

Registration form

**Chlorination 303 CEU Training Course \$200.00
48 HOUR RUSH ORDER PROCESSING FEE ADDITIONAL \$50.00**

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

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

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

Water Treatment _____ Distribution _____ Collection _____

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Your certificate will be emailed to you in about two weeks.

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 Do not solely trust our list for it may be outdated.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

You can obtain a printed version of the course from TLC for an additional \$69.95 plus shipping charges.

AFFIDAVIT OF EXAM COMPLETION

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

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 303 CEU Course Answer Key

Name _____ Telephone # _____

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Method of Course acceptance confirmation. Please fill this section

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Please use Adobe Acrobat DC to complete this answer Key

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

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(928) 272-0747**

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

**CHLORINATION 303 CEU TRAINING COURSE
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Please rate the difficulty of the testing process.

Very Easy 0 1 2 3 4 5 Very Difficult

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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...

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 not be in non-compliance and do not follow this course for proper compliance.

Chlorination 303 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.**

Chlorine Gas Section

- 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
- 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 (OCI-).
A. HCl
B. HOCl
C. High chlorine concentrations
D. pH of 7.0 than at pH 8.5
E. the hypochlorite ion (OCI-)
F. None of the Above
- In alkaline conditions, which term becomes the predominant species and lacks the biocidal efficacy of the non-dissociated form?
A. Chlorine
B. Sodium hypochlorite
C. OCI-
D. Chlorine gas
E. Hypochlorous acid (HOCl), and hydrochloric acid (HCl)
F. None of the Above
- 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 (OCI-)
F. None of the Above
- 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 (OCI-)
F. None of the Above

6. High chlorine concentrations have 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

7. 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

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

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

9. Which of the following terms can damage or penetrate the passive oxide layer, leading to localized damage of the metal surface?

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

Pathophysiology

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

11. Because chlorine gas is so dangerous, the odor threshold for chlorine is approximately?

- A. 1 parts per million (ppm) D. 3-5 parts per million (ppm)
B. 3 parts per million (ppm) E. 0.3-0.5 parts per million (ppm)
C. 10 parts per million (ppm) F. None of the Above

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

Mechanism of Activity

13. 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

14. Chlorine gas should be stored in vented rooms that have panic bar equipped doors.

- A. True B. False

15. 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
- B. Chlorine acid
- C. Hydrochloric acid
- D. A caustic effect
- E. Hypochlorous and hydrochloric acid
- F. None of the Above

Solubility Effects

16. 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

17. 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

18. Which of the following terms 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

19. 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

20. 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

21. 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

22. 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

23. 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

24. Chlorine is a highly reactive gas.

- A. True B. False

25. According to the text, treatment plants use _____ to reduce water levels of microorganisms that can spread disease to humans.

- A. HCl D. Chlorine
B. HOCl E. The hypochlorite ion (OCI-)
C. High chlorine concentrations F. None of the Above

26. 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

27. There is no threshold value for 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 stomachache, a burning sensation, coughing, diarrhea, a sore throat and vomiting. Sodium hypochlorite on skin or eyes causes redness and pain.

- A. True B. False

28. After prolonged exposure, the skin can become sensitive. Sodium hypochlorite is poisonous for water organisms. It is mutagenic and very toxic when it encounters Ammonium salts.

- A. True B. False

Routes of Exposure

Inhalation

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

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

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

- A. True B. False

Ingestion

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

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

Sources/Uses

32. According to the text, these compounds 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

33. Which 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

Halogen Section

Halides

34. 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 (OCI-)
- F. None of the Above

35. 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

36. 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

37. 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

38. On the other hand, neither fluorine nor bromine are believed to be 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

39. 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

40. 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

Halogens

41. 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

Principles of Modern Chemistry

42. Which term means the basis of a chemical transformation is the rearrangement of electrons in the chemical bonds between atoms. It can be symbolically depicted through a, which usually involves atoms as subjects?

- A. Chemical element(s)
- B. Metamorphous
- C. Chemistry
- D. Chemical reaction
- E. Chemical equation
- F. None of the Above

43. The number of atoms on the left and the right in the equation for a _____ is equal. A.

- A. Chemical transformation
- B. Atomic balance
- C. Chemical propertie(s)
- D. The type of chemical reaction(s)
- E. Mixture of substances
- F. None of the Above

44. What is the term that expresses a type of chemical reaction and the energy changes that may accompany it are constrained by certain basic rules?

- A. Chemical substance(s)
- B. Atomic balancing
- C. Chemical propertie(s)
- D. Chemical law(s)
- E. Mixture of substances
- F. None of the Above

45. What is the study of elementary particles, atoms, molecules, substances, metals, crystals and other aggregates of matter?

- A. Nuclear chemistry
- B. Neurochemistry
- C. Organic chemistry
- D. Analytical chemistry
- E. Traditional chemistry
- F. None of the Above

46. Chemistry is generally the study of various result of interactions between atoms, leading to rearrangements of the _____ which hold atoms together. Such behaviors are studied in a chemistry laboratory.

- A. Chemical bonds
- B. Chemical substance(s)
- C. Chemical(s)
- D. Chemical compound
- E. Physical chemistry
- F. None of the Above

47. Which of the following terms is a transformation of some substances into one or more different substances?

- A. Chemical element(s)
- B. An electron
- C. Atom
- D. A chemical reaction
- E. Energy and entropy
- F. None of the Above

48. What important considerations are invariably important in almost all chemical studies?
- | | |
|-------------------------------------|--------------------------|
| A. Chemical element(s) | D. Mixture of substances |
| B. An electron | E. Energy and entropy |
| C. The type of chemical reaction(s) | F. None of the Above |
49. What are classified in terms of their structure, phase, as well as their chemical compositions?
- | | |
|--------------------------|-------------------------------------|
| A. Chemical substance(s) | D. The type of chemical reaction(s) |
| B. Atom(s) | E. Mixture of substances |
| C. Chemical propertie(s) | F. None of the Above |

Matter

50. According to the text, Matter can be a pure chemical substance or?
- | | |
|--------------------------|----------------------------|
| A. Chemical bond(s) | D. Forms of energy |
| B. Chemical substance(s) | E. A mixture of substances |
| C. Chemical(s) | F. None of the Above |
51. This term is generally defined as anything that has rest mass and volume (it takes up space) and is made up of particles.
- | | |
|------------------------|-----------------------|
| A. Chemical element(s) | D. Matter |
| B. An electron | E. Energy and entropy |
| C. Atom | F. None of the Above |
52. The particles that make up matter have rest mass as well - not all particles have rest mass, such as?
- | | |
|------------------------|-----------------------|
| A. Chemical element(s) | D. The photon |
| B. An electron | E. Energy and entropy |
| C. Atom | F. None of the Above |

Element

53. The standard presentation of the _____ is in the periodic table, which orders elements by atomic number.
- | | |
|------------------------|-----------------------|
| A. Chemical element(s) | D. Photon |
| B. An electron | E. Energy and entropy |
| C. Atom | F. None of the Above |

Compound

54. The properties of a compound bear little similarity to those of its _____.
- | | |
|---------------------|-----------------------|
| A. Chemical bond(s) | D. Forms of energy |
| B. Elements | E. Physical chemistry |
| C. Chemical(s) | F. None of the Above |

Chemical Compounds

55. Which term means represents substances, but not all substances are compounds?
- | | |
|---------------------------|-----------------------------|
| A. Bulk chemical(s) | D. Compound(s) |
| B. Chemical(s) | E. A pure chemical compound |
| C. Mechanical processe(s) | F. None of the Above |

56. Organic compounds are _____ based primarily on carbon and hydrogen atoms.
- A. Bulk chemical(s)
 - B. Chemical(s)
 - C. Mechanical processe(s)
 - D. Compound(s)
 - E. A pure chemical compound
 - F. None of the Above

pH Section

57. According to the manual, which of the following parameter/methods/measurements determine a parameter using a concentration cell with transference by measuring the potential difference?

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

58. Mathematically speaking, pH is the negative logarithm of the activity of the (solvated) hydronium ion, often expressed as the measurement of?

- A. Electrons
- B. Alkalinity
- C. Hydronium ion concentration
- D. Cation measurement(s)
- E. Ions
- F. None of the Above

59. When measuring alkalinity in determining a stream's ability to neutralize acidic pollution from rainfall or wastewater, this measurement can be one of the best measures of the sensitivity of the stream to acid inputs.

- A. True
- B. False

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

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

61. What is the term associated with a charged species, an atom or a molecule, that has lost or gained one or more electrons?

