

**Registration form**

**SAFE DRINKING WATER ACT \$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** \_\_\_\_\_

**Email** \_\_\_\_\_ **Fax ( )** \_\_\_\_\_

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

**Operator ID #** \_\_\_\_\_ **Exp. Date** \_\_\_\_\_

**Class/Grade** \_\_\_\_\_

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

Water Treatment \_\_\_ Water Distribution \_\_\_ Other \_\_\_\_\_

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

If you've paid on the Internet, please write your Customer# \_\_\_\_\_

Please invoice me, my PO# \_\_\_\_\_

**Please pay with your credit card on our website under Bookstore or Buy Now. Or call us and provide your credit card information.**

***We will stop mailing the certificate of completion so we need either your fax number or e-mail address. We will e-mail the certificate to you, if no e-mail address; we will fax it to you.***

## **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 also understand that this type of study program deals with dangerous conditions and that I will not hold Technical Learning College, Technical Learning Consultants, Inc. (TLC) liable for any errors or omissions or advice contained in this CEU education training course or for any violation or injury or neglect or damage caused by this CEU education training or course material suggestion or error. I will 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.

**State Approval Listing Link**, check to see if your State 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.

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

<http://www.abctlc.com/downloads/PDF/CEU%20State%20Approvals.pdf>

**Do not solely depend on TLC's Approval list for it may be outdated.**

**Some States and many employers require the final exam to be proctored.**

<http://www.abctlc.com/downloads/PDF/PROCTORFORM.pdf>

**All downloads are electronically tracked and monitored for security purposes.**

*You can obtain a printed version of the course manual from TLC for an additional \$99.95 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.

## **Rush Grading Service**

If you need this assignment graded and the results mailed to you within a 48-hour period, prepare to pay an additional rush service handling fee of \$50.00. This fee may not cover postage costs. If you need this service, simply write RUSH on the top of your Registration Form. We will place you in the front of the grading and processing line.

For security purposes, please fax or e-mail a copy of your driver's license and always call us to confirm we've received your assignment and to confirm your identity.

# 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

**SDWA Answer Key** Name \_\_\_\_\_

Phone \_\_\_\_\_

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

**You are responsible 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 can electronically complete this assignment in Adobe Acrobat DC.***

Please Circle, Bold, Underline or X, one answer per question. A **felt tipped pen** works best.

- |             |             |             |             |
|-------------|-------------|-------------|-------------|
| 1. A B C D  | 20. A B C D | 39. A B C D | 58. A B C D |
| 2. A B C D  | 21. A B C D | 40. A B C D | 59. A B C D |
| 3. A B C D  | 22. A B C D | 41. A B C D | 60. A B     |
| 4. A B C D  | 23. A B C D | 42. A B C D | 61. A B     |
| 5. A B C D  | 24. A B C D | 43. A B C D | 62. A B     |
| 6. A B C D  | 25. A B C D | 44. A B C D | 63. A B     |
| 7. A B C D  | 26. A B C D | 45. A B C D | 64. A B     |
| 8. A B C D  | 27. A B C D | 46. A B C D | 65. A B     |
| 9. A B C D  | 28. A B C D | 47. A B C D | 66. A B     |
| 10. A B C D | 29. A B C D | 48. A B C D | 67. A B     |
| 11. A B C D | 30. A B C D | 49. A B C D | 68. A B     |
| 12. A B C D | 31. A B C D | 50. A B C D | 69. A B C D |
| 13. A B C D | 32. A B C D | 51. A B C D | 70. A B C D |
| 14. A B C D | 33. A B C D | 52. A B C D | 71. A B C D |
| 15. A B C D | 34. A B C D | 53. A B C D | 72. A B C D |
| 16. A B C D | 35. A B C D | 54. A B C D | 73. A B C D |
| 17. A B C D | 36. A B C D | 55. A B C D | 74. A B C D |
| 18. A B C D | 37. A B C D | 56. A B C D | 75. A B C D |
| 19. A B C D | 38. A B C D | 57. A B C D | 76. A B C D |

77. A B C D  
78. A B C D  
79. A B C D  
80. A B C D  
81. A B C D  
82. A B C D  
83. A B  
84. A B  
85. A B  
86. A B  
87. A B C D  
88. A B C D  
89. A B C D  
90. A B C D  
91. A B C D  
92. A B C D  
93. A B C D  
94. A B  
95. A B  
96. A B  
97. A B  
98. A B  
99. A B  
100. A B C D  
101. A B  
102. A B C D  
103. A B  
104. A B C D  
105. A B C D  
106. A B  
107. A B

108. A B  
109. A B C D  
110. A B C D  
111. A B C D  
112. A B  
113. A B  
114. A B C D  
115. A B C D  
116. A B  
117. A B  
118. A B C D  
119. A B C D  
120. A B C D  
121. A B C D  
122. A B C D  
123. A B C D  
124. A B C D  
125. A B C D  
126. A B C D  
127. A B C D  
128. A B C D  
129. A B C D  
130. A B C D  
131. A B  
132. A B C D  
133. A B C D  
134. A B  
135. A B  
136. A B  
137. A B C D  
138. A B

139. A B C D  
140. A B  
141. A B  
142. A B C D  
143. A B C D  
144. A B C D  
145. A B  
146. A B  
147. A B  
148. A B  
149. A B C D  
150. A B C D  
151. A B C D  
152. A B C D  
153. A B C D  
154. A B C D  
155. A B  
156. A B C D  
157. A B C D  
158. A B C D  
159. A B C D  
160. A B C D  
161. A B C D  
162. A B C D  
163. A B C D  
164. A B C D  
165. A B  
166. A B C D  
167. A B C D  
168. A B C D  
169. A B C D

170. A B C D  
171. A B C D  
172. A B  
173. A B C D  
174. A B C D  
175. A B C D  
176. A B C D  
177. A B C D  
178. A B C D  
179. A B C D  
180. A B C D  
181. A B C D  
182. A B  
183. A B C D  
184. A B C D  
185. A B C D  
186. A B C D  
187. A B C D  
188. A B C D  
189. A B C D  
190. A B  
191. A B C D  
192. A B C D  
193. A B C D  
194. A B C D  
195. A B C D  
196. A B C D  
197. A B C D  
198. A B C D  
199. A B C D  
200. A B C D

***Please write down any questions you were not able to find the answers or that have errors.***

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

Always call us after faxing the paperwork to ensure that we've received it.

**Rush Grading Service**

If you need this assignment graded and the results mailed to you within a 48-hour period, prepare to pay an additional rush service handling fee of \$50.00.

