Registration form

Chlorination 101 CEU Training Course $100.00
48 HOUR RUSH ORDER PROCESSING FEE ADDITIONAL $50.00

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

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

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Please circle/check which certification you are applying the course CEU's.
Water Treatment _____ Distribution _____ Collection _____

Wastewater Treatment_____ Other _____

Your certificate will be e mailed to you in about two weeks.

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

State Approval Listing Link, check to see if your State accepts or has pre-approved this course. Not all States are listed. Not all courses are listed. Do not solely trust our list for it may be outdated. It is your sole responsibility to ensure this course is accepted for credit.

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AFFIDAVIT OF EXAM COMPLETION

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

Grading Information

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

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Chlorination 101 CEU Course Answer Key

Name _____ ***Telephone #*** _____

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Method of Course acceptance confirmation. Please fill this section

Website __ Telephone Call___ Email____ Spoke to_____

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What is the approval number if Applicable? _____

PA DEP Students are required to complete the original version of the text. _____
Please initial

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Please circle, underline, bold or X only one correct answer

1. A B C D E F	17. A B C D E F	33. A B C D E F
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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 compliance and do not follow this course for proper compliance.

Please fax the answer key to TLC
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Rush Grading Service

If you need this assignment graded and the results mailed to you within a 48-hour period, prepare to pay an additional rush service handling fee of $50.00. This fee may not cover postage costs. If you need this service, simply write RUSH on the top of your Registration Form. We will place you in the front of the grading and processing line. Thank you…

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Chlorination 101 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 manual 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.**

Waterborne Pathogens Section
The reason we disinfect.

1. 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.

2. When infected humans or animals pass the bacteria, viruses, and _____in their stool, pathogens may get into water and spread disease.

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

3. 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

Safe Drinking Water Act (SDWA) Review

4. 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

5. Public water systems must provide water treatment, ensure proper drinking water quality through monitoring, and provide public notification of contamination problems.

A. True B. False

Relating to prevention of waterborne disease, the SDWA required EPA to:
6. 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

Microbes
7. Coliform bacteria are common in the environment and are considered harmful.
A. True B. False

8. The presence of coliform bacteria in drinking water indicates the water may be contaminated with germs that can cause disease.
A. True B. False

9. Giardia lamblia is a parasite that enters lakes and rivers through sewage and animal waste. It causes?
A. Fecal Coliform and E coli
B. Gastrointestinal illness
C. Microorganisms
D. Cryptosporidiosis
E. Coliform bacteria
F. None of the Above

Conclusion
10. 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

11. Areas of concern include life cycles, mechanisms of infection, protective or dormant states, emergence of disinfection resistant variants, _____, regrowth in distribution lines.
A. Optimal pathogen removal techniques
B. Disinfection process
C. Environmental and regulatory impact
D. Primary methods used for the disinfection
E. Extensive waterborne disease research
F. None of the Above

Salmonella Typhi
12. 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

Shigella Species
13. 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

Campylobacter

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

A. True B. False

15. 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

Legionella

16. Legionella, prevention. Legionella in water systems. Hot water in tanks should be maintained between _____degrees Centigrade.

A. 81 to 100
B. 110 to 210
C. 75 – 212
D. 71 and 77
E. 75 and 85
F. None of the Above

Pseudomonas

17. 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

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

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

Norovirus

19. Humans are the reservoir for the Norovirus. Prevention strategies include?

A. Maintaining water systems
B. Source protection
C. Chlorine monoxide
D. Containment protection
E. Internal protection
F. None of the Above

Cryptosporidium

20. 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

21. Cryptosporidium, prevention. 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

Giardia

22. 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

Bacteriological Monitoring Section
Repeat Sampling

23. 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

24. Repeat samples must be collected from: The original sampling location of the_____.

A. Routine sample
B. Surface water
C. Coliform present sample
D. Sample
E. MCL area
F. None of the Above

25. Samples should be taken elsewhere in the _____or at the wellhead, if necessary.

A. Sewage system
B. Surface system
C. Sampling location
D. Distribution system
E. MCL compliance calculation
F. None of the Above

26. Generally speaking, and depending on your State, if a system which normally collects fewer than five (5) routine samples per month has a coliform present sample; it must collect five (5) routine samples the following _____regardless of whether a MCL violation occurred or if repeat sampling was coliform absent.