- A. A proton
- B. Ion
- C. Anti-matter
- D. An electron
- E. A cation
- F. None of the Above

62. What is a substance that has the ability to reduce other substances and is said to be reductive in nature?

- A. Protons
- B. An electron donor
- C. Anti-matter
- D. Electrons
- E. Cations
- F. None of the Above

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

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

64. One definition of pH is that it is defined as the decimal logarithm of the reciprocal of the _____, a_{H^+} , in a solution.

- A. Hydrogen ion activity
- B. Ion-selective electrode(s)
- C. (Solvated) hydronium ion
- D. Brønsted–Lowry acid–base theory
- E. Acid-base behavior
- F. None of the Above

65. With respect to standard buffer values, when more than two buffer solutions are used the electrode can be calibrated by fitting observed pH values to a straight line.

- A. True
- B. False

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

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

67. Because the pH scale is logarithmic, therefore pH is?

- A. Universal indicator
- B. A dimensionless quantity
- C. A Spectrophotometer
- D. Excess of Ion concentrations
- E. A set of non-linear equations
- F. None of the Above

68. What is the new pH scale is referred to as?

- A. Total scale
- B. POH
- C. P3H
- D. Ph₃
- E. POE
- F. None of the Above

69. Alkalinity is able to neutralize _____ and is measured in a quantitative capacity in an aqueous solution.

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

70. When using a visual comparison of the test solution with a standard color chart, measuring pH values should be done to the?

- A. Universal indicator
- B. Colorwheel measurement
- C. Nearest whole number
- D. Spectrophotometer Example
- E. Lab test
- F. None of the Above

71. According to the manual, which device/method/calculation consists of a mixture of indicators which shows a continuous color change from pH 2 to pH 10?

- A. Universal indicator
- B. Colorimeter of spectrophotometer
- C. Spectrophotometer
- D. Excess of alkaline earth metal concentrations
- E. A set of non-linear simultaneous equations
- F. None of the Above

72. Which of the following term is an example of a mathematical procedure for calculating the concentrations of all chemical species that are present in the solution?

- A. Universal indicator
- B. pH log
- C. A set of linear equations
- D. A chemical speciation calculation
- E. A set of non-linear simultaneous equations
- F. None of the Above

73. According to the manual, under normal circumstances, strong acids and bases are compounds that, for practical purposes, are completely dissociated in water; this means that the concentration of hydrogen ions in acidic solution can be taken to be equal to the concentration of the acid. The pH is then equal to minus the logarithm of?

- A. The concentration value
- B. The pH
- C. The Spectrophotometer
- D. End-point pH
- E. A set of non-linear simultaneous equations
- F. None of the Above

74. The sum of all the titratable bases is the Alkalinity of water and its acid-neutralizing capacity. What would cause the measured value to vary significantly?

- A. Acid
- B. Alkalinity
- C. pH
- D. pH measurement(s)
- E. End-point pH
- F. None of the Above

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

- A. True
- B. False

76. If the pH of a solution contains a weak base, this may require?

- A. The solution of a cubic equation
- B. The solution of a linear equation
- C. The solution of a squared equation
- D. A set of linear simultaneous equations
- E. A set of non-linear simultaneous equations
- F. None of the Above

77. While the general case requires the pH solution of?

- A. The solution of a cubic equation
- B. The solution of a linear equation
- C. The solution of a squared equation
- D. A set of linear simultaneous equations
- E. A set of non-linear simultaneous equations
- F. None of the Above

78. Because alkalinity is significant in many uses and treatments of natural waters and wastewaters. The measured values also may include contributions from _____ or other bases if these are present.

- A. Acids
- B. Light metals
- C. Rare earths
- D. Borates, phosphates, silicates
- E. Caustics
- F. None of the Above

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

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

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

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

81. The calculation of the pH of a solution containing acids and/or bases is an example of a _____ calculation, that is, a mathematical procedure for calculating the concentrations of all chemical species that are present in the solution

- A. Universal indicator
- B. Colorwheel measurement
- C. Spectrophotometer
- D. Visual comparison
- E. Chemical speciation
- F. None of the Above

82. Since pH is a logarithmic scale, a difference of one pH unit is equivalent to a _____ difference in hydrogen ion concentration

- A. 1
- B. 2
- C. 5
- D. 10
- E. 100
- F. None of the Above

83. According to the manual, this key water measurement is used in the interpretation and control of water and wastewater treatment processes.

- A. Acid
- B. Alkalinity
- C. pH
- D. Chemical ion
- E. Hydrogen bond formation
- F. None of the Above

84. Which compounds for all practical purposes are completely dissociated in water?

- A. Strong acids and bases
- B. Strong bases
- C. Chemical ions in chains
- D. Strong bases and weak acids
- E. Weak acids and weak bases
- F. None of the Above

85. Sodium hydroxide, NaOH, is an example of?

- A. Strong acid and base
- B. Strong base
- C. Weak base
- D. Strong base and weak acid
- E. Weak acids and weak bases
- F. None of the Above

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

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

Understanding Chlorine Basics and Disinfection Section

Chlorine Basics

87. By dropping a few drops of hydrochloric acid onto a piece of manganese dioxide, Steele had discovered?

- A. Halogens
- B. Ammonia
- C. Chlorine
- D. Manganese dioxide
- E. H₂SO₄
- F. None of the Above

88. English chemist Sir Humphrey Davy discovered that chlorine gas was actually an element. Until that time, people were convinced that the gas was a?

- A. Chlorine chemistry
- B. Compound of oxygen
- C. Compound of ammonia
- D. Economical germ-killers
- E. Theory
- F. None of the Above

What Happens to Chlorine When it Enters the Environment?

89. 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

90. 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

91. 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

Disinfectant Qualities

92. 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

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

- A. True B. False

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

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

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

Chlorine's Effectiveness

97. 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

98. 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

99. 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

100. Which of the following terms is used 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

101. 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

102. 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

103. 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

104. 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

105. 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

106. 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

107. 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

108. 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

109. 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's Appearance and Odor (QA/QC)

110. 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

111. 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

112. 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

113. 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

114. 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

115. 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

116. 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

Disinfection Essentials

117. 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

118. 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

119. 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

120. 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

121. 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

122. 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

123. 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

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

- A. True
- B. False

125. 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

Chlorination Equipment Requirement Section

126. 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

127. 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

128. 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

129. 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

130. 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

131. 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

132. Which 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

Capacity

133. 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

Methods of Control

134. 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

135. 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

136. Which piece of 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

137. Which piece of 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

138. 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

139. 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

140. 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

141. 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

142. 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

143. 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

144. Which of the following related chlorine alarm equipment 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

145. 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

146. 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

147. Chlorine leak detection equipment may not be required for very small chlorine rooms with an exterior door (e.g., floor area less than 3m²).

- A. True
- B. False

148. You can use a spray solution of ammonia or a rag soaked with sulfur dioxide to detect a small Cl₂ 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

149. 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

150. 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

Ventilation

151. 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

152. 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

153. 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

Heating

154. 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

155. Which chlorine safety related equipment term should be protected to ensure that the chlorine maintains its gaseous state when entering the chlorinator?

- A. Cylinders or containers
- B. Corrosion resistant
- C. Securely positioned
- D. Automatic chlorine leak detection
- E. Chlorine room ventilation system
- F. None of the Above

Storage of Chlorine Cylinders

156. 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

157. 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

158. 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

Scrubbers

159. 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

160. 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

161. 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

162. 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

163. 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

164. 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

165. Liquid and concentrated gas could produce severe?

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

Understanding Disinfection

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

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

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

168. 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 D. The primary methods used for the disinfection
B. Disinfection process E. Economical and versatile chemicals
C. Environmental and regulatory impact F. None of the Above

Water Disinfection

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

170. 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 D. Microbiological contamination
B. Adverse health effects E. Sodium chloride
C. Disinfection of water F. None of the Above

171. Which of the following terms 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

172. According to the text, surface waters have been the focal point of _____ since their inception, as groundwaters (like wells) have been historically considered to be free of microbiological contamination.

- A. Chlorates are powerful oxidizers
- B. Adverse health effects
- C. Water disinfection regulations
- D. Microbiological contamination
- E. Sodium chloride
- F. None of the Above

Chlorate Ion

173. Which of the following terms is predicted by VSEPR, about chlorate anions?

- A. Acid/base balance
- B. Stable perchlorates
- C. Formula ClO_3
- D. Trigonal pyramidal structures
- E. Chemical formula CaCl_2
- F. None of the Above

174. Which of the following terms and should be kept away from organics or easily oxidized materials?

- A. Chlorates are powerful oxidizers
- B. Adverse health effects
- C. Formula ClO_3
- D. Microbiological contamination
- E. Sodium chloride
- F. None of the Above

175. Chlorates were once widely used in _____ for this reason, though their use has fallen due to their instability. Most pyrotechnic applications which formerly used chlorates in the past now use the more stable perchlorates instead.

