

**Registration form**

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**RUSH PROCESS FEE ADDITIONAL \$50.00 ONLY IF NECESSARY**

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

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**Water Quality Answer Key**

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1. Please rate the difficulty of your course.

Very Easy    0      1      2      3      4      5    Very Difficult

2. Please rate the difficulty of the testing process.

Very Easy    0      1      2      3      4      5    Very Difficult

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

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

5. What would you do to improve the Course?

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Any other concerns or comments.

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



# Water Quality CEU Training Course Assignment

*The Assignment (Exam) is also available in Word on the Internet for your Convenience, please visit [www.ABCTL.com](http://www.ABCTL.com) and download the assignment and e-mail it back to TLC.*

You will have 90 days from the start of this course to complete in order to receive your Professional Development Hours (**PDHs**) or Continuing Education Unit (**CEU**). A score of 70 % is necessary to pass this course. We prefer if this exam is proctored. No intentional trick questions. If you should need any assistance, please email all concerns and the completed manual to [info@tlch2o.com](mailto:info@tlch2o.com).

We would prefer that you utilize the enclosed answer sheet in the front, but if you are unable to do so, type out your own answer key. Please include your name and address on your Answer Key and make copy for yourself. You can e-mail or fax your Answer Key along with the Registration Form to TLC. **(S) Means answer may be plural or singular. Multiple Choice Section. One answer per question and please use the answer key.**

1. The ICR data is used by EPA to support future regulation of microbial contaminants, disinfectants, and disinfection byproducts.  
A. True B. False

## **Disinfection Byproduct Regulations Some of this information is from Stage 1**

2. The new TTHM standards in the \_\_\_\_\_ became effective in December 2001 for large surface water public water systems and in December 2003 for small surface water and all ground water systems.

- A. Cryptosporidium Rules D. Total Trihalomethane Rule  
B. Disinfection Rules E. Stage 1 DBPR  
C. Disinfection byproduct F. None of the Above

3. When disinfectants used in water treatment plants react with bromide and/or natural organic matter in the source water, \_\_\_\_\_ are formed.

- A. Cryptosporidium D. New regulations  
B. Giardia E. Disinfection byproducts (DBPs)  
C. Chlorine byproducts F. None of the Above

4. Different types or amounts of \_\_\_\_\_ are produced by different disinfectants.

- A. Cryptosporidium D. Regulations  
B. Giardia E. Disinfection byproducts (DBPs)  
C. Chlorine byproducts F. None of the Above

5. Disinfection byproducts that have been identified in drinking water include trihalomethanes, \_\_\_\_\_, bromate, and chlorite.

- A. Cryptosporidium D. Chlorine  
B. Giardia E. Disinfection byproducts (DBPs)  
C. Haloacetic acids F. None of the Above

6. Chloroform, bromodichloromethane, dibromochloromethane, and bromoform are \_\_\_\_\_.

- A. Trihalomethanes (THM) D. Giardia and viruses  
B. Chlorites E. Disinfection Byproducts (DBPs)  
C. Haloacetic Acids (HAA5) F. None of the Above

7. Which of the following terms is a disinfection byproduct that forms when ozone reacts with naturally occurring bromide in the source water?

- A. Bromate
- B. Counter pathogens
- C. Monobromoacetic acid
- D. From the results of coliform testing
- E. Bacteria, Virus and Intestinal parasites
- F. None of the Above

8. Under the \_\_\_\_\_, total trihalomethanes (TTHM) are regulated at a maximum allowable annual average level of 80 ppb for large surface water public water systems.

- A. Cryptosporidium Rules
- B. Disinfection Rules
- C. Disinfection byproduct
- D. Total Trihalomethane Rule
- E. Stage 1 DBPR
- F. None of the Above

9. The regulated \_\_\_\_\_ are monochloroacetic acid, dichloroacetic acid, trichloroacetic acid, monobromoacetic acid, and dibromoacetic acid.

- A. Cryptosporidium
- B. Trihalomethanes
- C. Haloacetic Acids (HAA5)
- D. Organic compounds
- E. Maximum Contaminant Levels MCLs
- F. None of the Above

### Stage 2 DBP Rule Federal Register Notices

10. The Microbial and Disinfection Byproducts Rules (MDBPs) are a set of interrelated regulations that address risks from microbial pathogens and disinfectants/disinfection byproducts. The \_\_\_\_\_ is one part of these rules.

- A. Groundwater Rule (GWR)
- B. Compliance Rule
- C. Stage 2 DBP Rule
- D. Total Coliform Rule
- E. ICR Rule
- F. None of the Above

11. Which Rule focuses on public health protection by limiting exposure to DBPs, specifically total trihalomethanes (TTHM) and five haloacetic acids (HAA5), which can form in water through disinfectants used to control microbial pathogens?

- A. Stage 2 DBPR
- B. DBP exposure
- C. The Stage 2 DBP
- D. Long Term 2 Enhanced Surface Water Treatment
- E. Traditional disinfection practices
- F. None of the Above

12. This rule will apply to all community water systems and nontransient non-community water systems that add a primary or residual disinfectant other than this missing term or deliver water?

- A. Ultraviolet (UV) light
- B. The open-channel system
- C. UV rather than ozone
- D. UV source
- E. UV radiation
- F. None of the Above

13. In the past 30 years, the \_\_\_\_\_ has been highly effective in protecting public health and has also evolved to respond to new and emerging threats to safe drinking water.

- A. Stage 2 DBPR
- B. DBP exposure
- C. Stage 3 DBP rule
- D. Long Term 2 Enhanced Surface Water Treatment Rule
- E. Safe Drinking Water Act (SDWA)
- F. None of the Above

14. There are specific microbial pathogens, such as \_\_\_\_\_, which can cause illness, and are highly resistant to traditional disinfection practices.

- A. Enteric virus(es)
- B. Oocyst(s)
- C. Cryptosporidium
- D. C. perfringens
- E. E. coli host culture
- F. None of the Above

15. The Stage 1 Disinfectants and Disinfection Byproducts Rule and the \_\_\_\_\_ were the first phase in a rulemaking strategy required by Congress.

- A. Major public health advances
- B. The Stage 2 DBPR
- C. This final rule
- D. Amendments to the SDWA in 1996
- E. Interim Enhanced Surface Water Treatment Rule
- F. None of the Above

16. The Stage 2 Disinfectants and Disinfection Byproducts Rule (Stage 2 DBPR) builds upon the \_\_\_\_\_ to address higher risk public water systems for protection measures beyond those required for existing regulations.

- A. Stage 2 DBPR
- B. DBP exposure
- C. Stage 1 DBPR
- D. Long Term 2 Enhanced Surface Water Treatment Rule
- E. Traditional disinfection practices
- F. None of the Above

17. Which of the following terms and the Long Term 2 Enhanced Surface Water Treatment Rule are the second phase of rules that address disinfectants/disinfection byproducts and microbial pathogens?

- A. Major public health advances
- B. The Stage 2 DBPR
- C. Final rule
- D. Amendments to the SDWA in 1996
- E. Primary or residual disinfectant
- F. None of the Above

18. Which of the following terms will reduce the risk of cancer and reproductive and developmental health issues caused by disinfection byproducts in drinking water?

- A. Stage 3 DBPR
- B. DBP exposure
- C. Stage 2 DBPR
- D. Long Term 2 Enhanced Surface Water Treatment Rule
- E. Traditional disinfection practices
- F. None of the Above

19. Which of the following terms tightens compliance monitoring requirements for trihalomethanes (TTHM) and haloacetic acids (HAA5)?

- A. Major public health advances
- B. Stage 3 DBPR
- C. Stage 2 Disinfection Byproducts Rule
- D. Amendments to the SDWA in 1996
- E. Primary or residual disinfectant
- F. None of the Above

20. Which of the following terms builds incrementally upon the Stage 1 DBPR to reduce DBP exposure and related health risks?

- A. Stage 3 DBPR
- B. Stage 2 DBPR
- C. Stage 1 DBP rule
- D. Long Term 2 Enhanced Surface Water Treatment Rule
- E. Stage 4 DBPR
- F. None of the Above

21. Which of the following terms and the Long Term 2 Enhanced Surface Water Treatment Rule are being promulgated at the same time to address concerns about risk tradeoffs between pathogens and DBPs?

- A. Major public health advances
- B. Stage 2 DBPR
- C. Final rule
- D. Amendments to the SDWA in 1996
- E. Primary or residual disinfectant
- F. None of the Above

**What does the rule require?**

22. Which of the following terms will require systems to conduct an Initial Distribution System Evaluation to identify the locations with high disinfection byproduct concentrations?

- A. Stage 2 DBPR
- B. DBP exposure
- C. Stage 1 DBP rule
- D. Long Term 2 Enhanced Surface Water Treatment Rule
- E. Traditional disinfection practices
- F. None of the Above

23. The locations with high DBP concentrations that are identified in the IDSE will be used by the systems as the sampling sites for Stage 2 DBPR compliance monitoring.