A. Week
B. Hour
C. Immediately
D. Day
E. Month or quarter
F. None of the Above

Total Coliforms

27. 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

28. For systems that collect fewer than _____ samples per month, no more than one sample per month may be positive. In other words, the second positive result (repeat or routine) in a month or quarter results in a MCL violation.

A. 5
B. 10
C. 100
D. 200
E. 40
F. None of the Above

29. For systems that collect _____ or more samples per month, no more than five (5) percent may be Positive, check with your state drinking water section or health department for further instructions.
A. 5 D. 200
B. 10 E. 40
C. 100 F. None of the Above

Mechanism of Activity
30. The mechanisms of cellular injury are believed to result from the oxidation of functional groups in cell components, from reactions with tissue water to form_____, and from the generation of free oxygen radicals.
A. Generation of free oxygen radicals D. A caustic effect
B. Chlorine acid E. Hypochlorous and hydrochloric acid
C. Hydrochloric acid F. None of the Above

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

32. Chlorine gas should be stored in vented rooms that have panic bar equipped doors.
A. True B. False

Solubility Effects
33. _____may account for the toxicity of elemental chlorine and hydrochloric acid to the human body.
A. Hydrochloric acid D. Hypochlorous acid
B. H2SO4 E. Sulfuric Acid
C. Hypchloric acid F. None of the Above

Early Response to Chlorine Gas
34. If you mix ammonia with chlorine gas, this compound reacts to form?
A. Hypochlorous acid D. Sulfuric acid
B. Chlorine gas E. Chloramine gas
C. Hydrochloric acid F. None of the Above

35. 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
36. 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 D. Sulfuric acid
B. Chlorine gas E. HOCL
C. Hypochlorous gas F. None of the Above

Pathological Findings

37. Chlorine is a highly reactive gas.

A. True B. False

38. 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

Exposure

39. 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.

A. True B. False

Routes of Exposure

Inhalation

40. 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

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

A. True B. False

Ingestion

42. 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

43. 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

Chlorine's Appearance and Odor (QA/QC)

44. 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

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

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

47. According to the text, chlorine is also incompatible with _____.
A. Air D. Hydrogen sulfide
B. Ammonia E. Moisture, steam, and water
C. Sodium Chloride F. None of the Above

Flammability
48. When there is a fire that involves Chlorine, the firefight should be fought downwind from the minimum distance possible.
A. True B. False

49. Keep unnecessary people away; isolate the hazard area and deny entry.
A. True B. False

What Happens to Chlorine When it Enters the Environment?
50. 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

51. 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

52. 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

Disinfection Essentials
53. Selecting the right _____requires understanding several factors governing the particular site and the water or wastewater to be treated.
A. Operating costs D. Operating method
B. Disinfection weapon E. Net-positive environmental benefit
C. UV device F. None of the Above

54. _____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

55. 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

56. 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

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

A. True B. False

Disinfectant Qualities

58. 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

59. Because it is highly reactive, chlorine is usually found in nature bound with other elements like sodium, potassium, and magnesium.

A. True B. False

60. Which substance 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

61. Various states of chlorine includes when chlorine is isolated as a free element, chlorine is a greenish yellow gas, which is_____.

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

Chlorine's Effectiveness

62. 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
B. Color change
C. Chlorine demand
D. Chlorination
E. Required contact time
F. None of the Above

63. Sometimes chlorine is not available for disinfection because _____ in the water (like iron, manganese, hydrogen sulfide, and ammonia).

A. pH increases
B. Chlorine level and water quality
C. Free chlorine residual
D. Required contact time
E. Part of it combines with other chemicals
F. None of the Above

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

A. Chlorine residual
B. Color change
C. Chlorine demand
D. Total
E. Free chlorine residual
F. None of the Above

65. The _____ to disinfect decreases, as the concentration of the chlorine increases.

A. pH increases
B. Chlorine level and water quality
C. Free chlorine residual
D. Required contact time
E. Not available for disinfection
F. None of the Above

66. Chlorination is more effective as?

A. Chlorine residual
B. Colors change
C. Chlorine demand
D. Water cools down
E. Water temperature increases
F. None of the Above

