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# Bacteriological Diseases Answer Key

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

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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 / SDWA regulations that may be more stringent than EPA's regulations. Check with your state environmental/health agency for more information. These rules change frequently and are often difficult to interpret and follow. Be careful to be in compliance with your regulatory agencies and do not follow this course for any compliance concerns.*

## Bacteriological Diseases CEU Training Course Assignment

The Bacteriological Diseases 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 Microbiology Section

1. Between 1948 and 1955, scientists at the National Institutes of Health (NIH) and at Johns Hopkins Medical Institutions revolutionized the study of animal viruses by developing \_\_\_\_\_ that permitted the growth and study of many animal viruses in laboratory dishes.

- A. Cell culture systems
- B. Bacteriophages
- C. Macroorganisms
- D. None of the above

2. Louis Pasteur along with which scientist developed the germ theory of disease that states that "a specific disease is caused by a specific type of microorganism?"

- A. Robert Koch
- B. Matthias Schleiden
- C. Rudolph Virchow
- D. None of the above

3. \_\_\_\_\_ completed the cell theory with the idea that all cells must arise from preexisting cells.

- A. Theodore Schwann
- B. Matthias Schleiden
- C. Rudolph Virchow
- D. None of the above

### Bacteria

4. Bacteria are prokaryotes (Kingdom Monera), which means that they have No true nucleus. They do have one chromosome of double-stranded DNA in a ring.

- A. True
- B. False

5. There are some bacteria relatives that can do photosynthesis--they don't have chloroplasts, but their \_\_\_\_\_ and other needed chemicals are built into their cell membranes.

- A. Chlorophyll
- B. An organelle
- C. Cellulose
- D. None of the above

6. Bacteria consist of only \_\_\_\_\_?

- A. A single cell
- B. An organelle
- C. Double-stranded DNA
- D. None of the above

### Prokaryotes

7. The only prokaryotes are Bacteria and archaea all other life forms are \_\_\_\_\_ creatures whose cells have nuclei.
- A. Bacteria                      C. Eukaryotes  
B. Peptidoglycan              D. None of the above

### Gram Stain

8. Two possible types of \_\_\_\_\_ may have more peptidoglycan than the other.
- A. Bacteria                      C. Bacterial cell walls  
B. Chemical cross linkages   D. None of the above
9. 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
10. Which type of bacteria have simpler cell walls with lots of peptidoglycan, and stain a dark purple color?
- A. Aerobic                      C. Gram<sup>+</sup>  
B. Gram<sup>-</sup>                      D. None of the above
11. With the Gram-stain, appearance is not particularly characteristic although rods are somewhat thinner than those seen for the?
- A. Coliform bacteria                      C. Standard plate count  
B. Enteric-like bacteria                      D. None of the above

### Two types of cells- Prokaryotes and Eukaryotes

12. Which of the following exhibits all the characteristics of life but it lacks the complex system of membranes and organelles?
- A. Prokaryotic cell                      C. Coliform bacteria  
B. Enteric-like bacteria                      D. None of the above

### Structure of a Eukaryotic Cell

13. Cell Membrane: The cell is enclosed and held intact by the cell membrane/plasma membrane/cytoplasmic membrane and is composed of large molecules of proteins and?
- A. Cytoplasmic granules                      C. Phospholipids  
B. Cell wall                      D. None of the above
14. Which of the following is selectively permeable?
- A. Cytoplasmic granules                      C. Cellular membrane  
B. DNA and proteins                      D. None of the above

### Cytoplasm

15. Cytoplasm is comprised of a semifluid gelatinous nutrient matrix and cytoplasmic organelles including endoplasmic reticulum, ribosomes, Golgi complex, mitochondria, \_\_\_\_\_, microtubules, lysosomes and vacuoles.
- A. Chromosomes                      C. Centrioles  
B. Prokaryotes                      D. None of the above



