

**Registration form**

**WASTEWATER TREATMENT TRAINING COURSE \$100.00  
48 HOUR RUSH ORDER PROCESSING FEE ADDITIONAL \$50.00**

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. \_\_\_\_\_

Name \_\_\_\_\_ Signature \_\_\_\_\_  
*I have read and understood the disclaimer notice on page 2. Digitally sign XXX*

Address: \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

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Phone:  
Home ( \_\_\_\_\_ ) \_\_\_\_\_ Work ( \_\_\_\_\_ ) \_\_\_\_\_

Operator ID# \_\_\_\_\_ Exp Date \_\_\_\_\_

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

Wastewater Treatment \_\_\_\_\_ Other \_\_\_\_\_

**Technical Learning College PO Box 3060, Chino Valley, AZ 86323  
Toll Free (866) 557-1746 Fax (928) 272-0747 [info@tlch2o.com](mailto:info@tlch2o.com)**

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## **DISCLAIMER NOTICE**

I understand that it is my responsibility to ensure that this CEU course is either approved or accepted in my State for CEU credit. I understand State laws and rules change on a frequent basis and I believe this course is currently accepted in my State for CEU or contact hour credit, if it is not, I will not hold Technical Learning College responsible. I fully understand that this type of study program deals with dangerous, changing conditions and various laws and that I will not hold Technical Learning College, Technical Learning Consultants, Inc. (TLC) liable in any fashion for any errors, omissions, advice, suggestions or neglect contained in this CEU education training course or for any violation or injury, death, neglect, damage or loss of your license or certification caused in any fashion by this CEU education training or course material suggestion or error or my lack of submitting paperwork. It is my responsibility to call or contact TLC if I need help or assistance and double-check to ensure my registration page and assignment has been received and graded. It is my responsibility to ensure all information is correct and to abide with all rules and regulations.

**State Approval Listing Link;** Check to see if your State or Agency accepts or has pre-approved this course. Not all States are listed. Not all courses are listed. If the course is not accepted for CEU credit, we will give you the course free if you ask your State to accept it for credit.

**Professional Engineers;** Most states or agencies will accept our courses for credit but we do not officially list the States or Agencies. Please check your State for approval.

## **State Approval Listing URL...**

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## **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.

## For Texas Wastewater Licensed Operators Information Changes

### Wastewater/Collections Rule Changes (Texas Only)

#### Rule Changes and Updates for Domestic Wastewater Systems

On Nov. 4, 2014, TCEQ commissioners adopted revisions to 30 Texas Administrative Code (TAC), Chapter 217, Design Criteria for Domestic Wastewater Systems, and “re-adopted” previously repealed rules in 30 TAC, Chapter 317, Design Criteria Prior to 2008.

#### *Some of the changes to Chapter 217 include:*

- Adding new definitions and clarifying existing definitions;
- Adding design criteria and approval requirements for rehabilitation of existing infrastructure;
- Adding design criteria for new technologies, including cloth filters and air lift pumps;
- Making changes to reflect modern practices, standards and trends;
- Modifying rule language to improve readability and enforceability; and
- Modifying the design organic loadings and flows for a new wastewater treatment facility.

#### **SUBCHAPTER A: ADMINISTRATIVE REQUIREMENTS §§217.1 - 217.18**

Effective December 4, 2015 §217.1. Applicability. (a) Applicability. (1) This chapter applies to the design, operation, and maintenance of: (A) domestic wastewater treatment facilities that are constructed with plans and specifications received and approved by the executive director after the effective date of the amendments to this chapter; (B) treatment units that are altered, constructed, or re-rated with plans and specifications received and approved by the executive director after the effective date of the amendments to this chapter; (C) collection systems that are constructed with plans and specifications received and approved by the executive director after the effective date of the amendments to this chapter; (D) collection system units that are altered, constructed, or re-rated with plans and specifications received and approved by the executive director after the effective date of the amendments to this chapter; (E) existing domestic wastewater treatment facilities that do not have a current Texas Pollutant Discharge Elimination System permit or a Texas Land Application Permit and are required to have an active wastewater permit; (F) existing wastewater treatment facilities and collection systems that never received approval for plans and specifications from the executive director; and (G) collection system rehabilitation projects covered in §217.56(c) and §217.69 of this title (relating to Trenchless Pipe Installation; and Maintenance, Inspection, and Rehabilitation of the Collection System). (2) Domestic wastewater treatment facilities, treatment units, collection systems, and collection system units with plans and specifications approved by the executive director that were received on or after August 28, 2008 and before the effective date of this chapter must comply with the rules in this chapter, as they existed immediately before the effective date of the amendments to this chapter.

