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Start and Finish Dates: ____________________________ You will have 90 days from this date in order to complete this course

List number of hours worked on assignment must match State Requirement. ________

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Please circle/check which certification you are applying the course CEU’s.

Wastewater Treatment______ Other _________________________________

Your certificate will be mailed to you in about two weeks.

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You can obtain a printed version of the course from TLC for an additional $69.95 plus shipping charges.

AFFIDAVIT OF EXAM COMPLETION
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.
Tertiary 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*

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Did you receive the approval number, if applicable? ________________

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You are responsible to ensure that TLC receives the Assignment and Registration Key. Please call us to ensure that we received it.

*Please circle, underline, bold or X only one correct 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 not be in non-compliance and do not follow this course for proper compliance.
Please e-mail or fax this survey along with your final exam

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7
Tertiary Assignment  1/13/2020   TLC (866) 557-1746
Tertiary Treatment
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.

Basic Wastewater Treatment Processes
1. In wastewater treatment, particles with which of the following terms, float to the top of water and can be removed?
   A. Entrapped air   C. Inorganic material
   B. Activated Sludge   D. None of the Above

2. Bacteria and other small organisms in water consume organic matter in sewage, turning it into new bacterial cells, ________________, and other by-products.
   A. Oxygen   D. Secondary treatment
   B. Carbon dioxide   D. None of the Above

3. The bacteria normally present in wastewater must have oxygen to do their part in breaking down the sewage.
   A. True   B. False

4. Which of the following wastewater terms means a suspended growth process for removing organic matter from sewage by saturating it with air and microorganisms that can break down the organic matter?
   A. Biosolid(s)   C. Organic material
   B. Activated Sludge   D. None of the Above

5. Masses of microorganisms grow and rapidly metabolized organic pollutants because of the addition of which term to wastewater?
   A. Oxygen   C. MLVSS
   B. Carbon dioxide   D. None of the Above
Chemical
6. Which of the following wastewater terms are often used at the later stages of treatment to improve the settling of excess microbiological growth or biosolids?
A. Polymers       C. Methanol
B. Activated Sludge D. None of the Above

7. According to the text, chemicals can be used to create changes in pollutants that increase the removal of these new forms by physical processes.
A. True    B. False

Organic Matter
8. 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

Oil and Grease
9. Fatty organic materials from animals, vegetables, and petroleum are quickly broken down by bacteria and can cause pollution in receiving environments.
A. True    B. False

Inorganics
10. According to the text, heavy metals can be discharged with many types of industrial wastewaters are easy to remove by conventional treatment methods.
A. True    B. False

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

Nutrients
12. 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

13. An excess of 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

14. 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
15. 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

Primary Treatment
16. 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. Tertiary Filtration C. Suspended growth process(es)
   B. Trickling ditch D. Primary and secondary stages

Preliminary Treatment
17. 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

Primary Sedimentation
18. 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

19. 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

Bacteria Section
20. Bacteria come in a variety of shapes. The. Bacteria formed like simple shapes, round spheres or balls are called Cocci (singular coccus). The next simplest shape is cylindrical. Cylindrical bacteria are called rods (singular rod).
   A. True B. False

21. 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
22. Pleomorphic bacteria can assume a variety of shapes.
   A. True B. False

23. 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
24. 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**
25. Shigellae are Gram-negative, non-spore-forming, facultatively anaerobic, Pleomorphic bacteria.
A. True   B. False

26. 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

**Salmonella**
27. 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**
28. 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

29. 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

**Filamentous Bacteria**
30. 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

31. 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

**Site Specific Bacteria**
32. 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
Facultative Bacteria
33. 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

34. 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
35. Which of the following terms live and reproduce in the absence of free oxygen?
A. Aerobic bacteria    C. Facultative bacteria
B. Anaerobic bacteria    D. None of the Above

36. 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

37. A typical use for ______________________ would be in a septic tank.
A. Aerobic bacteria    C. Facultative bacteria
B. Anaerobic bacteria    D. None of the Above

38. Which of the following terms 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

Aerobic Bacteria
39. Aerobic bacteria live and multiply in the presence of free oxygen.
A. True    B. False

40. Facultative bacteria always achieve an aerobic state when oxygen is present.
A. True    B. False

41. The metabolism of aerobes is much higher than?
A. Application-specific bacteria    C. Aerobic bacteria
B. Anaerobes    D. None of the Above

42. The by-products of ________________ are carbon dioxide and water.
A. Anaerobic action    C. Aerobic bacteria
B. Application-specific bacteria    D. None of the Above
Protozoans and Metazoans
43. 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

44. Which of the following terms 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

45. Which of the following terms 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

46. Which of the following terms 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

Dispersed Growth
47. 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

48. 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.
49. 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

50. 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

51. 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
**Activated Sludge Bugs**

52. 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

53. 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

54. 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

55. 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

56. 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

57. 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

58. 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

59. 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

60. 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
61. 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

62. 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

63. 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.**
64. 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

65. 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.**
66. 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

67. 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

68. 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.**
69. 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
70. Euchlanis is a typical?
A. Euglypha  C. Rotifer(s)
B. Shelled amoeba(s)  D. None of the Above

71. 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

72. 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

73. 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

74. 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

75. 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

76. 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

77. 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, chemotrophic, filamentous
B. Staining gram-positive  D. None of the Above

