Registration form

Chlorine and Disinfection CEU Training Course

48 HOUR RUSH ORDER PROCESSING FEE ADDITIONAL $50.00

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

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

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

Address: _____

City_____State_____Zip_____

Email_____ Fax (_____) _____

Phone:
Home (_____) _____Work (_____) _____

Operator ID# _____Exp Date_____

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

Wastewater Treatment_____ Other _____

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

If you've paid on the Internet, please write your Customer#_____

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Please pay with your credit card on our website under Bookstore or Buy Now. Or call us and provide your credit card information.

We will stop mailing the certificate of completion we need your e-mail address. We will e-mail the certificate to you, if no e-mail address; we will mail it to you.

DISCLAIMER NOTICE

I understand that it is my responsibility to ensure that this CEU course is either approved or accepted in my State for CEU credit. I understand State laws and rules change on a frequent basis and I believe this course is currently accepted in my State for CEU or contact hour credit, if it is not, I will not hold Technical Learning College responsible. I fully understand that this type of study program deals with dangerous, changing conditions and various laws and that I will not hold Technical Learning College, Technical Learning Consultants, Inc. (TLC) liable in any fashion for any errors, omissions, advice, suggestions or neglect contained in this CEU education training course or for any violation or injury, death, neglect, damage or loss of your license or certification caused in any fashion by this CEU education training or course material suggestion or error or my lack of submitting paperwork. It is my responsibility to call or contact TLC if I need help or assistance and double-check to ensure my registration page and assignment has been received and graded. It is my responsibility to ensure all information is correct and to abide with all rules and regulations.

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

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

State Approval Listing URL…

http://www.abctlc.com/downloads/PDF/CEU%20State%20Approvals.pdf

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

AFFIDAVIT OF EXAM COMPLETION

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

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.

All downloads are tracked and monitored for security purposes.

No refunds.

For Texas TCEQ Wastewater Licensed Operators

Wastewater/Collections Rule Changes

Rule Changes and Updates for Domestic Wastewater Systems
On Nov. 4, 2014, TCEQ commissioners adopted revisions to 30 Texas Administrative Code (TAC), Chapter 217, Design Criteria for Domestic Wastewater Systems, and "re-adopted" previously repealed rules in 30 TAC, Chapter 317, Design Criteria Prior to 2008.

Some of the changes to Chapter 217 include:

- Adding new definitions and clarifying existing definitions;
- Adding design criteria and approval requirements for rehabilitation of existing infrastructure;
- Adding design criteria for new technologies, including cloth filters and air lift pumps;
- Making changes to reflect modern practices, standards and trends;
- Modifying rule language to improve readability and enforceability; and
- Modifying the design organic loadings and flows for a new wastewater treatment facility.

SUBCHAPTER A: ADMINISTRATIVE REQUIREMENTS §§217.1 - 217.18
Effective December 4, 2015 §217.1. Applicability. (a) Applicability. (1) This chapter applies to the design, operation, and maintenance of: (A) domestic wastewater treatment facilities that are constructed with plans and specifications received and approved by the executive director after the effective date of the amendments to this chapter; (B) treatment units that are altered, constructed, or re-rated with plans and specifications received and approved by the executive director after the effective date of the amendments to this chapter; (C) collection systems that are constructed with plans and specifications received and approved by the executive director after the effective date of the amendments to this chapter; (D) collection system units that are altered, constructed, or re-rated with plans and specifications received and approved by the executive director after the effective date of the amendments to this chapter; (E) existing domestic wastewater treatment facilities that do not have a current Texas Pollutant Discharge Elimination System permit or a Texas Land Application Permit and are required to have an active wastewater permit; (F) existing wastewater treatment facilities and collection systems that never received approval for plans and specifications from the executive director; and (G) collection system rehabilitation projects covered in §217.56(c) and §217.69 of this title (relating to Trenchless Pipe Installation; and Maintenance, Inspection, and Rehabilitation of the Collection System). (2) Domestic wastewater treatment facilities, treatment units, collection systems, and collection system units with plans and specifications approved by the executive director that were received on or after August 28, 2008 and before the effective date of this chapter must comply with the

rules in this chapter, as they existed immediately before the effective date of the amendments to this chapter.