67. 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

68. Chlorination is less effective in_____.

A. Clear water
B. Color change
C. Warm temps
D. Daytime
E. Cloudy (turbid) water
F. None of the Above

Chlorine's Effectiveness

69. 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

70. _____ is less effective in cloudy water.
A. Oxidizing chemical(s) D. Caustic soda
B. Chlorination E. Sodium and chlorine ions
C. Sodium F. None of the Above

71. _____ is less effective as the water's pH increases (becomes more alkaline).
A. Chlorination D. Chlor-alkali membrane process
B. Caustic soda E. Required contact time
C. Chlorine ion F. None of the Above

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

73. Which term best describes an amount of substance that reacts with the other chemicals and the amount required to achieve disinfection is the chlorine demand of the water?
A. Oxidizing chemical(s) D. Caustic soda
B. Chlorine E. Sodium and chlorine ions
C. Sodium F. None of the Above

74. If the concentration of the _____ increases, the required contact time to disinfect decreases.
A. Chlorination D. Chlor-alkali membrane process
B. Caustic soda E. Required contact time
C. Chlorine F. None of the Above

75. _____ is more effective as water temperature increases.
A. Oxidizing chemical(s) D. Caustic soda
B. Chlorination E. Sodium and chlorine ions
C. Sodium F. None of the Above

Oxidation Chemistry

76. 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 .

77. 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

78. 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 D. The primary methods used for the disinfection
B. Disinfection process E. Economical and versatile chemicals
C. System pH F. None of the Above

79. 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

80. One oxidant is chlorine dioxide, which destroys these proteins depriving the cell of its ability to carry out _____and quickly kills it.

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

Chlorine Gas Section

81. 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

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

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

83. 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

84. 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

85. 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

86. Which of the following terms removes alkalinity, pH depression and system corrosion could occur. In low pH water, the passive metal oxide layers protecting the metal may resolubulize, exposing the surface to corrosion?

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

87. According to the text, which substance 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

88. High chlorine concentrations have also been shown to directly attack traditional organic-based corrosion inhibitors. When these inhibitors are "deactivated," the metal surface would then be susceptible to corrosion. Process Safety Management (PSM) guidelines dictated by the U.S. Occupational Safety and Health Administration (OSHA), discharge problems related to Chlorinated organic compounds such as trihalomethane (THM), dezincification of admiralty brass and delignification of cooling tower wood are other significant concerns associated with the use of chlorine.

A. True B. False

Pathophysiology

89. 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

90. Because chlorine gas is so dangerous, the odor threshold for chlorine is approximately _____; distinguishing toxic air levels from Permissible air levels may be difficult until irritative symptoms are present.

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

Methods of Control

91. 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

92. 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

93. 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

94. 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

95. 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

96. 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

Weigh Scales

97. 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

Securing Cylinders

98. 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

Chlorine Leak Detection

99. Which of the following related chlorine alarm equipment shall be installed at all water treatment plants using chlorine gas?

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

100. 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

Chlorine Room Design Requirements

101. 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

Ventilation

102. 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

103. Which chlorine safety related equipment term should be outside the room at all entrance or viewing points, and a clear wire-reinforced glass window?

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

Heating

104. Chlorine rooms shall have_____, if a forced air system is used to heat the building.

A. Gas chlorine room
B. Separate heating systems
C. The room
D. Automatic chlorine leak detection
E. Chlorine room ventilation system
F. None of the Above

Storage of Chlorine Cylinders

105. If necessary, _____may be provided to simply store the chlorine gas cylinders, with no connection to the line.

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

106. 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

Scrubbers

107. According to the text, facilities located within residential or densely populated areas, consideration shall be given to provide scrubbers for_____.

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

Chlorine Health Hazard Section

108. 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

109. Which term 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

110. 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

111. 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

Eye

112. 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

Skin

113. 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

Chronic

114. 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

Pre-hospital Management

115. Rescue personnel are at low risk of noncardiogenic pulmonary edema contamination from victims who have been exposed only to gases released from hypochlorite solutions. Clothing or skin soaked with industrial-strength bleach or similar solutions may be corrosive to rescuers and may release harmful gases.

