubbles may occur in the final clarifier.
A. True B. False

Return Rates Too High
234. A sludge blanket in the final clarifier and a thick return activated sludge.
A. True B. False

Denitrification in Final Clarifier
235. In the absence of oxygen, a sludge blanket that is too thick and remains in the clarifier too long can denitrify. Nitrates in the sludge will be converted to nitrogen gas. The release of nitrogen gas will cause small gas bubbles that will be observed at the clarifier surface. Clumps of sludge may also rise to the surface.
A. True B. False

Old Sludge
236. Old sludge filaments include M. parvicella, Type 0041, Type 0675, Type 1851 and Type 0803. M.parvicella is known for causing foaming and bulking occurrences, especially during winter operating conditions, in WWTPs that must remove ammonia year-round.
A. True B. False

Stable Nitrification
237. At a water temperature of 20^{o}C, the washout SRT for AOBs is approximately 1.6 weeks and the washout for POAs is approximately 2.0 days. To maintain a stable population and to avoid accidental loss of these bacteria resulting from accidental overwasting, the target SRT would need to be two to three times as long or between 1 and 3 days.
A. True B. False

Slimy Foam
238. A grayish slimy foam that is very thick is commonly caused by nutrient deficiencies. It is often noted with a slime bulking condition.
A. True B. False

Foam Trapping

239. A long-term solution includes some facilities using a vacuum truck to remove the foam from the surface. A short-term solution includes eliminating grease from the influent

A. True B. False

Bacteria and Temperature Effect

240. Washout SRT is affected by temperature. For every 10°C drop in water temperature, the growth rate of bacteria decreases by 50% and the _____ doubles. Growth rates for floc forming and filament forming bacteria are similarly affected.

A. MLSS C. Washout SRT
B. CBOD D. WAS

Denitrification

241. When _____ flow rates are too low, thick sludge blankets in the final clarifier can result. The operator will see gas bubbles (from ammonia gas) and rising/floating sludge clumps on the clarifier surface.

A. MLSS C. RAS
B. CBOD D. WAS

Food –To- Microorganism Ratio (F/M Ratio)

242. For microbiological health and effective treatment, the microorganisms (mixed liquor suspended solids) under aeration should be maintained at a certain level for the amount of food (influent BOD) coming into the plant. This is known as the_____.

A. MLSS C. Food to microorganism ratio
B. CBOD D. WAS

Nutrient Section

TKN

243. Recalcitrant means a certain compound is difficult to break down. This material can often be broken down given enough time, but not within the time it spends in secondary treatment.

A. True B. False

244. Inert means the material is safe for all microorganisms.

A. True B. False

245. The TKN content of influent municipal wastewater is typically between 5,000 and 6,000 mg/L.

A. True B. False

246. Organic nitrogen compounds in wastewater undergo microbial conversion to NH_3 and ammonium ion NH_4^+.

A. True B. False

Ammonia

247. Ammonia is a nutrient that contains_____. Its chemical formula is NH_3 in the un-ionized state and NH_4+ in the ionized form.

A. Nitrogen and hydrogen C. Phosphate
B. Total ammonia D. Both total and unionized ammonia

248. Ammonia results can be expressed as: total ammonia (mg/l), un-ionized ammonia (mg/l), total ammonia (as N, mg/l), un-ionized ammonia (_____).
A. µg/l C. As N, mg/l
B. mg/l/day D. mg/l

Nitrification
249. Nitrification is an anaerobic process in which heterotrophic bacteria oxidize carbon for energy production.
A. True B. False

250. Nitrification is normally a one-step aerobic biological process for the oxidation of ammonia to nitrate.
A. True B. False

251. Ammonia-nitrogen (NH_3-N) is first converted to nitrite (NO_2^-) by ammonia oxidizing bacteria (AOB). The nitrite produced is then converted to nitrate (NO_3-) by nitrite oxidizing bacteria (NOB). Both reactions usually occur in the same process unit at a wastewater treatment plant (e.g., activated sludge mixed liquor or fixed film biofilm).
A. True B. False

Nitrifying Bacteria
252. Ammonia can be converted into nitrite and nitrate by nitrifying bacteria. Effluent ammonia-nitrogen (NH_3-N) concentrations less than 1 mg/L NH_3-N are achievable.
A. True B. False

Autotrophic Bacteria
253. AOB and NOB are classified as autotrophic bacteria because they derive energy from the oxidation of reduced inorganic compounds (in this case, nitrogenous compounds) and use inorganic carbon (CO_2) as a food source.
A. True B. False

Significant Amount of Oxygen
254. Nitrifying bacteria require a significant amount of oxygen to complete the reactions, produce a small amount of biomass, and cause destruction of alkalinity through the consumption of carbon dioxide and production of hydrogen ions.
A. True B. False

Nitrogen Gas
255. Nitrate can be converted to nitrogen gas by a variety of autotrophic bacteria. The nitrogen gas is returned to the digester.
A. True B. False

256. Nitrate removal is limited by the amount of COD available.
A. True B. False

Total Inorganic Nitrogen (TIN)
257. Total inorganic nitrogen (TIN) as low as 5 mg/L N can be met through biological nitrification and denitrification.
A. True B. False