- A. Acid/base balance
- B. Stable perchlorates
- C. Formula ClO_3
- D. Pyrotechnics
- E. Chemical formula CaCl_2
- F. None of the Above

Chloride Ion

176. The chloride ion is formed when the _____, a halogen, gains an electron to form an anion (negatively-charged ion) Cl^- .

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

177. The salts of hydrochloric acid contain chloride ions and can also be called chlorides. The chloride ion, and its salts such as sodium chloride, _____.

- A. Acid/base balance
- B. The stable perchlorates
- C. The formula ClO_3
- D. Are very soluble in water
- E. The chemical formula CaCl_2
- F. None of the Above

178. Methyl chloride, more commonly called chloromethane, (CH_3Cl) is _____, which does not contain a chloride ion.

- A. Chlorates are powerful oxidizers
- B. Adverse health effects
- C. The chloride ion
- D. An organic covalently bonded compound
- E. Sodium chloride
- F. None of the Above

179. Other salts such as calcium chloride, magnesium chloride, potassium chloride has varied uses ranging from medical treatments to?

- A. Chemical formula CaCl_2
- B. Cement formation
- C. Chlorite ion is ClO_2^- .
- D. Corresponding anions Cl^- , ClO^- , ClO_2^- , ClO_3^- , or ClO_4^-
- E. Chlorine dioxide
- F. None of the Above

180. Which of the following compounds is an example of table salt, which is sodium chloride with the chemical formula?

- A. Chemical formula CaCl_2
- B. NaCl
- C. Chlorite ion is ClO_2^- .
- D. Corresponding anions Cl^- , ClO^- , ClO_2^- , ClO_3^- , or ClO_4^-
- E. Chlorine dioxide
- F. None of the Above

181. 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 CaCl_2
- B. A chloride ion
- C. Chlorite ion is ClO_2^- .
- D. Corresponding anions Cl^- , ClO^- , ClO_2^- , ClO_3^- , or ClO_4^-
- E. Chlorine dioxide
- F. None of the Above

182. Which of the following compounds is also used for maintaining unpaved roads and for sanite fortifying roadbases for new construction?

- A. Chemical formula CaCl_2
- B. Calcium chloride
- C. Chlorite ion is ClO_2^- .
- D. Corresponding anions Cl^- , ClO^- , ClO_2^- , ClO_3^- , or ClO_4^-
- E. Chlorine dioxide
- F. None of the Above

183. Which of the following compounds are a closely monitored constituent of the mud system?

- A. Chemical formula CaCl_2
- B. Chloride
- C. Chlorite ion is ClO_2^- .
- D. Chlorides
- E. Chlorine dioxide
- F. None of the Above

184. 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 CaCl_2
- B. Chloride
- C. Chlorite ion is ClO_2^- .
- D. Corresponding anions Cl^- , ClO^- , ClO_2^- , ClO_3^- , or ClO_4^-
- E. Chlorine dioxide
- F. None of the Above

Chlorite Ion

185. The chlorite ion is?

- A. Chemical formula CaCl_2
- B. Chloride
- C. ClO_2^-
- D. Corresponding anions Cl^- , ClO^- , ClO_2^- , ClO_3^- , or ClO_4^-
- E. Chlorine dioxide
- F. None of the Above

186. 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. Chemical formula CaCl_2
- B. Chloride
- C. Chlorite ion is ClO_2^- .
- D. Chloride, hypochlorite, chlorite, chlorate, and perchlorate
- E. Chlorine dioxide
- F. None of the Above

187. 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 CaCl_2
 - B. Chloride
 - C. Chlorite ion is ClO_2^- .
 - D. Corresponding anions Cl^- , ClO^- , ClO_2^- , ClO_3^- , or ClO_4^-
 - E. Chlorine dioxide ClO_2
 - F. None of the Above

Chlorine Dioxide

188. Chlorine dioxide is a chemical compound with the formula?
- A. Chemical formula CaCl_2
 - B. Chloride
 - C. Chlorite ion is ClO_2^- .
 - D. Corresponding anions Cl^- , ClO^- , ClO_2^- , ClO_3^- , or ClO_4^-
 - E. ClO_2
 - F. None of the Above

Haloacetic Acids

189. 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
 - B. A single halogen
 - C. Hypochlorite compounds
 - D. Carboxylic acids
 - E. Calcium hypochlorite
 - F. None of the Above

190. 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)
 - B. Calcium hypochlorite tablets
 - C. Hypochlorous acid
 - D. Electronegative halogens
 - E. Chlorine dioxide
 - F. None of the Above

Contaminants in Drinking Water

191. 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

192. 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
193. 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

194. 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

195. 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

196. 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)

197. Which term 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

198. 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)

199. Which term 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

200. 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

Chloroform

201. 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

202. 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

Cryptosporidium and Giardia Analysis

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

- A. Total Organisms
- B. Indicator bugs
- C. Cholera, polio, typhoid, hepatitis
- D. Oocysts
- E. Cryptosporidium and Giardia
- F. None of the Above

204. Submerge the equipment in a vessel containing 12 percent hypochlorite solution for 30 minutes. Wash the equipment free of residual sodium hypochlorite solution with three rinses of filter-sterilized water; do not de-chlorinate the equipment using?

- A. Dibromochloromethane
- B. Bromoform
- C. Cl_2 and HOCl
- D. Sodium hypochlorite solution
- E. Sodium thiosulfate
- F. None of the Above

More on Chlorine (DDBP)

205. Which terms 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

Chlorine By-Products

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

- 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

The Principal Trihalomethanes are:

207. 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

208. 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

209. 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

210. Many cities use ozone to disinfect their source water and to reduce formation of this parameter?
- A. Chlorate and Chlorite D. Ammonia and THMS
B. CO₂ and H₂SO₄ E. Chloramines
C. Trihalomethanes (THMs) F. None of the Above
211. _____ 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 D. Chlorine Dioxide, Chlorine
B. UV, Chlorine E. Chloramines, Chlorine
C. Chlorite, Chlorine F. None of the Above
212. 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

213. 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
214. Water system managers may also consider switching from chlorine to alternative disinfectants to reduce formation of THMs and HAAs.
- A. True B. False
215. 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

Chemistry of Chlorination

216. The hypochlorite ion is a much weaker disinfecting agent than Hypochlorous acid, about 100 times less effective.
- A. True B. False
217. 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 D. "CT" disinfection concept
B. CT actual E. Ratio of hypochlorous acid
C. Free chlorine residual F. None of the Above

218. Under normal water conditions, hypochlorous acid will also chemically react and break down into the hypochlorite ion.

- A. True B. False

219. Temperature plays a small part in the acid ratio.

- A. True B. False

220. Although the ratio of _____ is greater at lower temperatures, pathogenic organisms are actually harder to kill.

- A. Hypochlorous acid D. Total chlorine
B. The amount of chlorine E. pH value and temperature
C. Chlorine Demand F. None of the Above

221. If all other things were equal, _____ and a lower pH are more conducive to chlorine disinfection.

- A. Lower pH D. Lower water temperature
B. Hypochlorous acid E. The hypochlorite ion
C. Higher water temperatures F. None of the Above

222. The disassociation of chlorine gas

(OCI⁻): HOCl H⁺ + OCI⁻ Also expressed HOCl → H⁺ + OCI⁻
(hypochlorous acid) (hydrogen) (hypochlorite ion)

- A. True B. False

223. All three forms of chlorine produce Sodium hypochlorite when added to water.

- A. True B. False

224. 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

225. Which of the following term is all 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

226. 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

227. 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

228. Which term is much more effective as a disinfecting agent?

- A. Chlorine residual
- B. Chlorine demand
- C. Free chlorine
- D. Break-point chlorination
- E. Total chlorine residual
- F. None of the Above

229. Either a total or a _____ can be read when a chlorine residual test is taken,

- A. Chlorine residual
- B. Chlorine demand
- C. Free chlorine residual
- D. Break-point chlorination
- E. Total chlorine residual
- F. None of the Above

230. Which of the following terms 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
- B. Total residual
- C. Free chlorine residual
- D. "CT" disinfection concept
- E. T10 of the process unit
- F. None of the Above

Residual Concentration/Contact Time (CT) Requirements

231. The effective reduction in pathogens can be calculated by reference to standard tables of required?

- A. Free chlorine
- B. Total residual
- C. Free chlorine residual
- D. "CT" s
- E. T10 of the process unit
- F. None of the Above

Calculation and Reporting of CT Data

232. Reduction Ratio should be reported, along with the appropriate pH, temperature, and?

- A. Reduction Ratio
- B. CT actual
- C. Free chlorine residual
- D. Disinfectant residual
- E. T10 of the process unit
- F. None of the Above

233. You can also calculate and record actual log reductions. Reduction Ratio = CT actual divide by?

- A. Reduction Ratio
- B. CT
- C. Free chlorine residual
- D. "CT" disinfection concept
- E. CT required
- F. None of the Above

234. 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

Microbial Regulations

235. One of the key regulations developed and implemented by the United States Environmental Protection Agency (USEPA) to counter pathogens in drinking water is the Surface Water Treatment Rule requires that a public water system, using surface water (or ground water under the direct influence of surface water) as its source, have sufficient treatment to reduce the source water concentration of Giardia and viruses by at least 99.9% and 99.99%, respectively.