A. True B. False

Hot Zone

116. Which term is the area that rescuers should be trained and appropriately attired before entering?

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

Rescuer Protection

117. Positive-pressure, self-contained breathing apparatus (SCBA) is recommended in response to situations that involve exposure to potentially unsafe levels of _____.

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

118. Chemical-protective clothing should be worn due to the risk of skin irritation and burns from direct contact with _____.

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

ABC Reminders

119. 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

120. 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

121. 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

122. 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

123. 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

124. 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.

125. 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

The Principal Trihalomethanes are:

126. Chloroform, bromodichloromethane, chlorodibromomethane, and bromoform. Other less common chlorination by-products include the haloacetic acids and haloacetonitriles.

A. True B. False

127. 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

Health Effects

128. 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

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

A. Chlorate and Chlorite
B. CO_2 and H_2SO_4
C. Trihalomethanes (THMs)
D. Ammonia and THMS
E. Chloramines
F. None of the Above

130. _____ 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

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

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

133. Chlorine dioxide can be an effective disinfectant, but it forms?
A. Chlorate and Chlorite D. Ammonia and THMS
B. CO2 and H2SO4 E. Chloramines
C. THMS F. None of the Above

134. 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 Byproduct Regulations Summary
135. 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

Calculation and Reporting of CT Data
136. 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

137. The _____ 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

138. 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

139. This missing 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

Chlorine Review

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

A. Chlorine Demand
B. Liquid
C. Total chlorine
D. Monitoring measurement
E. Ammonia or organic amines
F. None of the Above

141. Operator may add _____ to chlorinated public water supplies to provide inorganic chloramines.

A. Combined chlorine
B. Liquid
C. Total chlorine
D. Ammonia
E. Organic amines
F. None of the Above

142. What term describes the concentration of residual chlorine in water present as dissolved gas (Cl_2), hypochlorous acid (HOCl), and/or hypochlorite ion (OCl-)?

A. Chlorine Demand
B. Chlorine total
C. Free Chlorine
D. Total chlorine
E. Residual chlorine
F. None of the Above

143. Which term describes the concentration of chlorine in the water after the chlorine demand has been satisfied?

A. Chlorine Residual
B. Chlorine Demand
C. Combined
D. Total chlorine
E. Residual chlorine
F. None of the Above

144. What term describes the amount of chlorine used up in a water purification system; used as a monitoring measurement by system operators?

A. Chlorine Residual
B. Chlorine Demand
C. Combined Chlorine Residual
D. Total chlorine
E. Residual chlorine
F. None of the Above

145. What term describes the residual chlorine existing in water in chemical combination with ammonia or organic amines that can be found in natural or polluted waters?

A. Chlorine Residual
B. Chlorine Demand
C. Combined Chlorine Residual
D. Total chlorine
E. Residual chlorine
F. None of the Above

146. _____ of at least 1.0 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. Chlorine Demand
B. Chlorine total
C. Free chlorine residual
D. Total chlorine
E. Residual chlorine
F. None of the Above

147. What term describes the total of free residual and combined residual chlorine in a water purification system; and used as a monitoring measurement by system operators?
A. Chlorine Demand D. Total combined chlorine
B. Chlorine total E. Residual chlorine
C. Total Chlorine Residual F. None of the Above

148. What term describes the total chlorine is essentially equal to free chlorine since the concentration of ammonia or organic nitrogen compounds will be very low. When chloramines are present in the municipal water supply, then total chlorine will be higher than free chlorine.
A. Chlorine Demand D. Total chlorine
B. Chlorine total E. Residual chlorine
C. Combined chlorine F. None of the Above

149. The correct procedure to follow in changing a chlorine cylinder, hook up the Chlorinator to the container or cylinder with the chlorine valve turned on. Use the liquid side not the gas if using a 1-ton container. Remove the cylinder valve outlet cap and check the valve face or damage.
A. True B. False

150. When changing the Cl2 cylinder, clean with wire brush if necessary. If the valve face is smooth, clean proceed with hooking up the cylinder. Check the inlet face of the _____ and clean if necessary.
A. Fusible plug D. Chlorine valve
B. Chlorine cylinder E. Yoke
C. Chlorinator F. None of the Above

151. Place a new lead gasket on the chlorinator inlet, place the chlorinator on the cylinder valve, install the yoke clamp and slowly tighten the Yoke clamp until the two faces are against the lead gasket. Tighten the yoke, compressing the gasket one half to three quarters turn, do not over tighten. Replace the lead gasket with every change out.
A. True B. False

Halogen Chapter

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

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

Halogens
154. 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

Calcium Hypochlorite Section

155. Which of the following substances comes in two forms: powder and tablets. Tablets range in size from 5 mg about the size of an Aspirin to 3-inch tablets.