Total Nitrogen

258. Total nitrogen in domestic wastewater typically ranges from 1.5 to 2.0 mg/L for low to high strength wastewater.
A. True B. False

259. Factors affecting concentration include the extent of infiltration and the presence of industries. Influent concentration varies during the day and can vary significantly during rainfall events, as a result of inflow and infiltration to the collection system.
A. True B. False

Conversion of Nitrate to Nitrogen Gas

260. In this oxygen free environment, bacteria use the oxygen attached to the nitrogen that is in the nitrate form, then the nitrogen gas is released.
A. True B. False

261. Because nitrogen contains almost 50 percent of the earth's atmosphere, the release of nitrogen into the atmosphere causes a small amount of global warming.
A. True B. False

262. The conversion of nitrate to nitrogen gas is accomplished by bacteria in a process known as denitrification. Effluent with nitrogen in the form of nitrate is retained in a tank that lacks oxygen, where carbon-containing chemicals, such as methanol, are added or a small stream of raw wastewater is mixed in with the nitrified effluent.
A. True B. False

Phosphorus Section

263. Total phosphorus (TP) in domestic wastewater typically ranges between _____ mg/L but can be higher depending on industrial sources, water conservation, or whether a detergent ban is in place.
A. 4 and 8 C. 100 to 500
B. 2 and 4 D. 1,000 – 2,000

264. The _____fraction is soluble and can be in one of several forms (e.g., phosphoric acid, phosphate ion) depending on the solution pH.
A. Orthophosphate C. Phosphoric acid, phosphate ion
B. Phosphorus D. Total phosphorus (TP)

265. Polyphosphates are high-energy, condensed _____such as pyrophosphate and trimetaphosphate. They are also soluble but will not be precipitated out of wastewater by metal salts or lime. They can be converted to phosphate through hydrolysis, which is very slow, or by biological activity.
A. Polyphosphates C. Phosphates
B. Phosphorus D. Soluble organically bound non-biodegradable phosphorus

266. _____can either be in the form of soluble colloids or particulate. It can also be divided into biodegradable and non-biodegradable fractions.
A. Organically bound phosphorus C. Soluble biodegradable phosphorus
B. Phosphorus D. Particulate organically bound phosphorus

267. _____ is generally precipitated out and removed with the sludge.
A. Organically bound phosphorus C. Soluble biodegradable phosphorus
B. Phosphorus D. Particulate organically bound phosphorus

268. _____ can be hydrolyzed into orthophosphate during the treatment process.
A. Polyphosphate C. Particulate organically bound phosphorus
B. Phosphorus D. Soluble organically bound non-biodegradable phosphorus

Biological Phosphorus Control
269. Phosphorus removal can be achieved through chemical addition and a coagulation-sedimentation process discussed in the following section. Some biological treatment processes called biological nutrient removal (BNR) can also achieve nutrient reduction, removing _____.
A. Polyphosphate C. Both nitrogen and phosphorus
B. Phosphorus D. Soluble organically bound non-biodegradable phosphorus

Phosphate Accumulating Organisms (PAOs)
270. PAOs accomplish removal of phosphate by accumulating it within their cells as _____.
A. Polyphosphate C. Both nitrogen and phosphorus
B. Phosphorus D. Soluble organically bound non-biodegradable phosphorus

Production of Polyphosphate
271. PAOs are by no means the only bacteria that can accumulate _____within their cells and in fact, the production of polyphosphate is a widespread ability among bacteria.
A. Polyphosphate C. Phosphoric acid, phosphate ion
B. Phosphorus D. Total phosphorus (TP)

Luxury Uptake
272. In an anaerobic secondary treatment process, some of the CBOD is broken down through fermentation by anaerobic bacteria into soluble CBOD and simpler organic molecules called _____.
A. COD C. Carbon and energy
B. VFAs D. ATP

273. Volatile fatty acids are a preferred source of _____by heterotrophic bacteria, including the PAOs, because these compounds are easily absorbed into the bacteria.
A. COD C. Carbon and energy
B. VFAs D. ATP

Logistical Problem
274. The PAOs have a logistical problem: When PAOs are under anaerobic conditions, they are exposes to _____, but without oxygen, nitrite or nitrate present, they cannot access them.
A. COD C. Carbon and energy
B. VFAs D. ATP

Adenosine Triphosphate (ATP) Energy

275. The PAOs take ATP to the next level and form an energy-rich compound called_____, which strings together large numbers of phosphate molecules.

A. Polyphosphate C. Carbon and energy
B. VFAs D. ATP

Chemical Precipitation of Phosphorus

276. Phosphorus can also be precipitated through chemical addition. Alum, ferric chloride, or lime can be added to wastewater where these chemicals combine with phosphorus to form a solid. The precipitate is removed by settling or filtration.

A. True B. False

277. Chemical phosphorus removal can meet effluent levels as low as 0.03 mg/L TP. Chemical and biological phosphorus removal methods are often used together in various combination processes.