- A. True
- B. False

24. Which Rule also requires each system to determine if they have exceeded an operational evaluation level identified using their compliance monitoring results?

- A. Stage 2 DBPR
- B. DBP exposure
- C. The Stage 1 DBP rule
- D. Long Term 2 Enhanced Surface Water Treatment Rule
- E. Traditional disinfection practices
- F. None of the Above

25. If an operational evaluation level is exceeded, the system is required to review its operational practices and identify actions that may be taken to mitigate future high \_\_\_\_\_.

- A. TTHM5 and HTAA5
- B. Halos
- C. DBP levels
- D. UV
- E. Amounts of rainfall
- F. None of the Above

**Who must comply with the rule?**

26. Which of the following terms regulates community and nontransient noncommunity water systems that treat their water with a primary or residual disinfectant other than ultraviolet light?

- A. DBPs from chlorination
- B. Chlorine and chloramine
- C. Stage 2 DBPR
- D. Total Coliform Rule
- E. TTHM and HAA5
- F. None of the Above

27. A public water system that serves year-round residents of a community, subdivision, or mobile home park that has at least 15 service connections or an average of at least 25 residents is called?

- A. A nontransient non-community water system (NTNCWS)
- B. A non-community water system
- C. A community water system (CWS)
- D. Trailer park
- E. A nontransient water system
- F. None of the Above

28. Which system is a water system that serves at least 25 of the same people more than six months of the year, but not as primary residence, such as schools, businesses, and day care facilities?

- A. Trailer park
- B. A non-community water system
- C. A community water system (CWS)
- D. A nontransient non-community water system (NTNCWS)
- E. A nontransient water system
- F. None of the Above

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

29. Which of the following terms form when disinfectants used to treat drinking water react with naturally occurring materials in the water?

- A. Disinfectants
- B. DBLs
- C. Humic
- D. Disinfection byproducts (DBPs)
- E. Sodium Thiosulfate
- F. None of the Above

30. Total trihalomethanes and haloacetic acids (HAA5 - monochloro-, dichloro-, trichloro-, monobromo-, dibromo-) are widely occurring \_\_\_\_\_ formed during disinfection with chlorine and chloramine.

- A. Sodium Thiosulfate
- B. Chlorine and chloramine
- C. Stage 2 DBPR
- D. Classes of DBPs
- E. Trihalomethanes and haloacetic acids
- F. None of the Above

31. The amount of \_\_\_\_\_ can change daily, depending on the season, water temperature, amount of disinfectant added, and the amount of plant material in the water.

- A. Thiols
- B. Chlorine and chloramine
- C. Stage 2 DBPR
- D. Classes of DBPs
- E. Trihalomethanes and haloacetic acids
- F. None of the Above

**Are THMs and HAAs the only disinfection byproducts?**

32. Which of the following terms act as indicators for DBP occurrence? They typically occur at higher levels than other known or unknown DBPs.

- A. DBPs from chlorination
- B. Chlorine and chloramine
- C. Stage 2 DBPR
- D. Classes of DBPs
- E. TTHM and HAA5
- F. None of the Above

**Stage 2 DBP Rule Federal Register Notices**

33. Chlorine and its \_\_\_\_\_ are neutrally charged and therefore easily penetrate the negatively charged surface of pathogens.

- A. Halogen
- B. Water chlorination
- C. Chlorine as a disinfectant
- D. Hydrolysis product hypochlorous acid
- E. Hypochlorous acid
- F. None of the Above

34. There are specific microbial pathogens, such as \_\_\_\_\_, which can cause illness and is resistant to traditional disinfection practices.

- A. Cryptosporidium
- B. Sodium hypochlorite
- C. Bromoform
- D. Emerging threats to safe drinking water
- E. Hypochlorous acid (HOCl), and hydrochloric acid (HCl)
- F. None of the Above

**Microbes**

35. Coliform bacteria are common in the environment and are considered harmful.

- A. True
- B. False

36. The presence of coliform bacteria in drinking water indicates that the water may be contaminated with germs that can cause disease.

- A. True
- B. False

37. Microbes that are in human wastes can cause short-term effects, such as diarrhea, cramps, nausea, headaches, or other symptoms and are caused by?

- A. Fecal Coliform and E coli
- B. Giardia lamblia
- C. Microorganisms
- D. Cryptosporidiosis
- E. Coliform bacteria
- F. None of the Above

38. The presence of \_\_\_\_\_ bacteria indicates that the water may be contaminated with fecal matter from humans or animals.

- A. Fecal Coliform and E coli
- B. Protozoa
- C. Thermophilic
- D. Bac-T
- E. Coliform bacteria
- F. None of the Above

39. What is the parasite that enters lakes and rivers through sewage and animal waste, it causes cryptosporidiosis, a mild gastrointestinal disease?

- A. Fecal Coliform and E coli
- B. Giardia lamblia
- C. Microorganisms
- D. Cryptosporidiosis
- E. Cryptosporidium
- F. None of the Above

40. Giardia lamblia is a parasite that enters drinking water sources through sewage and animal waste. This parasite causes \_\_\_\_\_.

- A. Fecal Coliform and E coli
- B. Gastrointestinal illness
- C. Microorganisms
- D. Cryptosporidiosis
- E. Coliform bacteria
- F. None of the Above

### Radionuclides

41. Some people who consume water containing \_\_\_\_\_ over many years may have an increased risk of getting cancer.

- A. Lead
- B. Fluoride
- C. Copper
- D. Aluminum
- E. Arsenic
- F. None of the Above

42. Which of the following terms can be found in underground water sources, such as wells, and in the air in your home?

- A. Radon gas
- B. Beta/photon emitters
- C. Radioactive mineral
- D. Alpha emitters
- E. Combined Radium 226/228
- F. None of the Above

43. Which compound/element can dissolve and accumulate in underground water sources, such as wells, and in the air in your home?

- A. Radon gas
- B. Beta/photon emitters
- C. Radioactive material
- D. Alpha emitters
- E. Combined Radium 226/228
- F. None of the Above

44. Which compound/element do communities add to their drinking water to promote dental health?

- A. Fluorine
- B. Fluoride
- C. Floc
- D. Chlorine
- E. Arsenic
- F. None of the Above

45. The EPA standard for \_\_\_\_\_ in drinking water is 4 mg/L.

- A. Lead
- B. Fluoride
- C. Intestinal illness
- D. Waterborne outbreaks
- E. Arsenic
- F. None of the Above

46. Which compound/element typically leaches into water from plumbing in older buildings?
- A. Lead
  - B. Fluoride
  - C. Intestinal illness
  - D. Waterborne outbreaks
  - E. Arsenic
  - F. None of the Above

47. Which secondary standard of 2 mg/L is to protect against dental fluorosis?
- A. Lead
  - B. Fluoride
  - C. Arsenic
  - D. Florentine
  - E. Floraslitic
  - F. None of the Above

### **Drinking Water Rules Review**

48. Which of the following rules contained 60 contaminants/contaminant groups, included 10 pathogens, and was published in the Federal Register on March 2, 1998. A decision concerning whether to regulate  $\geq 5$  contaminants from CCL was required by August 2001?

- A. Total Coliform Rule (TCR)
- B. 1996 SDWA amendments
- C. Safe Drinking Water Act (SDWA) of 1974
- D. Contaminant Candidate List (CCL)
- E. Surface Water Treatment Rule (SWTR)
- F. None of the Above

49. Which of the following rules, the EPA is authorized to set national standards to protect drinking water and its sources against naturally occurring or man-made contaminants?

- A. Total Coliform Rule (TCR)
- B. 1996 SDWA amendments
- C. Safe Drinking Water Act (SDWA) of 1974
- D. Contaminant Candidate List (CCL)
- E. Surface Water Treatment Rule (SWTR)
- F. None of the Above

50. Which of the following rules require the EPA to publish a list every 5 years of contaminants that are known or anticipated to occur in public water systems and that might need to be regulated?

