

**Registration form**

**WATER QUALITY \$200.00**  
**48 HOUR RUSH ORDER PROCESSING FEE ADDITIONAL \$50.00**

**Start and Finish Dates:** \_\_\_\_\_

*You will have 90 days from this date in order to complete this course*

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

**Name** \_\_\_\_\_ **Signature** \_\_\_\_\_

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

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

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

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

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

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

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

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

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

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*You can obtain a printed version of the course manual from TLC for an additional \$169.95 plus shipping charges.*

## **AFFIDAVIT OF EXAM COMPLETION**

I affirm that I personally completed the entire text of the course. I also affirm that I completed the exam without assistance from any outside source. I understand that it is my responsibility to file or maintain my certificate of completion as required by the state or by the designation organization.

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In order to maintain the integrity of our courses we do not distribute test scores, percentages or questions missed. Our exams are based upon pass/fail criteria with the benchmark for successful completion set at 70%. Once you pass the exam, your record will reflect a successful completion and a certificate will be issued to you.

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

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Technical Learning College requires that our students who takes a correspondence or home study program course must pass a proctored course reading, quiz and final examination. The proctor must complete and provide to the school a certification form approved by the commission for each examination administered by the proctor.

**Instructions.** When a student completes the course work, fill out the blanks in this section and provide the form to the proctor with the examination.

Name of Course: \_\_\_\_\_

Name of Licensee: \_\_\_\_\_

**Instructions to Proctor.** After an examination is administered, complete and return this certification and examination to the school in a sealed exam packet or in pdf format.

I certify that:

1. I am a disinterested third party in the administration of this examination. I am not related by blood, marriage or any other relationship to the licensee that would influence me from properly administering the examination.
2. The licensee showed me positive photo identification prior to completing the examination.
3. The enclosed examination was administered under my supervision on \_\_\_\_\_. The licensee received no assistance and had no access to books, notes or reference material.
4. I have not permitted the examination to be compromised, copied, or recorded in any way or by any method.
5. Provide an estimate of the amount of time the student took to complete the assignment.

Time to complete the entire course and final exam. \_\_\_\_\_

Notation of any problem or concerns:

Name and Telephone of Proctor (please print):

\_\_\_\_\_

\_\_\_\_\_

Signature of Proctor



# Water Quality Answer Key

Name \_\_\_\_\_

Phone \_\_\_\_\_

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

**No refunds.**

You are responsible to ensure this course is accepted for credit. No refunds.

Method of Course acceptance confirmation. Please fill this section

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

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

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

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

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

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**Please Sign that you understand and will abide with TLC's Rules.**

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**Signature**

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

## When Finished with Your Assignment...

### REQUIRED DOCUMENTS

Please scan the **Registration Page, Answer Key, Proctoring report, Survey and Driver's License** and email these documents to [info@TLCH2O.com](mailto:info@TLCH2O.com).

### iPhone Scanning Instructions

If you are unable to scan, take a photo of these documents with your **iPhone** and send these photos to TLC, [info@TLCH2O.com](mailto:info@TLCH2O.com).

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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.*



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

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

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

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

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

Please rate the difficulty of your course.

Very Easy    0    1    2    3    4    5    Very Difficult

Please rate the difficulty of the testing process.

Very Easy    0    1    2    3    4    5    Very Difficult

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

Very Similar    0    1    2    3    4    5    Very Different

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

What would you do to improve the Course?

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Any other concerns or comments.

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# Water Quality CEU Training Course Assignment

The Water Quality CEU course assignment is available in Word on the Internet for your convenience, please visit [www.abctlc.com](http://www.abctlc.com) and download the assignment and e-mail it back to TLC.

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

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

## Hyperlink to the Glossary and Appendix

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

## Water Quality Section

### Surface (Raw) Water Introduction

1. Operators need to appropriately treat surface water is never pure of \_\_\_\_\_, it. Most of the earth's water sources obtain their water supplies through precipitation.

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

2. Water passes runoffs and infiltrates the ground during precipitation; this runoff acquires a wide variety of \_\_\_\_\_ that intensely alters its usefulness.

- A. Excess nutrients
- B. Biological actions
- C. Dissolved or suspended impurities
- D. None of the above

### Three Types of Public Water Systems

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

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

4. Approximately 18,000 water systems

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

### Surface Water Properties

5. Runoff could produce mud, leaves, decayed vegetation, and human and animal refuse. The discharge from industry could increase \_\_\_\_\_.