### **Cilia and Flagella**

16. Which of the following reflect cells that possess relatively long and thin structures called Flagella?
- A. Eukaryotic
  - B. Paramecium
  - C. Prokaryotic
  - D. None of the above

### **Structure of a Prokaryotic Cell**

17. All bacteria are prokaryotes and are simple cells and they divide by binary fission.
- A. True
  - B. False

### **Chromosome**

18. The chromosome of a prokaryotic cell normally consists of a single circular \_\_\_\_\_ and serves as the control center of the bacterial cell.
- A. Cytoplasmic granules
  - B. DNA molecule
  - C. Singular circular DNA molecule
  - D. None of the above

### **Cytoplasm**

19. Which of the following is a semi-liquid that surrounds the chromosome and is contained within the plasma membrane?
- A. Eukaryotic cell membrane
  - B. Cytoplasm
  - C. Macromolecular polymer-peptidoglycan
  - D. None of the above

### **Capsules**

20. Some bacteria have a layer of material outside the?
- A. Capsule
  - B. Cell wall
  - C. Membrane/cytoplasmic membrane
  - D. None of the above

### **Flagella**

21. Flagella are \_\_\_\_\_ that enable the bacteria to move.
- A. Forming spores
  - B. Cilia
  - C. False feet
  - D. None of the above

### **Pili or Fimbriae**

22. Pili or Fimbriae allow the bacteria to attach to other bacteria or to membrane surfaces such as intestinal linings or?
- A. Chromosomes
  - B. RBC
  - C. Pili or Fimbriae
  - D. None of the above

### **Spores**

23. Which of the following is enclosed in several protein coats that are resistant to heat, drying and most chemicals?
- A. Spores
  - B. Genetic material
  - C. Spore formation
  - D. None of the above

### **Bacterial Nutrition**

24. Which of the following is needed in substantial quantities, but some seem to need it in trace amounts?
- A. Iron, Zinc, Cobalt
  - B. Nitrogen
  - C. Calcium
  - D. None of the above

### **Fastidious**

25. Which of the following may synthesize every complex molecule they need from the basic minerals?
- A. Viruses
  - B. Bacteria
  - C. Centrioles
  - D. None of the above

### **What in the World is an Eukaryote?**

26. Which of the following terms represents animals, plants, and fungi, which are mostly multicellular, as well as various other groups called protists, many of which are unicellular?
- A. Eukaryote(s)
  - B. Bacteria
  - C. Prokaryote(s)
  - D. None of the above

### **Eukaryotic Cells**

27. According to the text, Eukaryotic cells are generally much larger than \_\_\_\_\_, typically with a thousand times their volumes.
- A. Macroorganisms
  - B. Bacteria
  - C. Prokaryote(s)
  - D. None of the above

### **Protozoan Reservoirs of Disease**

28. Which of the following represents the causative organism of Legionnaires' disease?
- A. Amoebae
  - B. Viruses
  - C. Bacterium *Legionella pneumophila*
  - D. None of the above

### **Symbionts**

29. Which of the following terms inhabit the rumen and reticulum of ruminates and the cecum and colon of equids?
- A. Ciliates
  - B. Marine protozoa
  - C. Freshwater protozoan
  - D. None of the above

### **Data on Protozoa**

30. Most ecologists who include \_\_\_\_\_ in their studies of aquatic habitats do not identify them, even if they do count and measure them for biomass estimates.
- A. Protozoa
  - B. Marine protozoa
  - C. Freshwater protozoan
  - D. None of the above

### **Ecological Role of Protozoa**

31. Which of the following terms represents an organism that is frequently overlooked; these play an important role in many communities where they occupy a range of trophic levels?
- A. Protozoa
  - B. Marine protozoa
  - C. Parasitic protozoa
  - D. None of the above

### **Factors Affecting Growth and Distribution**

32. Which of the following terms reproduce by cell division?
- A. Most free-living protozoa
  - B. Parasites
  - C. Trophozoites and cysts
  - D. None of the above