- A. Total Coliform Rule (TCR)
- B. 1996 SDWA amendments
- C. Safe Drinking Water Act (SDWA) of 1974
- D. Contaminant Candidate List (CCL)
- E. Surface Water Treatment Rule (SWTR)

51. Microbial contamination is regulated under the Total Coliform Rule (TCR) of 1989 and the \_\_\_\_\_ of 1989.

- A. Total Coliform Rule (TCR)
- B. 1996 SDWA amendments
- C. Safe Drinking Water Act (SDWA) of 1974
- D. Contaminant Candidate List (CCL)
- E. Surface Water Treatment Rule (SWTR)
- F. None of the Above

52. Which of the following rules covers all water systems that use surface water or groundwater under the direct influence of surface water?
- A. Total Coliform Rule (TCR)
  - B. 1996 SDWA amendments
  - C. Safe Drinking Water Act (SDWA) of 1974
  - D. Contaminant Candidate List (CCL)
  - E. Surface Water Treatment Rule (SWTR)
  - F. None of the Above
53. Which of the following rules is intended to protect against exposure to *Giardia intestinalis*, viruses, and *Legionella*, as well as selected other pathogens?
- A. Total Coliform Rule (TCR)
  - B. 1996 SDWA amendments
  - C. Safe Drinking Water Act (SDWA) of 1974
  - D. Contaminant Candidate List (CCL)
  - E. Surface Water Treatment Rule (SWTR)
  - F. None of the Above
54. Which of the following rules which provides additional protection against *Cryptosporidium* and other waterborne pathogens for systems that serve  $\geq 10,000$  persons?
- A. Total Coliform Rule (TCR)
  - B. 1996 SDWA amendments
  - C. Interim Enhanced Surface Water Treatment Rule (IESWTR)
  - D. Long Term 1 Enhanced SWTR (LT1ESWTR)
  - E. Surface Water Treatment Rule (SWTR)
  - F. None of the Above
55. Which of the following rules for public water systems that use surface water or groundwater under the direct influence of surface water and serve  $< 10,000$  persons?
- A. Total Coliform Rule (TCR)
  - B. 1996 SDWA amendments
  - C. Interim Enhanced Surface Water Treatment Rule (IESWTR)
  - D. Long Term 1 Enhanced SWTR (LT1ESWTR)
  - E. Surface Water Treatment Rule (SWTR)
  - F. None of the Above
56. Which of the following rules was proposed in combination with the Filter Backwash Recycling Rule (FBRR), which was finalized in 2002?
- A. Total Coliform Rule (TCR)
  - B. Filter Backwash Recycling Rule (FBRR)
  - C. Interim Enhanced Surface Water Treatment Rule (IESWTR)
  - D. Long Term 1 Enhanced SWTR (LT1ESWTR)
  - E. Surface Water Treatment Rule (SWTR)
  - F. None of the Above



57. Which of the following rules require the EPA to develop regulations that require disinfection of groundwater systems as necessary to protect the public health; EPA has proposed the Ground Water Rule (GWR) to meet this mandate?

- A. Total Coliform Rule (TCR)
- B. 1996 SDWA amendments
- C. Interim Enhanced Surface Water Treatment Rule (IESWTR)
- D. Long Term 1 Enhanced SWTR (LT1ESWTR)
- E. Surface Water Treatment Rule (SWTR)
- F. None of the Above

### Waterborne Disease Section

58. 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. Influenza route
- E. Waterborne mishaps
- F. None of the Above

59. When infected humans or animals pass the bacteria, viruses, and \_\_\_\_\_ in their stool, pathogens may get into water and spread disease.

- A. Fecal Coliform and E coli
- B. Protozoa
- C. Macroorganisms
- D. Cryptosporidiosis
- E. Bioslime
- F. None of the Above

60. For another person to become infected, he or she must take a pathogen in through the mouth.

- A. True
- B. False

61. Which term means when in nature it is different from other types of pathogens such as the viruses that cause influenza (the flu) or the bacteria that cause tuberculosis?

- A. Fecal Coliform and E coli
- B. Giardia lamblia
- C. Microorganism(s)
- D. Waterborne Pathogen(s)
- E. Coliform bacteria
- F. None of the Above

62. According to the text, \_\_\_\_\_ are spread by secretions that are coughed or sneezed into the air by an infected person.

- A. Fecal Coliform and E coli
- B. Giardia lamblia
- C. Microorganisms
- D. Influenza virus and tuberculosis bacteria
- E. Coliform bacteria
- F. None of the Above

### Bacterial Diseases

63. What is the most common diarrhea illness caused by bacteria?

- A. Pathogen
- B. Yersiniosis
- C. Hepatitis A
- D. Campylobacteriosis
- E. Incubation period
- F. None of the Above

64. Which of the following terms has most often been associated with food and un-chlorinated water?

- A. Pathogen
- B. Yersiniosis
- C. Hepatitis A
- D. Campylobacteriosis
- E. Beaver fever
- F. None of the Above

### Types of Bacteria

65. \_\_\_\_\_ can also cause "travelers' diarrhea."

- A. Illness
- B. Cryptosporidium
- C. Bacteria
- D. Campylobacteriosis
- E. Transmission of disease
- F. None of the Above

66. Other diseases caused by bacteria in water are cholera, Legionellosis, salmonellosis, \_\_\_\_\_, and yersiniosis.

- A. Shigellosis
- B. Cysts
- C. Hepatitis A
- D. Campylobacteriosis
- E. HIV
- F. None of the Above

67. Chlorine kills or inactivates \_\_\_\_\_ in water.

- A. Cysts
- B. Cryptogiardia
- C. Bacteria
- D. Viral Plaques
- E. Oocysts
- F. None of the Above

### Viral-Caused Diseases

68. \_\_\_\_\_ is a viral disease that may be spread through water.

- A. Pathogen
- B. Yersiniosis
- C. Hepatitis A
- D. Campylobacteriosis
- E. Incubation period
- F. None of the Above

69. Most \_\_\_\_\_ in drinking water can be inactivated by chlorine or other disinfectants.

- A. Illnesses
- B. Giardiasis
- C. Viruses
- D. Pathogen(s)
- E. Infections
- F. None of the Above

### Metabolism

70. Which of the following terms describes all the chemical reactions by which food is transformed for use by the cells?

- A. Fastidious
- B. Metabolism
- C. Chemical reactions
- D. Germ theory of disease
- E. Osmosis
- F. None of the Above

71. A cell can grow through its metabolism, reproduce and it can respond to changes in its environment.

- A. True
- b. False

### Bacteria

72. Bacteria are prokaryotes, and thus have no true nucleus.

- A. True
- B. False

73. The \_\_\_\_\_ that some bacteria need to do photosynthesis is built into their cell membranes.

- A. Chlorophyll
- B. Organelle
- C. Cellulose
- D. Double-stranded DNA
- E. Bacilli
- F. None of the Above

74. Bacteria have only one \_\_\_\_\_.
- A. Chloroplasts
  - B. Organelle
  - C. Cellulose
  - D. Double-stranded DNA
  - E. Cell
  - F. None of the Above

75. There are some bacteria that can live in temperatures above the boiling point.
- A. True
  - B. False

### Prokaryotes

76. The only prokaryotes are bacteria and archaea. All other life forms have cells with nuclei and are called \_\_\_\_\_.
- A. Bacteria
  - B. Peptidoglycan
  - C. Bacilli
  - D. Eukaryotes
  - E. Microorganism
  - F. None of the Above

### Early Origins

77. Bacilli bacteria are rod or stick-shaped. Cocci bacteria are shaped like little balls.
- A. True
  - B. False

78. Some bacterial cells cluster together to form \_\_\_\_\_.
- A. An organism
  - B. An organelle
  - C. Cellulose
  - D. Pairs, chains, squares or other groupings
  - E. Helical or spiral in shape
  - F. None of the Above

79. The mitochondria are \_\_\_\_\_ that make energy for your body cells.
- A. Chloroplasts
  - B. Organelle
  - C. Cellulose
  - D. Bacilli
  - E. Eukaryote(s)
  - F. None of the Above

80. There can be more than a billion (1,000,000,000) bacteria in a single teaspoon of topsoil.
- A. True
  - B. False

### Peptidoglycan

81. Bacterial cell walls do not contain cellulose, but are made mostly of \_\_\_\_\_.
- A. Capsule
  - B. Peptidoglycan
  - C. Cytoplasmic granules
  - D. Cell membrane/plasma membrane
  - E. True nucleus
  - F. None of the Above

82. Some antibiotics, like penicillin, stop bacteria from making \_\_\_\_\_, which keeps the bacteria from growing.
- A. Disease(s)
  - B. Mutation(s)
  - C. Carriers
  - D. Peptidoglycan
  - E. Bacteria
  - F. None of the Above

83. If a person stops taking an antibiotic too soon, any living bacteria left could start growing and reproducing by making \_\_\_\_\_.
- A. Bacteria
  - B. Peptidoglycan
  - C. Eukaryotes
  - D. Germ theory of disease
  - E. Microorganism
  - F. None of the Above

### Gram Stain

84. The two types of \_\_\_\_\_ have different amounts of peptidoglycan.

- A. Bacteria
- B. Peptidoglycan
- C. Gram<sup>+</sup> or Gram<sup>-</sup>
- D. Bacterial cell walls
- E. Gram stain
- F. None of the Above

85. In the Gram process, the amount of peptidoglycan in the cell walls of the bacteria under study will determine how those bacteria absorb the dyes with which they are stained; thus, bacterial cells can be Gram<sup>+</sup> or Gram<sup>-</sup>.