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

Description

156. 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

Accuracy

157. According to the text, this answer is an accurate dose, always yielding the stated level of available chlorine in water or very slightly over, never under.

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

Effectiveness

158. Liquid Sodium hypochlorite and chlorine tablets produce Hypochlorous Acid (HOCl) and _____ .

A. Calcium hypochlorite
B. Hydrochlorous Acid (HOCl)
C. Oxygen
D. Hypochlorite ion (OCl-) in solution
E. Hypochlorite ion
F. None of the Above

Corrosion

159. Which of the following 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. Hydrochlorite
F. None of the Above

Acute Exposure

160. 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

161. 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

162. 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

163. 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

Chlorine-Based Disinfectants Chloramines

Chloramine Disadvantages

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

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

Post Chlorination

165. Post chlorination is never done in water treatment, only in wastewater treatment but this can be replaced with ammonia.

A. True B. False

166. In the pre chlorination stage, chlorine is fed to the drinking water stream which is then sent to the raw water basin or river 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

167. 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

Chlorination Equipment Requirement Section

168. 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

169. 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

170. Which of the following, 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

171. 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

172. Which of the following 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

173. 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

174. 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

Capacity

175. Which of the following 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

Chlorine Dioxide Section

176. Which of the following compound(s) does not hydrolyze in water as chlorine does and 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

177. Which of the following compound(s) 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

178. Other common methods of generation use _____ 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

179. Another and more recent method of generation which uses sulfuric acid?

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

180. 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

181. Which of the following compound(s), can be in fact, be 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

182. _____ 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

183. Which of the following compound(s) is formed from the dissolution of chlorine gas or sodium hypochlorite in water, has satisfactorily controlled microorganisms in cooling water systems?

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

Water Disinfection Methods Review

184. 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

185. Since certain forms of chlorine react with _____naturally present in many water sources to form harmful chemical by-products.

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

Physical Methods

186. Formation of _____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

187. 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

188. Improved germicidal activity is counterbalanced by the formation of haloforms. They react with humates in water or wastewater effluent by the haloform reaction (HOBr, for example, reacts with humates yielding bromoform). In this context, hypobromite would be formed in Seawater by reaction of the natural bromides with hypochlorites in chlorinated wastewater effluent or cooling waters from power plants.

A. True B. False

Chlorination and Dechlorination

189. 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

pH Scale

190. Alkalinity and pH are similar because water is never strongly basic (high pH) to have a natural alkalinity.

A. True B. False

Ultraviolet Disinfection

191. The basic design flow of water of certain UV units is in the order of _____ for each inch of the lamp. Further, 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

192. 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

193. 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

194. Which term 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
B. UV rays
C. UV disinfection
D. UV reactor
E. Electromagnetic energy
F. None of the Above

195. The effective use of Ultraviolet treatment, the water to be disinfected can contain suspended solids. The water does not need to be colorless and can contain colloids, iron, manganese, taste, and odor.
A. True B. False

Strongest Oxidizing Agent
196. Which compound is obtained by passing a flow of air or oxygen between two electrodes that are subjected to an alternating current in the order of 10,000 to 20,000 volts?
A. Chloriamine
B. Liquid Ozone
C. Ozone
D. Oxygen and nascent oxygen
E. O2
F. None of the Above

197. Which compound is a light blue gas at room temperature?
A. Chloriamine
B. Liquid Ozone
C. Ozone
D. Oxygen and nascent oxygen
E. O2
F. None of the Above

Alternate Disinfectants Section Summary
Chloramines
198. Which compound is a very weak disinfectant for Giardia and virus reduction?
A. Chlorine
B. Chloramine
C. Ozone
D. Oxygen and nascent oxygen
E. Strongest oxidizing agent
F. None of the Above

Chlorine Dioxide
199. Chlorine dioxide may be used for either 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

Ozone
200. 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