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Chlorination 202 CEU Course Answer Key

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CHLORINATION 202 CEU TRAINING COURSE
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This course contains general EPA's SDWA federal rule requirements. Please be aware that each state implements water / sampling procedures/safety/ environmental / building regulations that may be more stringent than EPA's regulations. Check with your state environmental/health agency for more information. These rules change frequently and are often difficult to interpret and follow. Be careful to be in full-compliance and do not follow this course for proper compliance.

Chlorination 202 CEU Course Assignment

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

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

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

Preface

1. Selecting the right _____requires understanding several factors governing the particular site and the water or wastewater to be treated.

A. Operating costs
B. Disinfection weapon
C. UV device
D. Operating method
E. Net-positive environmental benefit
F. None of the Above

2. Safety. A system will often require significant safety protection—such as use of breathing apparatus and protective clothing—as well as high levels of operator training, it may be advisable to explore other, _____.

A. Disinfectant systems
B. Narrow tolerance
C. Desired parameters
D. Less intensive systems
E. Acceptable standards
F. None of the Above

3. Which of the following terms should be made for the effects of both intentional and unintentional releases to the environment even if the disinfectant is considered relatively safe to use.

A. Operating costs
B. Other than chlorine
C. Considerations
D. Dosage
E. Net-positive environmental benefit
F. None of the Above

4. An operator's treatment intent should be to reduce the levels of pathogens to acceptable standards and understanding how effective the disinfectant system is in achieving?

A. Target levels
B. Narrow tolerance
C. Desired parameters
D. Net-positive environmental benefit
E. Acceptable standards
F. None of the Above

5. If the disinfection system is complex it may require additional staff time to ensure that it operates within the?

A. Disinfectant system
B. Narrow tolerance
C. Desired parameters
D. Net-positive environmental benefit
E. Acceptable standards
F. None of the Above

6. Environmental/Adverse Effects. Some systems may need to have additional treatment of the disinfected effluent in order to render it benign when released, while other systems may provide a net-positive environmental benefit through increased?

A. Operating costs
B. Other than chlorine
C. Safeguards
D. Breathing apparatus and protective clothing
E. Oxygenation of the receiving waters
F. None of the Above

7. Flow and Water Characteristics. If your system cannot adjust for dry or wet weather flow rates of the receiving water body, _____ may also affect the system's appropriateness for your application.

A. Off-site concerns
B. Narrow tolerance
C. Desired parameters
D. Net-positive environmental benefit
E. Acceptable standards
F. None of the Above

8. Other than chlorine, there are primarily four basic disinfection systems currently available—chlorination, ozone gas, ultraviolet radiation, and Chemical treatment.

A. True B. False

9. An operator of an onsite water or wastewater treatment plant needs to consider some of the safeguards that need to be in place as well. One decision to install a system could be the result of local concerns and potential to mitigate health risks, as well as?

A. Improved community relations
B. Narrow tolerance
C. Desired parameters
D. Net-positive environmental benefit
E. Acceptable standards
F. None of the Above

Chapter 1- Disinfection Rules
Safe Drinking Water Act of 1974 Introduction

10. The states are expected to administer and enforce these regulations for public water systems (systems that either have 25 or more service connections or regularly serve an average of 50 or more people daily for at least 60 days each year).

A. True B. False

Relating to prevention of waterborne disease, the SDWA required EPA to:

11. Set numerical standards, referred to as Maximum Contaminant Levels (MCLs — the highest allowable contaminant concentrations in drinking water) or treatment technique requirements for contaminants in public water supplies;

A. True B. False

Disinfection Rules Disinfection Byproduct Regulations

12. Currently trihalomethanes are regulated at a maximum allowable annual average level of 100 parts per billion for water systems serving over 10,000 people under the _____finalized by the EPA in 1979.

A. Waterborne disease outbreaks
B. Total Trihalomethane Rule
C. Treatment measures
D. Amounts of disinfection byproducts
E. Trihalomethanes
F. None of the Above

Bromate

13. The EPA has established the Stage 1 Disinfectants/Disinfection Byproducts Rule to regulate _____at annual average of 10 parts per billion in drinking water.

A. Chlorine dioxide
B. Bromate
C. Trihalomethanes
D. Trihalomethanes, haloacetic acids, bromate, and chlorite
E. Disinfection byproducts
F. None of the Above

14. This standard became effective for large public water systems back in December 2001 and for small surface water and _____back in December 2003.

A. Waterborne disease outbreaks
B. Diagnosed cases of waterborne illness
C. Treatment measures
D. Amounts of disinfection byproducts
E. All ground public water systems
F. None of the Above

More on the Stage 2 DBP Rule

15. Which of the following rules is part of the Microbial and Disinfection Byproducts Rules, which are a set of interrelated regulations that address risks from microbial pathogens and disinfectants/disinfection byproducts?

A. Groundwater Rule (GWR)
B. Compliance
C. The Stage 2 DBP rule
D. Long Term 2 Enhanced Surface Water Treatment Rule (LT2)
E. Interim Enhanced Surface Water Treatment Rule
F. None of the Above

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

17. This rule will apply to all community water systems and nontransient non-community water systems that add a primary or residual disinfectant other than _____or deliver water that has been disinfected by a primary or residual disinfectant other than UV.

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

18. _____ has been highly effective in protecting public health and has also evolved to respond to new and emerging threats to safe drinking water.

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

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

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

20. There are specific microbial pathogens, such as_____, which can cause illness, and are highly resistant to traditional disinfection practices.
A. Enteric virus(es) D. C. perfringens
B. Oocyst(s) E. E. coli host culture
C. Cryptosporidium F. None of the Above

21. The Stage 1 Disinfectants and Disinfection Byproducts Rule and_____, promulgated in December 1998.
A. Major public health advances D. Amendments to the SDWA in 1996
B. The Stage 2 DBPR E. Interim Enhanced Surface Water Treatment Rule
C. This final rule F. None of the Above

22. The Stage 2 Disinfectants and Disinfection Byproducts Rule (Stage 2 DBPR) builds upon the _____to address higher risk public water systems for protection measures beyond those required for existing regulations.
A. Stage 2 DBPR D. Long Term 2 Enhanced Surface Water Treatment Rule
B. DBP exposure E. Traditional disinfection practices
C. Stage 1 DBPR F. None of the Above

23. _____ with the Long Term 2 Enhanced Surface Water Treatment Rule are the second phase of rules required by Congress.
A. Major public health advances D. Amendments to the SDWA in 1996
B. The Stage 2 DBPR E. Primary or residual disinfectant
C. This final rule F. None of the Above

24. Which of the following rules will reduce potential cancer and reproductive and developmental health risks from disinfection byproducts?
A. Stage 1 DBPR D. Long Term 2 Enhanced Surface Water Rule
B. DBP exposure E. Traditional disinfection practices
C. Stage 2 Disinfection Byproducts Rule F. None of the Above

25. Which of the following terms strengthens public health protection for customers by tightening compliance monitoring requirements for two groups of DBPs, trihalomethanes and haloacetic acids?
A. Major public health advances D. Amendments to the SDWA in 1996
B. The Stage 3 DBPR E. Primary or residual disinfectant
C. Stage 2 Disinfection Byproducts F. None of the Above

26. _____ targets systems with the greatest risk and builds incrementally on existing rules.
A. Stage 2 DBPR D. Long Term 2 Enhanced Surface Water Treatment Rule
B. The rule E. Traditional disinfection practices
C. The Stage 1 DBP rule F. None of the Above

27. Which of the following rules is being promulgated simultaneously with the Long Term 2 Enhanced Surface Water Treatment Rule to address concerns about risk tradeoffs between pathogens and DBPs?
A. Major public health advances D. Amendments to the SDWA in 1996
B. The Stage 2 DBPR E. Primary or residual disinfectant
C. This final rule F. None of the Above

What does the rule require?

28. Under _____ represents systems that will conduct an evaluation of their distribution systems, known as an Initial Distribution System Evaluation.

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

29. Compliance with the maximum contaminant levels for two groups of disinfection byproducts (TTHM and HAA5) will be calculated for each monitoring location in the distribution system. This approach is referred to as the?

A. TTHM and HAA5
B. DBP MCLs
C. Locational running annual average (LRAA))
D. Disinfection byproducts (DBPs)
E. Trihalomethanes and haloacetic acids
F. None of the Above

30. _____ also requires each system to determine if they have exceeded an operational evaluation level, which is identified using their compliance monitoring results.

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

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

A. TTHM and HAA5
B. DBP MCLs
C. DBPs from chlorination
D. Disinfection byproducts (DBPs)
E. Trihalomethanes and haloacetic acids
F. None of the Above

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

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

33. The amount of _____ in drinking water can change from day to day, depending on the season, water temperature, amount of disinfectant added, the amount of plant material in the water, and a variety of other factors.

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

Are THMs and HAAs the only disinfection byproducts?

34. _____ typically occur at higher levels than other known and unknown DBPs.

A. TTHM and HAAs
B. DBP MCLs
C. Classes of DBPs
D. Disinfection byproducts (DBPs)
E. Trihalomethanes and haloacetic acids
F. None of the Above

35. The presence of this missing term is representative of the occurrence of many other chlorination DBPs; thus, a reduction in the TTHM and HAA5 generally indicates a reduction of DBPs from chlorination.

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

What is in Water?

36. Water is a tasteless, odorless liquid at ambient temperature and pressure, and appears colorless in small quantities, although it has its own intrinsic very light blue hue. Ice also appears colorless, and water vapor is essentially invisible as a gas.

A. True B. False

37. Oxygen attracts protons much more strongly than hydrogen, resulting in a net negative charge on the hydrogen atoms, and a net negative charge on the oxygen atom. The presence of a charge on each of these atoms gives each water molecule a net dipole moment.

A. True B. False

38. Electrical attraction between water molecules due to this dipole pulls individual molecules closer together, making it more difficult to separate the molecules and therefore raising the boiling point.

A. True B. False

Introduction to Chlorine (DDBP)

39. These term means that chlorine is present as Cl, HOCl, and OCl^- is called _____, and that which is bound but still effective is _____.

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

40. Chloramines are formed by reactions with_____.

A. Acid and Cl2
B. Ammonia and Cl2
C. THMS and Cl2
D. Folic Acid and Cl2
E. THMs and Haploidic acid
F. None of the Above

41. While testing chlorine disinfection process, you will need to understand one especially important feature is the ease of overdosing to create a "_____" concentration.

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

42. According to the text, this type of chlorine residual concentration residuals from 0.1 to 0.5 ppm.

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

43. A typical chlorine residual is 2 ppm for this type of chlorine residual?

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

Chlorine By-Products

44. The most common chlorination by-products found in U.S. drinking water supplies are?

A. Chlorate and Chlorite
B. CO2 and H2SO4
C. Trihalomethanes (THMs)
D. Ammonia and THMS
E. Chloramines
F. None of the Above

The Principal Trihalomethanes are:

45. Chloroform, bromodichloromethane, chlorodibromomethane, and bromoform. Other less common chlorination by-products include the haloacetic acids and haloacetonitriles. The amount of THMs formed in drinking water can be influenced by a number of factors, including the season and the source of the water.

A. True B. False

46. THM concentrations are generally higher in winter than in summer, because concentrations of natural organic matter are greater and more chlorine is required to disinfect at colder temperatures.

A. True B. False

47. THM levels are also low when wells or large lakes are used as the drinking water source, because organic matter concentrations are generally low in these sources.

A. True B. False

Health Effects

48. The available studies on health effects do not provide conclusive proof of a relationship between exposure to THMs and cancer or reproductive effects, but indicate the need for further research to confirm their results and to assess the potential health effects of chlorination by-products other than THMs.

A. True B. False

Risks and Benefits of Chlorine

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

A. Chlorate and Chlorite
B. CO2 and H2SO4
C. Trihalomethanes (THMs)
D. Ammonia and THMS
E. Chloramines
F. None of the Above

50. _____ is a highly effective disinfectant, it breaks down quickly, so that small amounts of _____ or other disinfectants must be added to the water to ensure continued disinfection as the water is piped to the consumer's tap.

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

51. Modifying water treatment facilities to use _____ can be expensive, and _____ treatment can create other undesirable by-products that may be harmful to health if they are not controlled (e.g., bromate).