- A. True
- B. False

86. Which type of bacteria stain a dark purple color because they have simpler cell walls with lots of peptidoglycan?

- A. Aerobic
- B. Positive
- C. Gram<sup>+</sup> or Gram<sup>-</sup>
- D. Gram<sup>+</sup>
- E. Gram<sup>-</sup>
- F. None of the Above

87. Which type of bacteria stain a pinkish color because they have more complex cell walls with less peptidoglycan?

- A. Positive
- B. Fastidious
- C. Gram<sup>+</sup> or Gram<sup>-</sup>
- D. Gram<sup>+</sup>
- E. Gram<sup>-</sup>
- F. None of the Above

### Bacterial Nutrition

88. Most cells require significant quantities of \_\_\_\_\_.

- A. Water
- B. Nitrogen
- C. Iron, Zinc, Cobalt
- D. Oxygen
- E. Calcium
- F. None of the Above

89. All life requires \_\_\_\_\_ to grow and reproduce.

- A. Water
- B. Copper
- C. Iron, Zinc, Cobalt
- D. Oxygen
- E. Calcium
- F. None of the Above

### Fastidious

90. Many \_\_\_\_\_ can make the complex molecules they need from the basic minerals.

- A. Eukaryote(s)
- B. Bacteria
- C. Prokaryote(s)
- D. Centrioles
- E. Viruses
- F. None of the Above

91. Fastidious \_\_\_\_\_ require preformed organic molecules like vitamins, amino acids, nucleic acids, carbohydrates.

- A. Eukaryote(s)
- B. Bacteria
- C. Prokaryote(s)
- D. Centrioles
- E. Viruses
- F. None of the Above

### What in the World is an Eukaryote?

92. \_\_\_\_\_ include multicellular organisms such as animals, plants, and fungi, as well as unicellular protists.

- A. Eukaryote(s)
- B. Bacteria
- C. Prokaryote(s)
- D. Centrioles
- E. Viruses
- F. None of the Above

93. \_\_\_\_\_ include other organisms such as bacteria that lack nuclei and other complex cell structures.

- A. Eukaryote(s)
- B. Bacteria
- C. Prokaryote(s)
- D. Centrioles
- E. Viruses
- F. None of the Above

94. The eukaryotes share a common origin, and are treated formally as a super kingdom, empire, or domain.

- A. True
- B. False

### Symbiotic Protozoa

#### Parasites

95. A unique group of obligate, intracellular parasitic protozoa is \_\_\_\_\_.

- A. Foraminifera
- B. Protozoan fauna
- C. Cytoplasm of protozoa
- D. Soil biomass
- E. Microsporidia
- F. None of the Above

96. \_\_\_\_\_ are diverse organisms that are capable of infecting a variety of plant, animal, and even other protist hosts.

- A. Foraminifera
- B. Protozoan fauna
- C. Cytoplasm of protozoa
- D. Soil biomass
- E. Microsporidia
- F. None of the Above

97. Worldwide infections in AIDS patients caused by four different genera of microsporidia (Encephalitozoon, Nosema, Pleistophora, and \_\_\_\_\_) have increased since 1985.

- A. Foraminifera
- B. Protozoan fauna
- C. Cytoplasm of protozoa
- D. Enterocytozoon
- E. Microsporidia
- F. None of the Above

### Protozoan Reservoirs of Disease

98. It is well known that bacteria can be present in the \_\_\_\_\_?

- A. Foraminifera
- B. Protozoan fauna
- C. Cytoplasm of protozoa
- D. Soil biomass
- E. Microsporidia
- F. None of the Above

### Symbionts

99. Some \_\_\_\_\_ can be beneficial symbionts.

- A. Amoeba
- B. Viruses
- C. Protozoa
- D. Free-living amoebae
- E. Bacterium Legionella pneumophila
- F. None of the Above

### **Contractile Vacuoles**

100. Many protozoa have \_\_\_\_\_, which collect and expel excess water, and extrusomes, which expel material used to deflect predators or capture prey.
- A. Flagella
  - B. Contractile vacuoles
  - C. Vacuole or tonoplast
  - D. Free-living amoebae
  - E. Cell's cytoplasm
  - F. None of the Above

### **Centrioles**

101. Centrioles are found in cells that do not have flagella. They generally occur in groups of one or two, called \_\_\_\_\_.
- A. Kinetosome or centriole
  - B. Kinetids
  - C. Beneficial symbionts
  - D. Nonpathogenic protozoa
  - E. Various microtubular roots
  - F. None of the Above

### **Paramecium**

102. \_\_\_\_\_ are single-celled organisms in the kingdom Protista that live in fresh water.
- A. Kinetosome or centriole
  - B. E-coli
  - C. Paramecium
  - D. Eukaryotes
  - E. Bacterium Legionella pneumophila
  - F. None of the Above

103. The osmotic concentration in the external environment of paramecium is much lower than that in their \_\_\_\_\_.

- A. Contractile vacuoles
- B. Haptonema
- C. Cyst
- D. Protozoan pathogens
- E. Cytoplasm
- F. None of the Above

104. The continuous influx of water into Paramecium is caused by the difference in \_\_\_\_\_ concentration between their environment and cytoplasm.

- A. Contractile vacuoles
- B. Cytoplasm
- C. Homeostasis
- D. Osmotic
- E. Hypotonic to their cytoplasm
- F. None of the Above

105. The osmoregulation process in Paramecium is carried out by two organelles known as?

- A. Contractile vacuoles
- B. Cytoplasm
- C. Homeostasis
- D. Microtubule-supported organelles
- E. Osmosis
- F. None of the Above

### **Protozoan Diseases**

106. Which of the following terms can survive in the environment for long periods of time and be extremely resistant to conventional disinfectants such as chlorine?

- A. Paramecium
- B. Host
- C. Cyst
- D. Protozoan pathogen
- E. Cytoplasm
- F. None of the Above

### **Giardiasis**

107. Which bug/creature/organism has been responsible for more community-wide outbreaks of disease in the U.S. than any other pathogen?

- A. Legionella
- B. Giardia lamblia
- C. Cryptosporidium organisms
- D. E-coli
- E. Hepatitis A
- F. None of the Above

108. Which bug/creature/organism is a commonly reported protozoan-caused disease?

- A. Backpacker's disease
- B. Cytoplasm disease
- C. Paramecium disease
- D. Giardiasis
- E. Fever-caused disease
- F. None of the Above

109. Which bug/creature/organism has also been referred to as "Backpacker's disease" and "beaver fever" because of the many cases of drinking untreated surface water?

- A. Giardia lamblia
- B. Cytoplasm disease
- C. Paramecium disease
- D. Giardiasis
- E. Protozoan-caused disease
- F. None of the Above

### **Cryptosporidiosis**

110. Which bug/creature/organism has symptoms usually come and go, and end in fewer than 30 days in most cases? The incubation period is 1-12 days, with an average of about seven days.

- A. Giardia lamblia
- B. Incubation period
- C. Animal-to-person contact
- D. Cryptosporidiosis
- E. Giardiasis
- F. None of the Above

111. Which bug/creature/organism have been identified in human fecal specimens from more than 50 countries on six continents?

- A. E-coli
- B. Giardia lamblia
- C. Cryptosporidium organisms
- D. Giardia trophozoites
- E. Hepatitis A
- F. None of the Above

112. The mode of transmission is fecal-oral, either by person-to-person or animal-to-person. There is no specific treatment for \_\_\_\_\_.

- A. Giardia lamblia treatment
- B. Incubation period
- C. Animal-to-person contact
- D. Major symptom
- E. Cryptosporidium infections
- F. None of the Above

### **Giardia Lamblia**

113. Which bug/creature/organism absorb their nutrients from the lumen of the small intestine, and are anaerobes?

- A. Water-borne sources
- B. Giardia trophozoites
- C. Giardia cysts
- D. Giardia infections
- E. Giardia parasites
- F. None of the Above

114. Which bug/creature/organism/disease can occur through ingestion of dormant cysts in contaminated water, or by the fecal-oral route (through poor hygiene practices)?

- A. Giardiasis
- B. Giardia trophozoites
- C. Cytoplasm
- D. Giardia infection
- E. Trophozoites and cysts
- F. None of the Above

115. Which bug/creature/organism/disease is (synonymous with *Lamblia intestinalis* and *Giardia duodenalis*) is a flagellated protozoan parasite that colonizes and reproduces in the small intestine?

- A. Giardia trophozoites
- B. Incubations
- C. Animal-to-person contact
- D. Giardia lamblia
- E. Cryptosporidium infections
- F. None of the Above

116. Which bug/creature/organism/disease attaches to the epithelium by a ventral adhesive disc, and reproduces via binary fission?

- A. Water-borne source
- B. Giardia trophozoites
- C. Giardia cyst
- D. Giardia infection(s)
- E. Giardia parasite
- F. None of the Above

117. Which bug/creature/organism/disease does not spread via the bloodstream, nor does it spread to other parts of the gastro-intestinal tract, but remains confined to the lumen of the small intestine?

- A. Giardiasis
- B. Infected
- C. Cytoplasm
- D. Giardia infection
- E. Trophozoites and cysts
- F. None of the Above

118. Which bug/creature/organism/disease can survive for weeks to months in cold water and therefore can be present in contaminated wells and water systems?

- A. Water-borne sources
- B. Giardia trophozoites
- C. Giardia cyst
- D. Giardia infections
- E. Giardia parasite
- F. None of the Above

119. Which bug/creature/organism/disease is possible, and therefore Giardia infection is a concern for people camping in the wilderness or swimming in contaminated streams?