The rules in Texas Commission on Environmental Quality Page 2 Chapter 217 - Design Criteria for Domestic Wastewater Systems effect immediately before the effective date of the amendments to this chapter are continued in effect for that purpose. (3) This chapter does not apply to: (A) the design, installation, operation, or maintenance of domestic wastewater treatment facilities, treatment units, collection systems, or collection system units with plans and specifications that were approved by the executive director on or before August 27, 2008, which are governed by Chapter 317 of this title (relating to Design Criteria Prior to 2008) or design criteria that preceded Chapter 317 of this title; and (B) systems regulated by Chapter 285 of this title (relating to On-Site Sewage Facilities); or collection systems or wastewater treatment facilities that collect, transport, treat, or dispose of wastewater that does not have the characteristics of domestic wastewater, although the wastewater may contain domestic wastewater.
(b) The executive director may grant variances from new requirements added by the amendments of this chapter to a person who proposes to construct, alter, or re-rate a collection system or wastewater treatment facility if the plans and specifications for the project are submitted within 180 days after the date the amendments to this chapter are effective, provided the plans and specifications comply with the rules in effect immediately prior to the amendment. Adopted November 4, 2015 Effective December 4, 2015

The link to the rules is available on the TCEQ website at
https://www.tceq.texas.gov/rules/indxpdf.html

For Texas Students Only….

Please sign and date this notice

Printed Name

_____

Signature Date

_____

Texas Students Only

Acknowledgement of Notice of Potential Ineligibility for License

You are required to sign and return to TLC or your credit will not be reported.

Name:

_____

Date of Birth: _____

Email Address: _____

By signing this form, I acknowledge that Technical Learning College notified me of the following:

- the potential ineligibility of an individual who has been convicted of an offense to be issued an occupational license by the Texas Commission on Environmental Quality (TCEQ) upon completion of the educational program;
- the current TCEQ Criminal Conviction Guidelines for Occupational Licensing, which describes the process by which the TCEQ's Executive Director determines whether a criminal conviction:
- renders a prospective applicant an unsuitable candidate for an occupational license;
- warrants the denial of a renewal application for an existing license; or
- warrants revocation or suspension of a license previously granted.
- the right to request a criminal history evaluation from the TCEQ under Texas Occupations Code Section 53.102; and
- that the TCEQ may consider an individual to have been convicted of an offense for the purpose of denying, suspending or revoking a license under circumstances described in Title 30 Texas Administrative Code Section 30.33.

Enrollee Signature: _____ Date: _____

Name of Training Provider/Organization: Technical Learning College

Contact Person: Melissa Durbin Role/Title: Dean

CERTIFICATION OF COURSE PROCTOR

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

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

Name of Course:_____

Name of Licensee:_____

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

I certify that:

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

Time to complete the entire course and final exam. _____

Notation of any problem or concerns:

Name and Telephone of Proctor (please print):

_____

_____

Signature of Proctor

Chlorine and Disinfection CEU Course Answer Key

Name _____ ***Telephone #*** _____

Method of Course acceptance confirmation. Please fill this section

It is your sole responsibly to ensure this course is accepted for credit in your State. No refunds. Did you check with your State agency to ensure this course is accepted for credit?

Website __ Telephone Call___ Email____ Spoke to_____

Did you receive the approval number, if applicable? _____

What is the course approval number, if applicable? _____

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

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

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467. A B C D	478. A B C D	489. A B C D	500. A B C D

I understand that I am 100 percent responsible to ensure that TLC receives the Assignment and Registration Key. I will not hold TLC liable for any errors or damages and will abide with rules on page 2. I understand that TLC has a zero tolerance towards not following their rules, cheating or hostility towards staff or instructors. I need to complete the entire assignment for credit. There is no credit for partial assignment completion. My exam was proctored.

I will contact TLC if I do not hear back from them within 2 days of assignment submission. I will forfeit my purchase costs and will not receive credit or a refund if I do not abide with TLC's rules. I will not hold TLC liable for any errors, injury, death or non-compliance with rules. I will abide with all federal and state rules and rules found on page 2.