- A. Volatile organic compounds
- B. Water quality
- C. Excess nutrients
- D. None of the above

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

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

### Managing Water Quality at the Source

7. Contingent upon the region, source water may have several restrictions of use as part of a Water Shed Management Plan. In some areas, it may be restricted from recreational use, discharge or runoff from agriculture, or \_\_\_\_\_.

- A. Excess nutrients
- B. Biological actions
- C. Industrial and wastewater discharge
- D. None of the above

### Physical Characteristics of Water

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

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

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

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

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

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

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

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

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

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

### Alkalinity

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

- A. True
- B. False

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

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

15. Alkalinity measurements are used in the interpretation and control of water and wastewater treatment processes

- A. True
- B. False

### **Turbidity Introduction**

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

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

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

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

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

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

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

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

### **Turbidity MCL**

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

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

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

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

### **Dissolved Oxygen**

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

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

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

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

## Objections to Hard Water

### Scale Formation

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

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

### Secondary Standard

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

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

### Langelier Saturation Index

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

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

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

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

### More on the Stage 2 DBP Rule

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

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

29. Safe Drinking Water Act (SDWA) has been highly effective in protecting public health and has evolved to respond to new and emerging threats to safe drinking water.

- A. True
- B. False

30. Which of the following is one of the major public health advances in the 20th century?

- A. Disinfection of drinking water
- B. Water distribution
- C. Amendments to the SDWA
- D. None of the above

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

- A. Cryptosporidium
- B. E. coli host culture
- C. Protozoa
- D. None of the above

32. The Stage 1 Disinfectants and Disinfection Byproducts Rule and \_\_\_\_\_, promulgated in December 1998.

- A. Stage 1 DBPR
- B. Stage 2 DBPR
- C. Interim Enhanced Surface Water Treatment Rule
- D. None of the above

### What are Disinfection Byproducts (DBPs)?

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

- A. Chloramines
- B. Humic and fulvic acids
- C. Disinfection byproducts (DBPs)
- D. None of the above

34. Total trihalomethanes and haloacetic acids are widely occurring \_\_\_\_\_ formed during disinfection with chlorine and chloramine.

- A. Gases
- B. Substances
- C. Classes of DBPs
- D. None of the above

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

35. The presence of TTHM and HAA5 is representative of the occurrence of many other chlorination DBPs; thus, an increase of TTHM and HAA5 generally indicates an increase of DBPs from chlorination.

- A. True
- B. False

### All disinfectants form DBPs in one of two reactions:

36. Chlorine and chlorine-based compounds (halogens) react with organics in water causing the hydrogen atom to substitute other atoms, resulting in halogenated by-products.

- A. True
- B. False

### Public Health Concerns

37. Results from toxicology studies have shown several DBPs (e.g., bromodichloromethane, bromoform, chloroform, dichloroacetic acid, and bromate) to be inert to laboratory animals.

- A. True
- B. False

### Disinfection Byproduct Research and Regulations Summary

38. \_\_\_\_\_ is unquestionably the most important step in the treatment of water for drinking water supplies.

- A. DBP(s)
- B. Turbidity (particle)
- C. Disinfection
- D. None of the above

39. The \_\_\_\_\_ should not be compromised because of concern over the potential long-term effects of disinfectants and DBPs.

- A. DBP(s)
- B. Turbidity (particle)
- C. Microbial quality of drinking water
- D. None of the above

40. The risk of illness and death resulting from exposure to pathogens in drinking water is very much greater than the risks from \_\_\_\_\_.

- A. Disinfectants and DBPs
- B. Turbidity (particle)
- C. Natural organic matter precursors
- D. None of the above

### Controlling Disinfection Byproducts

41. Treatment techniques are available that provide water suppliers the opportunity to maximize potable water safety and quality while minimizing the risk of \_\_\_\_\_.

- A. DBP risks
- B. Turbidity (particle)
- C. Disinfectants and DBPs
- D. None of the above

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

42. Generally, the best approach to reduce \_\_\_\_\_ is to remove natural organic matter precursors prior to disinfection.

- A. DBP(s)
- B. Turbidity (particle)
- C. DBP formation
- D. None of the above

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

**Coagulation and Clarification**

43. Most treatment plants optimize their coagulation process for \_\_\_\_\_ removal.

- A. Inorganic coagulants
- B. Most contaminants
- C. Turbidity (particle)
- D. None of the above

44. Coagulation processes can also be optimized for natural organic matter removal with higher doses of \_\_\_\_\_ (such as alum or iron salts), and optimization of pH.