The rules in Texas Commission on Environmental Quality Page 2 Chapter 217 - Design Criteria for Domestic Wastewater Systems effect immediately before the effective date of the amendments to this chapter are continued in effect for that purpose. (3) This chapter does not apply to: (A) the design, installation, operation, or maintenance of domestic wastewater treatment facilities, treatment units, collection systems, or collection system units with plans and specifications that were approved by the executive director on or before August 27, 2008, which are governed by Chapter 317 of this title (relating to Design Criteria Prior to 2008) or design criteria that preceded Chapter 317 of this title; and (B) systems regulated by Chapter 285 of this title (relating to On-Site Sewage Facilities); or collection systems or wastewater treatment facilities that collect, transport, treat, or dispose of wastewater that does not have the characteristics of domestic wastewater, although the wastewater may contain domestic wastewater.

(b) The executive director may grant variances from new requirements added by the amendments of this chapter to a person who proposes to construct, alter, or re-rate a collection system or wastewater treatment facility if the plans and specifications for the project are submitted within 180 days after the date the amendments to this chapter are effective, provided the plans and specifications comply with the rules in effect immediately prior to the amendment. Adopted November 4, 2015 Effective December 4, 2015

The link to the rules is available on the TCEQ website at <https://www.tceq.texas.gov/rules/indxpdf.html>

*For Texas Students Only....*

Please sign and date this notice

Printed Name

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Signature

Date

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# Texas Students Only

**Acknowledgement of Notice of Potential Ineligibility for License**  
*You are required to sign and return to TLC or your credit will not be reported.*

Name: \_\_\_\_\_

Date of Birth: \_\_\_\_\_

Email Address: \_\_\_\_\_

By signing this form, I acknowledge that Technical Learning College notified me of the following:

- the potential ineligibility of an individual who has been convicted of an offense to be issued an occupational license by the Texas Commission on Environmental Quality (TCEQ) upon completion of the educational program;
- the current TCEQ Criminal Conviction Guidelines for Occupational Licensing, which describes the process by which the TCEQ's Executive Director determines whether a criminal conviction:
  - renders a prospective applicant an unsuitable candidate for an occupational license;
  - warrants the denial of a renewal application for an existing license; or
  - warrants revocation or suspension of a license previously granted.
- the right to request a criminal history evaluation from the TCEQ under Texas Occupations Code Section 53.102; and
- that the TCEQ may consider an individual to have been convicted of an offense for the purpose of denying, suspending or revoking a license under circumstances described in Title 30 Texas Administrative Code Section 30.33.

Enrollee Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Name of Training Provider/Organization: Technical Learning College

Contact Person: Melissa Durbin Role/Title: Dean



# Wastewater Treatment CEU Course Answer Key

Name \_\_\_\_\_ Telephone # \_\_\_\_\_

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

*Method of Course acceptance confirmation. Please fill this section*

Website \_\_\_ Telephone Call \_\_\_ Email \_\_\_ Spoke to \_\_\_\_\_

Did you receive the approval number, if applicable? \_\_\_\_\_

What is the course approval number, if applicable? \_\_\_\_\_

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

***Please write down any question that you are not able to find.***

***Please circle, underline, bold or X only one correct answer***

- |             |             |             |             |
|-------------|-------------|-------------|-------------|
| 1. A B C D  | 19. A B C D | 37. A B C D | 55. A B     |
| 2. A B C D  | 20. A B C D | 38. A B C D | 56. A B     |
| 3. A B C D  | 21. A B C D | 39. A B C D | 57. A B     |
| 4. A B C D  | 22. A B C D | 40. A B C D | 58. A B     |
| 5. A B C D  | 23. A B C D | 41. A B     | 59. A B C D |
| 6. A B      | 24. A B     | 42. A B     | 60. A B C D |
| 7. A B      | 25. A B C D | 43. A B C D | 61. A B C D |
| 8. A B C D  | 26. A B C D | 44. A B C D | 62. A B C D |
| 9. A B C D  | 27. A B C D | 45. A B C D | 63. A B C D |
| 10. A B C D | 28. A B C D | 46. A B     | 64. A B C D |
| 11. A B C D | 29. A B C D | 47. A B C D | 65. A B C D |
| 12. A B C D | 30. A B C D | 48. A B C D | 66. A B C D |
| 13. A B     | 31. A B C D | 49. A B     | 67. A B C D |
| 14. A B C D | 32. A B     | 50. A B     | 68. A B C D |
| 15. A B     | 33. A B C D | 51. A B C D | 69. A B C D |
| 16. A B C D | 34. A B C D | 52. A B     | 70. A B C D |
| 17. A B     | 35. A B C D | 53. A B     | 71. A B C D |
| 18. A B     | 36. A B C D | 54. A B C D | 72. A B C D |

