

**Registration form**

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48 HOUR RUSH ORDER PROCESSING FEE ADDITIONAL \$50.00**

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

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**Please circle/check which certification you are applying the course CEU's.**  
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# Water Monitoring Answer Key

Name \_\_\_\_\_

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Method of Course acceptance confirmation. Please fill this section

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

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**WATER MONITORING CEU COURSE  
CUSTOMER SERVICE RESPONSE CARD**

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**Please fax the answer key to TLC Western Campus  
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## Water Monitoring CEU Training Course Assignment

The Water Monitoring 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 Section

#### Surface (Raw) Water Introduction

1. 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
- B. Biological actions
- C. Pollution
- D. None of the above

2. Raw water generally contains varying amounts of dissolved minerals including calcium, magnesium, sodium, chlorides, sulfates and bicarbonates, depending on its source.

- A. True
- B. False

#### Surface Water Properties

3. Water is accepted as the \_\_\_\_\_ because will dissolve most substances that comes in contact.

- A. Universal solvent
- B. Water quality
- C. Surface water
- D. None of the above

4. 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
- B. Water quality
- C. Excess nutrients
- D. None of the above

5. Adjustments in the dissolved oxygen, algae, temperature, suspended solids, turbidity, and carbon dioxide will change because of \_\_\_\_\_.

- A. Excess nutrients
- B. Biological actions
- C. Discharge
- D. None of the above

#### Managing Water Quality at the Source

6. 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
- B. Biological actions
- C. Industrial and wastewater discharge
- D. None of the above

7. The \_\_\_\_\_ of the water will govern how these chemicals will react.
- A. pH and alkalinity      C. Powdered activated carbon and chlorine  
B. Metals, and non-metals      D. None of the above

### Physical Characteristics of Water

8. 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      C. Powdered activated carbon and chlorine  
B. Sulfides or acids      D. None of the above

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

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

10. 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      C. Alkalinity  
B. Base      D. None of the above

11. 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      C. Arsenic  
B. Colloids      D. None of the above

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

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

### Alkalinity

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

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

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

### Turbidity Introduction

15. 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      C. Temperature fluctuation  
B. Variations      D. None of the above



16. 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

17. 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

18. 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

### **Turbidity MCL**

19. 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

20. 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**

21. 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

22. 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**

23. 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

24. 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

25. 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

### More on the Stage 2 DBP Rule

26. 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

27. Safe Drinking Water Act (SDWA) has been highly effective in protecting public health and has evolved to respond to new and emerging threats to safe drinking water.
- A. True
  - B. False

28. Which of the following is one of the major public health advances in the 20th century?
- A. Disinfection of drinking water
  - B. Water distribution
  - C. Amendments to the SDWA
  - D. None of the above

29. There are specific microbial pathogens, such as \_\_\_\_\_, which can cause illness, and are highly resistant to traditional disinfection practices.
- A. Cryptosporidium
  - B. E. coli host culture
  - C. Protozoa
  - D. None of the above

30. The Stage 1 Disinfectants and Disinfection Byproducts Rule and \_\_\_\_\_, promulgated in December 1998.
- A. Stage 1 DBPR
  - B. Stage 2 DBPR
  - C. Interim Enhanced Surface Water Treatment Rule
  - D. None of the above

31. Which of the following rules will reduce potential cancer and reproductive and developmental health risks from disinfection byproducts?
- A. Stage 1 DBPR
  - B. Stage 2 DBPR
  - C. Long Term 2 Enhanced Surface Water Rule
  - D. None of the above

### What are Disinfection Byproducts (DBPs)?

32. Which of the following form when disinfectants used to treat drinking water react with naturally occurring materials in the water?
- A. Chloramines
  - B. Humic and fulvic acids
  - C. Disinfection byproducts (DBPs)
  - D. None of the above



## Absorption

42. Activated carbon can be used to absorb \_\_\_\_\_ that react with disinfectants to form byproducts.
- A. Inorganic coagulants      C. Soluble organics  
B. Most contaminants      D. None of the above