*This course contains general EPA's SDWA federal rule requirements. Please be aware that each state implements water / sampling procedures/ safety / environmental / SDWA regulations that may be more stringent than EPA's regulations. Check with your state environmental/health agency for more information. These rules change frequently and are often difficult to interpret and follow. Be careful to be in compliance with your regulatory agencies and do not follow this course for any compliance concerns.*

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

**SDWA CEU 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?

---

---

Any other concerns or comments.

---

---





## Safe Drinking Water Act CEU Training Course Assignment

The Safe Drinking Water Act CEU course 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 e-mail it back to TLC.

You will have 90 days from receipt of this manual to complete it in order to receive your Professional Development Hours (PDHs) or Continuing Education Unit (CEU). A score of 70 % or better is necessary to pass this course. If you should need any assistance, please email or fax all concerns and the completed ANSWER KEY to [info@tlch2o.com](mailto:info@tlch2o.com).

Select one answer per question. Please utilize the answer key. (s) on the answer will indicate either plural and singular tenses.

### Hyperlink to the Glossary and Appendix

<http://www.abctlc.com/downloads/PDF/WTGlossary.pdf>

### Water Quality Key Words

1. Which of the following substances has been processed to make it extremely porous and thus to have a very large surface area available for adsorption or chemical reactions?

- A. Activated alumina
- B. Activated carbon
- C. Dissolved organic carbon
- D. None of the above

2. The "dissolved" fraction of which compound is an operational classification?

- A. Activated alumina
- B. Activated carbon
- C. Organic carbon
- D. None of the above

### Three Types of Public Water Systems

3. Approximately 52,000 systems serving the majority of the U.S. population

- A. TNCWS
- B. CWSs
- C. NTNCWSs
- D. None of the above

4. Provides water to the same people at least six months a year, but not all year (for example: schools, factories, churches, office buildings that have their own water system)

- A. TNCWS
- B. CWSs
- C. NTNCWSs
- D. None of the above

5. Provides water to the same population year-round for example: homes, apartment buildings.

- A. TNCWS
- B. CWSs
- C. NTNCWSs
- D. None of the above

6. Approximately 85,000 systems

- A. TNCWS
- B. CWSs
- C. NTNCWSs
- D. None of the above

7. Provides water where people do not remain for long periods of time for example: gas stations, campgrounds.

- A. TNCWS
- B. CWSs
- C. NTNCWSs
- D. None of the above

8. Approximately 18,000 water systems  
 A. TNCWS C. NTNCWSs  
 B. CWSs D. None of the above

**Water Quality Section**

**Surface (Raw) Water Introduction**

9. \_\_\_\_\_ enhancement and formation of policy measures (administrative and engineering) revolves around most effective types of treatment methods and/or chemicals.  
 A. Universal solvent C. Surface water  
 B. Water quality D. None of the above
10. Operators need to appropriately treat surface water is never pure of \_\_\_\_\_, it. Most of the earth's water sources obtain their water supplies through precipitation.  
 A. Excess nutrients C. Pollution  
 B. Biological actions D. None of the above
11. Water passes runoffs and infiltrates the ground during precipitation; this runoff acquires a wide variety of \_\_\_\_\_ that intensely alters its usefulness.  
 A. Excess nutrients C. Dissolved or suspended impurities  
 B. Biological actions D. None of the above

**Surface Water Properties**

12. Runoff could produce mud, leaves, decayed vegetation, and human and animal refuse. The discharge from industry could increase \_\_\_\_\_. Some lakes and reservoirs may experience seasonal turnover.  
 A. Volatile organic compounds C. Excess nutrients  
 B. Water quality D. None of the above
13. Adjustments in the dissolved oxygen, algae, temperature, suspended solids, turbidity, and carbon dioxide will change because of \_\_\_\_\_.  
 A. Excess nutrients C. Discharge  
 B. Biological actions D. None of the above
14. Water is accepted as the \_\_\_\_\_ because will dissolve most substances that comes in contact.  
 A. Universal solvent C. Surface water  
 B. Water quality D. None of the above
15. Depending on the region, some lakes and rivers receive \_\_\_\_\_ from sewer facilities or defective septic tanks.  
 A. Excess nutrients C. Discharge  
 B. Biological actions D. None of the above

**Managing Water Quality at the Source**

16. Contingent upon the region, source water may have several restrictions of use as part of a Water Shed Management Plan. In some areas, it may be restricted from recreational use, discharge or runoff from agriculture, or \_\_\_\_\_.  
 A. Excess nutrients C. Industrial and wastewater discharge  
 B. Biological actions D. None of the above

(S) Means the answer can be plural or singular in nature

17. Contingent upon federal regulations and the amount of copper found natural in water, operators have used \_\_\_\_\_, powdered activated carbon and chlorine to control algae blooms.

- A. pH and alkalinity
- B. Metals, and non-metals
- C. Potassium permanganate
- D. None of the above

18. The \_\_\_\_\_ of the water will govern how these chemicals will react.

- A. pH and alkalinity
- B. Metals, and non-metals
- C. Powdered activated carbon and chlorine
- D. None of the above

### Physical Characteristics of Water

19. pH is the negative logarithm of the hydrogen ion concentration,  $[H^+]$ , a measure of the degree to which a solution is \_\_\_\_\_.

- A. Alkalinity
- B. Acidic or alkaline
- C. Hydrogen ion ( $H^+$ )
- D. None of the above

20. Physical characteristics are the elements found that are considered alkali, metals, and non-metals such as carbonates, fluoride, \_\_\_\_\_. The consumer relates it to scaling of faucets or staining.

- A. pH and alkalinity
- B. Sulfides or acids
- C. Powdered activated carbon and chlorine
- D. None of the above

21. Total Dissolved Solids (TDS) is not a primary pollutant; it is a gauge of appealing water characteristics such as hardness and an indication of an assortment of chemical contaminants that might be present, such as?

- A. Turbidity
- B. Colloids
- C. Arsenic
- D. None of the above

22. \_\_\_\_\_ is a substance that can give up a hydrogen ion ( $H^+$ ); a base is a substance that can accept  $H^+$ .

- A. Acid
- B. Base
- C. Acidic or alkaline
- D. None of the above

23. The more acidic a solution the greater the hydrogen ion concentration and the lower the pH; a pH of 7.0 indicates neutrality, a pH of less than 7 indicates acidity, and a pH of more than 7 indicates \_\_\_\_\_.

- A. Acid
- B. Base
- C. Alkalinity
- D. None of the above

### Alkalinity

24. Alkalinity is a measure of \_\_\_\_\_ and can be interpreted in terms of specific substances only when the chemical composition of the sample is known.