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|--------------|--------------|--------------|--------------|
| 73. A B C D  | 105. A B C D | 137. A B     | 169. A B     |
| 74. A B C D  | 106. A B C D | 138. A B     | 170. A B     |
| 75. A B C D  | 107. A B C D | 139. A B     | 171. A B C D |
| 76. A B C D  | 108. A B C D | 140. A B C D | 172. A B C D |
| 77. A B C D  | 109. A B     | 141. A B C D | 173. A B     |
| 78. A B C D  | 110. A B     | 142. A B C D | 174. A B C D |
| 79. A B C D  | 111. A B     | 143. A B     | 175. A B C D |
| 80. A B C D  | 112. A B C D | 144. A B     | 176. A B     |
| 81. A B      | 113. A B C D | 145. A B C D | 177. A B     |
| 82. A B      | 114. A B C D | 146. A B C D | 178. A B C D |
| 83. A B      | 115. A B     | 147. A B C D | 179. A B C D |
| 84. A B      | 116. A B C D | 148. A B     | 180. A B C D |
| 85. A B      | 117. A B C D | 149. A B C D | 181. A B C D |
| 86. A B      | 118. A B C D | 150. A B C D | 182. A B C D |
| 87. A B      | 119. A B C D | 151. A B C D | 183. A B C D |
| 88. A B C D  | 120. A B C D | 152. A B C D | 184. A B C D |
| 89. A B C D  | 121. A B C D | 153. A B C D | 185. A B     |
| 90. A B C D  | 122. A B C D | 154. A B C D | 186. A B     |
| 91. A B      | 123. A B C D | 155. A B C D | 187. A B     |
| 92. A B      | 124. A B C D | 156. A B C D | 188. A B C D |
| 93. A B      | 125. A B C D | 157. A B C D | 189. A B C D |
| 94. A B      | 126. A B C D | 158. A B C D | 190. A B C D |
| 95. A B      | 127. A B C D | 159. A B     | 191. A B C D |
| 96. A B      | 128. A B C D | 160. A B C D | 192. A B C D |
| 97. A B      | 129. A B C D | 161. A B C D | 193. A B C D |
| 98. A B C D  | 130. A B C D | 162. A B C D | 194. A B C D |
| 99. A B      | 131. A B C D | 163. A B C D | 195. A B C D |
| 100. A B C D | 132. A B C D | 164. A B     | 196. A B C D |
| 101. A B C D | 133. A B C D | 165. A B C D | 197. A B C D |
| 102. A B C D | 134. A B     | 166. A B C D | 198. A B C D |
| 103. A B C D | 135. A B C D | 167. A B C D | 199. A B C D |
| 104. A B C D | 136. A B     | 168. A B     | 200. A B C D |



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

**WASTEWATER TREATMENT  
CEU TRAINING COURSE  
CUSTOMER SERVICE RESPONSE CARD**

NAME: \_\_\_\_\_

E-MAIL \_\_\_\_\_ PHONE \_\_\_\_\_

***PLEASE COMPLETE THIS FORM BY CIRCLING THE NUMBER OF THE APPROPRIATE ANSWER IN THE AREA BELOW.***

Please rate the difficulty of your course.

Very Easy 0 1 2 3 4 5 Very Difficult

Please rate the difficulty of the testing process.

Very Easy 0 1 2 3 4 5 Very Difficult

Please rate the subject matter on the exam to your actual field or work.

Very Similar 0 1 2 3 4 5 Very Different

How did you hear about this Course? \_\_\_\_\_

What would you do to improve the Course?

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How about the price of the course? Poor \_\_ Fair\_\_ Average\_\_ Good \_\_ Great \_\_

How was your customer service? Poor \_\_ Fair\_\_ Average\_\_ Good \_\_ Great \_\_

Any other concerns or comments.

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**Please fax the answer key to TLC  
(928) 272-0747**

**Always call to confirm that we received your paperwork.**

*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.*

# Wastewater Treatment

## CEU Course Assignment

*The Assignment is available in Word on the Internet for your Convenience, please visit [www.ABCTLC.com](http://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](mailto: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.**

**Please write down any questions or answers that you could not find or has an error.**

### Biological

1. Bacteria and other small organisms in water consume organic matter in sewage, turning it into new bacterial cells, \_\_\_\_\_, and other by-products.