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

52. Which term is a weaker disinfectant than chlorine, especially against viruses and protozoa; however, they are very persistent and, as such, can be useful for preventing re-growth of microbial pathogens in drinking water distribution systems?

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

53. Chlorine dioxide can be an effective disinfectant, but it forms?

A. Chlorate and Chlorite
B. CO2 and H2SO4
C. THMS
D. Ammonia and THMS
E. Chloramines
F. None of the Above

54. It is extremely important that water treatment plants ensure that methods used to control chlorination by-products do not compromise the effectiveness of water disinfection.

A. True
B. False

Disinfection Rule Review

55. Chlorine is the most widely used water disinfectant due to its effectiveness and cost. Using chlorine as a drinking water disinfectant has prevented millions of water borne diseases, such as typhoid, cholera, dysentery, and diarrhea. Most states require community water systems to use chlorination.

A. True
B. False

56. All disinfectants form DBPs in one of two reactions: Chorine and chlorine-based compounds (halogens) react with organics in water causing the chlorine atom to substitute other atoms resulting in _____.

A. Chlorine
B. Organic sulfide(s)
C. Calcium carbonate
D. Halogenated by-products
E. HOCl
F. None of the Above

57. Oxidation reactions, where chlorine oxidizes _____present in water.

A. Carbon
B. Surface water
C. Compounds
D. Chorine and chlorine-based compounds (halogens)
E. Secondary by-products
F. None of the Above

58. Which of the following rules requires systems using public water supplies from either surface water or groundwater under the direct influence of surface water to disinfect?

A. TTHM and HAA5 Rule
B. DBP MCLs Rule
C. A community water system (CWS)
D. Disinfection byproducts (DBPs) Rule
E. Surface Water Treatment Rule (SWTR)
F. None of the Above

59. The maximum contaminant level (MCL) for the SWTR disinfection set by EPA. At this time, an MCL is set for only_____, and proposed for additional disinfection byproducts.

A. TTHM and HAA5 Rule
B. DBP MCLs Rule
C. A community water system (CWS)
D. Disinfection byproducts (DBPs) Rule
E. Total Trihalomethanes
F. None of the Above

60. Which of the following rules apply to all community and non-community water systems using a disinfectant such as chlorine, chloramines, ozone and chlorine dioxide?

A. TTHM and HAA5 Rule
B. DBP MCLs Rule
C. A community water system (CWS)
D. Disinfection byproducts (DBPs) Rule
E. Disinfectants and Disinfection Byproducts (DBP)
F. None of the Above

61. The Long Term 2 Enhanced Surface Water Treatment Rule (LT2) rule applies to all water systems using _____under the influence of a surface water, as well as groundwater/surface water blends.

A. Surface water, groundwater
B. DBP MCLs Rule
C. A community water system (CWS)
D. Disinfection byproducts (DBPs) Rule
E. Total Trihalomethanes
F. None of the Above

62. Which of the following rules began in 2006 with the characterization of raw water Cryptosporidium and E. coli levels?

A. DBPs requirements
B. Disinfectants requirements
C. SDWA in 1996
D. Stage 1 Disinfectant and Disinfection Byproduct Rule
E. The LT2 requirements
F. None of the Above

63. Which of the following rules applies to all public water systems using groundwater?

A. Groundwater Rule (GWR)
B. Compliance
C. SDWA in 1996
D. Long Term 2 Enhanced Surface Water Treatment Rule (LT2)
E. Interim Enhanced Surface Water Treatment Rule
F. None of the Above

Membrane Technology

64. Regulators and the public have focused greater attention on potential health risks from chemical contaminants in drinking water. One such concern relates to disinfection byproducts (DBPs), chemical compounds formed unintentionally when chlorine and other disinfectants react with certain inorganic matter in water.

A. True B. False

65. Water system managers may also consider switching from chlorine to alternative disinfectants to reduce formation of THMs and HAAs.

A. True B. False

66. All chemical disinfectants form some DBPs. Much less is known about the byproducts of these alternatives than is known about chlorination byproducts. Furthermore, each disinfection method has other distinct advantages and disadvantages.

A. True B. False

Chapter 2 - Waterborne Pathogens

67. 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. Limits the treatment process
B. Are mild in nature
C. Cause intestinal illness
D. Will cause fatalities
E. Limit the travel of pathogens
F. None of the Above

How Diseases Are Transmitted.

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

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

69. According to the text, _____ are spread by secretions that are coughed or sneezed into the air by an infected person.

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

70. Because of emerging waterborne diseases, a new dimension to the global epidemiology of cholera-an ancient scourge-was provided by the emergence of?

A. Cholera
B. Legionella pneumophila
C. Shigellosis
D. Vibrio cholerae O139
E. Campylobacter
F. None of the Above

71. Water authorities are reassessing the adequacy of current water-quality regulations because of outbreaks of chlorine-resistant?

A. Campylobacter
B. Pathogen
C. Pontiac fever
D. Cryptosporidium
E. Shigella dysenteriae
F. None of the Above

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

A. Campylobacter
B. Pathogen
C. Pontiac fever
D. Typhoid fever
E. Shigella dysenteriae
F. None of the Above

73. Shigella species, in the United States two-thirds of the shigellosis in the U.S. is caused by Shigella sonnei, and the remaining one-third is caused by Shigella flexnieri.

A. True B. False

74. Campylobacter, the basics. It's a bacterium. It causes diarrheal illness. And Campylobacter is primarily associated with poultry, animals, and humans.

A. True B. False

75. 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

76. 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. Campylobacter D. Typhoid fever
B. Pathogen E. Shigella dysenteriae
C. Pontiac fever F. None of the Above

77. Which pathogen is naturally found in water, both natural and artificial water sources?
A. Campylobacter D. Typhoid fever
B. Legionella E. Hydrodysenteriae
C. Pontiac fever F. None of the Above

78. Legionella, prevention. Legionella in water systems. Hot water in tanks should be maintained between _____degrees Centigrade.
A. 81 to 100 D. 71 and 77
B. 110 to 210 E. 75 and 85
C. 75 – 212 F. None of the Above

79. Pseudomonas, the basics. It's a protozoon. It is caused by visual contact with water. It can cause dermatitis, which is an inflammation of the skin, or it can cause otitis, which is an infection of the ear.
A. True B. False

80. Which of the following terms is typically associated with soil and water?
A. Hepatitis A virus D. Pseudomonas
B. Diarrheal illness E. Waterborne outbreaks
C. Cryptosporidium F. None of the Above

81. Pseudomonas prevention. Proper maintenance and disinfection of recreational water systems is important in preventing?
A. Pathogen D. Pseudomonas
B. Cryptosporidium E. Salmonellosis
C. Hepatitis A virus F. None of the Above

82. Humans are the reservoir for the Norovirus. Prevention strategies for this pathogen include?
A. Maintaining water systems D. Containment protection
B. Source protection E. Internal protection
C. Chlorine monoxide F. None of the Above

83. Cryptosporidium causes diarrheal illness known as?
A. Vomiting D. Cryptosporidiosis
B. Hemorrhagic colitis E. Salmonellosis
C. Diarrhea F. None of the Above

84. 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

85. Cryptosporidium, prevention. Prevention strategies for this pathogen include source protection. A CT value of 9,600 is required when dealing with fecally accidents. CT equals a concentration, in parts per million, while time equals a contact time in minutes. _____ can also be prevented or eliminated by boiling water for one minute.

A. Hemorrhagic colitis
B. Diarrheal illness
C. Cryptosporidium
D. Pseudomonas
E. Waterborne outbreaks
F. None of the Above

86. Filtration with an "absolute" pore size of one micron or smaller can eliminate _____. And reverse osmosis is known to be effective as well.

A. Pathogen
B. Cryptosporidium
C. Hepatitis A virus
D. Pseudomonas
E. Salmonellosis
F. None of the Above

87. Giardia prevention strategies for this pathogen include _____; filtration, coagulation, and halogenation of drinking water.

A. Maintaining hot water systems
B. Source protection
C. Sulfur dioxide
D. Primary protection
E. Secondary measurements
F. None of the Above

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

A. Swimmer's itch
B. Beaver fever
C. Hemorrhagic colitis
D. Pseudomonas
E. Salmonellosis
F. None of the Above

Microbes

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

A. True
B. False

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

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

Bacteriological Monitoring Section - Repeat Sampling

91. Repeat sampling replaces the old check sampling with a more comprehensive procedure to try to _____areas in the system.

A. Double check the routine sample
B. Identify problem
C. Originate the sampling location
D. Sample
E. Calculate MCL compliance
F. None of the Above

92. According to the text, whenever a Routine Sample is total coliform or fecal coliform present, a set of repeat samples must be collected within how many hours after being notified by the laboratory.

A. 12
B. 24
C. 48
D. 10
E. 2
F. None of the Above

The follow-up for repeat sampling is:
93. If only one _____ per month or quarter is required, four (4) repeat samples must be collected.
A. Routine sample
B. Surface water sample
C. Original sample
D. Sample
E. MCL sample
F. None of the Above

94. Within five (5) service connections upstream from the?
A. Routine sample
B. Surface water
C. Original sampling location
D. Sample
E. MCL location
F. None of the Above

Positive or Coliform Present Results
95. According to the text, if you are notified of a positive test result you need to contact either the Drinking Water Program or your local county health department within 24 hours, or by the next business day after the?
A. Results are reported to you
B. Positive violation
C. Repeat sampling immediately
D. Sample violation
E. MCL compliance violation
F. None of the Above

Maximum Contaminant Levels (MCLs)
96. State and federal laws establish standards for drinking water quality. Under normal circumstances when these guidelines are being met, the water is somewhat safe to drink with little threat to human health.
A. True B. False

Heterotrophic Plate Count HPC
97. Heterotrophic Plate Count (HPC) --- formerly known as the Standard Plate Count, 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

98. Colonies may arise from pairs, chains, clusters, or single cells, all of which are included in the terms "_____"?
A. Coliform bacteria units
B. MCLs units
C. Standards
D. HPC units
E. Colony-forming units
F. None of the Above

Heterotrophic Plate Count (Spread Plate Method)
99. Which of the following terms use inorganic carbon sources, this is in contrast to heterotrophic organisms utilize organic compounds as their carbon source?
A. Colonies
B. Surface growth
C. AGAR
D. Heterotrophic organisms
E. Autotrophic organisms
F. None of the Above

Total Coliforms
100. 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

Acute Risk to Health (Fecal coliforms and E. coli)

101. Which of the following terms to human health violation occurs if either one of the following happens (Questions 394-395)?

A. Routine analysis
B. Drinking violation
C. Acute risk
D. Human health violation
E. Fecal coliform or E. coli is present
F. None of the Above

102. A routine analysis shows total coliform present and is followed by a repeat analysis that indicates?

A. Routine analysis
B. Drinking violation
C. Water penalty
D. Human health violation
E. Fecal coliform or E. coli present
F. None of the Above

103. A routine analysis shows total and _____ is followed by a repeat analysis that indicates total coliform present.

A. Routine analysis
B. Drinking water violation
C. MCL violation
D. Human health violations
E. Fecal coliform or E. coli present
F. None of the Above

Public Notice

104. A public notice is required to be issued by a water system whenever it fails to comply with an applicable MCL or_____, or fails to comply with the requirements of any scheduled variance or permit.

A. Routine analysis
B. Drinking water rule
C. Treatment technique
D. Human health violation
E. Fecal coliform or E. coli present
F. None of the Above

105. Which term best describes what also is required whenever a water system fails to comply with its monitoring and/or reporting requirements or testing procedure?

A. Routine analysis
B. Drinking water rule
C. MCL violation
D. Public notice
E. Fecal coliform or E. coli present count
F. None of the Above

106. There shall be certain information, be issued properly and in a timely manner, and contain certain_____ on the public notice.