78. 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
Microthrix parvicella
79. Microthrix parvicella is another common cause of?
A. Disruptive foaming  C. Viscous brown color
B. Mixotrophic  D. None of the Above

Sphaeroliticus natans
80. 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

81. Which of the following terms requires high levels of oxygen are necessary?
A. Stain gram-negative  C. Slower growing filaments
B. A strict aerobe  D. None of the Above

Filamentous Bacteria
82. 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

83. 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

Other Wastewater Treatment Components
Biochemical Oxygen Demand
84. The BOD test has merit as a pollution parameter continues to be debated, ___________has the advantage of a long period of record.
A. BOD  C. MLSS
B. CBOD  D. MLVSS

Application Specific Microbiology
85. Which of the following terms is the preferred methodology in wastewater treatment affecting the efficiency of biological nutrient removal?
A. Attached growth  C. Application-specific microbiology
B. Advanced treatment technologies  D. None of the Above

86. Laboratory prepared bugs are more efficient in organics removal if they have the right growth environment; this efficiency is multiplied if microorganisms are allowed to grow.
A. True  B. False

87. To reduce the start-up phase for growing a mature biofilm one can also purchase application-specific microbiology culture from appropriate microbiology vendors.
A. True  B. False
Advanced Methods of Wastewater Treatment
88. 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

89. 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
90. WWTP treatment levels beyond secondary treatment are called advanced treatment.
A. True B. False

91. Which of the following terms 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

92. 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

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

94. 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

95. 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

96. 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

97. 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
98. 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

99. 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

**Biological Criteria**
99. A water body in its natural condition is free from ________________, habitat loss, and other negative stressors.
A. Allowable concentrations  C. Acute (short term) and chronic (long term)
B. Harmful effects of pollution  D. None of the Above

**pH**
100. The acidity or alkalinity of wastewater affects both treatment and the environment. Low pH indicates increasing acidity while a low pH indicates increasing alkalinity.
A. True  B. False

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

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

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

104. Which of the following wastewater terms 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

105. 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**
106. 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  C. Corrosiveness
B. TDS  D. Alkalinity
107. Which of the following wastewater terms 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

108. 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 C. Corrosiveness
B. TDS D. Alkalinity

109. 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. Total Solids C. Total Suspended solids
B. TDS D. Alkalinity

110. 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)**

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

112. Which of the following wastewater terms 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

113. 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

114. Which of the following wastewater terms 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

115. 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 C. Total Suspended solids
B. TDS D. Alkalinity

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

117. 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
118. If light is completely blocked from bottom dwelling plants, the plants will stop producing oxygen and will die.
A. True  B. False

**Water Quality Criteria**
119. 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

120. 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

**Human Health Criteria**
121. EPA scientists research information to determine the levels at which specific chemicals are not likely to adversely affect water quality standard(s).
A. True  B. False

**Aquatic Life Criteria**
122. Allowable concentrations provide protection for plants and animals that are found in surface waters.
A. True  B. False

**Biological Criteria**
123. A water body in its natural condition is free from ___________________________, habitat loss, and other negative stressors.
A. Allowable concentrations  C. Acute (short term) and chronic (long term)
B. Harmful effects of pollution  D. Human health and aquatic life criteria

124. The EPA is developing methodologies that states can use to assess the biological integrity of their waters and, in so doing, set protective__________________?
A. Water quality standards  C. Acute (short term) and chronic (long term)
B. Harmful effects of pollution  D. Human health and aquatic life criteria

125. These methodologies will describe scientific methods for determining a particular aquatic community’s health and for maintaining optimal conditions in__________?
A. Allowable concentrations  C. Various bodies of water
B. Water quality  D. Human health and aquatic life criteria

**Genera**
126. Which of the following terms means the microorganisms that are attached to a surface over which they grow are called “attached growth processes”?
A. Carbonaceous BOD  C. Suspended growth processes
B. Attached growth processes  D. Food-to-microorganism ratio, F/M
Aerobic Processes
127. The most common aerobic processes are: activated sludge systems, lagoons, trickling filters and rotating disk contactors.
A. True   B. False

128. Which of the following terms is used to degrade carbonaceous BOD?
A. Carbonaceous BOD    C. Suspended growth processes
B. Attached growth processes    D. Activated sludge processes

129. Which of the following terms is the amount of food provided to the bacteria in the aeration tank (the food-to-microorganism ratio, F/M)?
A. Carbonaceous BOD    C. Mean cell residence time (MCRT)
B. Attached growth processes    D. Food-to-microorganism ratio, F/M

Dissolved Oxygen
130. Aerobic means without air and some bacteria thrive under these conditions and utilize the nutrients and chemicals available to exist.
A. True   B. False

131. 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

132. The saprophytes exist on dead or decaying materials.
A. True   B. False

133. 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

134. Aerobic bacteria do not require oxygen to live and thrive.
A. True   B. False

135. Aerobes decompose inorganics in the water; the result is carbon dioxide and H2SO4.
A. True   B. False

136. Dissolved oxygen (DO) in water is considered a contaminant.
A. True   B. False

137. 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

138. A lack of Dissolved oxygen in natural waters creates?
A. Anaerobic conditions    C. Aerobic Conditions
B. Denitrification    D. None of the Above
139. Which of the following wastewater terms live on the volatile acids produced by these saprophyles?
A. Butyric acid fermenters C. VFAs
B. Methane fermenters D. None of the Above

140. Which of the following wastewater terms indicate that dissolved oxygen is present?
A. Sample(s) C. Aerobic conditions
B. DO analysis D. None of the Above