A. True B. False

Tertiary Filtration

278. WWTPs typically use biological phosphorus removal methods to reduce P concentrations above 50 mg/L as P followed by chemical precipitation at or after the secondary clarifier.

A. True B. False

Biological Phosphorus Removal and Combination Processes
Principles

279. Biological phosphorus removal is achieved by contacting phosphorus accumulating organisms (PAOs) in the RAS with feed, containing volatile fatty acids (VFA), in a zone free of nitrates and DO (anaerobic zone).

A. True B. False

Fuhs & Chen Theory

280. PAOs have the ability to store a large mass of _____in their cells in the form of polyphosphates.

A. Carbon C. Poly-β-hydroxybutyrate (PHB)
B. Phosphorus D. Magnesium and potassium ions

University of Cape Town (UCT) and Modified UCT (MUCT)

281. The UCT process was designed to reduce _____ to the anaerobic zone when high removal of nitrates in the effluent is not required. It consists of three stages: an anaerobic stage, an anoxic stage, and an aerobic stage.

A. Nitrates C. An anoxic zone
B. A nitrate rich stream D. An aerobic stage

Johannesburg (JHB), Modified Johannesburg and Westbank

282. The JHB process is similar to the 3 Stage Pho-redox process, but has a pre-anoxic tank ahead of the anaerobic zone to protect the zone from nitrates when low effluent nitrates are not required. The low COD of the wastewater limited the de-nitrification capacity in the original plant (Northern Works), resulting in nitrates in the _____.

A. RAS C. An anoxic zone
B. Pre-anoxic zone D. An aerobic stage

Nitrification and Nutrient Removal Sub-Section

283. Nitrosomonas europaea, which oxidizes ammonia to nitrite, and Nitrobacter winogradskyi, which oxidizes nitrite to nitrate.
A. True B. False

284. Nitrification ceases at pH values above pH 9 and declines markedly at pH values below 7.
A. True B. False

285. Nitrification is a major pathway for nitrogen removal in lagoons.
A. True B. False

286. Which of the following bugs require a neutral pH and substantial alkalinity?
A. Nitrifying bacteria C. Anaerobic, heterotrophic bacteria
B. Methane forming bacteria D. None of the Above

287. Nitrifying bacteria exists in low numbers in lagoons, they prefer attached growth systems and/or?
A. Nitrifying bacteria C. High MLSS sludge systems
B. Low MLSS sludge systems D. None of the Above

288. Complete nitrification would be expected at pond pH values between pH 7.0 and 8.5.
A. 7.5 and 9.5 C. 6.0 and 7.5
B. 7.0 and 8.5 D. None of the Above

289. Nitrification ceases at pH values above pH _____ and declines markedly at pH values below _____.
A. 9 and 6 C. 9 and 7
B. 8 and 5 D. None of the Above

290. Nitrification, however, is not a major pathway for nitrogen removal in lagoons. Nitrifying bacteria exists in low numbers in lagoons. They prefer _____and/or high MLSS sludge systems.
A. Nitrifying bacteria C. Attached growth systems
B. Low MLSS sludge systems D. None of the Above

291. Which of the following bugs or related terms commonly occur in lagoons are involved in methane formation and in sulfate reduction?
A. Nitrifying bacteria C. Anaerobic, heterotrophic bacteria
B. Methane forming bacteria D. None of the Above

292. Anaerobic methane formation involves _____bacteria.
A. Three different groups of anaerobic C. Organic overloading conditions
B. Methane fermentation D. None of the Above

293. Which of the following genera of anaerobic bacteria hydrolyze proteins, fats, and polysaccharides present in wastewater to amino acids?
A. Nitrifying bacteria C. General anaerobic degraders
B. Methane forming bacteria D. None of the Above

Photosynthetic Organisms

294. Which of the following bugs or related terms is a diverse group of bacteria that converts products from above under anaerobic conditions to simple alcohols and organic acids?

A. Acid-forming bacteria
C. Aerobic bacteria
B. Methane bacteria
D. None of the Above

295. 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
C. General anaerobic degraders
B. Methane forming bacteria
D. None of the Above

296. Which of the following bugs or related terms are environmentally sensitive and have a narrow pH range of 6.5-7.5 and require temperatures > 14° C.

A. Acid-forming bacteria
C. Aerobic bacteria
B. Methane bacteria
D. None of the Above

297. Which of the following bugs or related terms that the products of these bugs become the substrate for the methane producers?

A. Acid formers (principally acetic acid)
C. Aerobic bacteria
B. Methane bacteria
D. None of the Above

298. Which of the following bugs or related terms ceases at cold temperature?

A. Acid-forming bacteria
C. Aerobic bacteria
B. Methane fermentation
D. None of the Above

299. Which of the following bugs or related terms can use sulfate as an electron acceptor, reducing sulfate to hydrogen sulfide?

A. Nitrifying bacteria
C. Sulfate reducing bacteria
B. Methane forming bacteria
D. None of the Above

300. Which of the following bugs or related terms is a major cause of odors in ponds?

A. Sulfate reduction
C. Acid-forming bacteria
B. Methane fermentation
D. None of the Above