- A. True
- B. False

236. Which rule improves physical removal of Cryptosporidium, and to maintain control of pathogens?
- A. Long Term 1 Enhanced Surface Water Treatment Rule
 - B. Maximum Contaminant Level Goal (MCLG)
 - C. Stage 1 Disinfectants/Disinfection Byproducts Rule
 - D. Surface Water Treatment Rule
 - E. Interim Enhanced Surface Water Treatment Rule
 - F. None of the Above

Disinfection / Chlorine Section Review

237. 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

238. Which of the following terms 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

239. 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
- B. Chlorine total
- C. Combined chlorine
- D. Total chlorine
- E. Residual chlorine
- F. None of the Above

240. 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

Waterborne Disease / Virus Section Introduction

241. Which of the following terms does treatment processes and watershed management strategies designed on the basis of bacteriological criteria do not necessarily protect against?

- A. F-specific coliphages
- B. Indicators of fecal contamination
- C. Enteric viruses
- D. Viruses
- E. Viral infection
- F. None of the Above

242. Because of their smaller size, viruses (0.023 to 0.080 μm) are transported further in ground water than bacteria (0.5 to 3 μm) or _____ (4 to 15 μm).

- A. Protozoan pathogens
- B. Indicators of fecal contamination
- C. Enteric viruses
- D. Viruses
- E. Microorganisms
- F. None of the Above

243. Which is the current method for culturing _____ under the ICR (U.S. Environmental Protection Agency, 1996c) is recognized as being difficult to implement?

- A. Protozoan pathogens
- B. Indicators of fecal contamination
- C. Enteric viruses
- D. Viruses
- E. Microorganisms
- F. None of the Above

Sampling Procedures -Streamwater Sample Collection

244. Consider that the spatial and temporal distribution of microorganisms in surface water can be as variable as the distribution of _____ because microorganisms are commonly associated with solid particles.

- A. Suspended sediment
- B. Indicators of fecal contamination
- C. Enteric viruses
- D. Viruses
- E. Microorganisms
- F. None of the Above

245. The standard samplers used in by the majority of samplers can be used to collect streamwater samples for bacterial and viral indicators, _____ providing that the equipment coming in contact with the water is properly cleaned and sterilized.

- A. Cryptosporidium, and Giardia
- B. Indicator organisms
- C. Cholera, polio, typhoid, hepatitis
- D. Cryptosporidium
- E. Giardia
- F. None of the Above

Cryptosporidium and Giardia Analysis

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

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

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

- A. Dibromochloromethane
- B. Bromoform
- C. Cl_2 and HOCl
- D. Sodium hypochlorite solution
- E. Sodium thiosulfate
- F. None of the Above

Advanced Disinfection Supplement

Factors in Chlorine Disinfection: Concentration and Contact Time

248. The CXT formula demonstrates that if an operator chooses to decrease the chlorine concentration, the required contact time must be lengthened. Similarly, as higher strength chlorine solutions are used, contact times may be reduced.

- A. True
- B. False

Chloramines

249. What are chemical compounds formed by combining a specific ratio of chlorine and ammonia in water?

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

250. Which term provides a durable residual, and are often used as a secondary disinfectant for long distribution lines and where free chlorine demand is high?

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

251. Which term represents a compound that may also be used instead of chlorine in order to reduce chlorinated byproduct formation and to remove some taste and odor problems?

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

Chlorine Dioxide

252. Which term represents a compound that may be generated on-site at water treatment facilities. In most generators sodium chlorite and elemental chlorine are mixed in solution, which almost instantaneously forms chlorine dioxide?

- A. Chlorine dioxide (ClO₂)
- B. Bromate
- C. Chloramine
- D. Ozone
- E. Disinfection compounds
- F. None of the Above

Conclusion

253. 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

254. 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

255. 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 flexneri.

- A. True
- B. False

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

- A. True
- B. False

257. 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.

- A. True
- B. False

258. Legionnaire's disease, which causes a severe pneumonia, and the second, _____, which is a nonpneumonia illness; it's typically an influenza-like illness, and it's less severe.

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

259. This pathogen is naturally found in water, both natural and artificial water sources.

- A. Campylobacter
- B. Legionella
- C. Pontiac fever
- D. Typhoid fever
- E. Hydrodysenteriae
- F. None of the Above

260. Hepatitis A, the basics. It's a virus. It causes inflammation of the liver. And the reservoir for _____ is humans.

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

261. Cryptosporidium causes diarrheal illness known as?

- A. Vomiting
- B. Hemorrhagic colitis
- C. Diarrhea
- D. Cryptosporidiosis
- E. Salmonellosis
- F. None of the Above

262. 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

263. 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

264. 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

265. Schistosomatidae prevention strategies for this pathogen include _____ or interrupting the life cycle of the parasite by treating birds with an antihelminthic drug.

- A. Maintaining clarifiers
- B. Source protection
- C. Placing boric acid on berms
- D. Eliminating snails with a molluscicide
- E. Boiling
- F. None of the Above

More on Chlorination Byproducts -Disinfection Rule Review

266. 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

267. All disinfectants form DBPs in one of two reactions: Chlorine 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

268. 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

269. 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

270. 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

Public Health Concerns

271. While disinfectants are effective in controlling many microorganisms, they react with natural organic and inorganic matter in source water and distribution systems to form?

- A. DBPs
- B. Chlorine and chloramine
- C. Stage 2 DBPR
- D. Classes of DBPs
- E. Ultraviolet light
- F. None of the Above

272. Which of the following terms have also been shown to cause adverse reproductive or developmental effects in laboratory animals?

- A. DBPs
- B. Chlorine and chloramine
- C. Stage 2 DBPR
- D. Classes of DBPs
- E. Ultraviolet light
- F. None of the Above

273. More than 200 million people consume water that has been disinfected. Because of the large population exposed, health risks associated with _____, even if small, need to be taken seriously.

- A. DBPs
- B. Chlorine and chloramine
- C. Stage 2 DBPR
- D. Classes of DBPs
- E. Ultraviolet light
- F. None of the Above

Stage 2 DBP Rule Federal Register Notices

274. 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

275. Which Rule will reduce potential cancer and reproductive and developmental health risks from disinfection byproducts (DBPs) in drinking water, which form when disinfectants are used to control microbial pathogens?

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

276. 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

277. Which of the following rules has been highly effective in protecting public health and has 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

278. 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

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

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

280. The Stage 1 Disinfectants and Disinfection Byproducts Rule and _____, promulgated in December 1998.

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

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

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

282. Which of the following rules and the Long Term 2 Enhanced Surface Water Treatment Rule are the second phase of rules required by Congress?

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

283. Which of the following rules will reduce potential cancer and reproductive and developmental health risks from disinfection byproducts?

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

284. 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
- B. The Stage 3 DBPR
- C. This final rule
- D. Amendments to the SDWA in 1996
- E. Primary or residual disinfectant
- F. None of the Above

What does the rule require?

285. Under this term, systems 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

286. Compliance with the maximum contaminant levels for two groups of disinfection byproducts (TTHM and HAA5), referred to as?

- 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

287. Which of the following rules 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

Who must comply with the rule?

288. Entities potentially regulated by the _____ are community and nontransient noncommunity water systems that produce and/or deliver water that is treated with a primary or residual disinfectant other than ultraviolet light.

- 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

289. Which of the following terms is a public water system that serves year-round residents of a community, subdivision, or mobile home park that has at least 15 service connections or an average of at least 25 residents?

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

What are Disinfection Byproducts (DBPs)?

290. 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

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

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

292. The amount of this term 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?

293. Which of the following terms 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

294. The presence of _____ 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

Understanding Combined Chlorine Residual

295. 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

296. What term 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

297. 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

298. 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

299. 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

300. 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

301. What term best 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. Combined chlorine
- B. Disinfection
- C. Free chlorine
- D. Breakpoint chlorination
- E. Total chlorine residual
- F. None of the Above

302. 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

303. What term best describes this missing term, which includes both the free and combined or chemically bound chlorine residuals?