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

_____

Signature

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

When Finished with Your Assignment

REQUIRED DOCUMENTS
Please scan the **Registration Page, Answer Key, Survey and Driver's License** and email it to info@TLCH2O.com.

IPhone Scanning Instructions
If you are unable to scan, take a photo of these documents with your **iPhone** and send these photos to TLC, info@TLCH2O.com.

FAX
If you are unable to scan and email, please fax these to TLC, if you fax, call to confirm that we received your paperwork. **(928) 468-0675**

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

CHLORINE AND DISINFECTION CEU TRAINING COURSE
CUSTOMER SERVICE RESPONSE CARD

NAME: _____

E-MAIL_____PHONE_____

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

Please rate the difficulty of your course.
Very Easy 0 1 2 3 4 5 Very Difficult

Please rate the difficulty of the testing process.
Very Easy 0 1 2 3 4 5 Very Difficult

Please rate the subject matter on the exam to your actual field or work.
Very Similar 0 1 2 3 4 5 Very Different

How did you hear about this Course? _____

What would you do to improve the Course?

_____

_____

Any other concerns or comments.

_____

_____

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.

Chlorine and Disinfection CEU Course Assignment

The Chlorine and Disinfection CEU Assignment is 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. If you should need any assistance, please email all concerns and the completed manual to info@tlch2o.com.

We would prefer that you utilize the enclosed answer sheet in the front, but if you are unable to do so, type out your own answer key. Please include your name and address on your manual and make copy for yourself.

Multiple Choice, please select only one answer per question. There are no intentional trick questions.

Preface

Disinfection Essentials

1. 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 C. Net-positive environmental benefit
B. Narrow tolerance D. None of the above

2. 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 C. Oxygenation of the receiving waters
B. Safeguards D. None of the above

3. Flow and Water Characteristics: If your system cannot correct 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 C. Net-positive environmental benefit
B. Narrow tolerance D. None of the above

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

A. True B. False

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

A. Operating method C. Net-positive environmental benefit
B. Disinfection weapon D. None of the above

6. 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 C. Less intensive systems
B. Narrow tolerances D. None of the above

Waterborne Pathogens Section

Protozoan Caused Diseases

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

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

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

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

Giardia lamblia

9. Which of the following bugs has been responsible for more community-wide outbreaks of disease in the U.S. than any other, and drug treatment are not 100% effective?

A. Giardia lamblia C. Giardiasis
B. Cryptosporidiosis D. None of the above

10. All of these diseases, with the exception of _____, have one symptom in common: diarrhea. They also have the same mode of transmission, fecal-oral, whether through person-to-person or animal-to-person contact.

A. HIV infection C. Hepatitis A
B. Giardiasis D. None of the above

Primary Waterborne Diseases Section

Salmonella typhi

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

A. Campylobacter C. Typhoid fever
B. Shigella dysenteriae D. None of the above

12. Shigella species, in the United States two-thirds of the shigellosis in the U.S. is caused by Shigella dysenteriae and the remaining one-third is caused by Shigella Campylobacter.

A. True B. False

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

A. True B. False

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

A. True B. False

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

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

16. Which of the following is typically associated with soil and water?
A. Hepatitis A virus C. Pseudomonas
B. Legionella D. None of the above

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

18. Humans are the reservoir for the Norovirus. Prevention strategies for this pathogen include?
A. Internal protection C. Containment protection
B. Source protection D. None of the above

19. 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

20. Cryptosporidium, prevention. Prevention strategies for this pathogen include source protection. A CT value of 50 is required when dealing with fecally accidents. CT equals a concentration, in parts per million, while time equals a contact time in minutes.
A. True B. False

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

22. Legionnaire's disease, which causes a severe pneumonia, and the second, _____, which is a non-pneumonia illness; it's typically an influenza-like illness, and it's less severe.
A. Pontiac fever C. Typhoid fever
B. Yellow fever D. None of the above

23. Legionella, prevention. Legionella in water systems. Hot water in tanks should be maintained between _____degrees Centigrade.
A. 81 to 100 C. 71 and 77
B. 110 to 210 D. None of the above