- A. Oxygen
- B. Carbon dioxide
- C. Secondary treatment
- D. None of the Above

2. 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)
- B. Activated Sludge
- C. Organic material
- D. None of the Above

3. Masses of microorganisms grow and rapidly metabolized organic pollutants because of the addition of which term to wastewater?

- A. Oxygen
- B. Carbon dioxide
- C. MLVSS
- D. None of the Above

### Chemical

4. 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
- B. Activated Sludge
- C. Methenol
- D. None of the Above

### Organic Matter

5. 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
- B. Biodegradable material(s)
- C. Organic material(s)
- D. High supply of oxygen

### Oil and Grease

6. 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

7. 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

8. 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

9. 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

### Inorganic and Synthetic Organic Chemicals

10. 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

11. 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

12. 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

13. 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

14. 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

### Primary Sedimentation

15. 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

16. 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

17. 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

### Secondary Treatment

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

A. True B. False

19. 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

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

A. Solid(s) C. Finer solids  
B. Finer debris D. None of the Above

21. 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

### Biochemical Oxygen Demand

22. 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

23. 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

### Topic 3 - Secondary Treatment Section

#### Aerobic Processes

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

A. True B. False

25. 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

26. 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

#### Raw Water Screening

27. Raw wastewater may or may not be \_\_\_\_\_ before being directed into the pond treatment system. The first two ponds in the pond system may be operated in series or in parallel.

A. Screened and de-gritted C. Compacted clay bottoms and sides  
B. Series or in parallel D. None of the above

28. Microorganisms in the first two ponds treat the incoming effluent, while the third pond is the settling or polishing pond. The third pond is to provide \_\_\_\_\_ where the where the biological solids generated in the first two ponds can settle.

A. Wind and algae C. Compacted clay bottoms and sides  
B. A quiet zone D. None of the above

29. Ponds generally do not have a secondary clarifier, the \_\_\_\_\_ fulfils the clarifier action.

A. Wind and algae C. Settling or polishing pond  
B. Series or in parallel D. None of the above

#### Pond Lining

30. Ponds may be lined with a synthetic liner or simply have \_\_\_\_\_.

A. Wind and algae C. Compacted clay bottoms and sides  
B. Series or in parallel D. None of the above

31. Many ponds rely on \_\_\_\_\_ to supply oxygen instead of mechanical aeration.

A. Wind and algae C. Compacted clay bottoms and sides  
B. Series or in parallel operation D. None of the above

#### Lagoon Systems

32. Lagoon systems are shallow basins that hold the wastewater for several months to allow for the natural degradation of sewage.

A. True B. False

#### Lagoon Microorganisms Introduction

33. Swimming and \_\_\_\_\_ engulf bacteria or other prey.

A. Gliding ciliates C. Heterotrophic bacteria  
B. Predators D. None of the Above

34. Predators feed mostly on stalked and \_\_\_\_\_.
- A. Floc-forming bacteria                      C. Methane Fermenters  
B. Swimming ciliates                          D. None of the Above
35. Food (organic loading) regulates \_\_\_\_\_?
- A. Strict aerobes                              C. Microorganism numbers  
B. Predators                                  D. None of the Above
36. Filamentous bacteria generally do not cause any operational problems in lagoons, in contrast to activated sludge where \_\_\_\_\_ and poor sludge settling is a common problem.
- A. Redox potential                      C. BOD removal  
B. Filamentous bulking                  D. None of the Above
37. Most heterotrophic bacteria have a wide range in environmental tolerance and can function effectively in \_\_\_\_\_ over a wide range in pH and temperature.
- A. Redox potential                      C. BOD removal  
B. Poor sludge settling                  D. None of the Above
38. Aerobic BOD removal generally proceeds well from pH 6.5 to 9.0 and at temperatures from 3-4°C to 60-70°C (37.4 -39.2° F to 140-158°F in the ATAD process (mesophilic bacteria are replaced by thermophilic bacteria at temperatures above 35°C).
- A. 5.5 to 8.0                              C. 6.5 to 7.0  
B. 6.5 to 9.0                              D. None of the Above
39. BOD removal generally declines rapidly below \_\_\_\_\_ C and ceases at \_\_\_\_\_ C.
- A. 3-4° - 1-2°                      C. 1-2° - 3-4°  
B. 4-6° - 2-3°                      D. None of the Above
40. A very specialized group of bacteria occurs to some extent in lagoons (and other wastewater treatment systems) that can oxidize ammonia via nitrite to nitrate, termed nitrifying bacteria. These bacteria are strict aerobes and require a redox potential of at least +200 m V.
- A. +200                      C. 2,000  
B. - 200                      D. None of the Above