### **Protozoa**

33. When protozoa are in the form of \_\_\_\_\_, they actively feed and grow.
- A. Cysts
  - B. Trophozoites
  - C. Apicomplexans
  - D. None of the above

34. Which of the following play a role both as herbivores and as consumers in the decomposer link of the food chain?

- A. Protozoa
- B. Microinvertebrates
- C. Trophozoites and cysts
- D. None of the above

### Classification

35. Protozoa were usually grouped in the kingdom of Protista together with the plant-like algae and fungus-like water molds and slime molds. In the 21st-century systematics, protozoans, along with ciliates, mastigophorans, and apicomplexans, are arranged as animal-like protists.

- A. True
- B. False

### Amoebas

36. Pseudopods are used to capture prey; they simply engulf the food. They can detect the kind of prey and use different?

- A. Cells
- B. Cytoplasm
- C. Engulfing tactics
- D. None of the above

### Protozoa Information

37. Which of the following have been documented from almost every type of soil and in every kind of environment, from the peat-rich soil of bogs to the dry sands of deserts?

- A. Soil-dwelling protozoa
- B. Protozoan fauna
- C. Soil-loving Amoeba
- D. None of the above

### Environmental Quality Indicators

38. Polluted waters often have a rich and characteristic?

- A. Microsporidia
- B. Testate amoebae
- C. Protozoan fauna
- D. None of the above

### Symbiotic Protozoa

#### Parasites

39. Which term means a unique group of obligate, intracellular parasitic protozoa?

- A. Microsporidia
- B. Testate amoebae
- C. Protozoan fauna
- D. None of the above

40. There are four different genera of microsporidia (Encephalitozoon, Nosema, Pleistophora, and \_\_\_\_\_).

- A. Foraminifera
- B. Protozoan fauna
- C. Enterocytozoon
- D. None of the above

### Paramecium

41. Which of the following are single-celled, freshwater organisms in the kingdom Protista?

- A. Paramecium
- B. Bacteria
- C. Prokaryote(s)
- D. None of the above

42. Paramecium exist in an environment in which the osmotic concentration in their external environment is much lower than that in their?

- A. Contractile vacuoles
- B. Haptonema
- C. Cytoplasm
- D. None of the above

43. If Paramecium is to maintain \_\_\_\_\_, water must be continually pumped out of the cell at the same rate at which it moves in.

- A. Life
- B. Happiness
- C. Homeostasis
- D. None of the above

## **Bacteriological Monitoring Section**

### **Organisms Descriptors and Meanings**

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. Hetero means...
- A. Feed or nourish      C. Light
  - B. Other (Organic carbon)    D. None of the above
48. 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:**

49. Which of the following like salts and metals, which can be naturally occurring or result from urban stormwater runoff, industrial or domestic wastewater discharges, oil and gas production, mining or farming?
- A. Radioactive contaminants      C. Inorganic contaminants
  - B. Pesticides and herbicides      D. Microbial contaminants
50. Which of the following may come from a variety of sources such as agriculture, urban stormwater run-off, and residential uses?
- A. Radioactive contaminants      C. Inorganic contaminants
  - B. Pesticides and herbicides      D. Microbial contaminants
51. Which of the following, such as viruses and bacteria, which may come from sewage treatment plants, septic systems, agricultural livestock operations and wildlife?
- A. Microbial contaminants      C. Inorganic contaminants
  - B. Pesticides and herbicides      D. All of the above
52. 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
53. Which of the following can be naturally occurring or be the result of oil and gas production and mining activities?
- A. Radioactive contaminants      C. Inorganic contaminants
  - B. Pesticides and herbicides      D. Microbial contaminants

## **Background**

54. 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**

55. 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

56. 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

57. Coliform contamination may occur anywhere in the system, possibly due to problems such as; high-pressure conditions, line fluctuations, or wells, and therefore routine monitoring is required.