- A. THMs and HAAs
- B. Inorganic coagulants
- C. Natural organic matter
- D. None of the above

**Absorption**

45. Activated carbon can be used to absorb \_\_\_\_\_ that react with disinfectants to form byproducts.

- A. Inorganic coagulants
- B. Most contaminants
- C. Soluble organics
- D. None of the above

**Organisms Descriptors and Meanings**

46. Hetero means...

- A. Feed or nourish
- B. Other (Organic carbon)
- C. Light
- D. None of the above

47. Anaerobic means...

- A. Without air
- B. With air
- C. Self (Inorganic carbon)
- D. None of the above

48. Litho means...

- A. Rock
- B. Organic
- C. Light
- D. None of the above

49. Organo means...

- A. Rock
- B. Organic
- C. Light
- D. None of the above

50. Auto means...

- A. Without air
- B. With air
- C. Self (Inorganic carbon)
- D. None of the above

51. Photo means...

- A. Feed or nourish
- B. Other (Organic carbon)
- C. Light
- D. None of the above



52. Troph means...
- A. Feed or nourish
  - B. Other (Organic carbon)
  - C. Light
  - D. None of the above

53. Chemo means...
- A. Rock
  - B. Organic
  - C. Chemical
  - D. None of the above

54. Facultative means...
- A. Without air
  - B. With air or without air
  - C. Self (Inorganic carbon)
  - D. None of the above

55. Aerobic means...
- A. Without air
  - B. With air
  - C. Self (Inorganic carbon)
  - D. None of the above

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

56. Which of the following like salts and metals, which can be naturally occurring or result from urban stormwater runoff, industrial or domestic wastewater discharges, oil and gas production, mining or farming?

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

57. 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
- B. Pesticides and herbicides
- C. Inorganic contaminants
- D. Microbial contaminants

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

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

**Background**

59. 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**

60. The TCR recommends most of the Public Water Systems (PWS) to monitor their distribution system for bacteria according to the written sample sitting plan for that system.

- A. True
- B. False

61. The sample sitting plan identifies sampling frequency and locations throughout the distribution system that are selected to be representative of conditions in the entire system.

- A. True
- B. False

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

### **Routine Sampling Requirements**

63. Total coliform samples must be collected by PWSs at sites that are representative of water quality throughout the distribution system according to a written sample siting plan subject to state review and revision.  
A. True      B. False
64. For PWSs collecting more than one sample per month, collect total coliform samples at regular intervals throughout the month, except that ground water systems serving 4,900 or fewer people may collect all required samples on a single day if the samples are taken from different sites.  
A. True      B. False
65. Each total coliform-positive (TC+) routine sample must be tested for the presence of autotrophic bacteria.  
A. True      B. False
66. If any TC+ sample is also E. coli-positive (EC+), then the EC+ sample result must be reported to the state by the end of the month that the PWS is notified.  
A. True      B. False
67. If any routine sample is TC+, repeat samples are required. – PWSs on quarterly or annual monitoring must take a minimum of one additional routine samples (known as additional routine monitoring) the quarter following a TC+ routine or repeat sample.  
A. True      B. False

### **Dangerous Waterborne Microbes**

68. Which of the following is a parasite that enters lakes and rivers through sewage and animal waste. It causes gastrointestinal illness (e.g. diarrhea, vomiting, and cramps)?  
A. Coliform Bacteria    C. Protozoa  
B. Cryptosporidium    D. None of the above
69. Which of the following is a species of the rod-shaped bacterial genus Shigella?  
A. Fecal coliform bacteria    C. Shigella dysenteriae  
B. Cryptosporidium            D. None of the above
70. 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
71. 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

72. 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

### **Bacteriological Monitoring Introduction**

73. 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

74. 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

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

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

### **Bacteria Sampling**

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

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

### **Methods**

77. The MMO-MUG test, a product marketed as \_\_\_\_\_, is the most common. The sample results will be reported by the laboratories as simply coliforms present or absent.

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

### **Microbial Regulations**

78. 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**

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

- A. True
- B. False

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

80. Samples collected following a coliform present routine sample. The number of repeat samples to be collected is based on the number of \_\_\_\_\_ samples you normally collect.