## Organisms Descriptors and Meanings

43. Photo means...
- A. Feed or nourish      C. Light  
B. Other (Organic carbon)      D. None of the above
44. Organo means...
- A. Rock      C. Light  
B. Organic      D. None of the above
45. Auto means...
- A. Without air      C. Self (Inorganic carbon)  
B. With air      D. None of the above
46. Facultative means...
- A. Without air      C. Self (Inorganic carbon)  
B. With air or without air      D. None of the above
47. Aerobic means...
- A. Without air      C. Self (Inorganic carbon)  
B. With air      D. None of the above
48. Chemo means...
- A. Rock      C. Chemical  
B. Organic      D. None of the above
49. Hetero means...
- A. Feed or nourish      C. Light  
B. Other (Organic carbon)      D. None of the above
50. Troph means...
- A. Feed or nourish      C. Light  
B. Other (Organic carbon)      D. None of the above
51. Litho means...
- A. Rock      C. Light  
B. Organic      D. None of the above
52. Anaerobic means...
- A. Without air      C. Self (Inorganic carbon)  
B. With air      D. None of the above

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

53. 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

54. Which of the following can be naturally occurring or be the result of oil and gas production and mining activities?

- A. Radioactive contaminants
- B. Pesticides and herbicides
- C. Inorganic contaminants
- D. Microbial contaminants

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
- B. Pesticides and herbicides
- C. Inorganic contaminants
- 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
- B. Pesticides and herbicides
- C. Inorganic contaminants
- 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
- B. Pesticides and herbicides
- C. Inorganic contaminants
- D. All of the above

### **Background**

58. Coliform bacteria and chlorine residual are the only routine sampling and monitoring requirements for small ground water systems with chlorination. The coliform bacteriological sampling is governed by the Coliform Reduction amendment of the SDWA.

- A. True
- B. False

### **TCR**

59. 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

60. 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

61. 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

### **Routine Sampling Requirements**

62. 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

63. 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

64. Each total coliform-positive (TC+) routine sample must be tested for the presence of autotrophic bacteria.  
A. True      B. False
65. 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
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

### **Dangerous Waterborne Microbes**

68. 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
69. Which of the following are not necessarily agents of disease may indicate the presence of disease-carrying organisms?  
A. Fecal coliform bacteria    C. Shigella dysenteriae  
B. Cryptosporidium          D. None of the above
70. 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
71. 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
72. Which of the following can cause bacillary dysentery?  
A. Fecal coliform bacteria    C. Shigella  
B. Cryptosporidium          D. None of the above
73. 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    C. Shigella dysenteriae  
B. Cryptosporidium          D. None of the above

74. 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
- C. Giardia lamblia
- B. Cryptosporidium
- 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
- C. Shigella dysenteriae
- B. Cryptosporidium
- D. None of the above

### **Bacteriological Monitoring Introduction**

76. 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
- C. Viruses
- B. Amoebas
- D. None of the above

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

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

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

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

### **Bacteria Sampling**

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

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

### **Methods**

80. 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**

81. 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

82. 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

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

### Basic Types of Water Samples

83. It is important to properly identify the type of sample you are collecting.

- A. True                      B. False

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

84. 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

85. 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

86. 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

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

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

88. 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      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. 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)

92. 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

93. 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



94. 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**

95. 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

96. With a positive total coliform sample, after you have contacted 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              C. Corrective measures  
B. Repeat sampling immediately              D. None of the above

**Heterotrophic Plate Count HPC**

97. 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)**

98. 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**

99. 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

100. 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:**

101. Which determines a violation of nitrate?
- A. Presence              C. MCLG  
B. MCL                      D. None of the above

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

102. 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

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

103. 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

104. 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)      C. MCL violation  
B. PN      D. TC+ routine or repeat sample

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

- A. True      B. False

106. 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

107. 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

108. 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

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

- A. True      B. False

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

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

111. 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)      C. Total coliform positive samples  
B. PN      D. TC+ routine or repeat sample