- A. Giardiasis
- B. Infected
- C. Cytoplasm
- D. Giardia infection
- E. Zoonotic transmission
- F. None of the Above

120. Which bug/creature/organism/disease can also occur, for example in day care centers, where children may have poorer hygiene practices?

- A. Water-borne sources
- B. Giardia trophozoites
- C. Giardia cyst
- D. Giardia infections
- E. Fecal-oral transmission
- F. None of the Above

121. Which bug/creature/organism/disease is not symptomatic, so some people can unknowingly serve as carriers of the parasite?

- A. Water-borne illness sources
- B. Giardia trophozoites
- C. Giardia problems
- D. Giardia infections
- E. Parasites
- F. None of the Above

122. A distinguishing characteristic of the cyst is 4 nuclei and a \_\_\_\_\_.

- A. Large eye
- B. Foot
- C. Cytoplasm
- D. Retracted cytoplasm
- E. Trophozoites and cysts
- F. None of the Above

123. Which bug/creature/organism/disease is not primitively amitochondrial and that it has retained a functional organelle derived from the original mitochondrial endosymbiont?"

- A. Giardiasis
- B. Tubular sheath
- C. Cytoplasm
- D. Giardia
- E. Trophozoites and cysts
- F. None of the Above



### Protozoan Caused Diseases

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

- A. HIV infections
- B. Symptoms
- C. Giardiasis
- D. Hepatitis A
- E. Protozoan pathogens
- F. None of the Above

125. A few of the parasites enter the environment in a dormant form, with a protective cell wall, called a?

- A. Lamblia
- B. Shell
- C. Case
- D. Cyst
- E. Infection
- F. None of the Above

126. Which of the following terms can survive in the environment for long periods of time and is extremely resistant to conventional disinfectants such as chlorine?

- A. HIV
- B. Symptoms
- C. Infection
- D. Hepatitis A cyst
- E. Cyst
- F. None of the Above

127. Which of the following terms is a commonly reported protozoan-caused disease, it has been referred to as backpacker's disease?

- A. Giardia lamblia
- B. Giardiasis
- C. Malaise
- D. Cryptosporidiosis
- E. Anti-water Infection
- F. None of the Above

### Cholera Section Review

128. An organism called Vibrio Cholerae is the cause of cholera.

- A. True
- B. False

129. Cholera spreads rapidly in areas that have inadequate treatment of drinking water and sewage.

- A. True
- B. False

### Legionnaires' Disease Section

130. The bacteria that caused the 1976 outbreak of pneumonia at an American Legion convention came to be known as \_\_\_\_\_.

- A. Legionella
- B. Pontiac fever
- C. Aerosolized water
- D. Legionnaire's disease
- E. Legionella pneumophila
- F. None of the Above

### What have been the water sources for Legionnaires' disease?

131. The inhalation of small droplets of water or fine aerosol containing \_\_\_\_\_ is the most common cause of Legionnaires disease.

- A. Legionella
- B. Pontiac fever
- C. Legionella bacteria
- D. Legionnaire's disease
- E. Legionella pneumophila
- F. None of the Above

**How do people contract Legionella?**

132. The most common way that Legionella bacteria enter into the lungs to cause pneumonia is through breathing.

- A. True
- B. False

133. \_\_\_\_\_ can multiply rapidly in warm water-containing systems, from less than 10 per milliliter to over 1,000 per milliliter of water in a period of one month.

- A. Legionella bacteria
- B. Pontiac fever
- C. Monoclonal antibodies
- D. Legionnaire's disease
- E. Pneumophila
- F. None of the Above

**pH Section**

134. What is the theory that states that an acid is a substance that produces Hydronium ions when it is dissolved in water and a base is one that produces hydroxide ions when dissolved in water?

- A. Newton's
- B. Alkalinity
- C. Lord Calvin's
- D. Amadeus
- E. Arrhenius
- F. None of the Above

135. In chemistry, pH is a measure of the acidity or basicity of an aqueous solution. Solutions with a pH less than 7 are said to be acidic and solutions with a pH greater than 7 are basic or alkaline. Pure water has a pH very close to \_\_\_\_\_.

- A. 5
- B. 6
- C. 7
- D. 7.7
- E. 7.5
- F. None of the Above

136. According to the text, which of the following parameter/methods/measurements determine a parameter that uses a concentration cell with transference by measuring the potential difference?

- A. Primary pH standard values
- B. Alkalinity
- C. pH
- D. pH measurement(s)
- E. Measurement of pH
- F. None of the Above

137. Commercial standard buffer solutions usually comes with information about value and a correction factor to be applied for what temperatures?

- A. 4 °C
- B. 25 °C
- C. 39 °F
- D. 10 °C
- E. 70 °F
- F. None of the Above

138. Alkalinity is able to neutralize \_\_\_\_\_ and is measured in a quantitative capacity in an aqueous solution.

- A. Acid
- B. Base
- C. pH
- D. pH measurement(s)
- E. Bond formation
- F. None of the Above

139. Calculations are not necessary except in extreme situations for strong acids and bases. The pH of a solution containing a weak acid requires \_\_\_\_\_.

- A. The concentration value
- B. The solution of a quadratic equation
- C. The Spectrophotometer
- D. Visual comparison
- E. The solution of a cubic equation
- F. None of the Above

140. What factor is key in determining the suitability of water for irrigation?

- A. pH of 8
- B. pH of 7
- C. pH of 3
- D. Alkaline earth metal concentrations
- E. Borates, phosphates, silicates
- F. None of the Above

141. According to the text, what is the pH of pure water at 50 °C?

- A. 7.7
- B. 8.0
- C. 9.0
- D. 6.55
- E. 7.00
- F. None of the Above

### Chlorine (DDBP)

142. Two part question: Which term means that chlorine is present as Cl, HOCl, and OCl<sup>-</sup> is called \_\_\_\_\_, and that which is bound but still effective is \_\_\_\_\_.

- A. Free available chlorine and Total
- B. Free and Residual
- C. Break point and Free
- D. Free available chlorine and Combined Chlorine
- E. Combined chlorine and Readily available
- F. None of the Above

143. Chloramines are formed by reactions with?

- A. Acid and Cl<sub>2</sub>
- B. Ammonia and Cl<sub>2</sub>
- C. THMS and Cl<sub>2</sub>
- D. Folic Acid and Cl<sub>2</sub>
- E. THMs and Haploidic acid
- F. None of the Above

144. While testing the chlorine disinfection process, you will need to understand the ease of overdosing to create a "\_\_\_\_\_ " concentration.

- A. Free available chlorine and Total
- B. Residual
- C. Break point and Free
- D. Free available chlorine and Combined Chlorine
- E. Combined chlorine and Readily available
- F. None of the Above

145. According to the text, which type of chlorine residual concentration residual is from 0.1 to 0.5 ppm?

- A. Free available chlorine and Total
- B. Residual
- C. Break point and Free
- D. Free available
- E. Combined chlorine and readily available
- F. None of the Above

### The Principal Trihalomethanes are:

146. The chlorination by-products include the haloacetic acids and haloacetonitriles. The amount of THMs formed in drinking water can be influenced by a number of factors, including the season and the source of the water.

- A. True
- B. False

### Risks and Benefits of Chlorine

147. Many cities utilize ozone to disinfect their source water and to reduce formation of this parameter?

- A. Chlorate and Chlorite
- B. CO<sub>2</sub> and H<sub>2</sub>SO<sub>4</sub>
- C. Trihalomethanes (THMs)
- D. Ammonia and THMS
- E. Chloramines
- F. None of the Above

148. Two part question: \_\_\_\_\_ is a highly effective disinfectant; it breaks down quickly, so that small amounts of \_\_\_\_\_ or other disinfectants must be added to the water to ensure continued disinfection as the water is piped to the consumer's tap.

- A. Ozone, Chlorine
- B. UV, Chlorine
- C. Chlorite, Chlorine
- D. Chlorine Dioxide, Chlorine
- E. Chloramines, Chlorine
- F. None of the Above

#### Alternate Disinfectants -Chloramine

149. It is recommended that Chloramine be used in conjunction with a stronger disinfectant because it is best utilized as a?

- A. Chloramine
- B. T10 value disinfectant
- C. Free chlorine residual
- D. Stable distribution system disinfectant
- E. Sodium chlorite (NaClO<sub>2</sub>)
- F. None of the Above

#### Chlorine Dioxide

150. Which term provides good Giardia and virus protection but is limited by the restriction on the maximum residual of 0.5 mg/L ClO<sub>2</sub>/chlorite/chlorate allowed in finished water?

- A. Dry sodium chlorite
- B. Chlorine dioxide
- C. Chlorinated byproducts
- D. Ammonia residual(s)
- E. Free and/or combined chlorine
- F. None of the Above

151. Total residual oxidants (including chlorine dioxide and chlorite, but excluding Chlorine dioxide) shall not exceed 0.50 mg/L during normal operation or 0.30 mg/L (including chlorine dioxide, chlorite and chlorate) during periods of extreme variations in the raw water supply.