A. Legal analysis
B. Drinking water rule information
C. NOVs
D. Mandatory language
E. Fecal language
F. None of the Above

The following are acute violations:

107. Which is violation of nitrate?

A. Presence
B. MCL
C. MCLG
D. Count
E. Acute violations
F. None of the Above

108. Any outbreak of _____, as defined by the rules.

A. Total coliforms
B. MCL
C. Waterborne disease
D. Radioactive bacteria
E. Acute violations
F. None of the Above

Chapter 3 - Water Chemistry
Halogen Section - Halides

109. What is the negative ion often referred to as?
A. Salts
B. A halide proton
C. A halide ion
D. Free radical
E. Diatomic Compound
F. None of the Above

110. Which of the following terms contains ions known as halides?
A. Salts
B. CXT values
C. Primary disinfectant
D. Many synthetic organic compounds
E. Neither fluorine nor bromine
F. None of the Above

111. Halide ions combined with single hydrogen atoms form the hydrohalic acids (i.e., HF, HCl, HBr, HI), a series of particularly strong acids, one being _____ .
A. HCl
B. HOCl
C. Hydrastatic acid
D. Chlorine gas
E. The hypochlorite ion (OCl-)
F. None of the Above

112. Many synthetic organic compounds such as plastic polymers, and a few natural ones, contain halogen atoms; these are known as halogenated compounds or?
A. Organic halides
B. Free radicals
C. Diatomic Compound
D. Many synthetic organic compounds
E. Neither fluorine nor bromine
F. None of the Above

Chlorine

113. Only halogen is needed in relatively large amounts (as chloride ions) by humans?
A. Chlorine
B. Chlorine dioxide
C. Iodine
D. Halogen(s)
E. Inhibitory transmitter GABA
F. None of the Above

114. This halogen is needed only in very small amounts for the production of thyroid hormones such as thyroxine?
A. Chlorine
B. Chlorine dioxide
C. Iodine
D. Halogen(s)
E. Inhibitory transmitter GABA
F. None of the Above

115. On the other hand, neither fluorine nor bromine are believed to be really essential for humans, although small amounts of _____can make tooth enamel resistant to decay.
A. Salts
B. Iodine
C. Chlorine
D. Synthetic organic compounds
E. Fluoride
F. None of the Above

Halogens

116. All Halogens have 7 electrons in their outer shells, giving them an oxidation number of -1. The halogens exist, at room temperature, in all three states of matter:
A. True B. False

pH Section

117. Alkalinity is the capacity of water to increase acids. This increase is caused by the water's content of carbonate, bicarbonate, hydroxide and occasionally borate, silicate and phosphate.
A. True B. False

118. pH is an expression of the intensity of the basic or acid condition of a liquid. EPA has a suggested range of 5.5 to 7.5 for pH (called a primary maximum contaminant level or MCL).
A. True B. False

119. Alkalinity and pH are similar because water is never strongly basic (high pH) to have a natural alkalinity.
A. True B. False

Chapter 4 -Chlorine Section

What Happens to Chlorine When it Enters the Environment?

120. When chlorine is released to soil, chlorine will react with moisture forming?
A. Free oxygen radicals D. A greenish-yellow, noncombustible gas
B. Chlorine gas E. Hypochlorous acid and hydrochloric acid
C. Hydrochloric acid F. None of the Above

121. According to the text, chlorine does not accumulate in the?
A. Food chain D. Water
B. Bacteria and viruses E. Treatment filter
C. In air F. None of the Above

122. When released to air, chlorine will react with water to form hypochlorous acid and hydrochloric acid, which are removed from the atmosphere by generation of free oxygen radicals.
A. True B. False

123. Chlorine reacts with water to form hypochlorous acid and hydrochloric acid. The hypochlorous acid breaks down rapidly. The hydrochloric acid also breaks down; its breakdown products will raise the pH of the water (makes it more basic).
A. True B. False

124. Chlorine is so important in poultry processing that the US Department of Agriculture requires an almost constant chlorine rinse for much of the cutting equipment. In fact, no proven economical alternative to chlorine disinfection exists for use in Meat and poultry processing facilities.
A. True B. False

Properties

125. Because it is highly reactive, chlorine is usually found in nature bound with other elements like sodium, potassium, and magnesium.
A. True B. False

126. In studying and _____ -- compounds that have at least one atom of the element carbon in their molecular structure. All living organisms, including humans, are composed of organic compounds.

A. Synthesizing organic compounds
B. Chlorine disinfection compounds
C. Chlorine inorganic compounds
D. Organic compounds
E. Abundant chemical elements
F. None of the Above

127. This is a huge reservoir of dissolved chlorine weathered from the continents and transported to the oceans by Earth's rivers.

A. Brine
B. Sodium chloride
C. Ancient seawater
D. Useful chemical elements
E. Seawater
F. None of the Above

128. Chemical elements have their own set of unique properties and chlorine is known as _____--so reactive, in fact, that it is usually found combined with other elements in the form of compounds.

A. Synthesizing organic compounds
B. A very reactive element
C. Chlorine compounds
D. Organic compounds
E. One of the most abundant chemical elements
F. None of the Above

129. This substance is capable of removing a wide variety of disease-causing germs from drinking water and wastewater as well as from hospital and food production surfaces.

A. Inorganic disinfectant
B. Chlorine-based disinfectants
C. Ancient seawater
D. Useful chemical elements
E. Organic compounds
F. None of the Above

130. Various states of chlorine includes when chlorine is isolated as a free element, chlorine is a greenish yellow gas, which is_____. It turns to a liquid state at -34°C (-29°F), and it becomes a yellowish crystalline solid at -103°C (-153°F).

A. 2.5 times heavier than water
B. 2.5 times lighter than air
C. 10 times heavier than air
D. 2.5 times heavier than air
E. 25 times heavier than air
F. None of the Above

Released From the Salt of the Earth

131. According to the text, because of the slow evaporation of?

A. Water
B. Brine
C. Ancient seawater
D. Useful chemical elements
E. Organic compounds
F. None of the Above

Chlorine's Appearance and Odor

132. Chlorine is a greenish-yellow gas it will condense to an amber liquid at approximately _____F or at high pressures.

A. 32 degrees
B. – 100 degrees
C. 129 degrees
D. 29 degrees
E. -29.2 degrees
F. None of the Above

133. Prolonged exposures to chlorine gas may result in_____. Odor thresholds ranging from 0.08 to part per million (ppm) parts of air have been reported.

A. Exposure to chlorine
B. Odor thresholds
C. A corrosive material
D. Olfactory fatigue
E. Moisture, steam, and water
F. None of the Above

Reactivity

134. 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

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

A. Hydrogen sulfide
B. Oxomonosilane
C. Sodium Chloride
D. Chlorinates
E. Hydrochloric acid
F. None of the Above

136. According to the text, chlorine is also incompatible with_____ .

A. Air
B. Ammonia
C. Sodium Chloride
D. Hydrogen sulfide
E. Moisture, steam, and water
F. None of the Above

137. Conditions Contributing to Instability: Cylinders of chlorine may burst when exposed to elevated temperatures. When there is Chlorine in solution, this forms?

A. Hydrogen sulfide
B. Oxomonosilane
C. Ammonia
D. A characteristic pungent odor
E. A corrosive material
F. None of the Above

138. Incompatibilities: 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. Exposure to chlorine
B. Odor thresholds
C. A corrosive material
D. Fires and explosions
E. Moisture, steam, and water
F. None of the Above

139. When chlorine is added into the water stream, chlorine hydrolyzes into _____ .

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

140. The combination of high chlorine demand in process-contaminated systems and the dissociation process in alkaline systems creates the need for greater chlorine feed to obtain the same microbial efficacy. This results in a higher concentration of HCl in the cooling system.

A. True B. False

141. Which of the following terms removes alkalinity, pH depression and system corrosion could occur?

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

142. _____can damage or penetrate the passive oxide layer, leading to localized damage of the metal surface.

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

143. When chlorine hydrolyzation occurs, it provides an active toxicant, _____, which is pH-dependent. In alkaline cooling systems, it readily dissociates to form the hypochlorite ion (OCl-).

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

144. In alkaline conditions, _____ becomes the predominant species and lacks the biocidal efficacy of the non-dissociated form.

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

145. Considerably more _____ is present at a pH of 7.0 than at pH 8.5.

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

146. Chlorine can be non-selective, making it very sensitive to contamination from either cooling water makeup or from in-plant process leaks. _____, organic acids and organic compounds, sulfides, iron and manganese all easily react with HOCl.

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

147. What is the term that best describes the amount of chlorine needed to react with contamination species and it must be satisfied before active HOCl is available to provide a free chlorine residual?

A. Chlorine demand
B. HOCl
C. High chlorine concentration
D. Total residual
E. The hypochlorite ion (OCl-)
F. None of the Above

Pathophysiology

148. 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. Generation of free oxygen radicals
B. Vapor from Chlorine gas
C. Effects of Hydrochloric acid
D. Water solubility
E. The odor threshold for chlorine
F. None of the Above

149. According to the text, respiratory exposure to _____ may be prolonged because its moderate water solubility may not cause upper airway symptoms for several minutes.

A. Hydrochloric acid
B. Chlorine gas
C. The gas
D. The chemical species produced
E. Plasma exudation
F. None of the Above

150. Because chlorine gas is so dangerous, the odor threshold for chlorine is approximately?
A. 1 parts per million (ppm)
B. 3 parts per million (ppm)
C. 10 parts per million (ppm)
D. 3-5 parts per million (ppm)
E. 0.3-0.5 parts per million (ppm)
F. None of the Above

Solubility Effects

151. Which of the following terms is highly soluble in water?
A. Hydrochloric acid
B. H2SO4
C. Hypochloric acid
D. Sodium hypochlorite solution
E. Sulfuric Acid
F. None of the Above

152. Because it is highly water soluble, hypochlorous acid has an injury pattern similar to?
A. Hydrochloric acid
B. H2SO4
C. Hypochloric acid
D. Sodium hypochlorite solution
E. Sulfuric Acid
F. None of the Above

153. _____ may account for the toxicity of elemental chlorine and hydrochloric acid to the human body.
A. Hydrochloric acid
B. H2SO4
C. Hypochloric acid
D. Hypochlorous acid
E. Sulfuric Acid
F. None of the Above

Early Response to Chlorine Gas

154. If you mix ammonia with chlorine gas, this compound reacts to form_____.
A. Hypochlorous acid
B. Chlorine gas
C. Hydrochloric acid
D. Sulfuric acid
E. Chloramine gas
F. None of the Above

155. The early response to the odor threshold for chlorine depends on the (1) concentration of chlorine gas, (2) duration of exposure, (3) water content of the tissues exposed, and (4) individual susceptibility.
A. True B. False

Immediate Effects

156. Which of the following answers is the best choice for the immediate effects of this substance's toxicity include acute inflammation of the conjunctivae, nose, pharynx, larynx, trachea, and bronchi?
A. Hydrochloric acid
B. Chlorine gas
C. Hypochlorous gas
D. Sulfuric acid
E. HOCL
F. None of the Above

Pathological Findings

157. Chlorine is a highly reactive gas.
A. True B. False

158. According to the text, treatment plants use _____to reduce water levels of microorganisms that can spread disease to humans.
A. HCl
B. HOCl
C. High chlorine concentrations
D. Chlorine
E. The hypochlorite ion (OCl-)
F. None of the Above

159. Chlorine gas is greenish yellow in color and very toxic. It is heavier than air and will therefore sink to the ground if released from its container. It is the toxic effect of Chlorine gas that makes it a good disinfectant, but it is toxic to more than just waterborne pathogens; it is also toxic to humans. It is a respiratory irritant and it can also irritate skin and mucus membranes.
A. True B. False

160. Chlorine gas is sold as a compressed liquid, which is amber in color. Chlorine, as a solid, is heavier (less dense) than water. If the chlorine liquid is released from its container it will quickly return back to its liquid state.
A. True B. False

161. Chlorine gas is the most expensive form of chlorine to use. The typical amount of chlorine gas required for water treatment is 1-16 mg/L of water. Different amounts of chlorine gas are used depending on the quality of water that needs to be treated. If the water quality is good, a higher concentration of chlorine gas will be required to disinfect the water if the contact time cannot be increased.
A. True B. False

Chlorine's Effectiveness

162. There are several factors when considering chlorine residual. 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 D. Chlorination
B. Color change E. Required contact time
C. Chlorine demand F. None of the Above

163. Sometimes chlorine is not available for disinfection because _____ in the water (like iron, manganese, hydrogen sulfide, and ammonia).
A. pH increases D. Required contact time
B. Chlorine level and water quality E. Part of it combines with other chemicals
C. Free chlorine residual F. None of the Above

164. The amount of chlorine required to achieve disinfection and that reacts with the other chemicals is the _____.
A. Chlorine residual D. Total
B. Color change E. Free chlorine residual
C. Chlorine demand F. None of the Above

165. _____ is used to disinfect decreases, as the concentration of the chlorine increases.
A. pH increases D. Required contact time
B. Chlorine level and water quality E. Not available for disinfection
C. Free chlorine residual F. None of the Above

166. Chlorination is more effective as?
A. Chlorine residual D. Water cools down
B. Colors change E. Water temperature increases
C. Chlorine demand F. None of the Above

167. Chlorination becomes more alkaline and is less effective as the?
A. Water's pH increases
B. Water quality increases
C. Free chlorine residual drops
D. Required contact time is maximized
E. Contact time
F. None of the Above

168. Chlorination is less effective in?
A. Clear water
B. Color change
C. Warm temps
D. Day time
E. Cloudy (turbid) water
F. None of the Above

169. 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. Chlorine level and water quality
C. Chlorine demand
D. Required contact time
E. A free chlorine residual
F. None of the Above

Oxidation Chemistry

170. Oxidizing chemicals are often utilized in water treatment programs include: chlorine, chlorine dioxide, bromine, bromine/chlorine releasing compounds, ozone and Hydrogen peroxide.
A. True B. False .