24. Schistosomatidae, the basics. It is a parasite. It is acquired through dermal contact, cercarial dermatitis. It is commonly known as?
A. Swimmer's itch C. Hemorrhagic colitis
B. Beaver fever D. None of the above

25. Schistosomatidae prevention strategies for this pathogen include Placing boric acid on berms or interrupting the life cycle of the parasite by treating birds with a lead.
A. True B. False

Waterborne Bacterial Diseases

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

A. True B. False

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

A. True B. False

28. Cholera, Legionellosis, salmonellosis, shigellosis, yersiniosis, are other bacterial diseases that can be transmitted through water. All bacteria in water are readily killed or inactivated with chlorine or other disinfectants.

A. True B. False

Dangerous Waterborne Microbes

29. Which of the following are not necessarily agents of disease may indicate the presence of disease-carrying organisms?

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

30. Which of the following is a parasite that enters lakes and rivers through sewage and animal waste. It causes gastrointestinal illness (e.g. diarrhea, vomiting, and cramps)?

A. Coliform Bacteria C. Protozoa
B. Cryptosporidium D. None of the above

31. Which of the following is a species of the rod-shaped bacterial genus Shigella?

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

32. Which of the following is a parasite that enters lakes and rivers through sewage and animal waste. It causes cryptosporidiosis, a mild gastrointestinal disease. The disease can be severe or fatal for people with severely weakened immune systems.

A. Coliform Bacteria C. Giardia lamblia
B. Cryptosporidium D. None of the above

33. Which of the following can cause bacillary dysentery?

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

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

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

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

35. Which of the following are microscopic organisms that live in the intestines of warm-blooded animals? They also live in the waste material, or feces, excreted from the intestinal tract. When fecal coliform bacteria are present in high numbers in a water sample, it means that the water has received fecal matter from one source or another.
A. Fecal coliform bacteria C. Shigella dysenteriae
B. Cryptosporidium D. None of the above

36. Which of the following are common in the environment and are generally not harmful? However, the presence of these bacteria in drinking water are usually a result of a problem with the treatment system or the pipes which distribute water, and indicates that the water may be contaminated with germs that can cause disease.
A. Coliform Bacteria C. Giardia lamblia
B. Cryptosporidium D. None of the above

37. Which of the following are bacteria whose presence indicates that the water may be contaminated with human or animal wastes? Microbes in these wastes can cause short-term effects, such as diarrhea, cramps, nausea, headaches, or other symptoms.
A. Fecal Coliform and E. coli C. Shigella dysenteriae
B. Cryptosporidium D. None of the above

Bacteriological Monitoring Introduction
38. Which of the following are usually harmless, occur in high densities in their natural environment and are easily cultured in relatively simple bacteriological media?
A. Indicator bacteria C. Viruses
B. Amoebas D. None of the above

39. Indicators in common use today for routine monitoring of drinking water include total coliforms, fecal coliforms, and?
A. Cryptosporidium C. Escherichia coli (E. coli)
B. Protozoa D. None of the above

40. According to the text, the routine microbiological analysis of your water is for?
A. Contamination C. Coliform bacteria
B. Colloids D. None of the above

Bacteria Sampling
41. Water samples for _____must always be collected in a sterile container.
A. Amoebas C. Viruses
B. Bacteria tests D. None of the above

Methods
42. The MMO-MUG test, a product marketed as _____, is the most common. The sample results will be reported by the laboratories as simply coliforms present or absent.
A. Colilert C. Total coliform analysis
B. Coliform D. None of the above

Microbial Regulations
43. One of the key regulations developed and implemented by the United States Environmental Protection Agency (USEPA) to counter pathogens in drinking water is the Surface Water Treatment Rule.
A. True B. False

44. Among Surface Water Treatment Rule provisions, the rule requires that a public water system, using surface water (or ground water under the direct influence of surface water) as its source, have sufficient treatment to reduce the source water concentration of protozoa and coliform bacteria by at least 99.9% and 99.99%, respectively.
A. True B. False