- A. True
- B. False

#### Ozone

152. When determining Ozone CT values for the ozone basin alone; an accurate \_\_\_\_\_ must be obtained for the contact chamber, and residual levels.

- A. Chloramine amount
- B. T10 value
- C. Free chlorine
- D. Contact time
- E. Residual
- F. None of the Above

153. Ozone does not provide a system residual and should be used as a primary disinfectant only in conjunction with?

- A. Dry sodium chlorite
- B. Chlorine dioxide
- C. Chlorinated byproducts
- D. Ammonia residual(s)
- E. Free and/or combined chlorine
- F. None of the Above

154. Ozone does not produce chlorinated byproducts but it may cause an increase in such byproduct formation if it is fed ahead of free chlorine; ozone may also produce its own oxygenated byproducts such as Cl<sub>2</sub> + NH<sub>4</sub>.

- A. True
- B. False

155. Which system must include adequate ozone leak detection alarm systems and an ozone off-gas destruction system?

- A. Dry sodium chlorite
- B. Chlorine dioxide
- C. T10 value
- D. Ammonia residual(s)
- E. Ozonation
- F. None of the Above

### Chlorine Exposure Limits

156. OSHA PEL is \_\_\_\_\_

- A. 10 PPM
- B. 1 PPM
- C. 00.1 PPM
- D. 1,000 PPM
- E. 100 PPM
- F. None of the Above

157. Physical and chemical properties: A yellowish green, nonflammable and liquefied gas with an unpleasant and irritating smell.

- A. Cl<sub>3</sub>
- B. Chlorine
- C. HOCl and OCl<sup>-</sup>
- D. Combined Available Chlorine
- E. Monochloramine
- F. None of the Above

158. This can be readily compressed into a clear, amber-colored liquid, a \_\_\_\_\_, and a strong oxidizer.

- A. Cl<sub>2</sub>
- B. Cl
- C. HOCl and OCl<sup>-</sup>
- D. Combined Available Chlorine
- E. Noncombustible gas
- F. None of the Above

159. Chlorine gas is about \_\_\_\_\_ times heavier than air.

- A. 1.5
- B. 1.0
- C. 0.5
- D. 2.5
- E. 3.0
- F. None of the Above

160. The IDLH (Immediately Dangerous to Life and Health) value for chlorine is \_\_\_\_\_.

- A. 10 PPM
- B. 1 PPM
- C. 00.1 PPM
- D. 1,000 PPM
- E. 100 PPM
- F. None of the Above

161. The Fatal Exposure Limit for chlorine is \_\_\_\_\_.

- A. 10 PPM
- B. 1 PPM
- C. 00.1 PPM
- D. 1,000 PPM
- E. 100 PPM
- F. None of the Above

162. A worker's exposure to chlorine shall at no time exceed the OSHA PEL.

- A. True
- B. False

163. Only use chlorine gas in a well-ventilated area so that \_\_\_\_\_ cannot concentrate.

- A. Chlorine exposure
- B. The connection
- C. The leak area
- D. Any leaking gas
- E. Several safety precautions
- F. None of the Above

164. When chlorine is added to water, \_\_\_\_\_ (HOCl) and the hypochlorite ion (OCl<sup>-</sup>) are formed.

- A. Cl<sub>2</sub>
- B. Hypochlorous acid
- C. Hypochlorite ion
- D. Combined Available Chlorine, Total
- E. Monochloramine, Cl<sub>2</sub>
- F. None of the Above

165. The chemical equation that best describes the reaction when \_\_\_\_\_ is added to water is:  $\text{Cl}_2 + \text{H}_2\text{O} \rightarrow \text{H}^+ + \text{Cl}^- + \text{HOCl}$ .

- A. Chlorine gas
- B. Cl
- C. HOCl and OCl-
- D. Combined Available Chlorine
- E. Monochloramine
- F. None of the Above

166. Which of the following substances is the most germicidal of the chlorine compounds with the possible exception of chlorine dioxide?

- A. Hydrochlorous acid
- B. Sulfuric acid
- C. Hypochlorous acid
- D. Combined Available Chlorine
- E. Monochloramine
- F. None of the Above

### Ozone - Strongest Oxidizing Agent

167. Which compound is obtained by passing a flow of air or oxygen between two electrodes that are subjected to an alternating current in the order of 10,000 to 20,000 volts?

- A. Chloramine
- B. Liquid Ozone
- C. Ozone
- D. Oxygen and nascent oxygen
- E. O<sub>2</sub>
- F. None of the Above

168. Which compound is a light blue gas at room temperature?

- A. Chloramine
- B. Liquid Ozone
- C. Ozone
- D. Oxygen and nascent oxygen
- E. O<sub>2</sub>
- F. None of the Above

169. Ozone has a \_\_\_\_\_ similar to that sometimes noticed during and after heavy electrical storms. In use, ozone breaks down into oxygen and nascent oxygen.

- A. Self-policing pungent odor
- B. THMs
- C. Light blue gas
- D. Oxygen and nascent oxygen
- E. Strongest oxidizing agent
- F. None of the Above

170. Ozone does not form chloramines or \_\_\_\_\_, and while it may destroy some THMs, it may produce others when followed by chlorination.

- A. Carcinogens
- B. THMs
- C. Complete disinfectant
- D. Oxygen and nascent oxygen
- E. Flocculation and coagulation
- F. None of the Above

171. Ozone falls into the same category as other disinfectants in that it can produce \_\_\_\_\_.

- A. Carcinogens
- B. THMs
- C. DBPs
- D. Oxygen and nascent oxygen
- E. Strongest oxidizing agent
- F. None of the Above

172. Which compound is very unstable and can readily explode, as a result, it is not shipped and must be manufactured on-site?

- A. Chloramine
- B. Liquid Ozone
- C. Ozone
- D. Oxygen and nascent oxygen
- E. O<sub>2</sub>
- F. None of the Above

173. Each water has its own \_\_\_\_\_, in the order of 0.5 ppm to 5.0 ppm. Contact time, temperature, and pH of the water are factors to be determined.

- A. Carcinogens
- B. THMs
- C. Ozone demand
- D. Oxygen and nascent oxygen
- E. Strongest oxidizing agent
- F. None of the Above

### Alternate Disinfectants Section Summary

#### Chloramines

174. Which compound is a very weak disinfectant for Giardia and virus reduction?

- A. Chlorine
- B. Chloramine
- C. Ozone
- D. Oxygen and nascent oxygen
- E. Strongest oxidizing agent
- F. None of the Above

175. In the production of chloramines, the ammonia residuals in the finished water when fed in excess of stoichiometric amount needed, should be limited to inhibit growth of?

- A. Cryptosporidium
- B. Chlorine-based disinfectants
- C. Giardia lamblia
- D. An emerging parasitic protozoan pathogen
- E. Nitrifying bacteria
- F. None of the Above

#### Chlorine Dioxide

176. Chlorine dioxide may be used for either taste and odor control or as?

- A. Post disinfectant
- B.  $\text{ClO}_2$ /chlorite/chlorate
- C. An oxidant
- D. Total residual oxidants
- E. A pre-disinfectant
- F. None of the Above

177. Total residual oxidants (including \_\_\_\_\_, but excluding chlorate) shall not exceed 0.30 mg/L during normal operation or 0.50 mg/L during periods of extreme variations in the raw water supply.

- A. Pre-disinfectant
- B.  $\text{ClO}_2$ /chlorite/chlorate
- C. An oxidant
- D. Chlorine dioxide and chlorite
- E. 25% aqueous solution of sodium chlorite ( $\text{NaClO}_2$ )
- F. None of the Above

178. According to the text, Chlorine dioxide provides good \_\_\_\_\_ protection but its use is limited by the restriction on the maximum residual of 0.5 mg/L  $\text{ClO}_2$ /chlorite/chlorate allowed in finished water.

- A. Pre-disinfectant
- B.  $\text{ClO}_2$ /chlorite/chlorate
- C. Level of
- D. Chlorine residual
- E. Giardia and virus
- F. None of the Above

179. Where chlorine dioxide is approved for use as an oxidant, the preferred method of generation is to entrain chlorine gas into a packed reaction chamber with a?

- A. Pre-disinfectant
- B.  $\text{ClO}_2$ /chlorite/chlorate
- C. An oxidant
- D. Total residual oxidants
- E. 25% aqueous solution of sodium chlorite ( $\text{NaClO}_2$ )
- F. None of the Above

180. Because dry sodium chlorite is dangerous and can be \_\_\_\_\_ in feed equipment if leaking solutions or spills are allowed to dry out.

- A. Prone to fire
- B. Choking risk
- C. An oxidant
- D. Oxidant
- E. Explosive and can cause fires
- F. None of the Above

### Chlorine's Effectiveness

181. Chlorination depends upon the chlorine demand of the water, the concentration of the chlorine solution added, the time that \_\_\_\_\_ is in contact with the organism, and water quality.