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

172. All of the following play a role in the decision-making process: environmental and regulatory impact, _____, process contamination, and equipment capital and maintenance expense.
A. As necessary
B. Disinfection process
C. System pH
D. The primary methods used for the disinfection
E. Economical and versatile chemicals
F. None of the Above

173. The primary killing mechanism is oxidizing protein groups within a microorganism; these proteins are the basic components of _____that are necessary for life-sustaining cellular processes such as respiration.
A. Total Coliform (TC)
B. Indicator organisms
C. Cholera, polio, typhoid, hepatitis
D. Cryptosporidium
E. Essential cellular enzymes
F. None of the Above

174. One oxidant is chlorine dioxide, which destroys these proteins depriving the cell of its ability to carry out _____and quickly kills it.
A. Effects of life
B. Numerous processes
C. Functionality
D. Operations of Cellular amino acids
E. Fundamental life functions
F. None of the Above

Understanding Combined Chlorine Residual

175. What is the best term that describes chlorine addition of chlorine at the plant headworks or prior to other water treatment or groundwater production processes and mainly used for disinfection and control of tastes, odors, and aquatic growth?

A. Chlorination
B. Post-chlorination
C. Chlorine Demand
D. Demand
E. Pre-chlorination
F. None of the Above

176. What term best describes the sum of free and combined chlorine?

A. Organic amine(s)
B. Disinfection
C. Free chlorine
D. Breakpoint chlorination
E. Total Chlorine
F. None of the Above

177. When chlorinating most potable water supplies, total chlorine is essentially equal to _____since the concentration of ammonia or organic nitrogen compounds (needed to form combined chlorine) will be very low.

A. Chlorination
B. The amount of chlorine
C. Chlorine Demand
D. Total chlorine
E. Free chlorine
F. None of the Above

178. What term best describes the residual chlorine existing in water in chemical combination with ammonia or organic amines which can be found in natural or polluted waters.

A. Combined chlorine
B. Disinfection
C. Free chlorine
D. Breakpoint chlorination
E. Total chlorine residual
F. None of the Above

179. Ammonia is sometimes deliberately added to chlorinated public water supplies to provide?

A. Chlorination
B. Inorganic chloramines
C. Chlorine Demand
D. Flavor
E. Increase pH value
F. None of the Above

180. _____ best describes the concentration of residual chlorine in water present as dissolved gas (Cl_2), hypochlorous acid (HOCl), and/or hypochlorite ion (OCl-).

A. Organic amine(s)
B. Disinfection
C. Free chlorine
D. Breakpoint chlorination
E. Total chlorine residual
F. None of the Above

181. What term best describes the minimum amount of chlorine needed to react in a water purification system; used as a monitoring measurement by system operators?

A. Chlorination
B. The amount of chlorine
C. Chlorine Demand
D. Total chlorine
E. Disinfection
F. None of the Above

182. What term best describes the concentration of chlorine in the water after the chlorine demand has been satisfied?

A. Chlorine Residual
B. Disinfection
C. Free chlorine
D. Breakpoint chlorination
E. Total chlorine residual
F. None of the Above

183. What term best describes this missing term, which includes both the free and combined or chemically bound chlorine residuals?
A. Chlorine Residual D. Chlorine Demand
B. Disinfection E. Total chlorine residual
C. Free chlorine F. None of the Above

184. _____ describes the addition of chlorine after a process or adding chlorine downstream to meet a demand in the system.
A. Chlorination D. Demand
B. Post-chlorination E. Pre-chlorination
C. Chlorine Demand F. None of the Above

185. Solid chlorine is about 1.5 times heavier than water and gaseous chlorine is about 2.5 times heavier than air. Atomic number of chlorine is 17. Cl is the elemental symbol and Cl2 is the chemical formula.
A. True B. False

186. Which of the following term reacts with bacteria as if it was very corrosive and burns the skin or covering killing the bacteria?
A. Chlorine tablet(s) D. Sodium and calcium hypochlorite
B. Chlorine E. Calcium hypochlorite
C. Solid chlorine F. None of the Above

187. What term best describes the addition of Cl_2 to the water until the Cl_2 demand is satisfied. Until all the microorganisms are killed?
A. Organic amine(s) D. Breakpoint chlorination
B. Disinfection E. Total chlorine residual
C. Free chlorine F. None of the Above

188. _____ describes the amount of chlorine used up in a water purification system; used as a monitoring measurement by system operators.
A. Chlorination D. Total chlorine
B. Total E. Combined Chlorine Residual
C. Chlorine Demand F. None of the Above

189. According to the text, a free chlorine residual of at least 10 mg/L should be maintained in the clear well or distribution reservoir immediately downstream from the point of post-chlorination and 2 mg/L in the distribution system to guard against backflow.
A. True B. False

190. What term best describes the total of free residual and combined residual chlorine in a water purification system; used as a monitoring measurement by system operators?
A. Organic amine(s) D. Breakpoint chlorination
B. Disinfection E. Total Chlorine Residual
C. Free chlorine F. None of the Above

191. If chloramines are present in the municipal water supply, then total chlorine should be higher than?
A. Organic amine(s)
B. Disinfection
C. Free chlorine
D. Breakpoint chlorination
E. Total chlorine residual
F. None of the Above

192. What term best describes the method of water disinfection where gaseous, liquid, or dissolved chlorine is added to a water supply system?
A. Chlorination
B. Disinfection
C. Chlorine Demand
D. Sterilization
E. Free chlorine
F. None of the Above

193. What term best describes the killing of everything.
A. Sterilization
B. Disinfection
C. Free chlorine
D. Breakpoint chlorination
E. Total chlorine meltdown
F. None of the Above

194. Physical and chemical properties of chlorine gas: A yellowish green, nonflammable and liquefied gas with an unpleasant and irritating smell. It can be readily compressed into a clear, amber-colored liquid, a noncombustible gas, and a strong oxidizer.
A. True B. False

Chemistry of Chlorination

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

196. 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. CT actual
C. Free chlorine residual
D. "CT" disinfection concept
E. Ratio of hypochlorous acid
F. None of the Above

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

198. Temperature plays a small part in the acid ratio. 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. Chlorine Demand
D. Total chlorine
E. pH value and temperature
F. None of the Above

199. 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. Lower water temperature
E. The hypochlorite ion
F. None of the Above

200. The disassociation of chlorine gas
(OCl -): HOCl $H^+ + OCl^-$ Also expressed $HOCl \rightarrow H^+ + OCl^-$
(hypochlorous acid) (hydrogen) (hypochlorite ion)
A. True B. False

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

202. 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

Types of Residual
203. Which of the following term is all the chlorine that is available for disinfection?
A. Chlorine residual D. Break-point chlorination
B. Chlorine demand E. Total chlorine
C. Free chlorine F. None of the Above

204. Total chlorine residual = free +_____.
A. Chlorine residual D. Combined chlorine residual
B. Chlorine demand E. Total chlorine residual
C. Free chlorine F. None of the Above

205. In water, there are always other substances (interfering agents) such as iron, manganese, turbidity, etc., which will combine chemically with the chlorine, this is called the?
A. Chlorine residual D. Break-point chlorination
B. Chlorine demand E. Total chlorine residual
C. Pathogen reduction F. None of the Above

206. According to the text, once chlorine molecules are combined with these interfering agents, they are not capable of disinfection. _____ is much more effective as a disinfecting agent.
A. Chlorine residual D. Break-point chlorination
B. Chlorine demand E. Total chlorine residual
C. Free chlorine F. None of the Above

207. Either a total or a _____can be read when a chlorine residual test is taken,
A. Chlorine residual D. Break-point chlorination
B. Chlorine demand E. Total chlorine residual
C. Free chlorine residual F. None of the Above

208. _____ is a much stronger disinfecting agent, therefore, most water regulating agencies will require that your daily chlorine residual readings be of free chlorine residual.
A. Free chlorine D. "CT" disinfection concept
B. Total residual E. T10 of the process unit
C. Free chlorine residual F. None of the Above

209. Which of the following terms is where the chlorine demand has been satisfied, and any additional chlorine will be considered free chlorine?
A. Chlorine residual D. Break-point chlorination
B. Chlorine demand E. Total chlorine residual
C. Free chlorine F. None of the Above

Residual Concentration/Contact Time (CT) Requirements
210. Since monitoring for very low levels of pathogens in treated water is analytically very difficult, utilizing the _____ is recommended to demonstrate satisfactory treatment.
A. Free chlorine D. "CT" disinfection concept
B. Total residual E. T10 of the process unit
C. Free chlorine residual F. None of the Above

211. _____ = Concentration (mg/L) x Time (minutes)
A. CT D. Total chlorine
B. The amount of chlorine E. pH value and temperature
C. Chlorine Demand F. None of the Above

212. The effective reduction in pathogens can be calculated by reference to standard tables of required?
A. Free chlorine D. "CT" s
B. Total residual E. T10 of the process unit
C. Free chlorine residual F. None of the Above

213. The CT concept as developed by the United States Environmental Protection Agency (uses the combination of disinfectant residual concentration (mg/L) and the effective disinfection contact time (in minutes) to measure effective pathogen reduction.
A. True B. False

Calculation and Reporting of CT Data
214. Reduction Ratio should be reported, along with the appropriate pH, temperature, and?
A. Reduction Ratio D. Disinfectant residual
B. CT actual E. T10 of the process unit
C. Free chlorine residual F. None of the Above

215. Which of the following terms must be greater than 1.0 to be acceptable_____ .
A. Reduction Ratio D. "CT" disinfection concept
B. CT actual E. T10 of the process unit
C. Free chlorine residual F. None of the Above

216. You can also calculate and record actual log reductions. Reduction Ratio = CT actual divide by?
A. Reduction Ratio D. "CT" disinfection concept
B. CT E. CT required
C. Free chlorine residual F. None of the Above

217. Which term shall be calculated daily, using either the maximum hourly flow and the disinfectant residual at the same time, or by using the lowest CT value if it is calculated more frequently?

A. Free chlorine
B. Total residual
C. Free chlorine residual
D. "CT" disinfection concept
E. Disinfection CT values
F. None of the Above

Chlor-Alkali Membrane Process

218. When a low voltage direct current (DC) power supply is applied to the electrodes in the cell, the _____in the brine are attracted in opposite directions to the polarized electrodes.

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

219. Which of the following terms passes across an ion selective membrane leaving the chlorine ion to combine with a second chlorine ion, which makes a chlorine gas bubble at the anode?

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

220. When the sodium crosses the membrane, it combines with a hydroxyl ion at the cathode (electrode) making sodium hydroxide, or caustic soda (NaOH). The hydroxyl ion originates from the dissolution of water at the cathode where _____also develops.

A. Hydrogen gas
B. Chlorination
C. Sodium
D. Caustic soda
E. Sodium and chlorine ions
F. None of the Above

221. The membrane in the cell keeps the two solutions separate; otherwise, the chlorine gas bubble would immediately combine with the caustic soda forming?