- A. Repeat
- C. Routine
- B. Special
- D. None of the above

81. A PWS has a second Level 1 Assessment within a rolling 12-month period.

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

82. 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

83. A PWS fails to take every required repeat sample after any single TC+ sample

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

84. A PWS incurs an E. coli MCL violation.

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

85. 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

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

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

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

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

- A. True
- B. False

### **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, 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
- B. Repeat sampling immediately
- C. Corrective measures
- 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
- B. Agar
- C. Heterotrophic Plate Count
- 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 which collect fewer than \_\_\_\_\_ samples per month, no more than one sample per month may be positive. In other words, the second positive result (repeat or routine) in a month or quarter results in a MCL violation.

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

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

94. Which determines a violation of nitrate?

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

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

95. 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

96. 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

97. 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

98. 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

99. 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

100. 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

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

- A. True                      B. False

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

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

- A. True      B. False

103. 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

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

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

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

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

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

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

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

- A. True      B. False

108. 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

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

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

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

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

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

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

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

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

## Waterborne Pathogen Section - Introduction

### Pathogen Section

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

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

### Protozoan Caused Diseases

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

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

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

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

### Giardia lamblia

116. 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

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

- A. True
- B. False

118. Vibrio cholerae, the basics. It's a virus. It causes diarrheal illness, also known as cholera. It is typically associated with aquatic environments, shell stocks, and human. Vibrio cholerae has also been associated with ship ballast water.

- A. True
- B. False

119. Legionnaire's disease, which causes a severe pneumonia, and the second, \_\_\_\_\_, which is a non-pneumonia illness; it's typically an influenza-like illness, and it's less severe.

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

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

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

121. Hepatitis A virus is resistant to combined chlorines, so it is important to have an adequate free chlorine residual. Fecal matter can shield Hepatitis A virus from chlorine.

- A. True
- B. False

122. Cryptosporidium is typically associated with animals and humans, and it can be acquired through consuming fecally contaminated food, contact with fecally contaminated soil and water.

- A. True
- B. False

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

123. Giardia prevention strategies for this pathogen include \_\_\_\_\_; filtration, coagulation, and halogenation of drinking water.
- A. Internal protection                      C. Containment protection  
B. Source protection                      D. None of the above

### **Waterborne Bacterial Diseases**

124. 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

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

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

### **Viruses**

#### **Coronavirus**

127. It looks like the COVID-19 coronavirus is not able to live in water.
- A. True                      B. False

### **Chain of Custody Procedures**

128. If both parties involved in the transfer must sign, date and note the time on the chain of custody record, this is known as?
- A. TC Plan                      C. Samples transfer possession  
B. Sample siting plan                      D. None of the above

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

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

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

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

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



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

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

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

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

### **Water Treatment Section - Preliminary Treatment Process**

#### **Preliminary Treatment**

133. Weeds, leaves, and trash, if not removed, these will cause problems to the treatment plant's pumps and equipment, the best way to protect the plant is?

- A. Screening
- B. Super settling
- C. Change source
- D. None of the above

134. According to the text, wire mesh screens need maintenance and require?

- A. Manual cleaning
- B. PM cleaning
- C. No cleaning
- D. None of the above

135. Mechanical bar screens vary in size and use some type of horizontal raking mechanism that travels horizontally down the bars to scrap the debris off.

- A. True
- B. False

#### **Conventional Water Treatment Process Introduction**

136. \_\_\_\_\_ along with pre-chlorination for removal of dissolved iron when present with small amounts relative of manganese

- A. Disinfection
- B. Coagulation
- C. Pre-treatment
- D. Aeration

137. \_\_\_\_\_ to remove particles from water either by passage through a sand bed that can be washed and reused or by passage through a purpose- designed filter that is washable.

- A. Disinfection
- B. Coagulation
- C. Pre-treatment
- D. Filtration

138. \_\_\_\_\_ for killing bacteria viruses and other pathogens.

- A. Disinfection
- B. Coagulation
- C. Pre-treatment
- D. Aeration along with pre-chlorination

#### **SWTR Rule**

139. Turbidity is caused by particles suspended in water. These particles scatter or reflect light rays, making the water appear cloudy.

- A. True
- B. False

140. Turbidity is expressed in nephelometric turbidity units (ntu) and a reading in excess of 5 ntu is generally noticeable to water system customers.