45. The Surface Water Treatment Rule suggests treatment criteria to assure that certain performance recommendations are met; they may include turbidity limits, disinfectant residual and disinfectant contact time conditions.
A. True B. False

Basic Types of Water Samples
46. It is important to properly identify the type of sample you are collecting.
A. True B. False

The three (3) types of samples are:
47. Samples collected following a coliform present routine sample. The number of repeat samples to be collected is based on the number of _____ samples you normally collect.
A. Repeat C. Routine
B. Special D. None of the above

48. A PWS on state-approved annual monitoring has a Level 1 Assessment trigger in 2 consecutive years.
A. Trigger: Level 1 Assessment C. All of the above
B. Trigger: Level 2 Assessment D. None of the above

49. A PWS collecting fewer than 40 samples per month has 2 or more TC+ routine/ repeat samples in the same month.
A. Trigger: Level 1 Assessment C. All of the above
B. Trigger: Level 2 Assessment D. None of the above

50. A PWS fails to take every required repeat sample after any single TC+ sample
A. Trigger: Level 1 Assessment C. All of the above
B. Trigger: Level 2 Assessment D. None of the above

51. A PWS incurs an E. coli MCL violation.
A. Trigger: Level 1 Assessment C. All of the above
B. Trigger: Level 2 Assessment D. None of the above

52. A PWS collecting at least 40 samples per month has greater than 5.0 percent of the routine/repeat samples in the same month that are TC+.
A. Trigger: Level 1 Assessment C. All of the above
B. Trigger: Level 2 Assessment D. None of the above

53. A PWS has a second Level 1 Assessment within a rolling 12-month period.
A. Trigger: Level 1 Assessment C. All of the above
B. Trigger: Level 2 Assessment D. None of the above

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

55. Noncommunity and nontransient, noncommunity water systems with less than 10,000 daily population and groundwater as a source will sample on an annual basis.
A. True B. False

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

57. The MCLs are based on extensive research on toxicological properties of the contaminants, risk assessments and factors, short-term (acute) exposure, and long-term (chronic) exposure. You conduct the monitoring to make sure your water is in compliance with the MCL.
A. True B. False

58. There are two types of MCL violations for coliform bacteria. The first is for total coliform; the second is an acute risk to health violation characterized by the confirmed presence of fecal coliform or E. coli.
A. True B. False

Positive or Coliform Present Results
59. If you are notified of a positive coliform test result you need to contact either the Drinking Water Program or your local county health department within 72 hours, or by the next business day after the MCL compliance violation
A. True B. False

60. With a positive total coliform sample, after you have contacted an agency for assistance, you will be instructed as to the proper repeat sampling procedures and possible corrective measures for solving the problem. It is very important to initiate the _____as the corrective measures will be based on those results.
A. Perform routine procedures C. Corrective measures
B. Repeat sampling immediately D. None of the above

Heterotrophic Plate Count HPC
61. Heterotrophic Plate Count (HPC) --- formerly known as the Bac-T plate, is a procedure for estimating the number of live heterotrophic bacteria and measuring changes during water treatment and distribution in water or in swimming pools.
A. True B. False

Heterotrophic Plate Count (Spread Plate Method)
62. Which of the following provides a technique to quantify the bacteriological activity of a sample?
A. Colonies C. Heterotrophic Plate Count
B. Agar D. None of the above

Total Coliforms

63. 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

64. For systems which collect fewer than _____ samples per month, no more than one sample per month may be positive. In other words, the second positive result (repeat or routine) in a month or quarter results in a MCL violation.
A. 40 C. 200
B. 100 D. None of the above

The following are acute violations:

65. Which determines a violation of nitrate?
A. Presence C. MCLG
B. MCL D. None of the above

Revised Total Coliform Rule (RTCR) Summary

66. EPA published the Revised Total Coliform Rule (RTCR) in the Federal Register (FR) on February 13, 2013 (78 FR 10269). It is the revision to the 1989 Total Coliform Rule (TCR).
A. True B. False

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

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

69. The RTCR upholds the purpose of the 1989 TCR to protect public health by ensuring the duplicity of the drinking water distribution system and monitoring for the absence of microbial contamination.
A. True B. False