- A. Hydrogen ion ( $H^+$ )
- B. Alkaline earth metal
- C. An aggregate property of water
- D. None of the above

25 \_\_\_\_\_ with an overabundance of alkaline earth metal concentrations is significant in determining the suitability of water for irrigation.

- A. Alkalinity
- B. Acid
- C. Hydrogen ion ( $H^+$ )
- D. None of the above

### **Turbidity Introduction**

26. One physical feature of water is turbidity. A measure of the cloudiness of water caused by \_\_\_\_\_. The cloudy appearance of water caused by the presence of tiny particles.

- A. Suspended particles
- B. Variations
- C. Temperature fluctuation
- D. None of the above

27. The turbidity in natural surface waters is composed of a large number of sizes of particles. The sizes of particles can be changing constantly, depending on precipitation and \_\_\_\_\_ factors.

- A. MCL
- B. Manmade
- C. Temperature
- D. None of the above

28. Generally, higher turbidity levels require higher coagulant dosages. However, seldom is the relationship between turbidity level and \_\_\_\_\_ linear.

- A. Coagulant dosage
- B. Total Dissolved Solids (TDS)
- C. Temperature
- D. None of the above

29. Usually, the extra coagulant required is relatively small when turbidities are much higher than normal due to higher collision probabilities of the \_\_\_\_\_ during high turbidities.

- A. Turbidity
- B. Colloids
- C. Total Dissolved Solids (TDS)
- D. None of the above

30. Low \_\_\_\_\_ waters can be very difficult to coagulate due to the difficulty in inducing collision between the colloids.

- A. Turbidity
- B. Colloids
- C. Total Dissolved Solids (TDS)
- D. None of the above

31. \_\_\_\_\_ may be existing in a water supply due to pollution, and these colloids can be difficult to remove in the coagulation process. In this situation, higher coagulant dosages are generally required.

- A. Turbidity
- B. Organic colloids
- C. Total Dissolved Solids (TDS)
- D. None of the above

### **Turbidity MCL**

32. An MCL for turbidity established by the EPA because \_\_\_\_\_ interferes with disinfection. This characteristic of water changes the most rapidly after a heavy rainfall.

- A. Conductivity
- B. Turbidity
- C. Temperature
- D. None of the above

33. The temperature variation of a sample, a scratched or unclean sample tube in the nephelometer and selecting an incorrect wavelength of a light path may be conditions caused by an inaccurate \_\_\_\_\_ measurement.

- A. Conductivity
- B. Turbidity
- C. Temperature
- D. None of the above

### **Dissolved Oxygen**

34. The level of dissolved oxygen in natural waters is often a direct indication of quality, since aquatic plants produce oxygen, while microorganisms generally consume it as they feed on \_\_\_\_\_.

- A. Pollutants
- B. Organic matter
- C. E. coli bacteria
- D. None of the above

35. At low temperatures, the \_\_\_\_\_ is increased, so that in winter, concentrations as high as 20 ppm may be found in natural waters; during summer, saturation levels can be as low as 4 or 5 ppm.

- A. Dissolved oxygen
- B. Thermal stratification
- C. Solubility of oxygen
- D. None of the above

36. \_\_\_\_\_ is essential for the support of fish and other aquatic life and aids in the natural decomposition of organic matter.

- A. Dissolved oxygen
- B. Thermal stratification
- C. Solubility of oxygen
- D. None of the above

37. Thermal stratification is possible as water becomes less dense when heated; meaning water weighs less per unit volume. Therefore, warmer water will be lighter and colder water will be heavier. Due to this, there will always be a level of “self-induced” \_\_\_\_\_ in a water storage.

- A. Saturation level(s)
- B. Thermal stratification
- C. Permanent hardness
- D. None of the above

### Objections to Hard Water- Scale Formation

38. Hard water forms scale, usually \_\_\_\_\_, which causes a variety of problems. Left to dry on the surface of glassware and plumbing fixtures, including showers doors, faucets, and sink tops; hard water leaves unsightly white scale known as water spots.

- A. Magnesium carbonate
- B. Calcium carbonate
- C. Calcite
- D. None of the above

### Secondary Standard

39. TDS is most often measured in parts per million (ppm) or milligrams per liter of water (mg/L). The normal TDS level ranges from \_\_\_\_\_

- A. 50 ppm to 1,000 ppm
- B. 5 ppm to 10 ppm
- C. 50 ppm to 100 ppm
- D. None of the above

### Langelier Saturation Index

40. The Langelier Saturation index (LSI) is an evenness scale derived from the theoretical concept of saturation and provides an indicator of the degree of saturation of water with respect to calcium carbonate. It can be shown that the Langelier saturation index (LSI) approximates the base 10 logarithm of the \_\_\_\_\_ saturation level.

- A. Magnesium carbonate
- B. Calcium carbonate
- C. Calcite
- D. None of the above

41. The Langelier saturation level approaches the concept of saturation using pH as a main variable. The LSI can be interpreted as the pH change required to bring water to \_\_\_\_\_.

- A. Saturation level(s)
- B. Stratification
- C. Equilibrium
- D. None of the above

### More on the Stage 2 DBP Rule

42. Which of the following rules focuses on public health protection by limiting exposure to DBPs, specifically total trihalomethanes and five haloacetic acids, which can form in water through disinfectants used to control microbial pathogens?

- A. Stage 2 DBP rule
- B. Stage 1 DBPR
- C. Long Term 2 Enhanced Surface Water Treatment Rule
- D. None of the above

43. Which of the following is one of the major public health advances in the 20th century?  
 A. Disinfection of drinking water      C. Amendments to the SDWA  
 B. Water distribution                      D. None of the above
44. There are specific microbial pathogens, such as \_\_\_\_\_, which can cause illness, and are highly resistant to traditional disinfection practices.  
 A. Cryptosporidium                      C. Protozoa  
 B. E. coli host culture                      D. None of the above
45. The Stage 1 Disinfectants and Disinfection Byproducts Rule and \_\_\_\_\_, promulgated in December 1998.  
 A. Stage 1 DBPR                      C. Interim Enhanced Surface Water Treatment Rule  
 B. Stage 2 DBPR                      D. None of the above
46. Which of the following rules will reduce potential cancer and reproductive and developmental health risks from disinfection byproducts?  
 A. Stage 1 DBPR                                      C. Long Term 2 Enhanced Surface Water Rule  
 B. Stage 2 DBPR                                      D. None of the above