**Sludge Volume Index (SVI)**

141. The higher the (SVI), the better is the settling quality of the aerated mixed liquor, low (SVI) of 50 or less is considered a good settling sludge.
A. True B. False

142. __________________ settleability is central to the health of the biological system. It is important to point out that settleability is influenced by conditions in the activated sludge basin but manifests itself in the clarifier.
A. Solid(s) C. MLSS
B. Sludge D. RAS

**Primary Treatment**

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

144. 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

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

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. 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

148. 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

149. 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
150. Which of the following terms 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

151. Large amounts of this term 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. None of the Above

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 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. Wastewater effluent  D. None of the Above

155. 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

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

**Secondary Treatment**
157. 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

158. 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

159. Which of the following terms form larger and heavier aggregates that can by physically separated?
A. Solid(s)  C. Finer solids
B. Finer debris  D. None of the Above
160. 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

161. 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

162. 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

**Secondary Clarification Process**

163. The SCP provides quiescent (or calm) conditions that allow the larger aggregates of solids and microorganisms to settle out for collection.
A. True  B. False

164. In the SCP, the majority of microorganism-rich underflow (or lower layer) is re-circulated to Tanks as Return Sludge to help sustain the microorganism population in the?
A. Trickling filter(s)  C. Recirculating sand filters (RSFs)
B. Oxidation Ditches  D. None of the Above

**Lagoon Systems**

165. Lagoon systems are shallow basins that hold the wastewater for several months to allow for the natural degradation of sewage.
A. True  B. False

166. 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

**Temperature**

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

168. 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

**Microorganisms in Lagoons**

169. Swimming and ____________ engulf bacteria or other prey.
A. Gliding ciliates  C. Heterotrophic bacteria
B. Predators  D. None of the Above
170. 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

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

172. 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

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

**Aerobic Bacteria**

174. 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

175. Which of the following bugs or terms 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

176. Which of the following bugs or terms degrade wastes grow as single bacteria dispersed in the wastewater?
A. Strict aerobes  C. Many bacterial species
B. Predators  D. None of the Above

177. Which of the following bugs or terms, grow in a large aggregate due to exocellular polymer production?
A. Predators  C. Floc-forming bacteria
B. Aerobic bacteria  D. None of the Above

178. 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

179. 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
180. Which of the following bugs or terms 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

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

182. BOD removal increases rapidly below 3-4°C and ceases at 1-2°C.
A. True B. False

183. 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

**Aerated lagoons**

184. The aerated lagoons are basins, normally excavated in earth and operated without Solids recycling into the system. This is the major difference with respect to activated sludge systems.
A. True B. False

185. Two types are the most common: The Aerobic-anaerobic or partially suspended lagoon in which the concentration of solids and dissolved oxygen are maintained fairly uniform and neither the incoming solids nor the biomass of microorganisms’ settle, and the completely mixed lagoon.
A. True B. False

186. 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

**Anaerobic Bacteria**

187. 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

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

189. Which of the following bugs or related terms many 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
**Activated Sludge Process Section**

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

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

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

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

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

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

196. Methane Fermenters – bacteria that break down the volatile acids to methane, carbon dioxide and water.
A. True   B. False

197. Reduction is the addition of oxygen to an element or compound, or removal of hydrogen or an electron from an element or compound in a chemical reaction.
A. True   B. False

198. Oxidation is the addition of hydrogen, removal of oxygen or addition of electrons to an element or compound.
A. True   B. False

199. Under anaerobic conditions in wastewater, sulfur compounds or elemental sulfur are reduced to H₂S or sulfide ions.
A. True   B. False

**Basic System Components of Activated Sludge**

200. In the activated sludge process, the wastewater enters an aerated tank where previously developed biological floc particles are brought into contact with the organic matter of the wastewater.
A. True   B. False

201. The organic matter is a carbon and an energy source for the bug’s cell growth and is converted into cell tissue. The oxidized endproduct is mainly carbon dioxide, CO₂.
A. True   B. False
202. Mixed liquor is suspended solids and consists mostly of microorganisms, suspended matter, and non-biodegradable suspended matter (MLVSS).
A. True    B. False

**Nitrification**

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

204. 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

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

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

207. 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

**Activated Sludge Methods**

**Organic Load**

208. The organic load (generally coming from primary treatment operations such as settling, screening or flotation) enters the reactor where the active microbial population is present. The reactor must be continuously aerated.
A. True    B. False

209. The mixture then passes to a settling tank where the cells are settled. The treated wastewater is disinfected while the secondary settling and is recycled in part to the aeration basin.
A. True    B. False

210. 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

**Common Types**

211. The most common types of activated sludge are the conventional and the continuous flow stiffed 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. The oxygen demand for this arrangement is maximum at the inlet as is the organic load concentration.
A. True    B. False
Photosynthetic Organisms

212. 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  
B. Methane bacteria  
C. Aerobic bacteria  
D. None of the Above

213. 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. None of the Above

214. A problem exists at times where the acid formers overproduce organic acids, lowering the pH below where the methane bacteria can function (a pH < 6.5). This can stop methane formation and lead to a buildup of sludge in a lagoon with a low pH. In an anaerobic fermenter, this is known as a "stuck digester".
A. True  
B. False

215. 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  
B. Methane bacteria  
C. Aerobic bacteria  
D. None of the Above