### **Mixed or Suspended Lagoons**

41. 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
42. 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
43. In the facultative lagoons, the power input is reduced causing accumulation of solids in the bottom which undergo \_\_\_\_\_, while the upper portions are maintained aerobic.
- A. Facultative lagoon(s)                      C. Dissolved organic and inorganic constituents  
B. Anaerobic decomposition                  D. None of the Above

### **Advanced Methods of Wastewater Treatment**

44. 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
- B. Some contaminants
- C. Soluble nutrients
- D. None of the Above

45. All WWTPs provide a minimum of?

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

### **Advanced Treatment Technologies**

46. WWTP treatment levels beyond secondary treatment are called advanced treatment.

- A. True
- B. False

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

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

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

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

### **Clarifier Sludge Blanket**

49. 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

### **Constant MLSS (Mixed Liquor Suspended Solids)**

50. 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

### **Denitrification**

51. 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
- B. CBOD
- C. RAS
- D. WAS

### **Extended Aeration Activated Sludge Plants**

52. 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



### **Filaments**

53. 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

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

54. 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

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

### **Pin Floc**

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

### **Sludge Age**

57. 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

### **Young Sludge**

58. 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

### **Regular MLSS Removal**

59. To maintain a stable treatment process, MLSS must be removed on a regular schedule. The MLSS can be removed from the bottom of the clarifier or from the \_\_\_\_\_.  
A. Secondary sludge wasting C. Activated sludge basin  
B. Solids handling process D. None of the above

60. The \_\_\_\_\_ removed directly from the basin is renamed as WAS.  
A. MLSS C. WAS  
B. CRT D. None of the above

61. Some clarifiers have separate pipelines for RAS and WAS. In other cases, WAS is pumped out of the \_\_\_\_\_ pipeline.  
A. RAS C. WAS  
B. CRT D. None of the above

### Wasting Rates

62. CRT was defined as the average length of time in days that an organism remains in the \_\_\_\_\_.
- A. Secondary treatment system
  - B. Solids handling process
  - C. Many activated sludge plants
  - D. None of the above
63. The operator determines the operating \_\_\_\_\_ for the facility and maintains it through wasting the appropriate amount of excess biomass (Waste Activated Sludge, WAS) from the secondary system.
- A. Mixed Liquor
  - B. CRT
  - C. WAS
  - D. None of the above
64. The amount of \_\_\_\_\_ in the secondary system is controlled and maintained through solids wasting.
- A. Biomass (MLSS)
  - B. CRT
  - C. WAS
  - D. None of the above
65. In nearly all activated sludge plants, wasting is accomplished by directing a portion of the Return Sludge to the \_\_\_\_\_.
- A. Secondary sludge wasting
  - B. Solids handling facility
  - C. Many activated sludge plants
  - D. None of the above
66. Wasting Return Sludge rather than \_\_\_\_\_ minimizes the volume of water that must be processed by the sludge thickening/dewatering equipment.
- A. Mixed Liquor
  - B. CRT
  - C. RAS
  - D. None of the above
67. If intermittent wasting is practiced, it is usually best to waste over as long a time period as practical, and when the loading on the \_\_\_\_\_ is at the low point of the day.
- A. Secondary system
  - B. Solids handling process
  - C. Many activated sludge plants
  - D. None of the above
68. Drastic changes should not be made in wasting rates from one day to the next; allow the \_\_\_\_\_ time to acclimate to a change before another change is made.
- A. Secondary sludge wasting
  - B. Biological system
  - C. Advanced system
  - D. None of the above
69. Consistency is a key element in successful \_\_\_\_\_ operation.
- A. Secondary system
  - B. The operator
  - C. Activated sludge plant
  - D. None of the above
70. Many activated sludge plants were originally designed to waste secondary solids into the primary clarifiers. The reasoning was that as the less dense biological solids co-settle with the \_\_\_\_\_ the combined sludge density would be increased.
- A. Mixed Liquor
  - B. Heavier primary solids
  - C. Scum
  - D. None of the above

71. A more efficient operation will result if the WAS is wasted directly to a \_\_\_\_\_ and not allowed to return to the treatment system.

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

72. It is crucial that adequate solids concentrating equipment and \_\_\_\_\_ are part of any plans for building or expanding an activated sludge plant.

- A. Secondary system
- B. The operator
- C. Solids storage capability
- D. None of the above

73. Which of the following is one of the most important controls available to the operator because it controls the most important aspect of treatment, biomass population?