A. True      B. False

## **Routine Sampling Requirements**

58. 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

59. 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

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

A. True      B. False

61. 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

62. 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

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

A. True      B. False

### **Dangerous Waterborne Microbes**

64. 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

65. Which of the following can cause bacillary dysentery?

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

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

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

67. 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

68. 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

69. 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**

70. 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

71. 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

72. 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

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

### **Bacteria Sampling**

73. Water samples for \_\_\_\_\_ must always be collected in a sterile container.
- A. Amoebas
  - B. Bacteria tests
  - C. Viruses
  - D. None of the above

### **Methods**

74. 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
  - B. Coliform
  - C. Total coliform analysis
  - D. None of the above

### **Microbial Regulations**

75. 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
76. Among Surface Water Treatment Rule provisions, the rule requires that a public water system, using surface water (or ground water under the direct influence of surface water) as its source, have sufficient treatment to reduce the source water concentration of protozoa and coliform bacteria by at least 99.9% and 99.99%, respectively.
- A. True
  - B. False
77. The Surface Water Treatment Rule suggests treatment criteria to assure that these performance recommendations are met; they may include turbidity limits, disinfectant residual and disinfectant contact time conditions.
- A. True
  - B. False

### **Basic Types of Water Samples**

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

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

79. 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
  - B. Trigger: Level 2 Assessment
  - C. All of the above
  - D. None of the above
80. A PWS has a second Level 1 Assessment within a rolling 12-month period.
- A. Trigger: Level 1 Assessment
  - B. Trigger: Level 2 Assessment
  - C. All of the above
  - D. None of the above
81. A PWS on state-approved annual monitoring has a Level 1 Assessment trigger in 2 consecutive years.
- A. Trigger: Level 1 Assessment
  - B. Trigger: Level 2 Assessment
  - C. All of the above
  - D. None of the above
82. 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
  - B. Special
  - C. Routine
  - D. None of the above

83. 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
84. 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
85. 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
86. Noncommunity and nontransient noncommunity public water systems will sample at the same frequency as a like sized community public water system if:  
 1. It has more than 1,000 daily population and has ground water as a source, or  
 2. It serves 25 or more daily population and utilizes surface water as a source or ground water under the direct influence of surface water as its source.  
 A. True      B. False
87. 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

**Positive or Coliform Present Results**

88. 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
89. With a positive total coliform sample, and 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**

90. 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)**

91. 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**

92. 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



93. For systems that 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

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

94. 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

95. 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

96. 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

97. 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

98. 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

99. 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

100. The RTCR requires public water systems that are vulnerable to microbial contamination to identify and fix problems.
- A. True                    B. False

101. The water provider shall collect repeat samples (at least 3) for each TC+ positive routine sample.
- A. True                    B. False

102. 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

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

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

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

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

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

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

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

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

- A. True
- B. False

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

- A. True
- B. False

### Disinfection Key

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

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

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

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

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

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

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

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

### Giardia lamblia

112. 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

113. 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

114. 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

115. *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

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

- A. True
- B. False

### Waterborne Bacterial Diseases

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

- A. True
- B. False

### Viruses

#### Coronavirus

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

- A. True
- B. False

### Chain of Custody Procedures

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

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

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

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

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

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

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

### Escherichia Coli Section

#### Fecal Coliform Bacteria

122. Fecal Coliform Bacteria live in the waste material, or feces, excreted from the intestinal tract. When fecal coliform bacteria are present in high numbers in a water sample, it means that the water has received \_\_\_\_\_ from one source or another.

- A. Bacteria levels
- B. Fecal matter
- C. Enrichment concentrations
- D. None of the above

123. Although not necessarily agents of disease, \_\_\_\_\_ may indicate the presence of disease-carrying organisms, which live in the same environment as the fecal coliform bacteria.