- A. True
- B. False

141. Besides the appearance of turbidity being unpleasant to customers, turbidity in water is significant from a public health standpoint because suspended particles could shelter microorganisms from the disinfectant and allow them to still be viable when they reach the customer.

A. True      B. False

142. EPA regulations direct that, for most water systems, the turbidity of water entering the distribution system must be equal or less than 0.5 ntu in at least 95 percent of the measurements taken each month. At no time may the turbidity exceed 5 ntu.

A. True      B. False

143. Turbidity changes in the distribution system can indicate developing problems. Increases in turbidity may also be caused by changes in velocity or inadequate flushing following main replacement.

A. True      B. False

### **Zeta Potential Introduction**

144. Zeta potential is a physical property exhibited by all solid-liquid and liquid-liquid colloidal systems. Surrounding the surface of all dispersed particles is a thick layer of ions that have the same charge of the particle's surface called the ATP layer.

A. True      B. False

145. The zeta potential is defined as the voltage at the edge of the slipping (shear) plane with respect to the bulk-dispersing medium, where ions, molecules and other agents are no longer associated with a particle's surface.

A. True      B. False

146. If two adjacent particles have sufficiently high zeta potentials of the same sign, they will agglomerate due to repulsive electrostatic forces between particles with unlike charges.

A. True      B. False

### **Solubility of Substances in Water**

147. Water is an excellent solvent for many compounds. Some dissolve in it as molecules while others, called electrolytes, dissociate and dissolve not as neutral molecules but as charged species called ions.

A. True      B. False

### **EPA Filter Backwash Rule- Introduction**

148. The U.S. Environmental Protection Agency (EPA) has finalized the Long Term 1 Enhanced Surface Water Treatment Rule and Filter Backwash Rule (LT1FBR) to increase protection of finished drinking water supplies from contamination by *Cryptosporidium* and other microbial pathogens.

A. True      B. False

### **LT1FBR Required**

149. The LT1FBR provisions does not apply to public water systems using surface water or ground water under the direct influence of surface water systems.

A. True      B. False

## Water Laboratory Analysis Section

### pH Testing Section

150. 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

151. 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

152. 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

153. Pure water has a pH very close to?

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

154. \_\_\_\_\_ 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

155. 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

156. 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

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

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

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

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

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

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

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

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

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

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

162. Which of the following terms of the color of a test solution with a standard color chart provides a means to measure pH accurate to the nearest whole number?

- A. Universal indicator
- B. Colorwheel measurement
- C. Visual comparison
- D. None of the above

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

- A. True
- B. False

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

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

165. Under normal circumstances this means that the concentration of hydrogen ions in acidic solution can be taken to be equal to the concentration of the acid. The pH is then equal to minus the logarithm of?

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

166. Alkalinity of water is its acid-neutralizing capacity. It is the sum of all the titratable bases. The measured value may vary significantly with the?

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

167. For strong acids and bases no calculations are necessary except in extreme situations. The pH of a solution containing a weak acid requires the solution of a quadratic equation. The pH of a solution containing a weak base may require the?

- A. Solution of a cubic equation
- B. Non-linear simultaneous equations
- C. Excess of alkaline earth metal concentrations
- D. None of the above

168. Alkalinity is a measure of this missing term and can be interpreted in terms of specific substances only when the chemical composition of the sample is known.

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

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

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

170. For strong acids and bases no calculations are necessary except in extreme situations. The pH of a solution containing a weak acid requires?  
 A. The concentration value                      C. Excess of alkaline concentrations  
 B. The solution of a quadratic equation        D. None of the above
171. Alkalinity in excess of which term is significant in determining the suitability of water for irrigation?  
 A. 8                      C. Alkaline earth metal concentrations  
 B. pH of 7              D. None of the above
172. The calculation of the pH of a solution containing acids and/or bases is an example of a \_\_\_\_\_ calculation, that is, a mathematical procedure for calculating the concentrations of all chemical species that are present in the solution  
 A. Chemical speciation              C. Visual comparison  
 B. Spectrophotometer                D. None of the above
173. Since pH is a logarithmic scale, a difference of one pH unit is equivalent to \_\_\_\_\_ fold difference in hydrogen ion concentration  
 A. 1    C. 10  
 B. .1   D. None of the above
174. Which of the following terms measurements is used in the interpretation and control of water and wastewater treatment processes?  
 A. Acid              C. Hydrogen bond formation  
 B. Alkalinity      D. None of the above
175. Which of the following terms are compounds that, for practical purposes, are completely dissociated in water.  
 A. Strong acids and bases    C. Strong bases and weak acids  
 B. Chemical ions in chains    D. None of the above
176. The pH of a solution containing a \_\_\_\_\_ may require the solution of a cubic equation.  
 A. Strong acids and bases    C. Weak base  
 B. Strong base                D. None of the above
177. Sodium hydroxide, NaOH, is an example of a?  
 A. Weak base              C. Strong acid  
 B. Strong base             D. None of the above