- A. Secondary system
- B. Secondary sludge wasting
- C. Activated sludge plant
- D. None of the above

74. A good \_\_\_\_\_ control situation is one that allows the operator to set a totalizer which determines the maximum number of gallons wasted in a particular day and also allows the operator to control and monitor the WAS flow rate.

- A. MLSS concentration
- B. WAS
- C. BOD, nutrients, and oxygen
- D. None of the above

### **Environmental Conditions**

75. Waste activated sludge flow, along with environmental conditions such as water temperature and accessibility to \_\_\_\_\_, influences the process biology and level of treatment achieved.

- A. MLSS concentration
- B. WAS
- C. BOD, nutrients, and oxygen
- D. None of the above

76. Slower growing microorganisms, including the nitrification bacteria and some bacteria and some filaments, can only remain in the treatment process if the \_\_\_\_\_ is held long enough for them to reproduce.

- A. MLSS
- B. WAS
- C. BOD, nutrients, and oxygen
- D. None of the above

### **Sludge Settling**

77. Waste activated sludge determines how long the \_\_\_\_\_ stays in the system and, therefore, helps to determine which type of microorganisms will be present.

- A. MLSS
- B. WAS
- C. BOD, nutrients, and oxygen
- D. None of the above

78. The presence or absence of \_\_\_\_\_ will influence how fast the sludge settles in the clarifier.

- A. MLSS concentration
- B. WAS
- C. Filaments
- D. None of the above

79. Waste activated sludge also determines the \_\_\_\_\_.

- A. MLSS concentration
- B. WAS
- C. BOD, nutrients, and oxygen
- D. None of the above

## **Organic Loading Methods**

### **Organic Load**

80. 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
- B. High degradation rate
- C. Flocculating
- D. None of the Above

### **Common Types**

81. The most common types of activated sludge are the conventional and the continuous flow stirred tank, in which the contents are completely mixed. In the conventional process, the wastewater is circulated along the aeration tank, with the flow being arranged by baffles in plug flow mode. The oxygen demand for this arrangement is maximum at the inlet as is the organic load concentration.

- A. True
- B. False

## **Sludge Problems and Solutions Section**

### **Excess Solids**

82. 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)**

83. 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

### **Return Rates Too Low**

84. 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

### **Excessive Old Sludge**

85. 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

## **Topic 5 – Nutrient Section**

### **TKN**

86. 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

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

- A. True
- B. False

### Ammonia

88. Ammonia is a nutrient that contains \_\_\_\_\_. Its chemical formula is  $\text{NH}_3$  in the un-ionized state and  $\text{NH}_4^+$  in the ionized form.

- A. Nitrogen and hydrogen
- B. Total ammonia
- C. Phosphate
- D. Both total and un-ionized ammonia

89. 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.  $\mu\text{g/l}$
- B. mg/l/day
- C. As N, mg/l
- D. mg/l

### Nitrogen Introduction

90. The major contributors of nitrogen to wastewater are \_\_\_\_\_ such as food preparation, showering, and waste excretion.

- A. Human activities
- B. Oxygen-demanding pollutants
- C. Bacteria and other microbes
- D. None of the Above

### Nitrifying Bacteria

91. Ammonia can be converted into nitrite and nitrate by nitrifying bacteria. Effluent ammonia-nitrogen ( $\text{NH}_3\text{-N}$ ) concentrations less than 1 mg/L  $\text{NH}_3\text{-N}$  are achievable.

- A. True
- B. False

### Autotrophic Bacteria

92. 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 ( $\text{CO}_2$ ) as a food source.

- A. True
- B. False

### Significant Amount of Oxygen

93. 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

### Nitrification

94. Nitrification is an anaerobic process in which heterotrophic bacteria oxidize carbon for energy production.

- A. True
- B. False

### Nitrogen Gas

95. 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

### Total Inorganic Nitrogen (TIN)

96. 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

97. 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

98. 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

### Conversion of Nitrate to Nitrogen Gas

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

- A. True B. False

### Phosphorus Section

100. 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

101. \_\_\_\_\_ 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

### Phosphorus Section

102. 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

### Biological Phosphorus Control

103. 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)

104. 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

105. 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
- B. Phosphorus
- C. Phosphoric acid, phosphate ion
- D. Total phosphorus (TP)

### Luxury Uptake

106. 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
- B. VFAs
- C. Carbon and energy
- D. ATP

### Logistical Problem

107. 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
- B. VFAs
- C. Carbon and energy
- D. ATP