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

304. What term best describes the addition of chlorine after a process or adding chlorine downstream to meet a Demand in the system?

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

305. 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.
A. True B. False

306. 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

Chlor-Alkali Membrane Process

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

308. The second electrode is the cathode and is submerged in a _____ solution.
A. Oxidizing chemical(s) D. Sodium hydroxide (caustic soda)
B. A salt water solution E. Sodium and chlorine ions
C. Sodium F. None of the Above

309. Which of the following terms is used to keep the two different solutions from mixing?
A. A membrane D. Chlor-alkali membrane process
B. Caustic soda E. Required contact time
C. Chlorine ion F. None of the Above

310. 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) D. Caustic soda
B. Sodium and chlorine ions E. Sodium and chlorine
C. Sodium F. None of the Above

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

312. The hydroxyl ion originates from the dissolution of water at the cathode where _____ also develops.
A. Hydrogen gas D. Caustic soda
B. Chlorination E. Sodium and chlorine ions
C. Sodium F. None of the Above

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

Chlorine's Effectiveness

314. 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

315. 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

316. Which of the following terms 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

317. 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

318. This 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

319. 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

320. 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

Calcium Hypochlorite Section

321. 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

322. Which of the following substances is generally available as a white powder, pellets, or flat plates; sodium hypochlorite is usually a greenish yellow, aqueous solution?

- A. Chlorine tablet(s)
- B. HCL powder
- C. Solid chlorine
- D. Sodium and calcium hypochlorite
- E. Calcium hypochlorite
- F. None of the Above

323. 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
- B. Hypochlorous Acid (HOCl)
- C. Oxygen and chlorine
- D. Chlorine tablet(s)
- E. Hypochlorite ion
- F. None of the Above

Description

324. 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

325. 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

326. Which of the following answers 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)
- B. Household bleach
- C. Hypochlorous Acid (HOCl)
- D. Sodium hypochlorite
- E. Calcium hypochlorite
- F. None of the Above

Accuracy

327. According to the text, _____ 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

328. Which compound's strengths vary so widely and are mostly unknown (the container usually says "less than 5%") that it is impossible to make up accurate in-use solutions without access to laboratory equipment?

- A. Chlorine tablet(s)
- B. Liquid chlorine
- C. Solid chlorine
- D. Sodium and calcium hypochlorite
- E. Calcium hypochlorite
- F. None of the Above

Effectiveness

329. 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

330. 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
- B. Hypochlorous Acid (HOCl)
- C. Oxygen and chlorine
- D. Hypochlorite ion
- E. Hypochlorite
- F. None of the Above

Safety

331. Which of the following can affect eyes, skin and mucous membranes; it is easily splashed and rots clothing?

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

Corrosion

332. 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

Comparison

333. 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

334. 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

335. 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. Hydrochlorite ion
- F. None of the Above

336. Which substance produces tissue injury by liquefaction necrosis? Systemic toxicity is rare, but metabolic acidosis may occur after ingestion.

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

Acute Exposure

337. 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

338. This material causes tissue damage by liquefaction necrosis.

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

339. Calcium hypochlorite decomposes in water releasing?

- A. Chlorine gas
- B. Hypochlorous Acid (HOCl)
- C. Fulmic acid
- D. THM
- E. Hypochlorite ion
- F. None of the Above

Sodium Hypochlorite Solutions

340. 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

341. 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

342. 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

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

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

Chloramine Section

344. _____: $\text{NH}_3 + \text{HOCl} \rightarrow \text{NH}_2\text{Cl} + \text{H}_2\text{O}$

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

345. _____: $\text{NHCl}_2 + 3\text{HOCl} \rightarrow \text{NHCl}_3 + 3\text{H}_2\text{O}$

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

346. Which of the following terms are an effective disinfectant against bacteria but not against viruses?
- A. Free chlorine
 - B. Chloramine(s)
 - C. Dichloramine
 - D. Monochloramine and dichloramine
 - E. Ammonia and chlorine compounds
 - F. None of the Above

347. 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: $2\text{NH}_2\text{Cl} + \text{HOCl} \rightarrow \text{N}_2 + 6\text{HCl} + \text{H}_2\text{O}$
- A. Free chlorine
 - B. Chloramine(s)
 - C. Dichloramine
 - D. Nitrogen gas
 - E. Ammonia and chlorine compounds
 - F. None of the Above

348. _____: $\text{NH}_2\text{Cl} + 2\text{HOCl} \rightarrow \text{NHCl}_2 + 2\text{H}_2\text{O}$
- A. Free chlorine
 - B. Trichloramine
 - C. Dichloramine
 - D. Monochloramine
 - E. Ammonia and chlorine compounds
 - F. None of the Above

349. 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
 - B. Chloramine(s)
 - C. Dichloramine
 - D. Monochloramine and dichloramine
 - E. Ammonia and chlorine compounds
 - F. None of the Above

Post Chlorination

350. Post chlorination is almost always done in water treatment, but can be replaced with chlorine dioxide or chloramines.
- A. True
 - B. False

351. 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

Chlorine Dioxide Section

352. 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

353. 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

354. 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

355. Which of the following compound(s) 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

356. 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

357. 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

358. 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

359. Which of the following compound(s) 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

360. 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

361. 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

362. 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

363. 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

364. Which of the following compound(s) is a non-specific oxidant that 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

365. Which of the following compound(s) 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

366. 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

367. 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

368. This 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

369. Which compound is a yellow-green gas with an irritating odor not unlike Chlorine?

- A. Sodium thiosulfate
- B. Chlorine
- C. Chlorine dioxide
- D. Sodium chlorate (NaClO_3) and sulfuric acid
- E. Ozone
- F. None of the Above

370. Which compound cannot be compressed and shipped in a container, so it must be generated on site?

- A. Sodium thiosulfate
- B. Chlorine
- C. Chlorine dioxide
- D. Sodium chlorate (NaClO_3) and sulfuric acid
- E. Ozone
- F. None of the Above

371. Which of the following compound(s) under efficient generation, THMs are not formed and THM precursor(s) are reduced. In one application, THM formation was reduced from 34 m g/l to 1 m g/l?

- 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

372. 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

373. The effects of _____ on hypochlorous acid and its reactivity with a variety of compounds both combine to vastly diminish its effectiveness in contaminated, high-pH cooling water systems. Conversely, chlorine dioxide remains completely pH-independent in the range where recirculating and once-through cooling systems are typically operated.

- A. THM precursor(s)
- B. Chlorine gas
- C. Chlorine dioxide
- D. pH
- E. THM formation
- F. None of the Above

Alternative Water Disinfection Methods Section - Ultraviolet Disinfection

374. In UV, quartz is often used in this case since the quartz absorbs practically none of the UV rays, 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

375. 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

376. 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
- B. Contact
- C. Channel
- D. UV reactor
- E. Ballasts and shields
- F. None of the Above

377. 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
- B. UV rays
- C. UV disinfection
- D. UV reactor
- E. Electromagnetic energy
- F. None of the Above

378. 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
- B. UV Flux
- C. UV disinfection
- D. UV reactor
- E. Ballasts and shields
- F. None of the Above

379. 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

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

381. 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

382. 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

383. 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

384. 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

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

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

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

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

387. 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 D. Oxygen and nascent oxygen
B. THMs E. Strongest oxidizing agent
C. Light blue gas F. None of the Above

388. 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

389. 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

390. 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

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

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

Alternate Disinfectants Section Summary

Chloramines

392. 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

393. 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

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

- A. Post disinfectant
- B. ClO₂/chlorite/chlorate
- C. An oxidant
- D. Total residual oxidants
- E. A pre-disinfectant
- F. None of the Above

395. 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. ClO₂/chlorite/chlorate
- C. An oxidant
- D. Chlorine dioxide and chlorite
- E. 25% aqueous solution of sodium chlorite (NaClO₂)
- F. None of the Above

396. 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

397. 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

398. 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

399. This 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

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

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

401. 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

402. 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

Heterotrophic Plate Count (Spread Plate Method)

403. 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

404. Which of the following terms provides a technique to quantify the bacteriological activity of a sample?

- A. Colonies
- B. Heat
- C. Agar
- D. Heterotrophic Plate Count
- E. MCL
- F. None of the Above

405. After an incubation period, a bacteriological colony count provides an estimate of the concentration of heterotrophs in the sample of interest. The R2A agar provides a medium that will support a large variety of?

- A. Colonies
- B. Bugs
- C. Germs
- D. Heterotrophic bacteria
- E. MCL
- F. None of the Above

Total Coliforms

406. 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

407. 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

408. For systems that collect _____ or more samples per month, no more than five (5) percent may be Positive.

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

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

409. Which of the following terms to human health violation occurs if either one of the following happens?

- 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

410. 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

411. 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

412. Which of the following terms requires the water system to provide public notice via radio and television stations in the area?