70. The RTCR establishes criteria for systems to qualify for and stay on for special increased monitoring, which could reduce water system problems for better system operation.
A. True B. False

71. The water provider shall develop and follow a sample-siting plan that designates the PWS's collection schedule. This includes location of_____.
A. Routine and repeat water samples C. Microbial contamination
B. Reduced monitoring D. Repeat water samples

72. The water provider shall collect _____on a regular basis (monthly, quarterly, annually). Have samples tested for the presence of total coliforms by a state certified laboratory.
A. Routine water samples C. Microbial contamination
B. Reduced monitoring D. Repeat water samples

73. PN is required for violations incurred. Within required timeframes, the PWS must use the required health effects language and notify the public if they did not comply with certain requirements of the RTCR. The type of _____ depends on the severity of the violation.
A. CCR(s) C. MCL violation
B. PN D. TC+ routine or repeat sample

74. For PWSs on quarterly or annual routine sampling, collect additional routine samples (at least 3) in the month after a _____ .
A. CCR(s) C. Total coliform positive samples
B. PN D. TC+ routine or repeat sample

75. PWSs incur violations if they do not comply with the requirements of the RTCR. The violation types are essentially the same as under the TCR with few changes. The biggest change is no acute or monthly MCL violation for _____only.
A. CCR(s) C. Total coliform positive samples
B. PN D. TC+ routine or repeat sample

76. Community water systems (CWSs) must use specific language in their CCRs when they must conduct an assessment or if they incur_____.
A. CCR(s) C. An E. coli MCL violation
B. PN D. TC+ routine or repeat sample

77. The water provider shall analyze all _____ that are total coliform positive (TC+) for E. coli.
A. Routine or repeat water samples C. Microbial contamination
B. Reduced monitoring D. Repeat water samples

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

79. The RTCR suggests the frequency and timing of required microbial testing based on public water type and source water type.
A. True B. False

Disinfection Key

80. The RTCR requires 99.99% or 4 log inactivation of _____ .
A. Enteric viruses C. Giardia lamblia cysts
B. Crypto D. None of the above

81. The RTCR requires 99% or 2 log inactivation of _____ .
A. Enteric viruses C. Giardia lamblia cysts
B. Crypto D. None of the above

82. The RTCR requires 99.9% or 3 log inactivation of _____.
A. Enteric viruses C. Giardia lamblia cysts
B. Crypto D. None of the above

83. The RTCR requires the chlorine residual leaving the plant must be = or _____ mg/L and measurable throughout the system.
A. > 0.2 C. 0.2
B. 2.0 D. None of the above

Summary
Detailed Disinfection Supplement Section
Factors in Chlorine Disinfection: Concentration and Contact Time
84. CXT values [final free chlorine concentration (mg/L) multiplied by minimum contact time (minutes)], offer water operators guidance in computing an effective combination of chlorine concentration and chlorine contact time required to achieve disinfection of water at a given temperature.
A. True B. False

85. The CXT formula demonstrates that if an operator chooses to decrease the chlorine concentration, the required contact time must be lengthened.
A. True B. False

86. As higher strength chlorine solutions are used, contact times may be reduced.
A. True B. False

Understanding Cryptosporidiosis
87. Cryptosporidium is an emerging parasitic protozoan pathogen because its transmission has increased dramatically over the past two decades.
A. True B. False

Understanding Giardia lamblia
88. Which of the following was discovered about 20-40 years ago, is another emerging waterborne pathogen?
A. Cryptosporidium C. Corona
B. Giardia lamblia D. None of the above

Disinfection Rule Section

Safe Drinking Water Act (SDWA) Review
89. The states are expected to administer and enforce these regulations for public water systems (systems that either have 25 or more service connections or regularly serve an average of 50 or more people daily for at least 60 days each year).
A. True B. False

90. Public water systems must provide water treatment, ensure proper drinking water quality through monitoring, and provide public notification of contamination problems.
A. True B. False

Relating to prevention of waterborne disease, the SDWA required EPA to:
91. Set numerical standards, referred to as Maximum Contaminant Levels (MCLs — the highest allowable contaminant concentrations in drinking water) or treatment technique requirements for contaminants in public water supplies;
A. True B. False