### Adenosine Triphosphate (ATP) Energy

108. 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
- B. VFAs
- C. Carbon and energy
- D. ATP

### Chemical Precipitation of Phosphorus

109. 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

### Tertiary Filtration

110. 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

111. 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

112. PAOs have the ability to store a large mass of \_\_\_\_\_ in their cells in the form of polyphosphates.

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

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

113. 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
- B. A nitrate rich stream
- C. An anoxic zone
- D. An aerobic stage

### Johannesburg (JHB), Modified Johannesburg and Westbank

114. 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
- B. Pre-anoxic zone
- C. An anoxic zone
- D. An aerobic stage

### Nitrification and Nutrient Removal Sub-Section

115. Nitrosomonas europaea, which oxidizes ammonia to nitrite, and Nitrobacter winogradskyi, which oxidizes nitrite to nitrate.

- A. True
- B. False

116. Nitrifying bacteria exists in low numbers in lagoons, they prefer attached growth systems and/or?

- A. Nitrifying bacteria
- B. Low MLSS sludge systems
- C. High MLSS sludge systems
- D. None of the Above

117. Complete nitrification would be expected at pond pH values between pH 7.0 and 8.5.

- A. 7.5 and 9.5
- B. 7.0 and 8.5
- C. 6.0 and 7.5
- D. None of the Above

118. Nitrification ceases at pH values above pH \_\_\_\_\_ and declines markedly at pH values below \_\_\_\_\_.

- A. 9 and 6
- B. 8 and 5
- C. 9 and 7
- D. None of the Above

119. Nitrification, however, is not a major pathway for nitrogen removal in lagoons. Nitrifying bacteria exists in low numbers in lagoons. They prefer \_\_\_\_\_ and/or high MLSS sludge systems.

- A. Nitrifying bacteria
- B. Low MLSS sludge systems
- C. Attached growth systems
- D. None of the Above

### Anaerobic Bacteria

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

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

121. Anaerobic methane formation involves \_\_\_\_\_ bacteria.

- A. Three different groups of anaerobic
- B. Methane fermentation
- C. Organic overloading conditions
- D. None of the Above



122. 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
- B. Methane forming bacteria
- C. General anaerobic degraders
- D. None of the Above

### Photosynthetic Organisms

123. 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

### Methane Forming Bacteria

124. 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

### Nutrient Constituents and Measurement Methods

**The TKN method has three major steps:**

125. Digestion to convert organic nitrogen to?

- A. Ammonium sulfate
- B. Organic nitrogen
- C. Dissolved, biodegradable compounds
- D. None of the Above

126. 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
- B. Inorganic nitrogen
- C. Aliphatic N compounds
- D. None of the Above

127. 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
- B. Nitrites
- C. Aliphatic N compounds
- D. None of the Above

128. Which of the following terms may be released in secondary treatment by microorganisms either through metabolism or upon death and lysis?

- A. TKN
- B. Organic nitrogen
- C. Aliphatic N compounds
- D. None of the Above

129. Conversion of which term into condensed ammonia gas through addition of a strong base and boiling?

- A. Ammonia gas
- B. Ammonium sulfate
- C. Ammonia-nitrogen concentration
- D. None of the Above

130. Measuring the concentration includes ammonia, with this term being subtracted from the TKN to determine organic nitrogen.

- A. Ammonia gas
- B. Ammonium sulfate
- C. Ammonia-nitrogen concentration
- D. None of the Above

131. Nitrogen components in wastewater are typically reported on an “\_\_\_\_\_” basis?  
A. As Nitrite                      C. As nitrogen  
B. As Nitrate                      D. None of the Above

132. 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

133. 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

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

### **Topic 6- Wastewater Microbiology Section**

#### **Bacteria Section**

135. 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

136. 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

#### **Peritrichous Bacteria**

137. 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

138. 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

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

#### **Fecal Coliform Bacteria**

140. 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

141. 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**

142. According to the text, filamentous Bacteria function similar to \_\_\_\_\_ since they degrade BOD quite well.

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

### **Site Specific Bacteria**

143. 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**

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

- A. True
- B. False

### **Anaerobic Bacteria**

145. 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
- B. Anaerobic bacteria
- C. Facultative bacteria
- D. None of the Above

### **Aerobic Bacteria**

146. The metabolism of aerobes is much higher than?

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

### **Protozoans and Metazoans**

147. 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
- B. Macroinvertebrates
- C. Protozoans and metazoans
- D. None of the Above

### **Dispersed Growth**

148. 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

149. 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
- B. Dispersed growth
- C. Bulking sludge
- D. None of the Above

### **Activated Sludge Bugs**

150. In the Activated Sludge process, the \_\_\_\_\_ are also called waste activated sludge.

- A. Organisms
- B. Settled bugs
- C. Mixed liquor
- D. None of the Above



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

160. Which of the following terms' content in clarified effluent, which may be due to too high or too low solids retention time and to growth of filamentous microorganisms?