- A. Paramecium
- B. Bacteria
- C. Fecal coliform bacteria
- D. None of the above

#### Reasons for Natural Variation

124. Which of the following is dependent on specific conditions for growth, and these conditions change quickly, fecal coliform bacteria counts are not easy to predict?

- A. Fecal matter
- B. Fecal coliform bacteria
- C. Bacterial concentrations
- D. None of the above

125. Winter rains may wash more \_\_\_\_\_ from urban areas into a stream; cool water temperatures may cause a major die-off.

- A. Fecal matter
- B. Fecal coliform bacteria
- C. Bacterial concentrations
- D. None of the above

#### Expected Impact of Pollution

126. The primary sources of \_\_\_\_\_ to fresh water are wastewater treatment plant discharges, failing septic systems, and animal waste.

- A. Bacteria levels
- B. New sources of bacteria
- C. Fecal coliform bacteria
- D. None of the above

#### Indicator Connection Varies

127. General coliforms, E. Coli, and Enterococcus bacteria are the " \_\_\_\_\_ " organisms generally measured to assess microbiological quality of water.

- A. Pathogens
- B. Fecal coliforms
- C. Indicator
- D. None of the above

#### E. coli O157:H7

128. Symptoms of E. coli O157:H7 (bacterium) vary with type caused \_\_\_\_\_.

- A. Gastroenteritis
- B. Bacterium
- C. E. coli
- D. None of the above

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

129. Systems serving 25 to 1,000 people typically take one sample per month. Some states reduce this frequency to quarterly for ground water systems if a recent sanitary survey shows that the system is free of sanitary defects.

- A. True
- B. False

130. Larger types of systems can qualify for five samples a month.

- A. True
- B. False

131. Systems using surface water, rather than ground water, are required to take extra steps to protect against bacterial contamination because surface water sources are more vulnerable to such contamination.

- A. True
- B. False

132. Which of the following is a normal occupant of the intestines of all animals, including humans?

- A. Shigella dysenteriae
- B. E. coli O157:H7
- C. Bacterium
- D. None of the above

133. Under the Safe Drinking Water Act, the EPA requires public water systems to monitor for ?  
 A. Indicators C. Coliform bacteria  
 B. Five samples a month D. None of the above
134. Systems analyze first for total coliform, any time that a sample is positive for total coliform, the same sample must be analyzed for either \_\_\_\_\_.  
 A. Total coliform C. Fecal coliform or E. coli  
 B. Sanitary survey D. None of the above

### **Giardiasis Giardia lamblia Section**

135. According to the text, Giardia lamblia (intestinalis) is a single celled animal, i.e., a protozoa, that moves with the aid of five flagella. In Europe, it is sometimes referred to as?  
 A. Lambia intestines C. Lamblia intestinalis  
 B. Giardia intestinalis D. None of the above
136. Giardiasis is the most frequent cause of non-bacterial diarrhea in North America. Giardia duodenalis, cause of giardiasis, is a one-celled, Microscopic parasite that can live in the intestines of animals and people.  
 A. True B. False
137. Giardia is found in every region throughout the world and has become recognized as one of the most common causes of waterborne (and occasionally foodborne) illness often referred to as "Beaver Fever."  
 A. True B. False
138. Approximately one week after ingestion of the \_\_\_\_\_, prolonged, greasy diarrhea, gas, stomach cramps, fatigue, and weight loss begin.  
 A. Intestinal flora C. Degrees of symptoms  
 B. Giardia cysts D. None of the above
139. Giardiasis disease runs its course in a week or two, although in some cases, the disease may linger for months, causing severe illness and weight loss. Nonetheless, the basic biology of this \_\_\_\_\_--including how it ravages the digestive tract--is poorly understood.  
 A. Intestinal flora C. Parasite  
 B. Giardia cysts D. None of the above
140. Which of the following uses these mitosomes in the maturation of iron-sulfur proteins rather than in ATP synthesis as is the case in mitochondria-possessing eukaryotes?  
 A. Intestinal flora C. Microaerophilic Giardia  
 B. Giardia cysts D. None of the above