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

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

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

113. The water provider shall analyze all \_\_\_\_\_ that are total coliform positive (TC+) for E. coli.  
 A. Routine or repeat water samples C. Microbial contamination  
 B. Reduced monitoring D. Repeat water samples
114. The RTRC requires public water systems (PWSs) to meet a legal limit for E. coli, as demonstrated by required monitoring.  
 A. True B. False
115. The RTRC suggests the frequency and timing of required microbial testing based on, public water type and source water type.  
 A. True B. False

### Disinfection Key

116. The RTRC requires 99.9% or 3 log inactivation of \_\_\_\_\_.  
 A. Enteric viruses C. Giardia lamblia cysts  
 B. Crypto D. None of the above
117. The RTRC requires the chlorine residual leaving the plant must be = or \_\_\_\_\_ mg/L and measurable throughout the system.  
 A. > 0.2 C. 0.2  
 B. 2.0 D. None of the above
118. The RTRC requires 99.99% or 4 log inactivation of \_\_\_\_\_.  
 A. Enteric viruses C. Giardia lamblia cysts  
 B. Crypto D. None of the above
119. The RTRC requires 99% or 2 log inactivation of \_\_\_\_\_.  
 A. Enteric viruses C. Giardia lamblia cysts  
 B. Crypto D. None of the above

### Waterborne Pathogen Section - Introduction

#### Pathogen Section

120. 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 C. Will cause fatalities  
 B. Are mild in nature D. None of the above

#### How Diseases are Transmitted.

121. Waterborne pathogens are primarily spread by the?  
 A. Fecal-oral or feces-to-mouth route C. Oral to fecal route  
 B. Dermal to fecal route D. None of the above

#### Protozoan Caused Diseases

122. Which of the following bugs is larger than bacteria and viruses but still microscopic; they invade and inhabit the gastrointestinal tract?  
 A. Hepatitis A C. Protozoan pathogens  
 B. E.coli D. None of the above
123. Some of the parasites enter the environment in a dormant form, with a protective cell wall, called a?  
 A. Lamblia C. Cyst  
 B. Shell D. None of the above

### **Giardia lamblia**

124. 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

125. 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**

126. 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

127. 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

128. 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
- B. Yellow fever
- C. Typhoid fever
- D. None of the above

129. 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

130. Campylobacter, the basics. It's a bacterium. It causes diarrheal illness.

- A. True
- B. False

131. Campylobacter is primarily associated with poultry, animals, and humans.

- A. True
- B. False

132. Legionella, prevention. Legionella in water systems. Hot water in tanks should be maintained between \_\_\_\_\_degrees Centigrade.

- A. 81 to 100
- B. 110 to 210
- C. 71 and 77
- D. None of the above

133. Which of the following is typically associated with soil and water?

- A. Hepatitis A virus
- B. Legionella
- C. Pseudomonas
- D. None of the above

134. 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

135. 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

136. Schistosomatidae, the basics. It is a parasite. It is acquired through dermal contact, cercarial dermatitis. It is commonly known as?  
A. Swimmer's itch                         C. Hemorrhagic colitis  
B. Beaver fever                              D. None of the above

137. 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

138. 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

139. 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

140. Schistosomatidae prevention strategies for this pathogen include Placing boric acid on berms or interrupting the life cycle of the parasite by treating birds with a lead.  
A. True                      B. False

### **Waterborne Bacterial Diseases**

141. Cholera, Legionellosis, salmonellosis, shigellosis, yersiniosis, are other bacterial diseases that can be transmitted through water. All bacteria in water are readily killed or inactivated with chlorine or other disinfectants.  
A. True                      B. False

142. 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

143. 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

### **Chain of Custody Procedures**

144. 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                                      C. Samples transfer possession  
B. Sample siting plan                        D. None of the above

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

145. 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      C. Sample siting plan  
B. Chain of custody release      D. None of the above

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

146. 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      C. Higher strength chlorine solutions  
B. Chlorine contact time      D. None of the above

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

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

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

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

### **Water Laboratory Analysis Section**

#### **pH Testing Section**

149. 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

150. 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

151. 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

152. Pure water has a pH very close to?

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

153. \_\_\_\_\_ are determined using a concentration cell with transference, by measuring the potential difference between a hydrogen electrode and a standard electrode such as the silver chloride electrode.