**Alkalinity Sub-Section**

178. Alkalinity of water is its acid-neutralizing capacity. It is the sum of all the \_\_\_\_\_. The measured value may vary significantly with the end-point pH used.  
 A. Titratable bases    C. Disinfection by-products  
 B. pH and alkalinity   D. None of the above
179. Alkalinity is a measure of an aggregate property of water and can be interpreted in terms of specific substances only when the chemical composition of the sample is known.  
 A. True              B. False

### Alkalinity and pH Adjustment

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

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

181. Alkalinity is a measure of the concentration of hydrogen ions present in water; pH is a measure of water's ability to neutralize acids.

- A. True
- B. False

182. Generally, water pH less than \_\_\_\_\_ is associated with uniform corrosion, while pH between 6.5 and 8.0 can be associated with pitting corrosion.

- A. 9.0
- B. 6.5
- C. 7.0
- D. None of the above

183. Some studies have suggested that systems using only pH to control corrosion should maintain a pH of at least \_\_\_\_\_ to reduce the availability of hydrogen ions as electron receptors.

- A. 9.0
- B. 6.5
- C. 7.0
- D. None of the above

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

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

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

- A. True
- B. False

186. Chemicals commonly used for pH and alkalinity adjustment are \_\_\_\_\_, caustic soda (NaOH or sodium hydroxide), soda ash (Na<sub>2</sub>CO<sub>3</sub> or sodium carbonate), and sodium bicarbonate (NaHCO<sub>3</sub>, essentially baking soda).

- A. Sodium bicarbonate
- B. Sulfuric acid
- C. Hydrated lime
- D. None of the above

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

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

### Corrosion Inhibitors

188. Inhibitors reduce corrosion by forming protective coatings on pipes. The most common corrosion inhibitors are \_\_\_\_\_, sodium silicates and mixtures of phosphates and silicates. These chemicals have proven successful in reducing corrosion in many water systems.

- A. Sodium bicarbonate
- B. Sulfuric acid
- C. Inorganic phosphates
- D. None of the above

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

- A. True
- B. False

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

191. Glassy phosphate has an appearance of table salt.  
A. True      B. False

192. Sodium silicates are particularly effective for systems with high water velocities, low hardness, low alkalinity and a pH of less than \_\_\_\_\_.  
A. 9.0      C. 7.0  
B. 8.4      D. None of the above

### **Turbidity Key**

193. Turbidity is normally measured in mg/L and its size is measured in multimeters.  
A. True      B. False

194. 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**

195. 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

### **Force due to van der Waals forces**

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

### **How to Treat Turbidity**

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

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

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

200. Ferrous Sulfate works well through a range of pH values, \_\_\_\_\_.  
A. 5.0 - 7.5    C. 4.5 to 9.5  
B. 4.5            D. None of the above

201. Alum works best in the pH range of natural waters, \_\_\_\_\_.  
A. 5.0 - 7.5    C. 4.5 to 9.5  
B. 4.5            D. None of the above

202. Ferric Chloride works best at lower pH values, down to pH \_\_\_\_\_.  
A. 5.0 - 7.5    C. 4.5 to 9.5  
B. 4.5            D. None of the above

### Disinfection Section

#### Chlorine's Appearance and Odor

203. Chlorine is a greenish-yellow gas it will condense to an amber liquid at approximately \_\_\_\_\_ F or at high pressures.  
A. -29.2 degrees            C. 29 degrees  
B. - 100 degrees            D. None of the above

204. Prolonged exposures to chlorine gas may result in?  
A. Moisture, steam, and water            C. Olfactory fatigue  
B. Odor thresholds                          D. None of the above

#### Chlorine Gas Pathophysiology

205. As far as chlorine safety and respiratory protection, the intermediate \_\_\_\_\_ of chlorine accounts for its effect on the upper airway and the lower respiratory tract.  
A. Effects of Hydrochloric acid            C. Water solubility  
B. Vapor from Chlorine gas                D. None of the Above