**What are Disinfection Byproducts (DBPs)?**

47. Which of the following form when disinfectants used to treat drinking water react with naturally occurring materials in the water?  
 A. Chloramines                                      C. Disinfection byproducts (DBPs)  
 B. Humic and fulvic acids                      D. None of the above
48. Total trihalomethanes and haloacetic acids are widely occurring \_\_\_\_\_ formed during disinfection with chlorine and chloramine.  
 A. Gases    C. Classes of DBPs  
 B. Substances                                      D. None of the above

**Disinfection Byproduct Research and Regulations Summary**

49. \_\_\_\_\_ is unquestionably the most important step in the treatment of water for drinking water supplies.  
 A. DBP(s)    C. Disinfection  
 B. Turbidity (particle)                              D. None of the above
50. The \_\_\_\_\_ should not be compromised because of concern over the potential long-term effects of disinfectants and DBPs.  
 A. DBP(s)    C. Microbial quality of drinking water  
 B. Turbidity (particle)                              D. None of the above

**Controlling Disinfection Byproducts**

51. Treatment techniques are available that provide water suppliers the opportunity to maximize potable water safety and quality while minimizing the risk of \_\_\_\_\_.  
 A. DBP risks    C. Disinfectants and DBPs  
 B. Turbidity (particle)                              D. None of the above
52. Generally, the best approach to reduce \_\_\_\_\_ is to remove natural organic matter precursors prior to disinfection.  
 A. DBP(s)    C. DBP formation  
 B. Turbidity (particle)                              D. None of the above

**The EPA guidance discusses three processes to effectively remove natural organic matter prior to disinfection:**

**Coagulation and Clarification**

53. Most treatment plants optimize their coagulation process for \_\_\_\_\_ removal.  
A. Inorganic coagulants      C. Turbidity (particle)  
B. Most contaminants      D. None of the above
54. Coagulation processes can also be optimized for natural organic matter removal with higher doses of \_\_\_\_\_ (such as alum or iron salts), and optimization of pH.  
A. THMs and HAAs      C. Natural organic matter  
B. Inorganic coagulants      D. None of the above

**Contaminants that may be present in sources of drinking water include:**

55. Which of the following like salts and metals, which can be naturally occurring or result from urban stormwater runoff, industrial or domestic wastewater discharges, oil and gas production, mining or farming?  
A. Radioactive contaminants      C. Inorganic contaminants  
B. Pesticides and herbicides      D. Microbial contaminants
56. Which of the following may come from a variety of sources such as agriculture, urban stormwater run-off, and residential uses?  
A. Radioactive contaminants      C. Inorganic contaminants  
B. Pesticides and herbicides      D. Microbial contaminants
57. Which of the following, such as viruses and bacteria, which may come from sewage treatment plants, septic systems, agricultural livestock operations and wildlife?  
A. Microbial contaminants      C. Inorganic contaminants  
B. Pesticides and herbicides      D. Microbial contaminants
58. Which of the following can be synthetic and volatile organic chemicals, which are by-products of industrial processes and petroleum production, and can come from gas stations, urban stormwater run-off, and septic systems?  
A. Organic chemical contaminants      C. Inorganic contaminants  
B. Pesticides and herbicides      D. Microbial contaminants
59. Which of the following can be naturally occurring or be the result of oil and gas production and mining activities?  
A. Radioactive contaminants      C. Inorganic contaminants  
B. Pesticides and herbicides      D. Microbial contaminants

**TCR**

60. The TCR recommends most of the Public Water Systems (PWS) to monitor their distribution system for bacteria according to the written sample sitting plan for that system.  
A. True      B. False
61. The sample sitting plan identifies sampling frequency and locations throughout the distribution system that are selected to be representative of conditions in the entire system.  
A. True      B. False
62. Coliform contamination may occur anywhere in the system, possibly due to problems such as; high pressure conditions, line fluctuations, or wells, and therefore routine monitoring is required.  
A. True      B. False

### **Routine Sampling Requirements**

63. Total coliform samples must be collected by PWSs at sites that are representative of water quality throughout the distribution system according to a written sample siting plan subject to state review and revision.

- A. True      B. False

64. For PWSs collecting more than one sample per month, collect total coliform samples at regular intervals throughout the month, except that ground water systems serving 4,900 or fewer people may collect all required samples on a single day if the samples are taken from different sites.

- A. True      B. False

65. Each total coliform-positive (TC+) routine sample must be tested for the presence of heterotrophic bacteria.

- A. True      B. False

66. If any TC+ sample is also E. coli-positive (EC+), then the EC+ sample result must be reported to the state by the end of the month that the PWS is notified.

- A. True      B. False

67. If any routine sample is TC+, repeat samples are required. – PWSs on quarterly or annual monitoring must take a minimum of one additional routine samples (known as additional routine monitoring) the quarter following a TC+ routine or repeat sample.

- A. True      B. False

68. Reduced monitoring is general available for PWSs using only surface water and serving 1,000 or fewer persons that meet certain additional PWS criteria.

- A. True      B. False

### **Dangerous Waterborne Microbes**

69. Which of the following is a parasite that enters lakes and rivers through sewage and animal waste. It causes cryptosporidiosis, a mild gastrointestinal disease. The disease can be severe or fatal for people with severely weakened immune systems.

- A. Coliform Bacteria    C. Giardia lamblia  
B. Cryptosporidium    D. None of the above

70. Which of the following are not necessarily agents of disease, fecal coliform bacteria may indicate the presence of disease-carrying organisms, which live in the same environment as the fecal coliform bacteria.

- A. Fecal coliform bacteria    C. Shigella dysenteriae  
B. Cryptosporidium          D. None of the above

71. Which of the following is a parasite that enters lakes and rivers through sewage and animal waste. It causes gastrointestinal illness (e.g. diarrhea, vomiting, and cramps)?

- A. Coliform Bacteria    C. Protozoa  
B. Cryptosporidium    D. None of the above

72. Which of the following is a species of the rod-shaped bacterial genus Shigella?

- A. Fecal coliform bacteria    C. Shigella dysenteriae  
B. Cryptosporidium          D. None of the above

(S) Means the answer can be plural or singular in nature



73. Which of the following can cause bacillary dysentery?

- A. Fecal coliform bacteria
- B. Cryptosporidium
- C. Shigella
- D. None of the above

74. Which of the following are Gram-negative, non-spore-forming, facultatively anaerobic, non-motile bacteria.

- A. Fecal coliform bacteria
- B. Cryptosporidium
- C. Shigellae
- D. None of the above

75. Which of the following are bacteria whose presence indicates that the water may be contaminated with human or animal wastes? Microbes in these wastes can cause short-term effects, such as diarrhea, cramps, nausea, headaches, or other symptoms.