- A. Routine analysis violation
- B. Drinking water rule violation
- C. MCL violation
- D. Human health violation
- E. Acute health risk violation
- F. None of the Above

413. According to the text, the type of contamination can pose an immediate threat to human health and notice must be given as soon as possible, but no later than 24 hours after notification from your laboratory of the test results.

- A. True
- B. False

Public Notice

414. 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

415. 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

416. 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

417. If there is a(n) _____ present to users, the timing and place of posting of the public notice may have different priorities.

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

Hazard Communication Section Introduction

418. New 2012 changes to OSHA's- this missing term - are bringing the U.S. into alignment with the Globally Harmonized System of Classification and Labeling of Chemicals, improving safety and health protections for America's workers.

- A. SDS/MSDS
- B. Safety data sheets and labels
- C. Specific criteria
- D. Hazard communication elements
- E. Hazard Communication Standard
- F. None of the Above

419. The new Hazard Communication Standard still requires chemical manufacturers and importers to evaluate the chemicals they produce or import and provide - this missing term - to employers and workers by putting labels on containers and preparing safety data sheets.

- A. SDS/MSDS
- B. Safety data sheets and labels
- C. Specific criteria
- D. Hazard communication elements
- E. Hazard information
- F. None of the Above

420. Which of the following terms allowed chemical manufacturers and importers to convey hazard information on labels and material safety data sheets in whatever format they chose?

- A. OSHA's HazCom rule
- B. Old standard
- C. Identities and hazards
- D. Hazardous chemicals
- E. Right to understand
- F. None of the Above

421. The Safety Data Sheet is at the heart of federal OSHA's?

- A. Hazard communication standard (HazCom)
- B. Hazard information
- C. Identities and hazards
- D. Hazardous chemicals
- E. Right to understand
- F. None of the Above

422. Which of the following terms is a detailed, written description of a hazardous chemical that must be kept in the workplace where such chemicals are used?

- A. SDS/MSDS
- B. Safety data sheets and labels
- C. Specific criteria
- D. Hazard communication elements
- E. Hazard Communication Standard (HCS)
- F. None of the Above

423. OSHA's HazCom rule has significant new requirements that will require employers to train their employees how to read and interpret the?

- A. New SDS
- B. Hazard information
- C. Identities and hazards
- D. Hazardous chemicals
- E. Right to understand
- F. None of the Above

Rationale

424. All employers with _____ in their workplaces must have labels and safety data sheets for their exposed workers, and train them to handle the chemicals appropriately.

- A. OSHA's HazCom rule
- B. Hazard information
- C. Identities and hazards
- D. Hazardous chemicals
- E. Right to understand
- F. None of the Above

Major changes to the Hazard Communication Standard

425. Which of the following terms provides specific criteria for classification of health and physical hazards, as well as classification of mixtures?

- A. SDS/MSDS
- B. Safety data sheets and labels
- C. Hazard classification
- D. Hazard communication elements
- E. Hazard Communication Standard (HCS)
- F. None of the Above

426. Labels: Chemical manufacturers and importers will be required to provide a label that includes a harmonized signal word, pictogram, and hazard statement for each?

- A. Specific, detailed criteria
- B. Standardized label elements
- C. HCS
- D. Hazard class and category
- E. GHS
- F. None of the Above

427. Safety Data Sheets: Will now have a specified 16-section format. Information and training: Employers are required to train workers by December 1, 2013 on the new labels elements and safety data sheets format to facilitate?
- A. Recognition and understanding
 - B. Model regulation
 - C. GHS
 - D. The Purple Book
 - E. Hazard Communication Standard (HCS)
 - F. None of the Above

What is the Globally Harmonized System?

428. The Globally Harmonized System is _____ to hazard communication, providing agreed criteria for classification of chemical hazards, and a standardized approach to label elements and safety data sheets.

- A. Hazard classification
- B. An international approach
- C. Degree of hazard
- D. Existing hazard communication regulatory schemes
- E. Hazards associated
- F. None of the Above

429. Which of the following terms was negotiated in a multi-year process by hazard communication experts from many different countries, international organizations, and stakeholder groups?

- A. Revised HCS
- B. Model regulation
- C. GHS
- D. The Purple Book
- E. Hazard Communication Standard (HCS)
- F. None of the Above

430. It is based on major existing systems around the world, including- this missing term - and the chemical classification and labeling systems of other US agencies.

- A. Specific, detailed criteria
- B. Standardized label elements
- C. SDS
- D. OSHA's Hazard Communication Standard
- E. GHS
- F. None of the Above

431. The result of this negotiation process is the United Nations' document entitled "Globally Harmonized System of Classification and Labeling of Chemicals," commonly referred to as?

- A. Revised HCS
- B. Model regulation
- C. GHS
- D. The Purple Book
- E. Hazard Communication Standard (HCS)
- F. None of the Above

432. This document provides harmonized classification criteria for health, physical, and environmental hazards of chemicals. It also includes standardized label elements that are assigned to these hazard classes and categories, and provide the appropriate signal words, pictograms, and hazard and precautionary statements to convey the?

- A. Specific, detailed criteria
- B. Standardized label elements
- C. HCS
- D. Hazard classes and hazard categories
- E. Hazards to users
- F. None of the Above

433. A standardized order of information for safety data sheets is also provided. These recommendations can be used by regulatory authorities such as OSHA to establish - this missing term - for hazard communication, but do not constitute a model regulation.

- A. Revised HCS
- B. Model regulation
- C. GHS
- D. Mandatory requirements
- E. Hazard Communication Standard (HCS)
- F. None of the Above

No intentional trick questions.

What Hazard Communication Standard provisions are unchanged in the revised HCS?

434. The revised Hazard Communication Standard is a modification to the existing standard. The parts of the standard that did not relate to the _____ remained largely unchanged.

- A. Specific, detailed criteria
- B. Standardized label elements
- C. HCS
- D. Hazard classes and hazard categories
- E. GHS
- F. None of the Above

435. There have been some modifications to terminology in order to align the - this missing term - with language used in the GHS.

- A. Hazard classification
- B. Safety Data Sheets
- C. Revised HCS
- D. Existing hazard communication regulatory schemes
- E. Hazards associated
- F. None of the Above

436. Which of the following terms has been changed to "hazard classification" and "material safety data sheet" was changed to "safety data sheet?"

- A. Revised HCS
- B. Model regulation
- C. GHS
- D. Hazard determination
- E. Hazard Communication Standard (HCS)
- F. None of the Above

How will chemical hazard evaluation change under the revised Hazard Communication Standard?

437. Under both the current Hazard Communication Standard and the- this missing term - an evaluation of chemical hazards must be performed considering the available scientific evidence concerning such hazards.

- A. Revised HCS
- B. Model regulation
- C. GHS
- D. Revised OSHA
- E. Hazard Communication Standard (HCS)
- F. None of the Above

438. Under the current - this missing term -, the hazard determination provisions have definitions of hazard and the evaluator determines whether or not the data on a chemical meet those definitions.

- A. Specific, detailed criteria
- B. Standardized label elements
- C. HCS
- D. Hazard classes and hazard categories
- E. GHS
- F. None of the Above

439. The hazard classification approach in the - this missing term - is quite different.

- A. Revised HCS
- B. Model regulation
- C. GHS
- D. The Purple Book
- E. Hazard Communication Standard (HCS)
- F. None of the Above

440. It also establishes both hazard classes and hazard categories—for most of the effects; the classes are divided into categories that reflect the?

- A. Specific, detailed criteria
- B. Standardized label elements
- C. HCS
- D. Hazard classes and hazard categories
- E. Relative severity of the effect
- F. None of the Above

441. Which of the following terms does not include categories for most of the health hazards covered, so this new approach provides additional information that can be related to the appropriate response to address the hazard?

- A. Revised HCS
- B. Model regulation
- C. GHS
- D. Current HCS
- E. Hazard Communication Standard (HCS)
- F. None of the Above

United Nations Globally Harmonized System of Classification and Labeling of Chemicals

1.0 Background

442. The purpose of this document is to describe the United Nations Globally Harmonized System of Classification and Labeling of Chemicals (GHS), why it was developed, and how it relates to the?