206. Respiratory exposure to \_\_\_\_\_ may be prolonged because its moderate water solubility may not cause upper airway symptoms for several minutes.  
A. Hydrochloric acid            C. Plasma exudation  
B. Chlorine gas                    D. None of the Above

207. The odor threshold for chlorine gas is approximately?  
A. 0.3-0.5 parts per million (ppm)    C. 3-5 parts per million (ppm)  
B. 3 parts per million (ppm)            D. None of the Above

#### Mechanism of Activity

208. Chlorine gas feeds out of the cylinder through a gas regulator. The cylinders are on a scale that operators use to measure the amount used each day. The chains are used to prevent the tanks from falling over.  
A. True            B. False

#### Early Response to Chlorine Gas

209. If you mix ammonia with chlorine gas, this compound reacts to form \_\_\_\_\_.  
A. Chloramine gas            C. Sulfuric gas  
B. Chlorine gas                D. None of the Above



## Reactivity

210. Cylinders of chlorine may burst when exposed to elevated temperatures. When there is Chlorine in solution, this forms?

- A. Hydrogen sulfide
- C. A corrosive material
- B. Oxomonosilane
- D. None of the above

211. What is formed when chlorine is in contact with combustible substances (such as gasoline and petroleum products, hydrocarbons, turpentine, alcohols, acetylene, hydrogen, ammonia, and sulfur), reducing agents, and finely divided metals?

- A. Fires and explosions
- C. Moisture, steam, and water
- B. Odor thresholds
- D. None of the above

212. Contact between chlorine and arsenic, bismuth, boron, calcium, activated carbon, carbon disulfide, glycerol, hydrazine, iodine, methane, oxomonosilane, potassium, propylene, and silicon should be avoided.

- A. True
- B. False

213. Chlorine reacts with hydrogen sulfide and water to form this substance?

- A. Hydrogen sulfide
- C. Chlorinates
- B. Hydrochloric acid
- D. None of the above

214. According to the text, chlorine is also incompatible with?

- A. Plastic
- C. Moisture, steam, and water
- B. Palladium
- D. None of the above

215. The effectiveness of chlorination depends on the \_\_\_\_\_ of the water, the concentration of the chlorine solution added, the time that chlorine is in contact with the organism, and water quality.

- A. Chlorine residual
- C. Oxygen
- B. Chlorine demand
- D. None of the above

216. Chlorine may not be available for disinfection because \_\_\_\_\_ in the water (like iron, manganese, hydrogen sulfide, and ammonia).

- A. pH increases
- C. Required contact time
- B. Part of it combines with other chemicals
- D. None of the above

217. The amount of chlorine required to achieve disinfection and that reacts with the other chemicals is the?

- A. Chlorine residual
- C. Free chlorine residual
- B. Chlorine demand
- D. None of the above

218. Which term is used when disinfection decreases, as the concentration of the chlorine increases?

- A. pH increases
- C. Required contact time
- B. Chlorine level and water quality
- D. None of the above

219. Chlorination is more effective as?

- A. Water temperature increases
- C. Water cools down
- B. Chlorine demand
- D. None of the above

220. Chlorination becomes more alkaline and is less effective as the?
- A. Water's pH increases
  - B. Water quality increases
  - C. Required contact time is maximized
  - D. None of the above

221. Chlorination is less effective in?
- A. Clear water
  - B. Cloudy (turbid) water
  - C. Day time
  - D. None of the above

222. By adding a little more chlorine to what is already sufficient, this action will generally result in \_\_\_\_\_ that can be measured easily.
- A. pH increases
  - B. A free chlorine residual
  - C. Required contact time
  - D. None of the above

### Chlorination Chemistry

223. The hypochlorite ion is a much weaker disinfecting agent than Hypochlorous acid, about 100 times less effective.
- A. True
  - B. False

224. According to the text, pH and temperature affect the ratio of hypochlorous acid to hypochlorite ions. As the temperature is decreased, the \_\_\_\_\_ increases.
- A. Reduction Ratio
  - B. Ratio of hypochlorous acid
  - C. "CT" disinfection concept
  - D. None of the above

225. Under normal water conditions, hypochlorous acid will also chemically react and break down into the hypochlorite ion.
- A. True
  - B. False