216. 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)  
B. Methane bacteria  
C. Aerobic bacteria  
D. None of the Above

217. Which of the following bugs or related terms ceases at cold temperature?
A. Acid-forming bacteria  
B. Methane fermentation  
C. Aerobic bacteria  
D. None of the Above

218. Which of the following bugs or related terms can use sulfate as an electron acceptor, reducing sulfate to hydrogen sulfide?
A. Nitrifying bacteria  
B. Methane forming bacteria  
C. Sulfate reducing bacteria  
D. None of the Above

219. Which of the following bugs or related terms is a major cause of odors in ponds?
A. Sulfate reduction  
B. Methane fermentation  
C. Acid-forming bacteria  
D. None of the Above

220. Which of the following bugs or related terms and represented by about 28 genera, oxidize reduced sulfur compounds using light energy to produce sulfur and sulfate?
A. Nitrifying bacteria  
B. Methane forming bacteria  
C. Red and green sulfur bacteria  
D. None of the Above

221. Which of the following bugs or related terms that can grow in profusion and give a lagoon a pink or red color?
A. Chromatium, Thiocystis, and Thiopedia  
B. Methane bacteria  
C. Acid-forming bacteria  
D. None of the Above
222. According to the text, conversion of odorous sulfides to sulfur and sulfate by these bugs is a significant odor control mechanism in facultative and anaerobic lagoons.
A. Methane bacteria   C. Acid-forming bacteria
B. Sulfur bacteria   D. None of the Above

Activated Sludge Process Terms

Excess Solids
223. Solids are generated by microorganism growth and reproduction. The influent BOD supplies the food for the growth and reproduction. As microorganisms’ populations multiply, excess solids (microorganisms) must be removed (wasted).
A. True   B. False

Final Clarifier Solids Loading Rate (SLR)
224. 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
225. 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
226. 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
227. Oxidation ditches are typically limited mix systems, and cannot be modified to approach plug flow conditions.
A. True   B. False

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

Sludge Age
229. 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

230. 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)
231. 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
232. 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
233. 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
234. 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
235. 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
236. 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
237. 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
238. A sludge blanket in the final clarifier and a thick return activated sludge.
A. True  B. False
Denitrification in Final Clarifier
239. 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
240. 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
241. At a water temperature of 20°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
242. 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
243. 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
244. 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
245. When _____________ flow rates are too low, thin 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)
246. 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
Total Kjeldahl Nitrogen
247. The TKN content of influent municipal wastewater is typically between 5,000 and 6,000 mg/L.
A. True        B. False

248. Organic nitrogen compounds in wastewater undergo microbial conversion to NH₃ and ammonium ion NH₄⁺.
A. True        B. False

249. 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

250. Inert means the material is safe for all microorganisms.
A. True        B. False

Ammonia
251. Ammonia is a nutrient that contains________________. Its chemical formula is NH₃ in the un-ionized state and NH₄⁺ in the ionized form.
A. Nitrogen and hydrogen        C. Phosphate  
B. Total ammonia        D. Both total and unionized ammonia

252. 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
253. Nitrification is an anaerobic process in which heterotrophic bacteria oxidize carbon for energy production.
A. True        B. False

254. Nitrification is normally a one-step aerobic biological process for the oxidation of ammonia to nitrate.
A. True        B. False
255. 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
256. 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
257. 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
258. 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
259. 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

260. Nitrate removal is limited by the amount of COD available.

A. True  B. False

Total Inorganic Nitrogen (TIN)
261. 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
262. 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

263. 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
264. 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

265. 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

266. 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

Phosphorus Section
267. 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

268. 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)

269. 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

270. ______________ 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

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

272. ______________ 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

273. 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)

274. 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

275. 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

276. 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

277. 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

278. The PAOs have a logistical problem: When PAOs are under anaerobic conditions, they are exposed 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

279. 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
280. 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

281. 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
282. 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
283. 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
284. 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)
285. 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
286. 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

Iodometric Test
287. The iodometric (titration) test is not a very precise and reliable for (DO) analysis of samples.
A. True  B. False
288. 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

289. Which of the following wastewater terms 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

290. Which of the following wastewater terms 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

291. Which of the following wastewater terms 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

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

293. 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

294. Which of the following wastewater terms passes through the membrane and measured by the meter?
A. Carbon dioxide  C. Only molecular oxygen
B. Dissolved Oxygen  D. None of the Above

295. According to the text, 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

296. 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

297. Which of the following wastewater terms –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
298. Which of the following wastewater terms measurement is essential for adequate process control?
A. Dissolved oxygen  C. Aerobic conditions
B. DO analysis  D. None of the Above

**Sludge Volume Index (SVI)**
299. The higher the (SVI), the better is the settling quality of the aerated mixed liquor, low (SVI) of 50 or less is considered a good settling sludge.
A. True  B. False

300. The Sludge Volume Index (SVI) of activated sludge is defined as the volume in milliliters occupied by __________________ after settling for 30 minutes.
A. 1g of activated sludge  C. 10 g of activated sludge
B. 5g of activated sludge  D. None of the Above

**Nutrient Constituents in Wastewater and Measurement Methods**

**Nitrogen**
301. The major contributors of nitrogen to wastewater are ________________ such as food preparation, showering, and waste excretion.
A. Human activities  C. Bacteria and other microbes
B. Oxygen-demanding pollutants  D. None of the Above