A. Chlorination
B. Caustic soda
C. Chlorine ion
D. Chlor-alkali membrane process
E. Sodium hypochlorite or bleach
F. None of the Above

222. The electrolysis occurs in a cell containing electrodes submerged in solutions called electrolytes. One electrode is referred to as the anode and is submerged in?

A. Chlorination
B. Caustic soda
C. Chlorine ion
D. Chlor-alkali membrane process
E. A salt water solution
F. None of the Above

223. The second electrode is the cathode and is submerged in a _____solution.

A. Oxidizing chemical(s)
B. A salt water solution
C. Sodium
D. Sodium hydroxide (caustic soda)
E. Sodium and chlorine ions
F. None of the Above

224. _____ is used to keep the two different solutions from mixing.

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

225. Chlorination depends on the chlorine demand of the water, the concentration of the chlorine solution added, the time that _____is in contact with the organism, and water quality.

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

226. Which of the following terms is less effective in cloudy (turbid) water?

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

227. _____ is less effective as the water's pH increases.

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

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

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

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

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

230. If the concentration of the _____ increases, the required contact time to disinfect decreases.

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

231. Which of the following terms is more effective as water temperature increases?

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

Disinfection Summary

232. According to the text, there are a number of chemicals and processes that will_____, but none are universally applicable.

A. Limit the effects of organic material
B. Numerous alternative disinfection processes
C. Residual level of disinfection
D. Disinfect wastewater
E. Limit the travel of pathogens
F. None of the Above

233. Aerobic treatment processes reduce pathogens, but not enough to qualify as?

A. As necessary
B. Disinfection process
C. Environmental and regulatory impact
D. Primary methods for the disinfection
E. Economical and versatile chemicals
F. None of the Above

234. Chlorination/dechlorination has been the most widely used disinfection technology in the U.S.; ozonation and UV light are emerging technologies." Each of these three methods have different considerations for the?

A. Disinfection of wastewater
B. Disinfection process
C. Environmental and regulatory impact
D. Disinfection
E. Economical and versatile chemicals
F. None of the Above

Water Disinfection

235. Disinfection is usually the final stage in the _____in order to limit the effects of organic material, suspended solids and other contaminants.

A. Limit the effects of organic material
B. Numerous alternative disinfection processes
C. Residual level of disinfection
D. Water treatment process
E. Limit the travel of pathogens
F. None of the Above

236. The primary methods used for the _____in very small (25-500 people) and small (501-3,300 people) treatment systems are ozone, ultraviolet irradiation (UV) and chlorine.

A. Chlorates are powerful oxidizers
B. Adverse health effects
C. Disinfection of water
D. Microbiological contamination
E. Sodium chloride
F. None of the Above

237. Which of the following term expresses that this is less widely used in small and very small water treatment systems, including chlorine dioxide, potassium permanganate, chloramines and peroxone (ozone/hydrogen peroxide).

A. Limit the effects of organic material
B. Numerous alternative disinfection processes
C. Residual level of disinfection
D. Additional killing mechanism
E. Pathogens
F. None of the Above

Chloride Ion

238. _____ is an example of table salt, which is sodium chloride with the chemical formula.

A. Chemical formula CaCl2
B. NaCl
C. Chlorite ion is ClO2-.
D. Corresponding anions Cl-, ClO-, ClO2-, ClO3-, or ClO4
E. Chlorine dioxide
F. None of the Above

239. Which of the following compounds or element is also the prosthetic group present in the amylase enzyme. Another example is calcium chloride with the chemical formula $CaCl_2$.

A. Chemical formula CaCl2
B. A chloride ion
C. Chlorite ion is ClO2-.
D. Corresponding anions Cl-, ClO-, ClO2-, ClO3-, or ClO4
E. Chlorine dioxide
F. None of the Above

240. _____ is also used for maintaining unpaved roads and for sanite fortifying roadbases for new construction.

A. Chemical formula CaCl2
B. Calcium chloride
C. Chlorite ion is ClO2-.
D. Corresponding anions Cl-, ClO-, ClO2-, ClO3-, or ClO4
E. Chlorine dioxide
F. None of the Above

241. Which of the following compounds are a closely monitored constituent of the mud system?
A. Chemical formula CaCl2 D. Chlorides
B. Chloride E. Chlorine dioxide
C. Chlorite ion is ClO2-. F. None of the Above

242. Which of the following terms is also a useful and reliable chemical indicator of river / groundwater fecal contamination, as chloride is a non-reactive solute and ubiquitous to sewage & potable water?
A. Chemical formula CaCl2 D. Corresponding anions Cl-, ClO-, ClO2-, ClO3-, or ClO4
B. Chloride E. Chlorine dioxide
C. Chlorite ion is ClO2-. F. None of the Above

Chlorite Ion
243. The chlorite ion is _____.
A. Chemical formula CaCl2 D. Corresponding anions Cl-, ClO-, ClO2-, ClO3-, or ClO4
B. Chloride E. Chlorine dioxide
C. ClO2- F. None of the Above

244. Chlorine can assume oxidation states of -1, +1, +3, +5, or +7 within the corresponding anions Cl-, ClO-, ClO_2-, ClO_3-, or ClO_4-, known commonly and respectively as?
A. CaCl2 D. Chloride, hypochlorite, chlorite, chlorate, and perchlorate
B. Chloride E. Chlorine dioxide
C. Chlorite ion is ClO2-. F. None of the Above

245. An additional oxidation state of +4 is seen in the neutral compound_____, which has a similar structure to chlorite ClO_2- (oxidation state +3) and the cation chloryl (ClO_2+) (oxidation state +5).
A. Chemical formula CaCl2 D. Corresponding anions Cl-, ClO-, ClO2-, ClO3-, or ClO4
B. Chloride E. Chlorine dioxide ClO_2
C. Chlorite ion is ClO2-. F. None of the Above

Chlorine Dioxide
246. Chlorine dioxide is a chemical compound with the formula?
A. Chemical formula CaCl2 D. Corresponding anions Cl-, ClO-, ClO2-, ClO3-, or ClO4
B. Chloride E. ClO_2
C. Chlorite ion is ClO2-. F. None of the Above

Haloacetic Acids
247. What type of substances are haloacetic acids in which a halogen atom takes the place of a hydrogen atom in acetic acid?
A. An anti-bonding orbital D. Carboxylic acids
B. A single halogen E. Calcium hypochlorite
C. Hypochlorite compounds F. None of the Above

248. The inductive effect caused by the _____often result in the higher acidity of these compounds by stabilizing the negative charge of the conjugate base.
A. High-test calcium hypochlorite(s) D. Electronegative halogens
B. Calcium hypochlorite tablets E. Chlorine dioxide
C. Hypochlorous acid F. None of the Above

Contaminants in Drinking Water

249. Which of the following terms expresses an exposure to such substances in drinking water has been associated with a number of health outcomes by epidemiological studies, although the putative agent in such studies has not been identified.

A. An anti-bonding orbital
B. A single halogen
C. Hypochlorite compounds
D. Disinfection by-products
E. Calcium hypochlorite
F. None of the Above

Hypochlorites

250. The same residuals are obtained as with gas chlorine, but the effect on the _____of the treated water is different.

A. High-test calcium hypochlorite(s)
B. Calcium hypochlorite tablets
C. Hypochlorous acid
D. Negative charge
E. pH
F. None of the Above

251. Hypochlorite compounds contain an excess of _____and tend to raise the pH of the water.

A. An anti-bonding orbital
B. Alkali
C. Hypochlorite compounds
D. A common undesirable by-product
E. Calcium hypochlorite
F. None of the Above

252. Calcium hypochlorite tablets are the predominant form in use in the United States for swimming pools. _____is the only liquid hypochlorite disinfectant in current use. There are several grades and proprietary forms available.

A. High-test calcium hypochlorite(s)
B. Calcium hypochlorite tablets
C. Hypochlorous acid
D. Sodium hypochlorite
E. Chlorine dioxide
F. None of the Above

Disinfection Byproducts

253. Which term represents when disinfectants used in water treatment plants react with bromide and/or natural organic matter present in the source water? Different disinfectants produce different types or amounts of disinfection byproducts.

A. Disinfection byproducts
B. Other disinfectants
C. Naturally occurring bromide
D. Occurring organic and inorganic matter in water
E. Most prevalent THM
F. None of the Above

254. Which term represents which regulations have been established have been identified in drinking water, including trihalomethanes, haloacetic acids, bromate, and chlorite?

A. Chlorine dioxide
B. HAA5
C. Trihalomethanes
D. Trihalomethanes, haloacetic acids, bromate, and chlorite
E. Disinfection byproducts
F. None of the Above

Trihalomethanes (THM)

255. _____ represents a group of four chemicals that are formed along with other disinfection byproducts when chlorine or other disinfectants used to control microbial contaminants in drinking water react with naturally occurring organic and inorganic matter in water.

A. Disinfection byproducts
B. Other disinfectants
C. Naturally occurring bromide
D. Occurring organic and inorganic matter in water
E. Trihalomethanes (THM)
F. None of the Above

256. Which term represents are chloroform, bromodichloromethane, dibromochloromethane, and bromoform?

A. Chlorine dioxide
B. HAA5
C. Trihalomethanes
D. Trihalomethanes, haloacetic acids, bromate, and chlorite
E. Chloroform
F. None of the Above

Haloacetic Acids (HAA5)

257. _____ represents substances in drinking water react with naturally occurring organic and inorganic matter in water.

A. Disinfection byproducts
B. Other disinfectants
C. Naturally occurring bromide
D. Occurring organic and inorganic matter in water
E. Microbial contaminants
F. None of the Above

258. Which term represents monochloroacetic acid, dichloroacetic acid, trichloroacetic acid, monobromoacetic acid, and dibromoacetic acid?

A. Chlorine dioxide
B. HAA5
C. Trihalomethanes
D. Trihalomethanes, haloacetic acids, bromate, and chlorite
E. Chloroform
F. None of the Above

259. Bromate is a chemical that is formed when which term is used to disinfect drinking water reacts with naturally occurring bromide found in source water?

A. Disinfection byproducts
B. Other disinfectants
C. Naturally occurring bromide
D. Occurring organic and inorganic matter in water
E. Ozone
F. None of the Above

260. Which term represents a byproduct formed when chlorine dioxide is used to disinfect water?

A. Chlorite
B. HAA5
C. Trihalomethanes
D. Trihalomethanes, haloacetic acids, bromate, and chlorite
E. Chloroform
F. None of the Above

Chloroform

261. Which is typically the most prevalent THM measured in chlorinated water, is probably the most thoroughly studied disinfection byproduct?

A. Disinfection byproducts
B. Other disinfectants
C. Naturally occurring bromide
D. Occurring organic and inorganic matter in water
E. Chloroform
F. None of the Above

Sodium Chlorate

262. Sodium Chlorate can also be synthesized by passing _____into a hot sodium hydroxide solution. It is then purified by crystallization.

A. Chlorate
B. Oxygen
C. Chlorine gas
D. Sodium metaborate or ammonium phosphates
E. The free acid, chlorous acid, $HClO_2$
F. None of the Above

Chapter 5- Hypochlorites and Chloramines
Chlorine-Based Disinfectants Chloramines
Chloramine Disadvantages

263. Which residual in tap water can pass through membranes in dialysis machines and directly induce oxidant damage to red blood cells?

A. Free chlorine D. Monochloramine
B. Chloramine E. Ammonia and chlorine compounds
C. Dichloramine F. None of the Above

Chloramine Section

264. _____: $NH_3 + HOCl \rightarrow NH_2Cl + H_2O$

A. Free chlorine D. Monochloramine
B. Trichloramine E. Ammonia and chlorine compounds
C. Dichloramine F. None of the Above

265. _____: $NHCl2 + 3HOCl \rightarrow NHCl_3 + 3H_2O$

A. Free chlorine D. Monochloramine
B. Trichloramine E. Ammonia and chlorine compounds
C. Dichloramine F. None of the Above

266. Free chlorine reacts with the chloramine to produce hydrogen ion, water, and _____which will come out of solution. In the case of the monochloramine, the following reaction occurs: $2NH_2Cl + HOCl \rightarrow N_2 + 6HCl + H_2O$

A. Free chlorine D. Nitrogen gas
B. Chloramine(s) E. Ammonia and chlorine compounds
C. Dichloramine F. None of the Above

267. _____: $NH_2Cl + 2HOCl \rightarrow NHCl2 + 2H_2O$

A. Free chlorine D. Monochloramine
B. Trichloramine E. Ammonia and chlorine compounds
C. Dichloramine F. None of the Above

268. Which of the following terms are formed in the pH range of 4.5 to 8.5, however, monochloramine is most common when the pH is above 8?