- A. Earth Summit
- B. Several U.S. regulatory agencies
- C. Regulatory authorities in countries
- D. National, regional and international levels
- E. The widespread use of chemicals
- F. None of the Above

1.1 What is the GHS?

443. The GHS is a system for - this missing term - the classification and labeling of chemicals. It is a logical and comprehensive approach to: Defining health, physical and environmental hazards of chemicals;

- A. Cradle to grave
- B. Hazards to human health
- C. Multiple safety data sheets
- D. Standardizing and harmonizing
- E. Hazardous properties of chemicals
- F. None of the Above

444. Creating classification processes that use available data on chemicals for comparison with the defined?

- A. Hazard classification
- B. Safety Data Sheets
- C. Degree of hazard
- D. Hazard criteria
- E. Hazards associated
- F. None of the Above

445. Communicating hazard information, as well as- this missing term - on labels and Safety Data Sheets (SDS).

- A. Cradle to grave
- B. Hazards to human health
- C. Multiple safety data sheets
- D. Protective measures
- E. Hazardous properties of chemicals
- F. None of the Above

446. The GHS itself is not a?

- A. Regulation or a standard
- B. Several U.S. regulatory agencies
- C. Regulatory authorities in countries
- D. National, regional and international levels
- E. The widespread use of chemicals
- F. None of the Above

447. The elements in the - this missing term - a mechanism to meet the basic requirement of any hazard communication system, which is to decide if the chemical product produced and/or supplied is hazardous and to prepare a label and/or Safety Data Sheet as appropriate.

- A. Cradle to grave
- B. Hazards to human health
- C. Multiple safety data sheets
- D. GHS supply
- E. Hazardous properties of chemicals
- F. None of the Above

448. Regulatory authorities in countries adopting the GHS will thus take the agreed criteria and provisions, and implement them through their own regulatory process and procedures rather than simply incorporating the text of the?

- A. Earth Summit
- B. Several U.S. regulatory agencies
- C. Regulatory authorities in countries
- D. National, regional and international levels
- E. GHS into their national requirements
- F. None of the Above

449. The GHS Document thus provides countries with the regulatory building blocks to develop or modify existing national programs that address classification of hazards and transmittal of information about those hazards and associated protective measures. This helps to ensure the safe use of chemicals as they move through the - this missing term - from "cradle to grave."

- A. Product life cycle
- B. Hazards to human health
- C. Multiple safety data sheets
- D. GHS
- E. Hazardous properties of chemicals
- F. None of the Above

1.2 Why was the GHS developed?

450. Chemicals directly or indirectly affect our lives and are essential to our food, our health, and our lifestyle. The widespread use of chemicals has resulted in the development of?

- A. Sector-specific regulations
- B. Several U.S. regulatory agencies
- C. Regulatory authorities in countries
- D. National, regional and international levels
- E. The widespread use of chemicals
- F. None of the Above

451. Having readily available information on the- this missing term - and recommended control measures, allows the production, transport, use and disposal of chemicals to be managed safely. Thus, human health and the environment are protected.

- A. Cradle to grave
- B. Hazards to human health
- C. Multiple safety data sheets
- D. GHS
- E. Hazardous properties of chemicals
- F. None of the Above

452. Which of the following terms should include systems through which chemical hazards are identified and communicated to all who are potentially exposed?

- A. Earth Summit
- B. Several U.S. regulatory agencies
- C. Regulatory authorities in countries
- D. National, regional and international levels
- E. The widespread use of chemicals
- F. None of the Above

453. It is important to know what chemicals are present and/or used, their hazards to human health and the environment, and the?

- A. Means to control them
- B. Hazards to human health
- C. Multiple safety data sheets
- D. GHS
- E. Hazardous properties of chemicals
- F. None of the Above

454. Which of the following terms - each addressing specific use patterns and groups of chemicals, exist at the national, regional and international levels?

- A. Hazard classification
- B. Safety Data Sheets
- C. Degree of hazard
- D. Number of classification and labeling systems
- E. Hazards associated
- F. None of the Above

455. While the existing laws and regulations are similar, they are different enough to require multiple labels for the same product both within the U.S. and in international trade and to require - this missing term - for the same product in international trade.

- A. Cradle to grave
- B. Hazards to human health
- C. Multiple safety data sheets
- D. GHS
- E. Hazardous properties of chemicals
- F. None of the Above

456. Several U.S. regulatory agencies and various countries have different requirements for hazard definitions as well as for information to be included on?

- A. Labels or material safety data sheets
- B. Several U.S. regulatory agencies
- C. Regulatory authorities in countries
- D. National, regional and international levels
- E. The widespread use of chemicals
- F. None of the Above

457. Flammable liquid is another hazard that is covered by most existing systems. The coverage varies between existing systems within the U.S. and globally. This means that the same product can be non-hazardous or hazardous with?

- A. Different labels/SDSs
- B. Hazards to human health
- C. Multiple safety data sheets
- D. GHS
- E. Hazardous properties of chemicals
- F. None of the Above

458. In the area of trade, the need to comply with multiple regulations regarding- this missing term - and labeling is costly and time-consuming.

- A. Hazard classification
- B. Safety Data Sheets
- C. Degree of hazard
- D. Existing hazard communication regulatory schemes
- E. Hazards associated
- F. None of the Above

459. Some multinational companies have estimated that there are over 100 - this missing term - for their products globally.

- A. Cradle to grave
- B. Hazards to human health
- C. Multiple safety data sheets
- D. GHS
- E. Hazardous properties of chemicals
- F. None of the Above

1.3 What was the International Mandate?

460. The single most important force that drove the creation of the - this missing term - was the international mandate adopted in the 1992 United Nations Conference on Environment and Development, often called the "Earth Summit".

- A. Earth Summit
- B. GHS
- C. Regulatory authorities in countries
- D. National, regional and international levels
- E. Widespread use of chemicals
- F. None of the Above

461. Which of the following terms - was one of six program areas that were endorsed by the United Nations General Assembly?

- A. A global approach
- B. Regulatory changes
- C. GHS
- D. Preventive and protective measures
- E. Harmonization of classification and labeling of chemicals
- F. None of the Above

462. It was recognized that an internationally - this missing term - to classification and labeling would provide the foundation for all countries to develop comprehensive national programs to ensure the safe use of chemicals.

- A. Self-classification
- B. Hazards of a substance or mixture
- C. Harmonized approach
- D. GHS labels and/or Safety Data Sheets
- E. Existing hazard communication systems
- F. None of the Above

1.4 How was the GHS developed?

463. The ILO concluded that there were - this missing term - that needed to be harmonized to achieve a global approach.

- A. A global approach
- B. The regulatory changes
- C. Four major existing systems
- D. Preventive and protective measure for their health and safety
- E. Be exposed (workplaces), and in transport
- F. None of the Above

464. No international organization covers all aspects of?

- A. Self-classification
- B. Hazards of a substance or mixture
- C. The data used for classification
- D. Chemical classification and labeling
- E. Existing hazard communication systems
- F. None of the Above

1.7 What are the benefits?

465. The basic goal of - this missing term - is to ensure that employers, employees and the public are provided with adequate, practical, reliable and comprehensible information.

- A. Achieve a global approach
- B. The regulatory changes
- C. GHS
- D. Preventive and protective measures
- E. Hazard communication
- F. None of the Above

Hazard Classification

466. A decision on whether the substance or mixture will be classified as a hazardous substance or mixture and the - this missing term -, where appropriate, by comparison of the data with agreed hazard classification criteria.

- A. Hazard classification
- B. Safety Data Sheets
- C. Degree of hazard
- D. Existing hazard communication regulatory schemes
- E. Hazards associated
- F. None of the Above

467. _____ may be obtained from tests, literature, and practical experience.

- A. Hazard classification
- B. Safety Data Sheets
- C. Degree of hazard
- D. Data used for classification
- E. Hazards associated
- F. None of the Above

468. Tests that determine hazardous properties conducted according to internationally recognized scientific principles can be used for purposes of?

- A. Hazard classification
- B. Safety Data Sheets
- C. Degree of hazard
- D. Existing hazard communication regulatory schemes
- E. Hazards associated
- F. None of the Above

3.1 What are the GHS Physical Hazards?

469. Which of the following terms - developed by the ILO and UNCETDG, were largely based on the existing criteria used by the UN Model Regulation on the Transport of Dangerous Goods?

- A. Physical hazards classification
- B. GHS criteria
- C. Liquid or a gas
- D. GHS physical hazard criteria
- E. Scope of the GHS includes all target audiences
- F. None of the Above

470. Which of the following terms - provides specific references to approved test methods and criteria for classification?

- A. Physical hazards classification process
- B. GHS criteria
- C. Liquid or a gas
- D. GHS physical hazard criteria
- E. Scope of the GHS includes all target audiences
- F. None of the Above

471. Which of the following terms - for physical hazards are quantitative or semi-quantitative with multiple hazard levels within an endpoint. This is different from several of the existing systems that currently have qualitative criteria for various physical hazards.