302. The per capita contribution of nitrogen in domestic wastewater is about 1/10th of that for BOD.
A. True  B. False

303. Which of the following terms in domestic wastewater typically ranges from 20 to 70 mg/L for low to high strength wastewater?
A. Organic carbon  C. BOD
B. Total nitrogen  D. None of the Above

304. Influent concentration varies during the day and can vary significantly during rainfall events, as a result of?
A. Oxygen-demanding pollutants  C. Inflow and infiltration to the collection system
B. Dissolved oxygen decrease  D. None of the Above

**The TKN method has three major steps:**
305. Digestion to convert organic nitrogen to?
A. Ammonium sulfate  C. Dissolved, biodegradable compounds
B. Organic nitrogen  D. None of the Above

306. Conversion of which term into condensed ammonia gas through addition of a strong base and boiling?
A. Ammonia gas  C. Ammonia-nitrogen concentration
B. Ammonium sulfate  D. None of the Above

307. Measuring the concentration includes ammonia, with this term being subtracted from the TKN to determine organic nitrogen.
A. Ammonia gas  C. Ammonia-nitrogen concentration
B. Ammonium sulfate  D. None of the Above
308. Nitrogen components in wastewater are typically reported on an “_______________” basis?
A. As Nitrite  C. As nitrogen
B. As Nitrate  D. None of the Above

309. Wastewater treatment plants are designed for nitrification and denitrification and these can remove 80 to 95 percent of ________________, but the removal of organic nitrogen is typically much less efficient.
A. TKN  C. Aliphatic N compounds
B. Inorganic nitrogen  D. None of the Above

310. According to the text, domestic wastewater organic nitrogen may be present in particulate, colloidal or dissolved forms and consist of proteins, amino acids, ____________, refractory natural compounds in drinking water.
A. VFAs  C. Aliphatic N compounds
B. Nitrites  D. None of the Above

311. Which of the following terms may be released in secondary treatment by microorganisms either through metabolism or upon death and lysis?
A. TKN  C. Aliphatic N compounds
B. Organic nitrogen  D. None of the Above

312. Which of the following terms happens by microorganisms releases some organic nitrogen as dissolved, biodegradable compounds?
A. Ammonia gas  C. Hydrolysis of particulate and colloidal material
B. THMs  D. None of the Above

313. Other forms of ______________ may be more persistent in wastewater treatment processes.
A. TKN  C. Dissolved, biodegradable compounds
B. Organic nitrogen  D. None of the Above

314. The chemical composition of DON in wastewater effluents is completely understood.
A. True  B. False

Phosphorus
315. Which of the following terms in domestic wastewater typically ranges between 4 and 8 mg/L but can be higher depending on sources?
A. Phosphorus as phosphate  C. Total phosphorus (TP)
B. Orthophosphate  D. None of the Above

Advanced Treatment Section
Types of Processes
316. Which of the following terms operate without heating and therefore use less energy than conventional thermal separation processes such as distillation, sublimation or crystallization?
A. Cold separation  C. Conventional thermal separation process(es)
B. Membrane separation processes  D. None of the Above
317. Which of the following terms uses membrane technology and is widely used in the food technology, biotechnology and pharmaceutical industries?
A. Cold separation C. Conventional thermal separation process(es)
B. Membrane separation processes D. None of the Above

318. According to the text, it is impossible to separate the constituents of azeotropic liquids or solutes which form isomorphic crystals by distillation or recrystallization but such separations can be achieved using ____________.
A. Membrane technology C. Reverse osmosis
B. Macromolecule(s) D. None of the Above

319. Applications include the production of drinking water by ______________ (worldwide approximately 7 million cubic meters annually), filtrations in the food industry, the recovery of organic vapors such as petro-chemical vapor recovery and the electrolysis for chlorine production.
A. Membranes C. Reverse osmosis
B. Macromolecule(s) D. None of the Above

320. Wastewater treatment membrane technology is becoming increasingly important. With the help of ____________ it is possible to remove particles, colloids and macromolecules, so that waste-water can be disinfected in this way.
A. Ultra/microfiltration C. Membrane technology
B. Fractional distillation D. None of the Above

321. Many azeotropic mixtures of pairs of compounds are known, and many azeotropes of three or more compounds are also known, it is not possible to separate the components by
A. Ultra/microfiltration C. Membrane technology
B. Fractional distillation D. None of the Above

Membrane Filtration Processes
322. Which of the following terms enables some water systems having contaminated water sources to meet new, more stringent regulations?
A. Ultra/microfiltration C. Membrane technology
B. Fractional distillation D. None of the Above

Description of Membrane Filtration Processes
323. Which of the following terms water is forced through a porous membrane under pressure, while suspended solid, large molecules or ions are held back or rejected?
A. Ultra/microfiltration C. Membrane processes
B. Fractional distillation D. None of the Above

Microfiltration
324. The current primary use of MF is by industries to remove very fine particles from process water, the process has also been used as a pretreatment for?
A. Ultra/microfiltration C. Other membrane processes
B. Fractional distillation D. None of the Above
325. RO membranes are susceptible to clogging or filter binding unless the ____________ being processed is already quite clean.
A. Process liquid  C. Total dissolved solids (TDS)
B. Water  D. None of the Above

326. Which of the following terms has been proposed as a filtering method for particles resulting from the direct filtration process?
A. Direct filtration process  C. Microfiltration or MF
B. Potable water treatment  D. None of the Above