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

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

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

155. 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

156. 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

157. 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

158. 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

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

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

160. Alkalinity is the name given to the quantitative capacity of an aqueous solution to neutralize an?

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

161. 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
- B. Colorwheel measurement
- C. Visual comparison
- D. None of the above

162. The pH scale is traceable to a set of standard solutions whose pH is established by US EPA.

- A. True
- B. False

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

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

164. 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
- B. The pH
- C. A set of non-linear simultaneous equations
- D. None of the above

165. 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
- B. Alkalinity
- C. pH measurement(s)
- D. None of the above

166. 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
- B. Non-linear simultaneous equations
- C. Excess of alkaline earth metal concentrations
- D. None of the above

167. 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
- B. An aggregate property of water
- C. Excess of alkaline earth metal concentrations
- D. None of the above

168. More precise measurements are possible if the color is measured spectrophotometrically, using a?

- A. Universal indicator
- B. Colorimeter or spectrophotometer
- C. Set of non-linear simultaneous equations
- D. None of the above

169. 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

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

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

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

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

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

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

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

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

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

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



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

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

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

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

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

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

### Alkalinity Sub-Section

#### Introduction

178. 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
- B. pH and alkalinity
- C. Disinfection by-products
- D. None of the above

179. 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

180. Adjusting \_\_\_\_\_ is the most common corrosion control method because it is simple and inexpensive.

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

181. 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

182. 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
- B. 6.5
- C. 7.0
- D. None of the above

183. 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
- B. 6.5
- C. 7.0
- D. None of the above

184. pH is not the only factor in the corrosion equation; \_\_\_\_\_ and alkalinity levels affect corrosion as well.

- A. Sodium bicarbonate
- B. Carbonate
- C. Phosphates
- D. None of the above

185. Generally, an increase in pH and alkalinity can increase corrosion rates and remove the protective layer of scale on corrodible pipe material.

- A. True      B. False

186. 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

187. Care must be taken, however, to maintain pH at a level that will control corrosion but not conflict with \_\_\_\_\_ for disinfection and control of disinfection by-products.

- A. End-point pH      C. Optimum pH levels  
B. pH and alkalinity      D. None of the above

### Corrosion Inhibitors

188. 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

189. 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

### 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.

190. 0.34 NTU in \_\_\_\_\_, never to exceed 1.0 NTU spike

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

191. Sample turbidity at each \_\_\_\_\_

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

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

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

193. 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)      C. Degree of turbulence  
B. An aesthetic point      D. None of the above

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

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

### Force due to van der Waals forces

195. Van der Waals forces are strong forces based on a polar characteristic induced by neighboring molecules. When two or more polar molecules, such as He, Ar, H<sub>2</sub>, are in close proximity, the nucleus of each atom will magnetically attract electrons in the counter atom resulting, at least momentarily, in an asymmetrical arrangement of the nucleus.

- A. True      B. False

### How to Treat Turbidity

196. By supercharging the water supply momentarily with a positive charge, we can upset the charge effect of the particle enough to reduce the Zeta potential (repulsive force), thereby allowing van der Waals forces (attractive forces) to take over.

- A. True      B. False

197. By introducing aluminum (Al<sub>3</sub><sup>+</sup>) into the water in the form of Alum (Al<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>•nH<sub>2</sub>O) we can accomplish the supercharging of the water. This is the coagulation part of the coagulation/flocculation process; flocculation follows coagulation.

- A. True      B. False

198. During the flocculation process the particles join together to form flocs; the larger the flocs, the faster they will settle within a clarifier. Other chemical coagulants used are Ferric Chloride and Ferrous Sulfate.

- A. True      B. False

199. Ferrous Sulfate works well through a range of pH values, \_\_\_\_\_.

- A. 5.0 - 7.5      C. 4.5 to 9.5  
B. 4.5            D. None of the above

200. Ferric Chloride works best at lower pH values, down to pH of \_\_\_\_\_.

- A. 5.0 - 7.5      C. 4.5 to 9.5  
B. 4.5            D. None of the above