- A. Physical hazards classification
- B. GHS criteria
- C. GHS more consistent
- D. GHS physical hazard criteria
- E. Scope of the GHS includes all target audiences
- F. None of the Above

472. In developing GHS criteria for - this missing term - it was necessary to define physical states.

- A. Physical hazards classification
- B. GHS criteria
- C. Physical hazards
- D. GHS physical hazard criteria
- E. Scope of the GHS includes all target audiences
- F. None of the Above

473. _____ that is not a gas and which has a melting point or initial melting point of 20°C or less at standard pressure of 101.3 kPa.

- A. Physical hazards classification
- B. GHS criteria
- C. Liquid or a gas
- D. A liquid is a substance or mixture
- E. A solid is a substance or mixture
- F. None of the Above

474. _____ that does not meet the definitions of a liquid or a gas.

- A. Physical hazards classification
- B. A liquid is a substance or mixture
- C. Liquid or a gas
- D. GHS physical hazard criteria
- E. A solid is a substance or mixture
- F. None of the Above

3.1.1 Explosives

475. An explosive substance (or mixture) is a solid or liquid which is in itself capable by - this missing term - of producing gas at such a temperature and pressure and at such a speed as to cause damage to the surroundings.

- A. Chemical reaction
- B. Single hazard category
- C. Flammable gas means a gas
- D. Ignition distance test
- E. Chemical heat of combustion
- F. None of the Above

476. Pyrotechnic substances are included even?

- A. Flammable components
- B. Substances and mixtures
- C. Foam aerosols
- D. Solid or liquid particles
- E. Exothermic chemical reactions
- F. None of the Above

3.1.7 Flammable Solids

477. Which of the following terms - are powdered, granular, or pasty substances which are dangerous if they can be easily ignited by brief contact with an ignition source?

- A. Flammable liquid
- B. Readily combustible solids
- C. Flammable solids
- D. Explosive, organic peroxides or as oxidizing
- E. Critical temperature
- F. None of the Above

478. _____ are assigned to one of two hazard categories on the basis of the outcome of the UN Test N.1.

- A. Flammable solids
- B. Substances and mixtures
- C. Ignition or pressure
- D. Physical state or compressed gases
- E. Substances and mixtures of this hazard class
- F. None of the Above

3.1.8 Self-Reactive Substances

479. _____ are thermally unstable liquids or solids liable to undergo a strongly exothermic thermal decomposition even without participation of oxygen.

- A. Combustion of other material
- B. Readily combustible solids
- C. Basis of the flash point
- D. Explosive, organic peroxides or as oxidizing
- E. Self-reactive substances
- F. None of the Above

3.1.12 Substances which on Contact with Water Emit Flammable Gases

480. Substances that, in contact with water, emit flammable gases are solids or liquids which, by interaction with water, are liable to become spontaneously flammable or to give off - this missing term - in dangerous quantities.

- A. Flammable solids
- B. Substances and mixtures
- C. Flammable gases
- D. Physical state or compressed gases
- E. Substances and mixtures of this hazard class
- F. None of the Above

3.1.13 Oxidizing Liquids

481. _____ is a liquid which, while in itself not necessarily combustible, may, generally by yielding oxygen, cause or contribute to the combustion of other material.

- A. Combustible liquid
- B. Readily combustible liquid
- C. Basis of the flash point
- D. Explosive liquid
- E. An oxidizing liquid
- F. None of the Above

482. Substances and mixtures of this hazard class are assigned to one of three hazard categories on the basis of test results which measure ignition or pressure rise time compared to?

- A. Flammable solids
- B. Substances and mixtures
- C. Ignition
- D. Physical state or compressed gases
- E. Substances and mixtures of this hazard class
- F. None of the Above

3.1.14 Oxidizing Solids

483. An oxidizing solid is a solid which, while in itself not necessarily combustible, may, generally by yielding oxygen, cause or contribute to the?

- A. Combustion of other material
- B. Readily combustible solids
- C. Basis of the flash point
- D. Explosive, organic peroxides or as oxidizing
- E. Critical temperature
- F. None of the Above

484. Substances and mixtures of this hazard class are assigned to one of three hazard categories on the basis of test results which measure mean burning time and?

- A. Flammable solids
- B. Substances and mixtures
- C. Ignition or pressure
- D. Physical state or compressed gases
- E. Substances and mixtures of this hazard class
- F. None of the Above

485. Currently, several workplace hazard communication systems cover - this missing term - as a class of chemicals.

- A. Oxidizers
- B. Readily combustible solids
- C. Flash points
- D. Explosives
- E. Critical temperatures
- F. None of the Above

3.1.15 Organic Peroxides

486. An organic peroxide is an organic liquid or solid which contains the- this missing term - and may be considered a derivative of hydrogen peroxide.

- A. Substances and mixtures
- B. Harmonized odors
- C. Chemical actions
- D. Structure/activity or structure property
- E. Organic radicals
- F. None of the Above

487. The term also includes organic peroxide formulations, such substances and mixtures may: be liable to- this missing term -; burn rapidly; be sensitive to impact or friction; react dangerously with other substances.

- A. Melt
- B. Decompose
- C. Corrode
- D. Explosive decomposition
- E. Burn
- F. None of the Above

3.1.16 Substances Corrosive to Metal

488. A substance or a mixture that by- this missing term - will materially damage, or even destroy, metals is termed 'corrosive to metal'.

- A. Substances and mixtures
- B. Harmonized approach
- C. Chemical action
- D. Structure/activity or structure property
- E. Organic radicals
- F. None of the Above

489. The concern in this case is the protection of metal equipment or installations in case of leakage, not - this missing term - between the container/tank and the product. This hazard is not currently covered in all systems.

- A. Not currently covered
- B. Analysis of existing
- C. Corrosive
- D. Health and environmental criteria
- E. Material compatibility
- F. None of the Above

3.2 What are the GHS Health and Environmental Hazards?

490. The work at the OECD to develop the GHS criteria included: A thorough analysis of existing classification systems, including the _____ its rationale and an explanation of the mode of use;

- A. Not currently covered
- B. Analysis of existing
- C. Corrosive
- D. Health and environmental criteria
- E. Scientific basis for a system and its criteria
- F. None of the Above

491. For some categories the harmonized approach was easy to develop because the existing systems had similar approaches. In cases where the approach was different, a compromise - this missing term - was developed.

- A. Consensus proposal
- B. Harmonized approach
- C. Harmonized chemical action
- D. Structure/activity or structure property
- E. Harmonizing
- F. None of the Above

492. _____ were established for substances and mixtures.

- A. Health criteria
- B. Analysis of existing
- C. Corrosive
- D. Health and environmental criteria
- E. Competent Authorities
- F. None of the Above

3.2.2 Skin Corrosion

493. _____ means the production of irreversible damage to the skin following the application of a test substance for up to 4 hours.

- A. Skin corrosion
- B. Harmonized approach
- C. Chemical action
- D. Structure/activity or structure property
- E. Organic radicals
- F. None of the Above

494. Substances and mixtures in this _____ - are assigned to a single harmonized corrosion category.

- A. Hazard class
- B. Harmonized approach
- C. Chemical class
- D. Structure/activity or structure property
- E. Organic class
- F. None of the Above

495. For Competent Authorities, such as transport packing groups, needing more than one designation for corrosivity, up to three subcategories are provided within the?

- A. Class
- B. Analysis
- C. Corrosive class
- D. Health and environmental criteria
- E. Corrosive category
- F. None of the Above

496. Several factors should be considered in determining the- this missing term - before testing is initiated: Human experience showing irreversible damage to the skin;

- A. Corrosion potential
- B. Harmonized approach
- C. Chemical potential
- D. Structure/activity or structure property
- E. Organic radicals
- F. None of the Above

497. Structure/activity or structure _____ to a substance or mixture already classified as corrosive.

- A. Substances and mixtures
- B. Harmonized approach
- C. Chemical action
- D. Property relationship
- E. Organic relationship
- F. None of the Above

498. Which of the following terms - means the production of reversible damage to the skin following the application of a test substance for up to 4 hours?

- A. Chemical action
- B. Analysis of existing
- C. Corrosive
- D. Health and environmental criteria
- E. Skin irritation
- F. None of the Above

499. Substances and mixtures in this hazard class are assigned to a single irritant category. For those authorities, such as pesticide regulators, wanting more than one designation for skin irritation, an additional?

- A. Substances and mixtures
- B. Harmonized approach
- C. Chemical action
- D. Structure/activity or structure property
- E. Mild irritant category is provided
- F. None of the Above

500. _____ should be considered in determining the irritation potential before testing is initiated: Human experience or data showing reversible damage to the skin following exposure of up to 4 hours;

- A. Several factors
- B. pH extremes
- C. Contact sensitizer
- D. Substances and mixtures in this hazard class
- E. Hypersensitivity
- F. None of the Above