327. The use of filter aids to improve filtering efficiency, especially for small particles that could contain ____________ are recommended.
A. Total dissolved solids (TDS)  C. Bacterial and protozoan life
B. Chloride and sodium  D. None of the Above

**Ultrafiltration**
328. The smaller pore size is designed to remove colloids and substances that have larger molecules, which are called?
A. Equal to a certain molecular weight  C. High-molecular-weight materials
B. Microfiltration or MF  D. None of the Above

329. UF membranes can be designed to pass material that weigh less than or?
A. Equal to a certain molecular weight  C. High-molecular-weight materials
B. Microfiltration or MF  D. None of the Above

330. UF does not generally work well for removal of__________, it can be used effectively for removal or most organic chemicals.
A. Process liquid  C. Salt or dissolved solids
B. Total dissolved solids (TDS)  D. None of the Above

**Nanofiltration**
331. Nanofiltration (NF) process has been used primarily for water softening and reduction of?
A. Process liquid  C. Salt or dissolved solids
B. Total dissolved solids (TDS)  D. None of the Above

332. NF capability will undoubtedly increase the use of ________________for potable water treatment.
A. Reverse osmosis or RO  C. Direct filtration process
B. NF  D. None of the Above

**Reverse Osmosis**
333. RO membranes have very low MWC pore size that can reject ions at very high rates, including?
A. Chloride and sodium  C. Salt or dissolved solids
B. Total dissolved solids (TDS)  D. None of the Above
334. RO also works most organic chemicals, and radionuclides and microorganisms. Industrial water uses such as semiconductor manufacturing is also an important?
A. RO process  C. Direct filtration process
B. Potable water treatment  D. None of the Above

Microfiltration Specific Process
335. Microfiltration is a type of physical filtration process where a contaminated fluid is passed through a special pore-sized membrane to separate microorganisms and suspended particles from?
A. Chloride and sodium  C. Salt or dissolved solids
B. Process liquid  D. None of the Above

336. Which of the following terms works with such as ultrafiltration and reverse osmosis to provide a product stream that is free of undesired contaminants?
A. Various other separation processes  C. Batch or semi-continuous filtration
B. MF membranes  D. None of the Above

337. Microfiltration usually serves as a pre-treatment for other separation processes such as?
A. Cross flow filtration  C. Ultrafiltration
B. Filtration process(es)  D. None of the Above

Common Applications
Water Treatment Process
338. Which of the following terms presents a physical means of separation (a barrier) as opposed to a chemical alternative?
A. Fouling membranes  C. Batch or semi-continuous filtration
B. MF membranes  D. None of the Above

339. Which of the following terms are used in secondary wastewater effluents to remove turbidity but also to provide treatment for disinfection?
A. Cross flow filtration  C. MF membranes
B. Filtration process(es)  D. None of the Above

Driving Force, Retentate Stream and Permeate Streams
340. Which of the following terms can be distinguished by three major characteristics; driving force, retentate stream and permeate streams?
A. Membrane filtration processes  C. Batch or semi-continuous filtration
B. Retentate and product streams  D. None of the Above

341. Which of the following terms is pressure driven with suspended particles and water as retentate and dissolved solutes plus water as permeate?
A. Cross flow filtration  C. Microfiltration process
B. The use of hydraulic pressure  D. None of the Above

342. Which of the following terms accelerates the separation process by increasing the flow rate (flux) of the liquid stream but does not affect the chemical composition of the species in the retentate and product streams?
A. Cross flow filtration  C. Microfiltration process
B. The use of hydraulic pressure  D. None of the Above
**Fouling**

343. A major characteristic that limits the performance of microfiltration or any membrane technology is a process known as?
   A. Cross flow filtration
   B. Performance of microfiltration
   C. Fouling
   D. None of the Above

344. Which of the following terms describes the deposition and accumulation of feed components such as suspended particles, impermeable dissolved solutes or even permeable solutes, on the membrane surface and or within the pores of the membrane?
   A. Cross flow filtration
   B. Performance of microfiltration
   C. Fouling
   D. None of the Above

345. Fouling of the membrane during the filtration processes decreases the flux and thus overall efficiency of the operation. This is indicated when the pressure drop increases to a certain point. It occurs even when operating parameters are constant (pressure, flow rate, temperature and concentration)
   A. True
   B. False

**Nanofiltration (NF) Section**

346. Nanofiltration is a relatively recent membrane filtration process used most often with low total dissolved solids water with the purpose of softening (polyvalent cation removal) and removal of __________ such as natural organic matter and synthetic organic matter.
   A. Process liquid
   B. Chloride and sodium
   C. Disinfection by-product precursors
   D. None of the Above

347. Nanofiltration is also becoming more widely used in food processing applications and for __________ and partial (monovalent ion) demineralization.
   A. Simultaneous concentration
   B. Pore dimensions
   C. Natural organic matter and synthetic organic matter
   D. None of the Above

348. Which of the following terms is a membrane filtration-based method that uses nanometer sized cylindrical through-pores that pass through the membrane at 90°?
   A. Reverse osmosis or RO
   B. Nanofiltration
   C. Direct filtration process
   D. None of the Above

349. Nanofiltration membranes have pore sizes from 1-10 nanometers, smaller than that used in microfiltration and?
   A. Ultrafiltration
   B. Track-etch™ membrane(s)
   C. Direct filtration process
   D. None of the Above