- A. Oxidizing chemical(s)
- B. Chlorine
- C. Sodium
- D. Caustic soda
- E. Sodium and chlorine ions
- F. None of the Above

182. Which missing term is less effective in cloudy water?

- A. Oxidizing chemical(s)
- B. Chlorination
- C. Sodium
- D. Caustic soda
- E. Sodium and chlorine ions
- F. None of the Above

183. Which term is less effective as the water's pH increases (becomes more alkaline)?

- A. Chlorination
- B. Caustic soda
- C. Chlorine ion
- D. Chlor-alkali membrane process
- E. Required contact time
- F. None of the Above

184. When chlorine is added to the water supply, part of it combines with other chemicals in water (like iron, manganese, \_\_\_\_\_) and is not available for disinfection.

- A. Hydrogen sulfide, and ammonia
- B. Caustic soda
- C. Chlorine ion
- D. Chlor-alkali membrane process
- E. Required contact time
- F. None of the Above

185. Which term best describes an amount of substance that reacts with the other chemicals and the amount required to achieve disinfection is the chlorine demand of the water?

- A. Oxidizing chemical(s)
- B. Chlorine
- C. Sodium
- D. Caustic soda
- E. Sodium and chlorine ions
- F. None of the Above

186. If the concentration of the \_\_\_\_\_ increases, the required contact time to disinfect decreases.

- A. Chlorination
- B. Caustic soda
- C. Chlorine
- D. Chlor-alkali membrane process
- E. Required contact time
- F. None of the Above

187. Which term is more effective as water temperature increases?

- A. Oxidizing chemical(s)
- B. Chlorination
- C. Sodium
- D. Caustic soda
- E. Sodium and chlorine ions
- F. None of the Above

### Oxidation Chemistry

188. Oxidizing chemicals are often utilized in water treatment programs include: chlorine, chlorine dioxide, bromine, bromine/chlorine releasing compounds, ozone and hydrogen peroxide.

- A. True
- B. False

189. Economical and versatile chemicals are often found at the forefront of many cooling water treatment programs. In large volume or once-through cooling systems, they are usually the primary biocide and often are the most cost-effective programs available to a plant.

- A. True
- B. False



190. The primary killing mechanism is oxidizing protein groups within a microorganism; these proteins are the basic components of \_\_\_\_\_ that are necessary for life-sustaining cellular processes such as respiration.

- A. Total Coliform (TC)
- B. Indicator organisms
- C. Cholera, polio, typhoid, hepatitis
- D. Cryptosporidium
- E. Essential cellular enzymes
- F. None of the Above

191. One oxidant is chlorine dioxide, which destroys these proteins depriving the cell of its ability to carry out \_\_\_\_\_ and quickly kills it.

- A. Effects of life
- B. Numerous processes
- C. Functionality
- D. Operations of Cellular amino acids
- E. Fundamental life functions
- F. None of the Above

### Chlorine Gas Section

192. When chlorine is added into the water stream, chlorine hydrolyzes into?

- A. HCL
- B. Sodium hypochlorite
- C. Bromoform
- D. Chlorine Acid
- E. Hypochlorous acid (HOCl), and hydrochloric acid (HCl)
- F. None of the Above

193. When chlorine hydrolyzation occurs, it provides an active toxicant, \_\_\_\_\_, which is pH-dependent. In alkaline cooling systems, it readily dissociates to form the hypochlorite ion.

- A. HCl
- B. HOCl
- C. High chlorine concentrations
- D. pH of 7.0 than at pH 8.5
- E. The hypochlorite ion (OCl<sup>-</sup>)
- F. None of the Above

194. In alkaline conditions, \_\_\_\_\_ becomes the predominant species and lacks the biocidal efficacy of the non-dissociated form.

- A. Chlorine
- B. Sodium hypochlorite
- C. OCl<sup>-</sup>
- D. Chlorine gas
- E. Hypochlorous acid (HOCl), and hydrochloric acid (HCl)
- F. None of the Above

195. Considerably more \_\_\_\_\_ is present at a pH of 7.0 than at pH 8.5.

- A. HCl
- B. HOCl
- C. High chlorine concentrations
- D. Alkalinity
- E. Hypochlorite ion (OCl<sup>-</sup>)
- F. None of the Above

196. \_\_\_\_\_, organic acids and organic compounds, sulfides, iron and manganese all easily react with HOCl.

- A. Chlorine
- B. Sodium hypochlorite
- C. Ammonia
- D. Chlorine gas
- E. Hypochlorous acid (HOCl), and hydrochloric acid (HCl)
- F. None of the Above

### Ozone

197. Which term must be determined for the ozone basin alone; an accurate T10 value must be obtained for the contact chamber, residual levels measured through the chamber and an average ozone residual calculated?

- A. Ozone CT (Contact time)
- B. Free and/or combined chlorine
- C. Residual levels
- D. Contact time
- E. Strongest oxidizing agent
- F. None of the Above

198. Ozone does not provide a \_\_\_\_\_ and should be used as a primary disinfectant only in conjunction with free and/or combined chlorine.

- A. Ozone CT
- B. Free and/or combined chlorine
- C. Residual level(s)
- D. System residual
- E. Risk
- F. None of the Above

199. Ozone does not produce \_\_\_\_\_ but it may cause an increase in such byproduct formation if it is fed ahead of free chlorine; ozone may also produce its own oxygenated byproducts such as aldehydes, ketones, or carboxylic acids.

- A. Carcinogens
- B. Organics
- C. Carboxylic acids
- D. Oxygen and nascent oxygen
- E. Chlorinated byproducts
- F. None of the Above

200. Ozone may also be used as \_\_\_\_\_ for removal of taste and odor, or may be applied as a pre-disinfectant.

- A. An oxidant
- B. Free and/or combined chlorine
- C. Residual levels
- D. System residual
- E. Strongest oxidizing agent
- F. None of the Above

### Types of Water Samples

201. It is important to properly identify the type of \_\_\_\_\_ you are collecting.

- A. Colilert
- B. Coliforms
- C. Sample
- D. Total coliform analysis
- E. Pathogens
- F. None of the Above

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

202. The number of repeat samples required are based on the number of \_\_\_\_\_ samples the water system normally collects.

- A. Repeat
- B. Special
- C. QA QC
- D. Total coliform analysis
- E. Routine
- F. None of the Above

203. A sample collected after repairs to the system and before it is placed back in operation is an example of a \_\_\_\_\_ sample.

- A. Repeat
- B. Special
- C. Sample
- D. Total coliform analysis
- E. Routine
- F. None of the Above

204. \_\_\_\_\_ samples are collected routinely in accordance with an approved sampling plan to monitor for contamination.

- A. Repeat
- B. Special
- C. Sample
- D. Total coliform analysis
- E. Routine
- F. None of the Above

### Repeat Sampling

205. If a \_\_\_\_\_ is total coliform- or fecal coliform-positive, a set of repeat samples must be collected within 24 hours after being notified by the laboratory.

- A. MCL compliance
- B. Distribution system
- C. Routine sample
- D. Original sampling location
- E. Repeat sample(s)
- F. None of the Above

**The follow-up for repeat sampling is:**

206. If only one \_\_\_\_\_ per month or quarter is required, four (4) repeat samples must be collected.

- A. Special Sample
- B. Routine sample
- C. Repeat sample(s)
- D. Coliform present
- E. Original sampling location
- F. None of the Above

207. If a system collects two (2) or more routine samples per month, it must collect three (3) \_\_\_\_\_.

- A. Compliance sample
- B. Distribution sample
- C. Routine sample
- D. QA/QC Split
- E. Repeat sample(s)
- F. None of the Above

208. One of the repeat samples must be collected from within five (5) service connections upstream from the \_\_\_\_\_.

- A. MCL compliance
- B. Distribution system
- C. Routine sample
- D. Original sampling location
- E. Repeat sample(s)
- F. None of the Above

209. The results of all \_\_\_\_\_ are included in the MCL compliance calculation.

- A. Special Samples
- B. Routine samples
- C. Repeat samples
- D. Coliform present
- E. Original sampling location
- F. None of the Above

**Sampling Procedures**

210. Which term must be followed and all operating staff must be clear on how to follow the sampling plan?

- A. Seal individual samples
- B. Chain of custody
- C. Distribution system
- D. Sample siting plan
- E. Positive for total coliform
- F. None of the Above

211. In order to properly implement the sample-siting plan, staff must understand the required sampling frequency and the \_\_\_\_\_ to be used for collecting the samples.

- A. Multiple sources
- B. Sample siting plan
- C. Total coliform rule
- D. Proper procedures and sampling containers
- E. Laboratory containers
- F. None of the Above

**Chain of Custody Procedures**

212. A \_\_\_\_\_ begins when the sample containers are obtained from the laboratory.

- A. Multiple sources
- B. Sample siting plan
- C. Total coliform
- D. Chain of custody record
- E. Sampling containers
- F. None of the Above

213. In addition to a \_\_\_\_\_, each custody sample may require a seal.

- A. Seal individual samples
- B. Chain of custody record
- C. Distribution system
- D. Sample siting plan
- E. Positive for total coliform
- F. None of the Above

214. If a sample must be split and sent to more than one laboratory, a separate \_\_\_\_\_ is required for each part of the sample.