- A. Fecal Coliform and E. coli
- B. Cryptosporidium
- C. Shigella dysenteriae
- D. None of the above

76. Which of the following are microscopic organisms that live in the intestines of warm-blooded animals? They also 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 fecal matter from one source or another.

- A. Fecal coliform bacteria
- B. Cryptosporidium
- C. Shigella dysenteriae
- D. None of the above

77. Which of the following are common in the environment and are generally not harmful? However, the presence of these bacteria in drinking water are usually a result of a problem with the treatment system or the pipes which distribute water, and indicates that the water may be contaminated with germs that can cause disease.

- A. Coliform Bacteria
- B. Cryptosporidium
- C. Giardia lamblia
- D. None of the above

### **Bacteriological Monitoring Introduction**

78. Which of the following are usually harmless, occur in high densities in their natural environment and are easily cultured in relatively simple bacteriological media?

- A. Indicator bacteria
- B. Amoebas
- C. Viruses
- D. None of the above

79. Indicators in common use today for routine monitoring of drinking water include total coliforms, fecal coliforms, and?

- A. Cryptosporidium
- B. Protozoa
- C. Escherichia coli (E. coli)
- D. None of the above

80. According to the text, the routine microbiological analysis of your water is for?

- A. Contamination
- B. Colloids
- C. Coliform bacteria
- D. None of the above

### **Bacteria Sampling**

81. Water samples for \_\_\_\_\_ must always be collected in a sterile container.

- A. Amoebas
- B. Bacteria tests
- C. Viruses
- D. None of the above

## Methods

82. The MMO-MUG test, a product marketed as \_\_\_\_\_, is the most common. The sample results will be reported by the laboratories as simply coliforms present or absent.
- A. Colilert                      C. Total coliform analysis  
B. Coliform                      D. None of the above

## Microbial Regulations

83. One of the key regulations developed and implemented by the United States Environmental Protection Agency (USEPA) to counter pathogens in drinking water is the Surface Water Treatment Rule.
- A. True                      B. False
84. Among Surface Water Treatment Rule provisions, the rule requires that a public water system, using surface water (or ground water under the direct influence of surface water) as its source, have sufficient treatment to reduce the source water concentration of protozoa and coliform bacteria by at least 99.9% and 99.99%, respectively.
- A. True                      B. False
85. The Surface Water Treatment Rule suggests treatment criteria to assure that these performance recommendations are met; they may include turbidity limits, disinfectant residual and disinfectant contact time conditions.
- A. True                      B. False

## Basic Types of Water Samples

86. It is important to properly identify the type of sample you are collecting.
- A. True                      B. False

## The three (3) types of samples are:

87. Samples collected following a coliform present routine sample. The number of repeat samples to be collected is based on the number of \_\_\_\_\_ samples you normally collect.
- A. Repeat      C. Routine  
B. Special      D. None of the above
88. A PWS fails to take every required repeat sample after any single TC+ sample
- A. Trigger: Level 1 Assessment      C. All of the above  
B. Trigger: Level 2 Assessment      D. None of the above
89. A PWS incurs an E. coli MCL violation.
- A. Trigger: Level 1 Assessment      C. All of the above  
B. Trigger: Level 2 Assessment      D. None of the above
90. A PWS collecting at least 40 samples per month has greater than 5.0 percent of the routine/repeat samples in the same month that are TC+.
- A. Trigger: Level 1 Assessment      C. All of the above  
B. Trigger: Level 2 Assessment      D. None of the above
91. A PWS has a second Level 1 Assessment within a rolling 12-month period.
- A. Trigger: Level 1 Assessment      C. All of the above  
B. Trigger: Level 2 Assessment      D. None of the above

(S) Means the answer can be plural or singular in nature

92. A PWS on state-approved annual monitoring has a Level 1 Assessment trigger in 2 consecutive years.

- A. Trigger: Level 1 Assessment
- B. Trigger: Level 2 Assessment
- C. All of the above
- D. None of the above

93. A PWS collecting fewer than 40 samples per month has 2 or more TC+ routine/ repeat samples in the same month.

- A. Trigger: Level 1 Assessment
- B. Trigger: Level 2 Assessment
- C. All of the above
- D. None of the above

94. Noncommunity and nontransient noncommunity public water systems will sample at the same frequency as a like sized community public water system if:

1. It has more than 1,000 daily population and has ground water as a source, or
2. It serves 25 or more daily population and utilizes surface water as a source or ground water under the direct influence of surface water as its source.

- A. True
- B. False

95. Noncommunity and nontransient, noncommunity water systems with less than 10,000 daily population and groundwater as a source will sample on an annual basis.

- A. True
- B. False

### **Maximum Contaminant Levels (MCLs)**

96. State and federal laws establish standards for drinking water quality. Under normal circumstances when these standards are being met, the water is safe to drink with no threat to human health. These standards are known as maximum contaminant levels (MCL). When a particular contaminant exceeds its MCL a potential health threat may occur.

- A. True
- B. False

97. The MCLs are based on extensive research on toxicological properties of the contaminants, risk assessments and factors, short-term (acute) exposure, and long-term (chronic) exposure. You conduct the monitoring to make sure your water is in compliance with the MCL.

- A. True
- B. False

98. There are two types of MCL violations for coliform bacteria. The first is for total coliform; the second is an acute risk to health violation characterized by the confirmed presence of fecal coliform or E. coli.

- A. True
- B. False

### **Positive or Coliform Present Results**

99. If you are notified of a positive coliform test result you need to contact either the Drinking Water Program or your local county health department within 72 hours, or by the next business day after the MCL compliance violation

- A. True
- B. False

100. With a positive total coliform sample, contact an agency for assistance, you will be instructed as to the proper repeat sampling procedures and possible corrective measures for solving the problem. It is very important to initiate the \_\_\_\_\_ as the corrective measures will be based on those results.

- A. Perform routine procedures
- B. Repeat sampling immediately
- C. Corrective measures
- D. None of the above

### **Heterotrophic Plate Count HPC**

101. Heterotrophic Plate Count (HPC) --- formerly known as the Bac-T plate, is a procedure for estimating the number of live heterotrophic bacteria and measuring changes during water treatment and distribution in water or in swimming pools.

- A. True      B. False

### **Heterotrophic Plate Count (Spread Plate Method)**

102. Which of the following provides a technique to quantify the bacteriological activity of a sample?

- A. Colonies      C. Heterotrophic Plate Count  
B. Agar      D. None of the above

### **Total Coliforms**

103. This MCL is based on the presence of total coliforms, and compliance is on a daily or weekly basis, depending on your water system type and state rule.