### **Nature of Disease**

141. Which of the following may involve diarrhea within 1 week of ingestion of the cyst, which is the environmental survival form and infective stage of the organism?  
 A. Human giardiasis C. Immune deficiencies  
 B. The disease mechanism D. None of the above
142. Which of the following have been isolated and described through analysis of their proteins and DNA; type of strain, however, is not consistently associated with disease severity?  
 A. Several strains of G. lamblia C. Human giardiasis  
 B. The microaerophilic Giardia D. None of the above

### **Diagnosis of Human Illness**

143. *Giardia lamblia* is frequently diagnosed by visualizing the organism, either the trophozoite (active reproducing form) or the cyst (the resting stage that is resistant to adverse environmental conditions) in stained preparations or unstained wet mounts with the aid of a microscope.

A. True      B. False

### **Target Populations**

144. Chronic symptomatic giardiasis is more common in adults than children are.

A. True      B. False

### **Cryptosporidiosis Section**

145. Until 1993, when over 400,000 people in Milwaukee became ill with diarrhea after drinking water contaminated with the parasite, few people had heard of *Cryptosporidium parvum*, or the disease it causes, cryptosporidiosis.

A. True      B. False

146. Transmission is also common from ingestion of food or water contaminated with stool, including water in the recreational water park and swimming pool settings.

A. True      B. False

147. Symptoms of cryptosporidiosis include, most commonly, watery diarrhea and cramps, sometimes severe. Weight loss, nausea, vomiting, and fever are also possible.

A. True      B. False

148. The severity of symptoms varies with the degree of underlying immunosuppression, with immunocompetent patients commonly experiencing watery diarrhea for a few days to 4 or more weeks and occasionally having a recurrence of diarrhea after a brief period of recovery.

A. True      B. False

149. Cryptosporidiosis is most particularly a danger for the immunocompromised, especially HIV-positive persons and persons with AIDS. Individuals with CD4 cell counts below 200 are more likely to experience severe complications, including prolonged diarrhea, dehydration, and possible death.

A. True      B. False

### **Cholera -*Vibrio cholerae* Section**

150. In 1883, Louis Pasteur discovered *V. cholerae* during a cholera outbreak in Egypt.

A. True      B. False

151. Cholera has been very common in industrialized nations for the last 100 years.

A. True      B. False

152. Cholera is always life-threatening, it is easily prevented and treated with chloramines.

A. True      B. False

153. In the United States, because of advanced water and sanitation systems, cholera is not a major threat; however, everyone, especially travelers, should be aware of how the disease is transmitted and what can be done to prevent it.

A. True      B. False

154. The *V. cholerae* organism is a comma-shaped, gram-negative aerobic bacillus whose size varies from 1-3 mm in length by 0.5-0.8 mm in diameter. Its antigenic structure consists of a flagellar H antigen and a somatic O antigen.

A. True      B. False

## Related Diseases and Associated Illnesses Section

### Amebic Meningoencephalitis PAM Section *Naegleria fowleri*

155. Primary Amebic Meningoencephalitis (PAM) is a common and usually deadly disease caused by infection with the amoeba (a multi-celled organism that maintains the original shape).

A. True      B. False

156. Following an incubation period of 2-15 days, there is a relatively sudden start of severe meningitis-like symptoms, which begin with fever and headache. These are rapidly followed by sensitivity to light, nausea, projectile vomiting, stiff neck, and, in many cases, disturbances to taste and smell. Changes in behavior and seizures may also be present. As conditions worsen the patient falls into a coma. Death usually occurs 3-7 days after the onset of symptoms.

A. True      B. False

157. The amoeba that causes the infection lives in soil and in freshwater ponds, lakes, rivers, poorly or non-chlorinated pools, discharge or holding basins, and hot springs throughout the world. *Naegleria* thrives in warm, stagnant bodies of fresh water when temperatures are high, usually above 80 degrees.