350. Which of the following terms are controlled by pH, temperature and time during development with pore densities ranging from 1 to 106 pores per cm²?
   A. Simultaneous concentration
   B. Pore dimensions
   C. Natural organic matter and synthetic organic matter
   D. None of the Above

351. Membranes made from polyethylene terephthalate are referred to as __________ , named after the way the pores on the membranes are made.
   A. Ultrafiltration
   B. Track-etch™ membrane(s)
   C. Direct filtration process
   D. None of the Above
352. “Tracking” results in making tracks that are chemically developed into the membrane or __________ into the membrane, which are the pores.
A. Gentle molecular separation  C. “Etched”
B. Tracking  D. None of the Above

353. According to the text, membranes created from metal such as ____________, are made by electrochemically growing a thin layer of aluminum oxide from aluminum metal in an acidic medium.
A. Solvent-stable membrane(s)  C. Alumina membranes
B. Membrane(s)  D. None of the Above

Range of Applications
354. The original uses for nanofiltration were water treatment and?
A. Gentle molecular separation  C. Water softening
B. Solvent-stable membrane(s)  D. None of the Above

355. Which of the following terms can “soften” water by retaining scale-forming, hydrated divalent ions (e.g. Ca^{2+}, Mg^{2+}) while passing smaller hydrated monovalent ions?
A. Track-etch” membrane(s)  C. Nanofilter(s)
B. Membrane(s)  D. None of the Above

356. Which of the following terms has allowed the application for nanofiltration membranes to extend into new areas such as pharmaceuticals, fine chemicals, and flavor and fragrance industries?
A. Solvent-stable membrane(s)  C. Alumina membranes
B. Membrane(s)  D. None of the Above

357. Organic solvent nanofiltration technology and __________ used has extended possibilities for applications in a variety of organic solvents ranging from non-polar through polar to polar aprotic.
A. Solvent-stable membrane(s)  C. Commercialization of membranes
B. Membrane(s)  D. None of the Above

Advantages and Disadvantages
358. One of the main advantages of nanofiltration as a method of softening water is that during the process of retaining calcium and magnesium ions while passing smaller hydrated monovalent ions, filtration is performed without adding extra sodium ions, as used in Ion exchangers.
A. True  B. False

359. Which of the following terms do not operate at room temperature (e.g. distillation), which greatly increases the cost of the process when continuous heating or cooling is applied?
A. Many separation processes  C. Organic solvent nanofiltration technology
B. Gentle molecular separation  D. None of the Above

360. Which of the following terms is linked with nanofiltration that is often not included with other forms of separation processes (centrifugation)?
A. Many separation processes  C. Organic solvent nanofiltration technology
B. Gentle molecular separation  D. None of the Above
361. Which of the following terms has a very favorable benefit of being able to process large volumes and continuously produce streams?
A. Ultrafiltration  C. Nanofiltration
B. Microfiltration or MF  D. None of the Above

362. Anything smaller, reverse osmosis is used and anything larger is used for?
A. Ultrafiltration  C. Nanofiltration
B. Microfiltration or MF  D. None of the Above

363. Which of the following terms can also be used in cases where nanofiltration can be used, due to it being more conventional?
A. Ultrafiltration  C. Nanofiltration
B. Microfiltration or MF  D. None of the Above

364. Which of the following terms membranes are an expensive part of the process. Repairs and replacement of membranes is dependent on total dissolved solids, flow rate and components of the feed?
A. Ultrafiltration  C. Nanofiltration
B. Microfiltration or MF  D. None of the Above

365. Which of the following terms being used across various industries, only an estimation of replacement frequency can be used?
A. Ultrafiltration  C. Nanofiltration
B. Microfiltration or MF  D. None of the Above

Reverse Osmosis Process Section
366. Osmosis is a natural phenomenon in which a liquid - water in this case - passes through a semi-permeable membrane from a relatively dilute solution toward a more concentrated solution. This flow produces a measurable pressure, called osmotic pressure.
A. True  B. False

367. Which of the following terms produces high quality water at low cost compared to other purifications processes?
A. Ultrafiltration  C. RO
B. Microfiltration or MF  D. None of the Above

368. Which of the following is determined by the total dissolved solids content of the saline solution, or contaminated solution on one side of the membrane?
A. This pressure differential  C. Virtually 100% of colloidal and suspended matter
B. Osmotic pressure  D. None of the Above

369. The higher the content of dissolved solids, the higher the?
A. This pressure differential  C. Virtually 100% of colloidal and suspended matter
B. Osmotic pressure  D. None of the Above

370. Which of the following result in higher osmotic pressures?
A. Pressure differential  C. Higher molecular weights
B. Osmotic pressure  D. None of the Above
371. According to the text, common tap water as found in most areas may have an osmotic pressure of about 10 PSI (Pounds per Square Inch), or about?
A. 376 PSI  
B. A pressure of 10 PSI  
C. 1.68 Bar  
D. None of the Above

372. According to the text, Seawater typically has an osmotic pressure of about 376 PSI (26.75 Bar).
A. 36,000 PPM  
B. A pressure of 10 PSI  
C. 1.68 Bar  
D. None of the Above

373. To reach the point at which osmosis stops for tap water, a pressure of 10 PSI would have to be applied to the saline solution, and to stop osmosis in seawater, a pressure of ____________ would have to be applied to the seawater side of the membrane.
A. 376 PSI  
B. A pressure of 10 PSI  
C. 1.68 Bar  
D. None of the Above