- A. True      B. False

104. For systems which collect fewer than \_\_\_\_\_ samples per month, no more than one sample per month may be positive. In other words, the second positive result (repeat or routine) in a month or quarter results in a MCL violation.

- A. 40      C. 200  
B. 100      D. None of the above

### **The following are acute violations:**

105. Which determines a violation of nitrate?

- A. Presence      C. MCLG  
B. MCL      D. None of the above

### **Revised Total Coliform Rule (RTCR) Summary**

106. EPA published the Revised Total Coliform Rule (RTCR) in the Federal Register (FR) on February 13, 2013 (78 FR 10269). It is the revision to the 1989 Total Coliform Rule (TCR).

- A. True      B. False

107. The RTCR upholds the purpose of the 1989 TCR to protect public health by ensuring the duplicity of the drinking water distribution system and monitoring for the absence of microbial contamination.

- A. True      B. False

108. The RTCR establishes criteria for systems to qualify for and stay on for special increased monitoring, which could reduce water system problems for better system operation.

- A. True      B. False

109. The water provider shall develop and follow a sample-siting plan that designates the PWS's collection schedule. This includes location of\_\_\_\_\_.

- A. Routine and repeat water samples      C. Microbial contamination  
B. Reduced monitoring      D. Repeat water samples

110. The water provider shall collect \_\_\_\_\_ on a regular basis (monthly, quarterly, annually). Have samples tested for the presence of total coliforms by a state certified laboratory.

- A. Routine water samples      C. Microbial contamination  
B. Reduced monitoring      D. Repeat water samples

111. PN is required for violations incurred. Within required timeframes, the PWS must use the required health effects language and notify the public if they did not comply with certain requirements of the RTCR. The type of \_\_\_\_\_ depends on the severity of the violation.

- A. CCR(s)
- B. PN
- C. MCL violation
- D. TC+ routine or repeat sample

112. The RTCR requires public water systems that are vulnerable to microbial contamination to identify and fix problems.

- A. True
- B. False

113. The water provider shall collect repeat samples (at least 3) for each TC+ positive routine sample.

- A. True
- B. False

114. For PWSs on quarterly or annual routine sampling, collect additional routine samples (at least 3) in the month after a \_\_\_\_\_.

- A. CCR(s)
- B. PN
- C. Total coliform positive samples
- D. TC+ routine or repeat sample

115. PWSs incur violations if they do not comply with the requirements of the RTCR. The violation types are essentially the same as under the TCR with few changes. The biggest change is no acute or monthly MCL violation for \_\_\_\_\_ only.

- A. CCR(s)
- B. PN
- C. Total coliform positive samples
- D. TC+ routine or repeat sample

116. The RTCR requires public water systems (PWSs) to meet a legal limit for E. coli, as demonstrated by required monitoring.

- A. True
- B. False

117. The RTCR suggests the frequency and timing of required microbial testing based on, public water type and source water type.

- A. True
- B. False

118. Community water systems (CWSs) must use specific language in their CCRs when they must conduct an assessment or if they incur \_\_\_\_\_.

- A. CCR(s)
- B. PN
- C. An E. coli MCL violation
- D. TC+ routine or repeat sample

119. The water provider shall analyze all \_\_\_\_\_ that are total coliform positive (TC+) for E. coli.

- A. Routine or repeat water samples
- B. Reduced monitoring
- C. Microbial contamination
- D. Repeat water samples

### Disinfection Key

120. The RTCR requires 99.99% or 4 log inactivation of \_\_\_\_\_.

- A. Enteric viruses
- B. Crypto
- C. Giardia lamblia cysts
- D. None of the above

121. The RTCR requires 99% or 2 log inactivation of \_\_\_\_\_.

- A. Enteric viruses
- B. Crypto
- C. Giardia lamblia cysts
- D. None of the above

122. The RTCR requires 99.9% or 3 log inactivation of \_\_\_\_\_.

- A. Enteric viruses
- B. Crypto
- C. Giardia lamblia cysts
- D. None of the above

123. The RTCR requires the chlorine residual leaving the plant must be = or \_\_\_\_\_ mg/L and measurable throughout the system.

- A. > 0.2
- B. 2.0
- C. 0.2
- D. None of the above

### **Waterborne Pathogen Section - Introduction Pathogen Section**

124. Most pathogens are generally associated with diseases that \_\_\_\_\_ and affect people in a relatively short amount of time, generally a few days to two weeks.

- A. Cause intestinal illness
- B. Are mild in nature
- C. Will cause fatalities
- D. None of the above

### **How Diseases are Transmitted.**

125. Waterborne pathogens are primarily spread by the?

- A. Fecal-oral, or feces-to-mouth route
- B. Dermal to fecal route
- C. Oral to fecal route
- D. None of the above

### **Protozoan Caused Diseases**

126. Which of the following bugs is larger than bacteria and viruses but still microscopic; they invade and inhabit the gastrointestinal tract?

- A. Hepatitis A
- B. E.coli
- C. Protozoan pathogens
- D. None of the above

127. Some of the parasites enter the environment in a dormant form, with a protective cell wall, called a?

- A. Lamblia
- B. Shell
- C. Cyst
- D. None of the above

### **Giardia lamblia**

128. Which of the following bugs has been responsible for more community-wide outbreaks of disease in the U.S. than any other, and drug treatment are not 100% effective?

- A. Giardia lamblia
- B. Cryptosporidiosis
- C. Giardiasis
- D. None of the above

129. All of these diseases, with the exception of \_\_\_\_\_, have one symptom in common: diarrhea. They also have the same mode of transmission, fecal-oral, whether through person-to-person or animal-to-person contact.