A. Free chlorine D. Monochloramine and dichloramine
B. Chloramine(s) E. Ammonia and chlorine compounds
C. Dichloramine F. None of the Above

Post Chlorination

269. Post chlorination is almost always done in water treatment, but can be replaced with chlorine dioxide or chloramines. In this stage, chlorine is fed to the drinking water stream which is then sent to the chlorine contact basin to allow the chlorine a long enough detention time to kill all viruses, bacteria, and protozoa that were not removed and rendered inactive in the prior stages of treatment.

A. True B. False

270. Drinking water requires a large addition of chlorine because there must be a residual amount of chlorine in the water that will carry through the system until it reaches the tap of the user. After Post chlorination, the water is retained in a clear well prior to distribution.

A. True B. False

Exposure

271. There is no threshold value for to sodium hypochlorite exposure. Various health effects occur after exposure to sodium hypochlorite. People are exposed to sodium hypochlorite by inhalation of aerosols. This causes coughing and a sore throat. After swallowing sodium hypochlorite, the effects are stomach ache, a burning sensation, coughing, diarrhea, a sore throat and vomiting. Sodium hypochlorite on skin or eyes causes redness and pain.

A. True B. False

272. After prolonged exposure, the skin can become sensitive. Sodium hypochlorite is poisonous for water organisms. It is mutagenic and very toxic when it comes in contact with Ammonium salts.

A. True B. False

Routes of Exposure- Inhalation

273. Which of the following can liberate toxic gases such as chlorine?

A. Air
B. Hypochlorite solutions
C. Higher levels of chlorine
D. Ammonia
E. Household bleach
F. None of the Above

274. Chlorine is lighter than air and may cause asphyxiation in poorly ventilated, enclosed, or high-lying areas.

A. True B. False

Ingestion

275. Metabolic acidosis is rare, but has been reported following the ingestion of?

A. Hypochlorous Acid (HOCl)
B. Residual disinfectant
C. Higher levels of chlorine
D. Sodium and calcium
E. Household bleach
F. None of the Above

Sources/Uses

276 According to the text, _____ are manufactured by the chlorination of sodium hydroxide or lime.

A. Sodium hypochlorite
B. Chlorine gas
C. Sodium and calcium hypochlorite
D. Hypochlorous acid
E. Hypochlorite solutions, powder, or concentrated vapor
F. None of the Above

277. These compounds are used primarily as oxidizing and bleaching agents or disinfectants. They are components of commercial bleaches, cleaning solutions, and disinfectants for drinking water and waste water purification systems and swimming pools.

A. Sodium hypochlorite
B. Chlorine gas
C. Sodium and calcium hypochlorite
D. Sodium hydroxide or lime
E. Hypochlorite solutions
F. None of the Above

Calcium Hypochlorite Section

278. Which of the following substances comes in two forms: powder and tablets?

A. Calcium hypochlorite
B. Hypochlorous Acid (HOCl)
C. Sodium hypochlorite
D. Chlorine
E. Hypochlorite
F. None of the Above

279. _____ is generally available as a white powder, pellets, or flat plates; sodium hypochlorite is usually a greenish yellow, aqueous solution. Although not flammable, they may react explosively.
A. Chlorine tablet(s) D. Sodium and calcium hypochlorite
B. HCL powder E. Calcium hypochlorite
C. Solid chlorine F. None of the Above

280. Which substance decomposes in water to release chlorine and oxygen; sodium hypochlorite solutions can react with acids or ammonia to release chlorine or chloramine?
A. Calcium hypochlorite D. Chlorine tablet(s)
B. Hypochlorous Acid (HOCl) E. Hypochlorite ion
C. Oxygen and chlorine F. None of the Above

Description
281. Solid chlorine stands alone as the safest form of chlorine disinfection. Requiring only minimal safety equipment for handling, users can breathe easy knowing our tablets are safe for both people and the environment. The elimination of costly scrubbers, containment, or hazard response capability, guarantees lower initial costs and reduced operating expense.
A. True B. False

282. Sodium hypochlorite is generally available as a white powder, pellets, or flat plates. It decomposes readily in water or when heated, releasing oxygen and chlorine. It has a strong chlorine odor, but odor may not provide an adequate warning of hazardous concentrations.
A. True B. False

283. _____ is not flammable, but it acts as an oxidizer with combustible material and may react explosively with ammonia, amines, or organic sulfides.
A. Chlorine tablet(s) D. Sodium hypochlorite
B. Household bleach E. Calcium hypochlorite
C. Hypochlorous Acid (HOCl) F. None of the Above

Effectiveness
284. Liquid sodium hypochlorite and chlorine tablets produce hypochlorous acid (HOCl) and?
A. Calcium hypochlorite D. Hypochlorite ion (OCl-) in solution
B. Hydrochlorous Acid (HOCl) E. Hypochlorite ion
C. Oxygen F. None of the Above

285. The ratio of Hypochlorous Acid to _____ increases with acidity. Chlorine tablets have a pH of 6.7 and liquid hypochlorite a pH of between 9 and 12. Ergo; tablets have a greater disinfection capacity and are less prone to inactivation due to soiling.
A. Calcium hypochlorite D. Hypochlorite ion
B. Hypochlorous Acid (HOCl) E. Hypochlorite
C. Oxygen and chlorine F. None of the Above

Safety
286. Which of the following can affect eyes, skin and mucous membranes; it is easily splashed and rots clothing?
A. Chlorine tablet(s) D. Sodium dichloroisocyanurate (NaDCC)
B. Hypochlorite E. Liquid chlorine
C. Chloramine F. None of the Above

Corrosion

287. _____ are much less corrosive than liquid chlorine, which is highly corrosive to most metals.

A. Sodium hypochlorite
B. Hypochlorous Acid (HOCl)
C. Oxygen and chlorine
D. Chlorine tablet(s)
E. Hydrochloride
F. None of the Above

Comparison

288. Which substance is comparable to Sodium dichloroisocyanurate (NaDCC) is their neutralization by organic matter.

A. Chlorine tablet(s)
B. Hypochlorite
C. Chloramine
D. Sodium hypochlorite (NaOCL)
E. Hypochlorous Acid
F. None of the Above

289. If there is a high concentration of organic material present, NaDCC will be very much more effective than?

A. Calcium hypochlorite
B. Hypochlorous Acid (HOCl)
C. Oxygen and chlorine
D. NaOCL
E. Hypochlorite ion
F. None of the Above

Health Effects

290. Hypochlorite powder, solutions, and vapor are irritating and corrosive to the eyes, skin, and respiratory tract. Ingestion and skin contact produces injury to any exposed tissues. Exposure to gases released from _____may cause burning of the eyes, nose, and throat; cough as well as constriction and edema of the airway and lungs can occur.

A. Hypochlorite
B. Hypochlorous Acid (HOCl)
C. Oxygen and chlorine
D. Sodium dichloroisocyanurate (NaDCC)
E. Hydrochloride ion
F. None of the Above

291. Which substance produces tissue injury by liquefaction necrosis?

A. Ammonia
B. Hypochlorite
C. Chloramine
D. Sodium dichloroisocyanurate (NaDCC)
E. Hypochlorous Acid
F. None of the Above

Acute Exposure

292. According to the text, the toxic effects of this compound are primarily due to the corrosive properties of the hypochlorite moiety.

A. Calcium hypochlorite
B. Hypochlorous Acid (HOCl)
C. Oxygen and chlorine
D. Sodium and calcium hypochlorite
E. Hypochlorite ion
F. None of the Above

Sodium Hypochlorite Solutions

293. Sodium hypochlorite solutions liberate the toxic gases chlorine or chloramine if mixed with acid or ammonia (this can occur when bleach is mixed with another cleaning product). Thus, exposure to hypochlorite may involve exposure to these gases.

A. True B. False

Potential Sequelae

294. Exposure to toxic gases generated from hypochlorite solutions can lead to reactive airways dysfunction syndrome (RADS), a chemical irritant-induced type of asthma. Chronic complications following ingestion of hypochlorite include esophageal obstruction, pyloric stenosis, squamous cell carcinoma of the esophagus, and vocal cord paralysis with consequent airway obstruction.

A. True B. False

Chronic Exposure

295. Because chronic dermal can cause dermal irritation due to exposure to this substance.

A. Chlorine tablet(s)
B. Hypochlorite
C. Chloramine
D. Sodium dichloroisocyanurate (NaDCC)
E. Hypochlorous Acid
F. None of the Above

Chapter 6 - Chlorination Safety and Equipment Section

Chlorine Health Hazard Section

296. Which term expresses low levels of chlorine results in eye, nose, and throat irritation, sneezing, Excessive salivation, general excitement, and restlessness?

A. Rambling
B. Inhalation
C. Acute exposure
D. Chronic exposure
E. Immediate attention after inhalation
F. None of the Above

297. _____ expresses low levels of chlorine gas can result in a dermatitis known as chloracne, tooth enamel corrosion, coughing, sore throat, hemoptysis and increased susceptibility to tuberculosis.

A. Rambling
B. Inhalation
C. Acute exposure
D. Chronic exposure
E. Immediate attention after inhalation
F. None of the Above

Inhalation

298. Which term expresses coughing, sneezing, shortness of breath, sensation of tightness in the chest, as well as severe restlessness or Anxiety, nausea, and vomiting?

A. Rambling
B. Inhalation
C. Acute exposure
D. Chronic exposure
E. Immediate attention after inhalation
F. None of the Above

299. The nose and throat may become irritated; a stinging and burning sensation may be experienced. Immediate fatalities can occur as a result of suffocation. Delayed fatalities can occur as a result of pulmonary edema (fluid in the lungs). For this reason, rest and immediate attention after inhalation is important.

A. True B. False

300. If breathing has stopped, give artificial respiration; if breathing is difficult, give oxygen if equipment and trained personnel are available. If exposed person is breathing, place in a comfortable position and keep person warm and at rest until medical assistance becomes available.

A. True B. False

301. Liquid and concentrated gas could produce severe_____ .

A. Burns and injury on contact
B. Plasma exudation
C. General excitement
D. Chronic exposure to low levels of chlorine gas
E. Inhalation due to stress
F. None of the Above

302. If you get chlorine in the eye, pour a gentle stream of _____through the affected eye for at least 15 minutes. Contact the poison control center, emergency room or physician right away as further treatment will be necessary.

A. Liquid
B. Warm water
C. Milk
D. Salt water
E. Cold water
F. None of the Above

303. If you get chlorine on the skin, run _____ over the affected area for 15 minutes.

A. A gentle stream of water
B. Warm water
C. Milk
D. Salt water
E. Cold water
F. None of the Above

304. Repeated exposures to chlorine gas can result in a loss of ability to detect the odor of chlorine. Long-term exposures may cause damage to teeth and inflammation or?

A. Chlorine gas toxicity
B. Plasma exudation
C. Pulmonary edema
D. Ulceration of the nasal passages
E. Noncardiogenic pulmonary edema
F. None of the Above

ABC Reminders

305**.** If a person is over taken with chlorine gas exposure, quickly establish a _____, ensure adequate respiration and pulse.

A. Support Zone
B. Patient airway
C. Chemical-protective clothing
D. Delay decontamination
E. Hot Zone to the Decontamination Zone
F. None of the Above

Victim Removal

306. During the chlorine evacuation, **i**f victims can walk, lead them out of the?

A. Decontamination area
B. Hot Zone
C. Chemical-free zone
D. Chemically contaminated zone
E. Hot Zone to the Decontamination Zone
F. None of the Above

Decontamination Zone

307. Victims may be transferred immediately to the _____. All others require decontamination.

A. Support Zone
B. Patient Zone
C. Chemical free zone
D. Decontamination area
E. Hot Zone to the Decontamination Zone
F. None of the Above

Rescuer Protection

308. Decontamination may be conducted by personnel wearing a lower level of protection than that worn in the _____, if exposure levels are determined to be safe.