A. True      B. False

### Noroviruses Section

158. Noroviruses (genus *Norovirus*, family *Caliciviridae*) are a group of related, single-stranded RNA, nonenveloped viruses that cause acute gastroenteritis in humans. Norovirus was recently approved as the official genus name for the group of viruses provisionally described as "Norwalk-like viruses" (NLV).

A. True      B. False

159. Persons who are infected with norovirus should not prepare food while they have symptoms and for 3 weeks after they recover from their illness. Food that may have been contaminated by an ill person can be eaten.

A. True      B. False

160. Illness caused by norovirus infection has several names, including stomach flu – this "stomach flu" is **not** related to the flu (or influenza), which is a respiratory illness caused by influenza virus.

A. True      B. False

161. Noroviruses are found in the stool or vomit of infected people. People can become infected with the virus in several ways, including eating food or drinking liquids that are contaminated with norovirus; touching surfaces or objects contaminated with norovirus, and then placing their hand in their mouth; having direct contact with another person who is infected and showing symptoms (for example, when caring for someone with illness, or sharing foods or eating utensils with someone who is ill).

A. True      B. False

162. Persons working in day-care centers or nursing homes should pay special attention to children or residents who have norovirus illness. This virus is very contagious and can spread rapidly throughout such environments.

A. True      B. False

## Water Laboratory Analysis Section

### pH Testing Section

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

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

164. 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

165. 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

166. Pure water has a pH very close to?

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

167. \_\_\_\_\_ 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
- B. Alkalinity
- C. pH measurement(s)
- D. None of the above

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

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

169. 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

170. 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

### 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.

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

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



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

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

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

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

### Surface Water (SW) System Compliance

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

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

175. 0.34 NTU in \_\_\_\_\_, never to exceed 1.0 NTU spike

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

176. Sample turbidity at each \_\_\_\_\_

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

### Disinfection Key

177. 99.9% or 3 log inactivation of \_\_\_\_\_

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

178. 99.99% or 4 log inactivation of \_\_\_\_\_

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

179. 99% or 2 log inactivation of \_\_\_\_\_

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

180. The chlorine residual leaving the plant must be = or > 2 mg/L and measurable throughout the system.

- A. True
- B. False

### Turbidity Key

181. Turbidity is normally measured in mg/L and its size is measured in multimeters.

- A. True
- B. False

182. Turbidity can be particles in the water consisting of finely divided solids, larger than bacteria, visible by the naked eye; ranging in size from 10 to 150mm.

- A. True
- B. False

### Cloudy Water

183. In order to have gravity affect these particles, we must somehow make them larger, somehow have them come together (agglomerate); in other words, somehow make them “stick” together, thereby increasing their size and mass.

- A. True      B. False

### Method 1623

#### Cryptosporidium and Giardia Analysis

184. Special sterilization procedures are needed for equipment used in the collection of samples for?

- A. Total Organisms      C. Indicator bugs  
B. Cryptosporidium and Giardia      D. None of the above

185. Washing the equipment free of residual sodium hypochlorite solution with three rinses of filter-sterilized water; do not de-chlorinate the equipment using?

- A. Sodium thiosulfate      C. Sodium hypochlorite solution  
B. Sulfuric acid      D. None of the above

### Laboratory Analysis

#### Sample Procedures

186. Samples need to be kept on ice and shipped to a central laboratory for analysis of coliphage, C. perfringens, Cryptosporidium, Giardia, and enteric viruses by the current analytical methods. The single-agar layer (SAL), direct plating method with induction of streptomycin and ampicillin is recommended for detection of somatic and F-specific coliphage in streamwater samples.