- A. HIV infection
- B. Giardiasis
- C. Hepatitis A
- D. None of the above

### **Primary Waterborne Diseases Section**

130. Humans are the reservoir for the Salmonella typhi pathogen, which causes diarrheal illness, and also known as?

- A. Campylobacter
- B. Shigella dysenteriae
- C. Typhoid fever
- D. None of the above

(S) Means the answer can be plural or singular in nature

131. Shigella species, in the United States two-thirds of the shigellosis in the U.S. is caused by Shigella dysenteriae and the remaining one-third is caused by Shigella Campylobacter.  
A. True      B. False
132. Legionnaire's disease, which causes a severe pneumonia, and the second, \_\_\_\_\_, which is a non-pneumonia illness; it's typically an influenza-like illness, and it's less severe.  
A. Pontiac fever      C. Typhoid fever  
B. Yellow fever      D. None of the above
133. Legionella, prevention. Legionella in water systems. Hot water in tanks should be maintained between \_\_\_\_\_ degrees Centigrade.  
A. 81 to 100      C. 71 and 77  
B. 110 to 210      D. None of the above
134. Campylobacter, the basics. It's a bacterium. It causes diarrheal illness.  
A. True      B. False
135. Campylobacter is primarily associated with poultry, animals, and humans.  
A. True      B. False
136. Vibrio cholerae, the basics. It's a virus. It causes diarrheal illness, also known as cholera. It is typically associated with aquatic environments, shell stocks, and human. Vibrio cholerae has also been associated with ship ballast water.  
A. True      B. False
137. Which of the following is typically associated with soil and water?  
A. Hepatitis A virus      C. Pseudomonas  
B. Legionella      D. None of the above
138. Hepatitis A virus is resistant to combined chlorines, so it is important to have an adequate free chlorine residual. Fecal matter can shield Hepatitis A virus from chlorine.  
A. True      B. False
139. Humans are the reservoir for the Norovirus. Prevention strategies for this pathogen include?  
A. Internal protection      C. Containment protection  
B. Source protection      D. None of the above
140. Cryptosporidium, prevention. Prevention strategies for this pathogen include source protection. A CT value of 50 is required when dealing with fecally accidents. CT equals a concentration, in parts per million, while time equals a contact time in minutes.  
A. True      B. False
141. Cryptosporidium is typically associated with animals and humans, and it can be acquired through consuming fecally contaminated food, contact with fecally contaminated soil and water.  
A. True      B. False
142. Giardia prevention strategies for this pathogen include \_\_\_\_\_; filtration, coagulation, and halogenation of drinking water.  
A. Internal protection      C. Containment protection  
B. Source protection      D. None of the above

143. Schistosomatidae, the basics. It is a parasite. It is acquired through dermal contact, cercarial dermatitis. It is commonly known as?

- A. Swimmer's itch
- B. Beaver fever
- C. Hemorrhagic colitis
- D. None of the above

### **Waterborne Bacterial Diseases**

144. Cholera, Legionellosis, salmonellosis, shigellosis, yersiniosis, are other bacterial diseases that cannot be transmitted through water.

- A. True
- B. False

145. All bacteria in water are readily killed or inactivated with chlorine or other disinfectants.

- A. True
- B. False

146. Campylobacteriosis is the most common diarrheal illness caused by bacteria. Other symptoms include abdominal pain, malaise, fever, nausea and vomiting; and begin three to five days after exposure. The illness is frequently over within two to five days and usually lasts no more than 10 days.

- A. True
- B. False

147. Campylobacteriosis outbreaks have most often been associated with food, especially chicken and un-pasteurized milk, as well as un-chlorinated water. These organisms are also an important cause of "travelers' diarrhea." Medical treatment generally is not prescribed for campylobacteriosis because recovery is usually rapid.

- A. True
- B. False

### **Viruses**

#### **Coronavirus**

148. It looks like the COVID-19 coronavirus is not able to live in water.

- A. True
- B. False

### **Chain of Custody Procedures**

149. If both parties involved in the transfer must sign, date and note the time on the chain of custody record, this is known as?

- A. TC Plan
- B. Sample siting plan
- C. Samples transfer possession
- D. None of the above

150. The recipient will then attach the \_\_\_\_\_ showing the transfer dates and times to the custody sheets. If the samples are split and sent to more than one laboratory, prepare a separate chain of custody record for each sample.

- A. Shipping invoices
- B. Chain of custody release
- C. Sample siting plan
- D. None of the above

### **Factors in Chlorine Disinfection: Concentration and Contact Time**

151. Based on the work of several researchers, CXT values [ final free chlorine concentration (mg/L) multiplied by minimum contact time (minutes)], offer water operators guidance in computing an effective combination of chlorine concentration and \_\_\_\_\_ required to achieve disinfection of water at a given temperature.

- A. Chlorine concentration
- B. Chlorine contact time
- C. Higher strength chlorine solutions
- D. None of the above

(S) Means the answer can be plural or singular in nature



152. The CXT formula demonstrates that if an operator chooses to decrease the chlorine concentration, the required \_\_\_\_\_ must be lengthened.

- A. Chlorine concentration
- B. Temperature
- C. Contact time
- D. None of the above

153. As \_\_\_\_\_ are used, contact times may be reduced.

- A. Chlorine concentration
- B. Temperature
- C. Higher strength chlorine solutions
- D. None of the above

### Water Laboratory Analysis Section

#### pH Testing Section

154. When an atom loses \_\_\_\_\_ and thus has more protons than electrons, the atom is a positively-charged ion or cation.

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

155. 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

156. Pure water has a pH very close to?

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

157. Mathematically, pH is the negative logarithm of the activity of the (solvated) hydronium ion, more often expressed as the measure of the?

- A. Electron concentration
- B. Alkalinity concentration
- C. Hydronium ion concentration
- D. None of the above

158. Which of the following terms for aqueous solutions can be done with a glass electrode and a pH meter, or using indicators?

- A. Primary sampling
- B. Measurement of pH
- C. Determining values
- D. None of the above

159. The pH scale is logarithmic and therefore pH is?

- A. An universal indicator
- B. A dimensionless quantity
- C. An excess of alkaline earth metal concentrations
- D. None of the above

160. Measuring alkalinity is important in determining a stream's ability to neutralize acidic pollution from rainfall or wastewater. It is one of the best measures of the sensitivity of the stream to acid inputs. There can be long-term changes in the \_\_\_\_\_ of rivers and streams in response to human disturbances.