92. Issue regulations requiring monitoring of all regulated and certain unregulated contaminants, depending on the number of people served by the system, the source of the water supply, and the contaminants likely to be found;
A. True B. False

93. Set criteria under which systems are obligated to filter water from surface water sources; it must also develop procedures for states to determine which systems have to filter.
A. True B. False

Chlorine DDBP
94. These term means that chlorine is present as Cl, HOCl, and OCl^- is called _____, and that which is bound but still effective is _____.
A. Free available chlorine and Total
B. Free and Residual
C. Free available chlorine and Combined Chlorine
D. None of the above

95. Chloramines are formed by reactions with?
A. Acid and Cl_2 C. Folic Acid and Cl2
B. Ammonia and Cl_2 D. None of the above

Microbial Regulations
96. 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

97. Which rule specifies treatment criteria to assure that these performance requirements are met; they include turbidity limits, disinfectant residual, and disinfectant contact time conditions?
A. Long Term 1 Enhanced Surface Water Treatment Rule
B. Interim Enhanced Surface Water Treatment Rule
C. Surface Water Treatment Rule
D. None of the above

98. Which rule was established to maintain control of pathogens while systems lower disinfection byproduct levels to comply with the Stage 1 Disinfectants/Disinfection Byproducts Rule and to control Cryptosporidium?
A. Long Term 1 Enhanced Surface Water Treatment Rule
B. Interim Enhanced Surface Water Treatment Rule
C. Surface Water Treatment Rule
D. None of the above

99. The EPA established a MCL of 0.0010 for all public water systems and a 99% removal requirement for Cryptosporidium in filtered public water systems that serve at least 100,000 people. The new rule will tighten turbidity standards by December 2001.
A. True B. False

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

EPA's Drinking Water Regulations for Disinfectants

100. Chlorine is the most widely used water disinfectant due to its effectiveness and cost.
A. True B. False

101. 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

102. All disinfectants form DBPs in one of two reactions: Chorine and chlorine-based compounds (halogens) react with organics in water causing the _____to substitute other atoms resulting in halogenated by-products.
A. Chlorine atom C. Carbon atom
B. Hydrogen atom D. None of the above

103. Oxidation reactions are where chlorine _____compounds present in water.
A. Reduces C. Oxidizes
B. Forms D. None of the above

104. _____are also formed when multiple disinfectants are used.
A. Secondary by-products C. Chorine and chlorine-based compounds (halogens)
B. Primary by-products D. None of the above

105. Which of the following rules requires systems using public water supplies from either surface water or groundwater under the direct influence of surface water to disinfect?
A. TTHM and HAA5 Rule C. Surface Water Treatment Rule (SWTR)
B. DBP MCLs Rule D. None of the above

106. The maximum contaminant level for the SWTR disinfection set by EPA. At this time, an MCL is set for only_____, and proposed for additional disinfection byproducts.
A. TTHM and HAA5 Rule C. A community water system (CWS)
B. Total Trihalomethanes D. None of the above

107. 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 C. A community water system (CWS)
B. Disinfectants and Disinfection Byproducts (DBP) D. None of the above

108. 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 C. DBP MCLsRule
B. Disinfection byproducts (DBPs) Rule D. None of the above

109. Which of the following rules began in 2006 with the characterization of raw water Cryptosporidium and E. coli levels?
A. DBPs requirements C. Stage 1 Disinfectant and Disinfection Byproduct Rule
B. The LT2 requirements D. None of the above

110. Which of the following rules applies to all public water systems using groundwater?
A. Groundwater Rule (GWR) C. Long Term 2 Enhanced Surface Rule (LT2)
B. SDWA in 1996 D. None of the above

111. Which of the following rules require EPA to develop rules to balance the risks between microbial pathogens and disinfection byproducts?
A. Amendments to the SDWA in 1996 C. Stage 1 Disinfectant and Disinfection Byproduct Rule
B. SDWA in 1996 D. None of the above