- A. True      B. False

187. In this method, 100-mL sample volumes are mixed with an agar medium, E. coli host culture, chemicals that induce the streptomycin and ampicillin enzymes, and appropriate antibiotics. The mixtures are poured into four 150- x 15-mm plates and incubated at 35°C.

- A. True      B. False

188. Upon infection by coliphage in the water sample, the E. coli host cells are lysed and stable indolyl product that is dark blue is visible within each plaque.

- A. True      B. False

189. Viral plaques are easily identified and enumerated by the distinct blue circle. Because of contamination by naturally occurring bacteria in streamwater samples, antibiotic-resistant host-culture strains, E. coli CN-13 (resistant to nalidixic acid) and E. coli F-amp (resistant to streptomycin and ampicillin) are used as hosts for somatic and F-specific coliphage, respectively.

- A. True      B. False

190. Large sample volumes, such as 1-L volumes or greater, are recommended for detection of coliphage in ground water.

- A. True      B. False

191. Standard MF techniques are used, and \_\_\_\_\_ are incubated anaerobically for 24 hours at 44.5°C.

- A. Oocyst(s)      C. Large sample volumes  
B. The plates      D. None of the above

192. After incubation, the plates are exposed to ammonium hydroxide, and all straw-colored colonies that turn dark pink to magenta are counted as \_\_\_\_\_.

- A. Enteric virus(es)
- B. E. coli host culture)
- C. C. perfringens
- D. None of the above

193. Which type of analyses is done with 100-, 30-, and 10-mL volumes of streamwater? In the case of a high-flow or high-turbidity streamwater sample, lower sample volumes may be plated.

- A. Coliphages
- B. C. perfringens
- C. Large sample volumes
- D. None of the above

194. Method 1623 (U.S. Environmental Protection Agency, 1999c) is recommended for detection of *Cryptosporidium* oocysts and *Giardia* cysts in water. The oocysts are concentrated on a capsule filter from a 10-L water sample, eluted from the capsule filter with buffer, and concentrated by centrifugation. Immunomagnetic separation (IMS) is used to separate the oocysts from other particulates in the sample.

- A. True
- B. False

195. In IMS, the \_\_\_\_\_ are magnetized by attachment of magnetic beads conjugated to an antibody and then are separated from sediment and debris by means of a magnet.

- A. Oocyst(s)
- B. C. perfringens
- C. *Cryptosporidium* oocysts and *Giardia* cysts
- D. None of the above

196. Fluorescently labeled antibodies and vital dye were used to make the final microscopic identification of?

- A. Enteric virus(es)
- B. Oocyst(s)
- C. Oocysts and cysts
- D. None of the above

197. To prepare samples for RT-PCR and cell culture, \_\_\_\_\_ are eluted from a 1MDS filter with beef extract (pH 9.5), concentrated using celite (pH 4.0), and eluted with sodium phosphate (pH 9.5).

- A. Oocyst(s)
- B. C. perfringens
- C. Attached viruses
- D. None of the above

### QA/QC Activities and Measures

198. QA/QC activities and measures to take to reduce contamination.

Use a sterilization indicator, such as autoclave tape, in preparing Viral plaques and other equipment for collection of microbiological samples to determine whether adequate temperatures and pressures have been attained during autoclaving.

- A. True
- B. False

### Field personnel should do the following:

199. Prepare \_\_\_\_\_, a 50- to 100-mL aliquot of sterile buffered water plated before the sample—for every sample by field personnel for total coliform, *E. coli*, and enterococci analyses to determine the sterility of equipment and supplies.

- A. Reagent water quality
- B. An environmental sample
- C. An MF equipment blank
- D. None of the above

### **Quality Assurance and Quality Control in the Laboratory**

200. According to the text, microbiology laboratories must follow good laboratory practices—cleanliness, safety practices, procedures for \_\_\_\_\_, specifications for reagent water quality—as set forth by American Public Health Association.

- A. Reagent water quality
- B. Microbiological sampling
- C. Media preparation
- D. None of the above