374. Concentrated raw water is called the reject stream or concentrate stream, it may also be called brine if it is coming from a?
A. Salt water source  
B. Microporous support layer  
C. The concentrate  
D. None of the Above

375. Which of the following terms when sufficient flows are maintained, serves to carry away the impurities removed by the membrane, thus keeping the membrane surface clean and functional?
A. Salt water source  
B. Microporous support layer  
C. The concentrate  
D. None of the Above

376. The membrane material itself is a special thin film composite (TFC) polyamide material, cast in a microscopically thin layer on another, thicker cast layer of Polysulfone called?
A. Salt water source  
B. Microporous support layer  
C. The concentrate  
D. None of the Above

377. Each sheet of membrane material is inspected at special light tables to ensure the quality of the membrane coating, before being assembled into the?
A. Spiral wound element design  
B. Microporous support layer  
C. Amount of permeate or product water  
D. None of the Above

378. To achieve Reverse Osmosis, the ___________ pressure is generally doubled.
A. Membrane material  
B. Osmotic  
C. Amount of permeate or product water  
D. None of the Above

379. The inverse occurs with lower temperatures, in that salt passage decreases (reducing the ___________ in the permeate or product water), while operating pressures increase. Or, if operating pressures do not increase, then the amount of permeate or product water is reduced.
A. TDS  
B. Raw water  
C. Concentrate  
D. None of the Above
380. The rejection rate is the percentage of _______________ rejected, or prevented from passing through the membrane.
A. Percentage of permeate  C. Dissolved solids
B. Raw water  D. None of the Above

381. A membrane with a rejection rate of 99% (usually based on Na (Sodium)) will allow only 1% of the concentration of ____________ to pass through into the permeate.
A. Percentage of permeate  C. Dissolved solids
B. Raw water  D. None of the Above

382. As the raw water is processed, the concentrations of ____________ increase as it passes along the membrane’s length and usually multiple membranes are employed, with each membrane in series seeing progressively higher dissolved solids levels.
A. Percentage of permeate  C. TDS
B. Raw water  D. None of the Above

383. Typically, starting with seawater of 36,000 PPM, standard rejection membranes produce?
A. Permeate above 500 PPM  C. Amount of permeate or product water
B. Permeate below 500 PPM  D. None of the Above

384. Optimum flows and pressures, optimum recovery rates (the ____________ from a given stream of raw water), prefiltration and other pretreatment considerations, and so forth.
A. Percentage of permeate  C. Amount of permeate or product water
B. Multi-media filtration  D. None of the Above

385. Well-designed systems employ multiple stages of prefiltration, tailored to the application, including ____________ and one or more stages of cartridge filtration.
A. Percentage of permeate  C. Amount of permeate or product water
B. Multi-media filtration  D. None of the Above

386. Which of the following terms has proved to be the most reliable and cost effective method of desalinating water, and hence its use has become more and more widespread?
A. Reverse Osmosis  C. Direct filtration process
B. Potable water treatment  D. None of the Above

387. Which of the following terms is usually some 70% less than for comparable evaporation technologies?
A. Energy consumption  C. Direct filtration process
B. Component parts  D. None of the Above

388. Which of the following terms have been improved as well, reducing maintenance and down time?
A. Each sheet of membrane material  C. Component parts
B. Microporous support layer  D. None of the Above

389. Which of the following terms delivers product water or permeate having essentially the same temperature as the raw water source?
A. Reverse Osmosis  C. Direct filtration process
B. Potable water treatment  D. None of the Above
390. R/O Systems can be designed to deliver virtually any?
A. Required product water quality    C. Amount of permeate or product water
B. Microporous support layer       D. None of the Above

391. Reverse osmosis, also known as?
A. Hyperfiltration      C. Direct filtration process
B. Microfiltration or MF    D. None of the Above

392. Reverse osmosis is used to purify water and remove salts and other impurities in order to improve the color, taste, or properties of the?
A. Cross-flow    C. Fluid
B. Concentrate      D. None of the Above

393. RO can be used to purify fluids such as ethanol and glycol, which will pass through the reverse osmosis membrane, while rejecting?
A. Percentage of permeate    C. Ions and contaminants
B. Raw water      D. None of the Above

394. RO is used to produce ____________ that are currently in place.
A. Permeate        C. Water that meets the most demanding specifications
B. Concentrate      D. None of the Above

395. Reverse osmosis technology uses a process known as _________________ to allow the membrane to continually clean itself.
A. Cross-flow     C. Fluid
B. Concentrate      D. None of the Above

396. Which of the following terms passes through the membrane the rest continues downstream, sweeping the rejected species away from the membrane?
A. Some of the fluid    C. Purify fluid(s)
B. The higher the pressure      D. None of the Above

397. According to the text, the process of reverse osmosis ________________ through the membrane, and the most common force is pressure from a pump.
A. Percentage of permeate    C. A driving force to push the fluid
B. Concentrate      D. None of the Above

398. Which of the following terms of the fluid being rejected increases, the driving force required to continue concentrating the fluid increases?
A. The concentration    C. Purify fluid(s)
B. The higher the pressure      D. None of the Above

399. RO is capable of rejecting bacteria, salts, ________, proteins, particles, dyes, and other constituents that have a molecular weight of greater than 150-250 daltons.
A. Charged Particles    C. Sugars
B. Concentrate      D. None of the Above

400. The separation of ions with reverse osmosis is aided by?
A. Charged Particles    C. Electricity
B. Concentrate      D. None of the Above