- A. Form
- B. Chain of custody record
- C. Shipping invoice
- D. Sample siting plan
- E. Positive for total coliform
- F. None of the Above

215. The chain of custody record must be locked with the sealed samples inside sealed boxes if the samples are delivered to an after-hours night drop-off box.

- A. True
- B. False

**Entamoeba histolytica**

216. Which bug/creature/organism/species/disease invades the liver and forms an abscess, even less commonly, it spreads to other parts of the body, such as the lungs or brain?

- A. Symptoms
- B. Ameba
- C. Cryptosporidiosis
- D. Shigellosis (bacillary dysentery)
- E. Entamoeba histolytica or E. histolytica
- F. None of the Above

217. Which bug/creature/organism/species/disease may eat the dead cell or just absorb nutrients released from the cell?

- A. Symptoms
- B. Ameba
- C. Endoplasmic reticulum
- D. Prokaryotes
- E. Cells
- F. None of the Above

218. Which bug/creature/organism/species/disease on the average, only about one in 10 people who are infected will become sick from the infection?

- A. Cyst of C. parvum
- B. Shigellosis (bacillary dysentery)
- C. E. histolytica
- D. Cryptosporidiosis
- E. Cryptosporidial oocysts
- F. None of the Above

**Bacteriophage**

219. The genetic material can be ssRNA (single stranded RNA), dsRNA, ssDNA, or dsDNA between 5 and 500 kilo base pairs long with linear arrangement. Bacteriophages are much smaller than the Plasma membrane they destroy - usually between 20 and 200 nm in size.

- A. True
- B. False

220. Which creature or substance is estimated to be the most widely distributed and diverse entities in the biosphere?

- A. Bacteriophages
- B. Phages
- C. Microbial mats
- D. Peptidoglycan
- E. Virions
- F. None of the Above

221. Which creature or substance is ubiquitous and can be found in all reservoirs populated by bacterial hosts, such as soil or the intestine of animals?

- A. Host cell secretion
- B. Phage(s)
- C. Lysozyme
- D. Plasma membrane
- E. Bacterial hosts
- F. None of the Above

222. Phages may be released via cell lysis or by?

- A. Host cell secretion
- B. Phage(s)
- C. Lysogenic
- D. Plasma membrane
- E. Bacterial hosts
- F. None of the Above

223. Which phages do not kill the host but rather become long-term parasites and make the host cell continually secrete more new virus particles?

- A. Host cell secretion
- B. Phage(s)
- C. Lysogenic
- D. Plasma membrane
- E. Bacterial hosts
- F. None of the Above

### **Shigella dysenteriae**

224. Shigellae are gram-negative, non-spore-forming, facultatively anaerobic, pleomorphic bacteria.

- A. True
- B. False

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

- A. True
- B. False

226. Amebiasis is typically via ingestion (fecal–oral contamination); depending on age and condition of the host as few as ten bacterial cells can be enough to cause an infection.

- A. True
- B. False

### **Salmonella**

227. Salmonella is a \_\_\_\_\_.

- A. Gram-negative bacterium
- B. Microscopic organism
- C. Fecal matter
- D. Fecal coliform bacteria
- E. Conditions are favorable for growth
- F. None of the Above

### **Fecal Coliform Bacteria**

228. A microscopic organism that lives in the intestines of warm-blooded animals is \_\_\_\_\_.

- A. Enrichment culture
- B. Microscopic organisms
- C. Fecal matter
- D. Fecal coliform bacteria
- E. Conditions are favorable for growth
- F. None of the Above

229. Although \_\_\_\_\_ do not necessarily cause disease, they are indicators that other disease-carrying organisms may be present.

- A. Enrichment culture
- B. Microscopic organisms
- C. Fecal matter
- D. Fecal coliform bacteria
- E. Conditions are favorable for growth
- F. None of the Above

### **Reasons for Natural Variation**

230. \_\_\_\_\_ are living organisms, unlike other drinking water quality parameters.

- A. Bacteria levels
- B. Fecal coliform bacteria
- C. Salmonellae
- D. Bacterial concentrations
- E. Fecal matter
- F. None of the Above

231. Fecal coliform counts are difficult to predict because \_\_\_\_\_ are dependent on specific conditions for growth that can change quickly.
- A. Bacteria levels
  - B. Fecal coliform bacteria
  - C. Salmonellae
  - D. Bacterial concentrations
  - E. Fecal matter
  - F. None of the Above

### Expected Impact of Pollution

232. Wastewater treatment plant discharges, failing septic systems and animal waste all contribute \_\_\_\_\_ to fresh water.

- A. Enrichment culture
- B. Microscopic organisms
- C. Fecal matter
- D. Fecal coliform bacteria
- E. Conditions are favorable for growth
- F. None of the Above

233. Urbanization does not necessarily decrease bacterial levels in a watershed because \_\_\_\_\_ are developed.

- A. Bacteria levels
- B. Fecal coliform bacteria
- C. New sources of bacteria
- D. Bacterial concentrations
- E. Fecal matter
- F. None of the Above

### What are these Indicators?

234. Which bug/creature/organism/species may indicate that there are feces from warm-blooded animals in the water?

- A. Pathogens
- B. General coliforms
- C. Fecal coliforms
- D. Enterococcus bacteria
- E. Fecal streptococci
- F. None of the Above

235. Which term represents that the water has come in contact with plant or animal life?

- A. Pathogen are present
- B. General coliforms
- C. Fecal coliforms
- D. Enterococcus bacteria
- E. Biological
- F. None of the Above

236. Which bug/creature/organism/species/disease are universally present, including in pristine spring water?

- A. Pathogens
- B. General coliforms
- C. Fecal coliforms
- D. Enterococcus bacteria
- E. Shigella dysenteriae
- F. None of the Above

237. Which bug/creature/organism/species/disease at very high levels they indicate there is what amounts to a lot of compost in the water, which could easily include ten thousand general coliform bacteria?

- A. Pathogens
- B. General coliforms
- C. Fecal coliforms
- D. Enterococcus bacteria
- E. Shigella dysenteriae
- F. None of the Above

238. Which bug/creature/organism/species/disease, particularly E. coli, indicate that there are mammal or bird feces in the water?

- A. Pathogens
- B. General coliforms
- C. Fecal coliforms
- D. Enterococcus bacteria
- E. Shigella dysenteriae
- F. None of the Above

239. The more closely related the animal, the more likely \_\_\_\_\_ excreted with their feces can infect us.

- A. Pathogens
- B. General coliforms
- C. Fecal coliforms
- D. Enterococcus bacteria
- E. Gastroenteritis
- F. None of the Above

**E. coli O157:H7**

240. E. coli O157:H7 is found in human feces and causes \_\_\_\_\_ when consumed.

- A. Shigella dysenteriae
- B. Bacterium
- C. Enterococcus bacteria
- D. E. coli
- E. Gastroenteritis
- F. None of the Above

241. \_\_\_\_\_ has been identified as a cause of foodborne illness.

- A. Preventive measures
- B. Escherichia coli O157:H7
- C. Enterovirulent E. coli
- D. Gastroenteritis
- E. Person-to-person contact
- F. None of the Above

242. Illnesses caused by \_\_\_\_\_ have been associated with eating undercooked, contaminated ground beef.

- A. Shigella dysenteriae
- B. Bacterium
- C. Most illnesses
- D. E. coli
- E. E. coli O157:H7
- F. None of the Above

**What is Escherichia coli O157:H7?**

243. Typically, systems serving 25 to 1,000 people take one sample for coliform bacteria per month.

- A. True
- B. False

244. To comply with the Safe Drinking Water Act, public water systems are required by the EPA to monitor for \_\_\_\_\_.

- A. Indicators
- B. Five samples a month
- C. Bacterial contamination
- D. E. coli contamination
- E. Coliform bacteria
- F. None of the Above

245. If a water sample tests positive for total coliform, it must be further analyzed for \_\_\_\_\_.

- A. Total coliform
- B. Sanitary survey
- C. Fecal coliform or E. coli
- D. EPA regulations
- E. Coliform bacteria
- F. None of the Above

246. Smaller water systems are required to take at least five samples per month.

- A. True
- B. False

247. E. coli O157:H7 is one of hundreds of strains of the Enterococcus bacteria.

- A. True
- B. False

248. A 1982 outbreak of severe bloody diarrhea was caused by hamburgers contaminated with E. coli O157:H7 bacteria.

- A. True
- B. False

249. Types of E. coli bacteria are distinguished from each other using a combination of letters and numbers in the name of the bacterium.

- A. True
- B. False

250. \_\_\_\_\_ in the EEC group cause gastroenteritis in humans.

- A. Preventive measures
- B. E. coli O157:H7
- C. Enterovirulent E. coli
- D. A cause of illness
- E. Person-to-person contact
- F. None of the Above