- A. Acid
- B. Alkalinity
- C. pH measurement(s)
- D. None of the above

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

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

(S) Means the answer can be plural or singular in nature

162. 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
163. Alkalinity is the name given to the quantitative capacity of an aqueous solution to neutralize an?
- A. Acid                              C. Bond formation  
B. Base                              D. None of the above
164. Which of the following terms of the color of a test solution with a standard color chart provides a means to measure pH accurate to the nearest whole number?
- A. Universal indicator            C. Visual comparison  
B. Colorwheel measurement    D. None of the above
165. The pH scale is traceable to a set of standard solutions whose pH is established by US EPA.
- A. True                      B. False
166. The calculation of the pH of a solution containing acids and/or bases is an example of a chemical speciation calculation, that is, a mathematical procedure for calculating the concentrations of all chemical species that are present in the solution. The complexity of the procedure depends on the?
- A. Nature of the solution            C. Alkaline earth metal concentrations  
B. pH                              D. None of the above
167. Under normal circumstances this means that the concentration of hydrogen ions in acidic solution can be taken to be equal to the concentration of the acid. The pH is then equal to minus the logarithm of?
- A. The concentration value        C. A set of non-linear simultaneous equations  
B. The pH                            D. None of the above
168. Alkalinity of water is its acid-neutralizing capacity. It is the sum of all the titratable bases. The measured value may vary significantly with the?
- A. End-point pH                    C. pH measurement(s)  
B. Alkalinity                        D. None of the above
169. For strong acids and bases no calculations are necessary except in extreme situations. The pH of a solution containing a weak acid requires the solution of a quadratic equation. The pH of a solution containing a weak base may require the?
- A. Solution of a cubic equation        C. Excess of alkaline earth metal concentrations  
B. Non-linear simultaneous equations    D. None of the above
170. Alkalinity is a measure of this missing term and can be interpreted in terms of specific substances only when the chemical composition of the sample is known.
- A. Universal indicator                      C. Excess of alkaline earth metal concentrations  
B. An aggregate property of water        D. None of the above
171. More precise measurements are possible if the color is measured spectrophotometrically, using a?
- A. Universal indicator                      C. Set of non-linear simultaneous equations  
B. Colorimeter or spectrophotometer    D. None of the above

172. Because the alkalinity of many surface waters is primarily a function of carbonate, bicarbonate, and hydroxide content, it is taken as an indication of the concentration of these constituents.

- A. True      B. False

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

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

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

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

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

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

176. 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

177. 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

178. 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

179. The pH of a solution containing a \_\_\_\_\_ may require the solution of a cubic equation.

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

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

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

### **Alkalinity Sub-Section**

#### **Introduction**

181. Alkalinity of water is its acid-neutralizing capacity. It is the sum of all the \_\_\_\_\_. The measured value may vary significantly with the end-point pH used.

- A. Titratable bases      C. Disinfection by-products  
B. pH and alkalinity      D. None of the above

182. Alkalinity is a measure of an aggregate property of water and can be interpreted in terms of specific substances only when the chemical composition of the sample is known.  
A. True      B. False

### Alkalinity and pH Adjustment

183. Adjusting \_\_\_\_\_ is the most common corrosion control method because it is simple and inexpensive.  
A. End-point pH      C. Disinfection by-products  
B. pH and alkalinity      D. None of the above

184. Alkalinity is a measure of the concentration of hydrogen ions present in water; pH is a measure of water's ability to neutralize acids.  
A. True      B. False

185. Generally, water pH less than \_\_\_\_\_ is associated with uniform corrosion, while pH between 6.5 and 8.0 can be associated with pitting corrosion.  
A. 9.0      C. 7.0  
B. 6.5      D. None of the above

186. Some studies have suggested that systems using only pH to control corrosion should maintain a pH of at least \_\_\_\_\_ to reduce the availability of hydrogen ions as electron receptors.  
A. 9.0      C. 7.0  
B. 6.5      D. None of the above

187. pH is not the only factor in the corrosion equation; \_\_\_\_\_ and alkalinity levels affect corrosion as well.  
A. Sodium bicarbonate      C. Phosphates  
B. Carbonate      D. None of the above

188. Chemicals commonly used for pH and alkalinity adjustment are \_\_\_\_\_, caustic soda (NaOH or sodium hydroxide), soda ash (Na<sub>2</sub>CO<sub>3</sub> or sodium carbonate), and sodium bicarbonate (NaHCO<sub>3</sub>, essentially baking soda).  
A. Sodium bicarbonate      C. Hydrated lime  
B. Sulfuric acid      D. None of the above

### Corrosion Inhibitors

189. Inhibitors reduce corrosion by forming protective coatings on pipes. The most common corrosion inhibitors are \_\_\_\_\_, sodium silicates and mixtures of phosphates and silicates. These chemicals have proven successful in reducing corrosion in many water systems.  
A. Sodium bicarbonate      C. Inorganic phosphates  
B. Sulfuric acid      D. None of the above

190. The phosphates used as corrosion inhibitors include polyphosphates, orthophosphates, glassy phosphates and bimetallic phosphates. In some cases, zinc is added in conjunction with orthophosphates or polyphosphates.  
A. True      B. False

191. Glassy phosphates, such as sodium hexametaphosphate, effectively reduce iron corrosion at dosages of \_\_\_\_\_ mg/l.  
A. 100 to 200      C. 1 to 2  
B. 20 to 40      D. None of the above

192. Sodium silicates are particularly effective for systems with high water velocities, low hardness, low alkalinity and a pH of less than\_\_\_\_\_.

- A. 9.0
- B. 8.4
- C. 7.0
- D. None of the above

### **Turbidity Testing Sub-Section**

These are QA/QC questions that ensure that you've read the questions. These questions may seem to be repeats, but are necessary for your comprehension and evaluation.

193. Turbidity is measured to evaluate the performance of \_\_\_\_\_.

- A. Water treatment plant(s)
- B. An aesthetic point
- C. Colloidal to coarse dispersions
- D. None of the above

194. Turbidity is caused by wide variety of suspended matter that range in size from colloidal to coarse dispersions, depending upon the\_\_\_\_\_, and ranges from pure inorganic substances to those that are highly organic in nature.

- A. Water treatment plant(s)
- B. An aesthetic point
- C. Degree of turbulence
- D. None of the above

195. Turbid waters are undesirable from \_\_\_\_\_ of view in drinking water supplies.

- A. Water treatment plant(s)
- B. An aesthetic point
- C. Colloidal to coarse dispersions
- D. None of the above

### **Surface Water (SW) System Compliance**

196. 0.34 NTU in \_\_\_\_\_, never to exceed 1.0 NTU spike

- A. Individual filter effluent
- B. 95% of samples
- C. Combined filter turbidity
- D. None of the above

197. Sample turbidity at each \_\_\_\_\_

- A. Individual filter effluent
- B. 95% of samples
- C. Combined filter turbidity
- D. None of the above

198. Sample the \_\_\_\_\_ at the clear well

- A. Individual filter effluent
- B. 95% of samples
- C. Combined filter turbidity
- D. None of the above

### **Disinfection Key**

199. 99.99% or 4 log inactivation of \_\_\_\_\_

- A. Crypto
- B. Enteric viruses
- C. Giardia lamblia cysts
- D. None of the above

200. 99% or 2 log inactivation of \_\_\_\_\_

- A. Crypto
- B. Enteric viruses
- C. Giardia lamblia cysts
- D. None of the above