A. Support Zone
B. Patient Zone
C. Chemical free zone
D. Decontamination area
E. Hot Zone
F. None of the Above

ABC Reminders

309. Quickly establish a _____, ensure adequate respiration and pulse.

A. Support Zone
B. Patient airway
C. Hot Zone
D. Decontamination zone
E. Chemical-protective clothing dressing area
F. None of the Above

Basic Decontamination

310. During a chlorine leak, _____ is critical.

A. Decontamination
B. Hot Zone
C. Chemical-protective clothing
D. Rapid decontamination
E. Hot Zone to the Decontamination Zone
F. None of the Above

In Cases of Ingestion, Do Not Induce Emesis or Offer Activated Charcoal.

311. During a chlorine leak, victims who are conscious and able to swallow should be given 4 to 8 ounces of?

A. Liquid
B. Warm water
C. Milk only
D. Water or milk
E. Cold water
F. None of the Above

312. During a chlorine leak, consider appropriate _____of chemically contaminated children at the exposure site. Provide reassurance to the child during decontamination, especially if separation from a parent occurs.

A. Decontamination
B. Hot Zone
C. Chemical-protective clothing
D. Management
E. Hot Zone to the Decontamination Zone
F. None of the Above

Equipment Requirements

313. Chlorine gas under pressure shall not be permitted outside the chlorine room. A chlorine room is where chlorine gas cylinders and/or ton containers are?

A. Under pressure
B. In this stage
C. Stored
D. At the point of solution application
E. Dosing enough chlorine
F. None of the Above

314. Which of the following shall also be located inside the chlorine room?

A. Gas vacuum line
B. Vacuum regulators
C. Manual chlorine feed systems
D. Mechanical gas proportioning equipment
E. Injectors
F. None of the Above

315. _____ which is the mechanical gas proportioning equipment, may or may not be located inside the chlorine room.

A. Gas vacuum line
B. Vacuum regulators
C. Manual chlorine feed systems
D. The chlorinator
E. Injectors
F. None of the Above

316. Which of the following should be located to minimize the length of pressurized chlorine solution lines?

A. Gas vacuum line
B. Vacuum regulators
C. Manual chlorine feed systems
D. Mechanical gas proportioning equipment
E. Injectors
F. None of the Above

317. _____ shall be included in the gas vacuum line between the vacuum regulator(s) and the chlorinator(s) to ensure that pressurized chlorine gas does not enter the gas vacuum lines leaving the chlorine room.

A. Gas vacuum line
B. A gas pressure relief system
C. Manual chlorine feed systems
D. Mechanical gas proportioning equipment
E. Post chlorination
F. None of the Above

318. Which of the following shall have positive shutdown in the event of a break in the downstream vacuum lines?

A. Gas vacuum line
B. A gas pressure relief system
C. Manual chlorine feed systems
D. Mechanical gas proportioning equipment
E. The vacuum regulating valve(s)
F. None of the Above

319. Anti-siphon valves shall be incorporated in the _____or in the discharge piping.

A. Gas vacuum line
B. A gas pressure relief system
C. Manual chlorine feed systems
D. Mechanical gas proportioning equipment
E. Pump heads
F. None of the Above

320. _____ shall have the capacity to dose enough chlorine to overcome the demand and maintain the required concentration of the "free" or "combined" chlorine.

A. The chlorinator
B. Constant flow rate(s)
C. Uninterrupted chlorination
D. Automatic proportional controlled
E. Constant pre-established dosage
F. None of the Above

Methods of Control

321. Which of the following shall be automatic proportional controlled, automatic residual controlled, or compound loop controlled?

A. A chlorine feed system
B. Constant flow rate(s)
C. Uninterrupted chlorination
D. Automatic proportional controlled
E. Constant pre-established dosage
F. None of the Above

322. Which piece of chlorination equipment adjusts the chlorine feed rate automatically in accordance with the flow changes to provide a constant pre-established dosage for all rates of flow?

A. Manual chlorine feed systems
B. Constant flow rate(s)
C. Uninterrupted chlorination
D. Automatic proportional controlled
E. Constant pre-established dosage
F. None of the Above

323. Which piece if chlorination equipment, the feed rate of the chlorinator is controlled by a flow proportional signal and a residual analyzer signal to maintain particular chlorine residual in the water?

A. Gas vacuum line
B. Compound loop control system
C. Manual chlorine feed systems
D. Mechanical gas proportioning equipment
E. After post chlorination
F. None of the Above

324. Which piece if chlorination equipment may be installed for groundwater systems with constant flow rates?

A. Manual chlorine feed systems
B. Constant flow rate(s)
C. Uninterrupted chlorination
D. Automatic proportional controlled
E. Constant pre-established dosage
F. None of the Above

Standby Provision

325. As a safeguard against_____ , standby chlorination equipment having the capacity to replace the largest unit shall be provided.

A. Flow change(s)
B. Constant flow rate(s)
C. Uninterrupted chlorination
D. Malfunction and/or shut-down
E. Constant pre-established dosage
F. None of the Above

326. For uninterrupted chlorination, _____shall be equipped with an automatic changeover system. In addition, spare parts shall be available for all chlorinators.

A. Flow change(s)
B. Constant flow rate(s)
C. Gas chlorinators
D. Automatic proportional controlled
E. Constant pre-established dosage
F. None of the Above

327. Scales for weighing cylinders shall be provided at all plants using chlorine gas to permit an accurate reading of total daily weight of chlorine used. At large plants, scales of the recording and indicating type are recommended. As a minimum, a platform scale shall be provided. Scales shall be of corrosion-resistant material.

A. True B. False

328. All chlorine cylinders shall be securely positioned to safeguard against movement. Tag the cylinder “empty” and store flat and chained. Ton containers may be stacked.

A. True B. False

329. Which of the following related chlorine alarm equipment shall be installed at all water treatment plants using chlorine gas? Leak detection shall be provided for the chlorine rooms.

A. Caustic soda solution reaction tanks
B. Corrosion resistant
C. Securely positioned
D. Automatic chlorine leak detection
E. Chlorine room ventilation system
F. None of the Above

330. Which of the following related chlorine alarm equipment should be connected to a remote audible and visual alarm system and checked on a regular basis to verify proper operation.

A. The chlorinator
B. The facility
C. All chlorine cylinders
D. The chlorine gas leakage
E. Chlorine leak detection equipment
F. None of the Above

331. _____ shall not automatically activate the chlorine room ventilation system in such a manner as to discharge chlorine gas.

A. Caustic soda solution reaction tanks
B. Corrosion resistant
C. Leak detection equipment
D. Automatic chlorine leak detection
E. Chlorine room ventilation system
F. None of the Above

332. During an emergency, if the chlorine room is occupied, the chlorine gas leakage shall be contained within the chlorine room itself in order to facilitate a proper method of clean-up.

A. True B. False

333. Consideration should also be given to the provision of caustic soda solution reaction tanks for absorbing the contents of leaking one-ton cylinders where such cylinders are in use.

A. True B. False

334. Chlorine leak detection equipment may not be required for very small chlorine rooms with an exterior door (e.g., floor area less than $3m^2$).
A. True B. False

335. You can use a spray solution of ammonia or a rag soaked with sulfur dioxide to detect a small Cl_2 leak. If there is a leak, the sulfur dioxide will create a white colored smoke - Sulfuric chloride.
A. True B. False

Chlorine Room Design Requirements
336. Where gas chlorination is practiced, the gas cylinders and/or the ton containers up to the vacuum regulators shall be housed in a gas-tight, well illuminated, corrosion resistant and?
A. Mechanically ventilated enclosure
B. Corrosion resistant
C. Securely positioned
D. Automatic chlorine leak detection
E. Chlorine room ventilation system
F. None of the Above

337. The chlorinator may or may not be located inside?
A. The chlorinator
B. The facility
C. All chlorine cylinders
D. The chlorine room
E. Chlorine leak detection equipment
F. None of the Above

338. Which chlorine safety related equipment term shall have entirely separate exhaust ventilation systems capable of delivering one (1) complete air change per minute during periods of chlorine room occupancy only?
A. Shut off
B. The chlorine room
C. The room
D. Automatic chlorine leak detection
E. Chlorine room ventilation system
F. None of the Above

339. Which chlorine safety related equipment term should be louvered near the ceiling, the air being of such temperature as to not adversely affect the chlorination equipment?
A. The ceiling
B. The chlorine room
C. Air inlets
D. Automatic chlorine leak detection
E. Chlorine room ventilation system
F. None of the Above

340. Which chlorine safety related equipment term should be outside the room at all entrance or viewing points, and a clear wire-reinforced glass window shall be installed in such a manner as to allow the operator to inspect from the outside of the room.
A. Gas chlorine room
B. The chlorine room
C. Chlorine room ventilation system
D. Automatic chlorine leak detection
E. Separate switches for fans and lights
F. None of the Above

Storage of Chlorine Cylinders
341. If necessary, _____may be provided to simply store the chlorine gas cylinders, with no connection to the line. The chlorine cylinder storage room shall have access either to the chlorine room or from the plant exterior, and arranged to prevent the uncontrolled release of spilled gas.
A. Cylinders or containers
B. The outside of the room
C. A separate storage room
D. Uncontrolled release of spilled gas
E. Air inlets
F. None of the Above

342. Which chlorine safety related equipment term shall have provision for ventilation at thirty air changes per hour?

A. A panic button
B. The chlorine room
C. Scrubber(s)
D. The chlorine gas storage room
E. The chlorine cylinder storage room
F. None of the Above

343. Sometimes entry in very large facilities, may be through a vestibule from outside in to?

A. Cylinders or containers access
B. The outside of the room
C. Chlorine rooms
D. Uncontrolled release of spilled gas
E. Air inlets
F. None of the Above

Chapter 7 - Alternative Disinfectants

Physical Methods

344. Water systems add _____ to destroy microorganisms that can cause disease in humans.

A. Alkalinity and pH
B. Hydrogen peroxide
C. Hypochlorous acid
D. Oxidizing and biocidal properties
E. Disinfectants
F. None of the Above

345. Formation of which term in water and wastewater effluent treated with chlorine has prompted research to seek alternative disinfecting methods that would minimize environmental and public health impacts?

A. Alkalinity
B. Mutagenic and carcinogenic agents
C. Hypochlorous acid
D. Oxidizing and biocidal properties
E. Hazardous trihalomethanes (THM)
F. None of the Above

Chemical Methods

346. Chemical methods depend mostly on selected chemicals with oxidizing and biocidal properties. Their practical applications range from removing _____ to disinfecting water supplies, wastewater treatment effluent, or industrial waters.

A. Alkalinity and pH
B. Undesirable constituents
C. Hypochlorous acid
D. Oxidizing and biocidal properties
E. Hazardous trihalomethanes (THM)
F. None of the Above

347. Which of the following compound(s) used for disinfection, other than chlorine and some of its compounds, potassium permanganate, and hydrogen peroxide?

A. Ammonia
B. Sodium chlorite ($NaClO_2$)
C. Hydrochlorous acid
D. NaOCl and HCl in place of chlorine gas
E. Ozone
F. None of the Above

348. Ozonation enhances the _____ despite its inherent weakness in leaving practically no residual in the distribution system.

A. Effectiveness and cost
B. Protecting public health
C. Mode of disinfection
D. Coagulation process
E. Superiority over chlorination
F. None of the Above

Chlorination and Dechlorination

349. Which of the following compound(s) and some of its derivatives will continue as an integral part of the disinfection process in water and wastewater treatment?