- A. Organic material
- B. High solids
- C. Biomass health and effluent quality
- D. None of the Above

161. 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
- B. Organic material
- C. Bulking sludge
- D. None of the Above

**Filamentous Organisms**

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

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

**Filamentous Bacteria Identification**

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

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

164. *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***

165. *Microthrix parvicella* is another common cause of?

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

***Sphaeroliticus natans***

166. Which of the following terms requires high levels of oxygen are necessary?

- A. Stain gram-negative
- B. A strict aerobe
- C. Slower growing filaments
- D. None of the Above

**Filamentous Bacteria**

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

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

**Water Quality Criteria**

168. 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

### Human Health Criteria

169. 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

170. Allowable concentrations provide protection for plants and animals that are found in surface waters.  
A. True B. False

### Biological Criteria

171. 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
172. 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

### Pollutants in the Sediment

173. Controlling the concentration of pollutants in the sediment helps to protect bottom dwelling species and prevents harmful toxins from moving up the food chain and accumulating in the tissue of animals at progressively higher levels.  
A. True B. False

### Genera

174. 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. Mass of biomat

### Topic 8- Laboratory Analysis/ Process Control Section

#### pH Testing Section

175. When an atom loses \_\_\_\_\_ and thus has more protons than electrons, the atom is a positively-charged ion or cation.  
A. A proton C. An electron  
B. Charge D. None of the Above
176. Measurement of pH for aqueous solutions can be done with a glass electrode and a pH meter, or using indicators like strip test paper.  
A. True B. False
177. In chemistry, pH is a measure of the acidity or basicity of an aqueous solution. Solutions with a pH greater than 7 are said to be acidic and solutions with a pH less than 7 are basic or alkaline.  
A. True B. False

178. Pure water has a pH very close to?

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

179. pH is defined as the decimal logarithm of the reciprocal of the \_\_\_\_\_,  $a_{H^+}$ , in a solution.

- A. Hydrogen ion activity      C. Brønsted–Lowry acid–base theory
- B. Acid-base behavior      D. None of the Above

180. Which of the following terms may be used to measure pH, by making use of the fact that their color changes with pH?

- A. Indicators      C. A set of non-linear simultaneous equations
- B. Spectrophotometer      D. None of the Above

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

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

182. Since pH is a logarithmic scale, a difference of one pH unit is equivalent to \_\_\_\_\_ difference in hydrogen ion concentration.

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

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

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

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

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

### **Dissolved Oxygen Testing Section**

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

- A. True    B. False

186. Aerobes decompose inorganics in the water; the result is carbon dioxide and H<sub>2</sub>SO<sub>4</sub>.

- A. True    B. False

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

- A. True    B. False

188. 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

**Iodometric Test**

189. According to the text, membrane electrodes provide an excellent method for \_\_\_\_\_ in polluted, highly colored turbid waters and strong waste effluents.

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

190. Proper samples must be taken in \_\_\_\_\_ bottles where agitation or contact with air is at a minimum.

- A. BOD
- B. DO analysis
- C. MLSS measurement
- D. None of the Above

**Total Dissolved Solids**

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

- A. Total Solids
- B. TDS
- C. Corrosiveness
- D. Alkalinity

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

- A. Total Solids
- B. TDS
- C. Total Suspended solids
- D. Dissolved solids

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

- A. Settleability
- B. Total dissolved solids (TDS)
- C. Quality of the water
- D. Total Solids

**Total Solids**

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

- A. Total Solids
- B. TDS
- C. Corrosiveness
- D. Alkalinity

195. 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
- B. TDS
- C. Total Suspended solids
- D. Alkalinity

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

- A. Total Solids
- B. TDS
- C. Corrosiveness
- D. Alkalinity

197. 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
- B. TDS
- C. Total Suspended solids
- D. Alkalinity



**Total Suspended Solids (TSS)**

198. 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
- B. High TSS
- C. Total Suspended solids
- D. Alkalinity

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

- A. Total Solids
- B. TDS
- C. Total Suspended solids
- D. Alkalinity

200. Which of the following wastewater terms can block light from reaching submerged vegetation?

- A. Oxygen
- B. High TSS
- C. Settling sediments
- D. Suspended sediment