226. Although the ratio of \_\_\_\_\_ is greater at lower temperatures, pathogenic organisms are actually harder to kill.
- A. Hypochlorous acid
  - B. The amount of chlorine
  - C. Total chlorine
  - D. None of the above

227. If all other things were equal, \_\_\_\_\_ and a lower pH are more conducive to chlorine disinfection.
- A. Lower pH
  - B. Hypochlorous acid
  - C. Higher water temperatures
  - D. None of the above

228. All three forms of chlorine produce Sodium hypochlorite when added to water.
- A. True
  - B. False

229. Hypochlorous acid is a strong acid but a weak disinfecting agent. The amount of hypochlorous acid depends on the pH and temperature of the water.
- A. True
  - B. False

### Chlorine DDBP

230. These term means that chlorine is present as Cl, HOCl, and  $\text{OCl}^-$  is called \_\_\_\_\_, and that which is bound but still effective is \_\_\_\_\_.
- A. Free available chlorine and Total
  - B. Free and Residual
  - C. Free available chlorine and Combined Chlorine
  - D. None of the above

231. Chloramines are formed by reactions with?  
A. Acid and Cl<sub>2</sub>                      C. Folic Acid and Cl<sub>2</sub>  
B. Ammonia and Cl<sub>2</sub>                D. None of the above

### Types of Residual

232. Which of the following is all chlorine that is available for disinfection?  
A. Chlorine residual    C. Total chlorine  
B. Chlorine demand    D. None of the Above

### Chlorine Exposure Limits

233. What is OSHA's PEL?  
A. 10 PPM                      C. 1,000 PPM  
B. 1 PPM                        D. None of the above

234. Chlorine's Physical and chemical properties: A yellowish green, nonflammable and liquefied gas with an unpleasant and irritating smell.  
A. True            B. False

235. Liquid chlorine is about \_\_\_\_\_ times heavier than water  
A. 1.5            C. 2.5  
B. 10             D. None of the above

236. Gaseous chlorine is about \_\_\_\_\_ times heavier than air.  
A. 1.5            C. 2.5  
B. 10             D. None of the above

### Alternate Disinfectants - Chloramine

237. It is recommended that Chloramine be used in conjunction with a stronger disinfectant. It is best utilized as a?  
A. Chloramine                      C. Stable distribution system disinfectant  
B. T10 value disinfectant        D. None of the above

238. In the production of \_\_\_\_\_, the ammonia residuals in the finished water, when fed in excess of stoichiometric amount needed, should be limited to inhibit growth of nitrifying bacteria.  
A. Dry sodium chlorite              C. Ammonia residual(s)  
B. Chloramines                        D. None of the above

### Chlorine Dioxide

239. Which term provides good Giardia and virus protection but its use 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. Chlorinated byproducts    C. Ammonia residual(s)  
B. Chlorine dioxide              D. None of the above

240. If chlorine dioxide is being used as an oxidant, the preferred method of generation is to entrain this term or substance into a packed reaction chamber with a 25% aqueous solution of sodium chlorite (NaClO<sub>2</sub>).  
A. Chloramine                      C. Chlorine dioxide  
B. Chlorine gas                      D. None of the above

241. According to the text, which chemical is explosive and can cause fires in feed equipment if leaking solutions or spills are allowed to dry out?

- A. Dry sodium chlorite
- B. Chlorine dioxide
- C. Ammonia
- D. None of the above

242. Chlorine dioxide may be used for either taste or odor control or as a?

- A. Chloramine
- B. Pre-disinfectant
- C. Gas
- D. None of the above

243. 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

244. Ozone is a very effective disinfectant for both Giardia and viruses

- A. True
- B. False

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

- A. Residual
- B. T10 value
- C. Contact time
- D. None of the above

246. 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. Free and/or combined chlorine
- D. None of the above

247. Ozone does not produce chlorinated byproducts (such as trihalomethanes) 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  $\text{Cl}_2 + \text{NH}_4$ .

- A. True
- B. False

248. Ozonation must include an adequate ozone leak detection alarm system and an ozone off-gas destruction system.

- A. True
- B. False

249. Some people who drink water containing chlorite in excess of EPA standards over many years may experience problems with their liver, kidneys, or central nervous systems, and may have an increased risk of getting cancer.

- A. True
- B. False

250. Some infants and young children who drink water containing trihalomethanes in excess of EPA standards could experience nervous system effects.

- A. True
- B. False

## **When Finished with Your Assignment...**

### **REQUIRED DOCUMENTS**

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