A. Chlorine tablet(s)
B. Hydrochlorous acid
C. Chlorine
D. Solid hypochlorite or concentrated solutions
E. Hypochlorous Acid
F. None of the Above

Chlorine Dioxide Section

350. ClO_2 generation uses _____ and chlorine gas.

A. Chlorine dioxide (ClO_2)
B. Sodium chlorite ($NaClO_2$)
C. Hypochlorous acid
D. NaOCl and HCl in place of chlorine gas
E. Ozone
F. None of the Above

351. Chlorine gas is educted into a motive water stream in a ClO_2 generator forming?

A. Hypochlorous acid
B. HOCl and HCl
C. Chlorine dioxide
D. Sodium chlorate ($NaClO_3$) and sulfuric acid
E. Sodium thiosulfate
F. None of the Above

352. This compound is pumped into the stream and allowed to react in a generating column to produce ClO_2?

A. Hypochlorous acid
B. HOCl and HCl
C. Chlorine dioxide
D. Sodium chlorite
E. Sodium thiosulfate
F. None of the Above

353. _____ does not hydrolyze in water as chlorine does and with it, no dissociation of ClO_2. It remains fully active in a pH range far broader than chlorine or sodium hypochlorite.

A. Sodium chlorite ($NaClO_2$)
B. Chlorine gas
C. Chlorine dioxide or ClO_2
D. Sodium chlorate ($NaClO_3$)
E. NaOCl and HCl
F. None of the Above

354. Which of the following compound(s) remains a gas in water, it does not have the corrosive tendencies of chlorine gas?

A. Sodium chlorite ($NaClO_2$)
B. Chlorine gas
C. Chlorine dioxide or ClO_2
D. Sodium chlorate ($NaClO_3$)
E. NaOCl and HCl
F. None of the Above

355. _____ is a dissolved gas in water, there is no mineral acid or caustic soda formation as happens when using HOCl.

A. ClO_2
B. Sodium chlorite ($NaClO_2$)
C. Hypochlorous acid
D. NaOCl and HCl in place of chlorine gas
E. Heavily pH-dependent
F. None of the Above

356. Which of the following compound(s) tends to be much less, if not totally non-reactive, with many organic and inorganic compounds?

A. ClO_2
B. Sodium chlorite ($NaClO_2$)
C. Hypochlorous acid
D. NaOCl and HCl in place of chlorine gas
E. Heavily pH-dependent
F. None of the Above

357. _____ is much less aggressive to traditional corrosion inhibitors.

A. Sodium chlorite ($NaClO_2$)
B. Chlorine gas
C. Chlorine dioxide or ClO_2
D. Sodium chlorate ($NaClO_3$)
E. NaOCl and HCl
F. None of the Above

358. Other common methods of generation use this compound(s) in place of chlorine gas. Also referred to as the "three pump" method of generation, this method is valuable to a facility that wants to eliminate gaseous chlorine.

A. Chlorine dioxide (ClO_2)
B. Sodium chlorite ($NaClO_2$)
C. Hypochlorous acid
D. NaOCl and HCl
E. HOCl and HCl
F. None of the Above

359. Another and, more recent method of generation uses sulfuric acid and?

A. Sodium chlorite ($NaClO_2$)
B. Chlorine gas
C. Chlorine dioxide
D. Sodium chlorate ($NaClO_3$)
E. NaOCl and HCl
F. None of the Above

360. Which of the following compound(s) holds many advantages over chlorine in cooling water systems?

A. ClO_2
B. Sodium chlorite ($NaClO_2$)
C. Hypochlorous acid
D. NaOCl and HCl in place of chlorine gas
E. Sodium chlorate ($NaClO_3$) and sulfuric acid
F. None of the Above

361. Which of the following compound(s) is heavily pH-dependent, because as system pH increases, there is a correspondingly rapid decrease in the concentration of the biocidally active species.

A. Chlorine dioxide (ClO_2)
B. Sodium chlorite ($NaClO_2$)
C. Hypochlorous acid
D. NaOCl and HCl in place of chlorine gas
E. Sodium chlorate ($NaClO_3$) and sulfuric acid
F. None of the Above

362. Which of the following compound(s) is a non-specific oxidant which readily reacts with various organic and inorganic compounds that may be present in a cooling water system.

A. Chlorine dioxide (ClO_2)
B. Sodium chlorite ($NaClO_2$)
C. Hypochlorous acid
D. NaOCl and HCl in place of chlorine gas
E. Sodium chlorate ($NaClO_3$) and sulfuric acid
F. None of the Above

363. _____ is considerably more selective than chlorine in the presence of various compounds, which allows it to be more effective in contaminated systems.

A. ClO_2
B. Sodium chlorite ($NaClO_2$)
C. Hypochlorous acid
D. NaOCl and HCl in place of chlorine gas
E. Sodium chlorate ($NaClO_3$) and sulfuric acid
F. None of the Above

364. Which of the following compound(s), can be in fact, are two-and-one-half times more reactive than chlorine?

A. ClO_2
B. Sodium chlorite ($NaClO_2$)
C. Hypochlorous acid
D. NaOCl and HCl in place of chlorine gas
E. Sodium chlorate ($NaClO_3$) and sulfuric acid
F. None of the Above

365. Which of the following terms as a water disinfectant increased in the 1970s when it was discovered that it did not promote THM formation?

A. Sulfur Dioxide
B. Chlorine gas
C. Chlorine dioxide
D. Sodium chlorate ($NaClO_3$) and sulfuric acid
E. UV
F. None of the Above

366. Which compound was used in the paper industry, has been an acceptable and effective alternative to chlorination in cooling systems?

A. Chlorine dioxide (ClO_2)
B. Sodium chlorite ($NaClO_2$)
C. Hypochlorous acid
D. NaOCl and HCl in place of chlorine gas
E. Sodium thiosulfate
F. None of the Above

Alternatives Methods for Water Disinfection
Ultraviolet Disinfection

367. The microorganisms spend maximum time and contact with the outside of the quartz tube and the source of the _____.

A. Sterilizer
B. UV rays
C. UV disinfection
D. UV reactor
E. Electromagnetic energy
F. None of the Above

368. The basic design flow of water of certain UV units is in the order of _____ for each inch of the lamp, the units are designed so that the contact or retention time of the water in the unit is not less than _____.

A. 2.0 gpm - 60 seconds
B. 20 gpm - 15 seconds
C. 2.0 gpm - 100 seconds
D. 1.5 gpm - 60 seconds
E. 2.0 gpm - 15 seconds
F. None of the Above

369. A disinfection process involves exposing water to_____, which inactivates various microorganisms. The technique has enjoyed increased application in wastewater treatment but very limited application in potable water treatment.

A. Sterilizer
B. UV rays
C. UV disinfection
D. Ultraviolet (UV) radiation
E. Electromagnetic energy
F. None of the Above

370. In UV, quartz is often used in this case since practically none of the UV rays are absorbed by the quartz, ordinary glass cannot be used since it will absorb the _____, leaving little for disinfection.

A. Bromine
B. UV rays
C. UV disinfection
D. UV reactor
E. Chemical process
F. None of the Above

371. According to the text, the _____will consist of a various number of lamps and tubes, depending upon the quantity of water to be treated.

A. UV sterilizer
B. UV rays
C. UV disinfection
D. UV reactor
E. Electromagnetic energy
F. None of the Above

372. Ensuring that the _____ maintains good contact with the water requires control of the water level within the channel to ensure that the UV is making total contact at the designed depths.
A. UV D. UV reactor
B. Contact E. Ballasts and shields
C. Channel F. None of the Above

373. Heat is generated by the electric components of the UV system, adequate ventilation and cooling must be applied to the _____to reduce heat build-up, otherwise the ballasts could fail.
A. UV arrays D. UV reactor
B. UV rays E. Electromagnetic energy
C. UV disinfection F. None of the Above

374. Because of the great electrical consumption of this system, combined with the cost of routine replacement of _____, should be considered against other systems.
A. UV capacitor D. UV reactor
B. UV Flux E. Ballasts and shields
C. UV disinfection F. None of the Above

375. The germicidal effect of UV is thought to be associated with its reduction by various inorganic components essential to the cell's functioning.
A. True B. False

376. _____ represents the transfer of electromagnetic energy from a mercury arc lamp to a pathogen's DNA material, thus affecting its ability to replicate itself.
A. UV radiation D. UV reactor
B. UV rays E. Electromagnetic energy
C. UV disinfection F. None of the Above

377. Which term represents the intensity being emitted, the length of time that the wastewater comes in contact with the UV radiation, and the arrangement of the UV reactor?
A. UV radiation D. UV reactor
B. UV arayment E. Electromagnetic energy
C. UV disinfection F. None of the Above

378. The contact time for the wastewater with the UV source is the shortest of any of the disinfectant strategies, lasting no longer than 20 to 30 seconds.
A. True B. False

379. Disadvantages include the effects of turbidity in the water reducing the infiltration and therefore the effectiveness of ballasts and shields and the need to provide an effective cleaning and replacement program for the UV components.
A. True B. False

Strongest Oxidizing Agent

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

A. Chloramine
B. Liquid Ozone
C. Ozone
D. Oxygen and nascent oxygen
E. O2
F. None of the Above

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

A. Chloramine
B. Liquid Ozone
C. Ozone
D. Oxygen and nascent oxygen
E. O2
F. None of the Above

382. Ozone has a _____similar to that sometimes noticed during and after heavy electrical storms. In use, ozone breaks down into oxygen and nascent oxygen.

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

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

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

384. Ozone falls into the same category as other disinfectants in that it can produce?

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

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

A. Chloramine
B. Liquid Ozone
C. Ozone
D. Oxygen and nascent oxygen
E. O2
F. None of the Above

386. Each water has its own_____, in the order of 0.5 ppm to 5.0 ppm. Contact time, temperature, and pH of the water are factors to be determined.

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

Alternate Disinfectants Summary

Chloramines

387. Which compound is a very weak disinfectant for Giardia and virus reduction? It is recommended that it be used in conjunction with a stronger disinfectant. It is best utilized as a stable distribution system disinfectant.

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

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

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

Chlorine Dioxide

389. Chlorine dioxide may be used for both taste and odor control or as?

A. Post disinfectant
B. ClO_2/chlorite/chlorate
C. An oxidant
D. Total residual oxidants
E. A pre-disinfectant
F. None of the Above

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

A. Pre-disinfectant
B. ClO_2/chlorite/chlorate
C. An oxidant
D. Chlorine dioxide and chlorite
E. 25% aqueous solution of sodium chlorite ($NaClO^2$)
F. None of the Above

391. According to the text, chlorine dioxide provides good _____protection but its use is limited by the restriction on the maximum residual of 0.5 mg/L ClO_2/chlorite/chlorate allowed in finished water.

A. Pre-disinfectant
B. ClO_2/chlorite/chlorate
C. Level of
D. Chlorine residual
E. Giardia and virus
F. None of the Above

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

A. Pre-disinfectant
B. ClO_2/chlorite/chlorate
C. An oxidant
D. Total residual oxidants
E. 25% aqueous solution of sodium chlorite ($NaClO^2$)
F. None of the Above

393. Because dry sodium chlorite is dangerous and can be _____in feed equipment if leaking solutions or spills are allowed to dry out.

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

Ozone

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

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

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

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

396. Ozone may also be used as _____for removal of taste and odor, or may be applied as a pre-disinfectant.

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

Chapter 9- Laboratory Analysis
Summary

397. The CDC and the U.S. Environmental Protection Agency collaborate to track _____of both microbial and chemical origins. Data on drinking water and recreational water outbreaks and contamination events have been collected and summarized since 1971.

A. Waterborne disease outbreaks
B. Diagnosed cases of waterborne illness
C. Treatment measures
D. Amounts of disinfection byproducts
E. Waterborne disease outbreaks
F. None of the Above

398. While useful, statistics derived from surveillance systems do not reflect the true incidence of _____because many people who fall ill from such diseases do not consult medical professionals.

A. Waterborne disease outbreaks
B. Chlorine-based disinfectants
C. Giardia lamblia
D. An emerging parasitic protozoan pathogen
E. Emerging waterborne pathogen
F. None of the Above

399. For those who do seek medical attention, attending physicians and laboratory and hospital personnel are required to report diagnosed cases of _____to state health departments.

A. Waterborne disease outbreaks
B. Diagnosed cases of waterborne illness
C. Treatment measures
D. Amounts of disinfection byproducts
E. Waterborne illness
F. None of the Above

400. Despite these limitations, surveillance data may be used to evaluate the relative degrees of risk associated with different types of_____, problems in current technologies and operating conditions, and the adequacy of current regulations.

A. Source water and systems
B. Chlorine-based disinfectants
C. Giardia lamblia
D. An emerging parasitic protozoan pathogen
E. Emerging waterborne pathogen
F. None of the Above