Public Health Concerns
112. Which of the following rules along with the Disinfection Byproducts Rule applies to all community and nontransient non-community water systems that treat their water with a chemical disinfectant?
A. Groundwater Rule (GWR) C. Long Term 2 Enhanced Surface Water Treatment Rule
B. The Stage 1 Disinfectants D. None of the above

113. Which of the following rules and Disinfection Byproduct Rule updates and supersedes the 1979 regulations for total trihalomethanes?
A. DBPs C. The Stage 1 Disinfectant
B. The LT2 requirements D. None of the above

Stage 2 DBP Rule Federal Register Notices
114. Which of the following rules is one 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) C. Long Term 2 Enhanced Surface Water Treatment Rule (LT2)
B. The Stage 2 DBP rule D. None of the above

115. Which of the following rules focuses on public health protection by limiting exposure to DBPs, specifically total trihalomethanes and five haloacetic acids, which can form in water through disinfectants used to control microbial pathogens?
A. Stage 1 DBPR C. Long Term 2 Enhanced Surface Water Treatment Rule
B. The Stage 2 DBP rule D. None of the above

116. The Stage 2 DBP rule will apply to all community water systems and nontransient non-community water systems that add a primary or residual disinfectant other than chloramines or deliver water that has been disinfected by a primary or residual disinfectant other than chloramines.
A. True B. False

117. Which of the following rules has been highly effective in protecting public health and has also evolved to respond to new and emerging threats to safe drinking water?
A. Stage 2 DBPR C. Surface Water Treatment Rule
B. Safe Drinking Water Act (SDWA) D. None of the above

118. Which of the following terms is one of the major public health advances in the 20th century?
A. Major public health advances C. Amendments to the SDWA in 1996
B. Disinfection of drinking water D. None of the above

119. There are specific microbial pathogens, such as_____, which can cause illness, and are highly resistant to traditional disinfection practices.
A. Enteric virus(es) C. C. perfringens
B. Cryptosporidium D. None of the above

120. The Stage 1 Disinfectants and Disinfection Byproducts Rule and_____, promulgated in December 1998.
B. The Stage 2 DBPR C. Interim Enhanced Surface Water Treatment Rule
C. SDWA D. None of the above

121. The Stage 2 Disinfectants and Disinfection Byproducts Rule builds upon the _____to address higher risk public water systems for protection measures beyond those required for existing regulations.
A. Stage 2 DBPR C. Long Term 2 Enhanced Surface Water Treatment Rule
B. Stage 1 DBPR D. None of the above

122. 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. The Stage 2 DBPR C. Primary or residual disinfectant
B. This final rule D. None of the above

123. Which of the following rules will reduce potential cancer and reproductive and developmental health risks from disinfection byproducts?
A. DBP exposure C. Traditional disinfection practices
B. Stage 2 Disinfection Byproducts Rule D. None of the above

124. Stage 2 Disinfection Byproducts Rule strengthens public health protection for customers by tightening _____for two groups of DBPs, trihalomethanes and haloacetic acids.
A. Primary or residual disinfectant C. Compliance monitoring requirements
B. Major public health advances D. None of the above

Are THMs and HAAs the only disinfection byproducts?
125. TTHM and HAAs normally occur at higher levels than other known and unknown DBPs.
A. True B. False

126. 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. Chlorine and chloramine C. TTHM and HAA5
B. Classes of DBPs D. None of the above

Chlorine By-Products
127. The most common chlorination by-products found in U.S. drinking water supplies are?
A. Chlorate and Chlorite C. Ammonia and THMS
B. Trihalomethanes (THMs) D. None of the above

The Principal Trihalomethanes are:
128. 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

129. 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

130. THM levels are also low when wells or large lakes are used as the drinking water source, because organic matter concentrations are generally low in these sources. The opposite — high organic matter concentrations and high THM levels — is true when rivers or other surface waters are used as the source of the drinking water.
A. True B. False

Health Effects
131. 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
132. Many cities utilize the use ozone to disinfect their source water and to reduce formation of this parameter?
A. Chlorate and Chlorite C. Chloramines
B. Trihalomethanes (THMs) D. None of the above

133. _____ 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 C. Chlorine Dioxide, Chlorine
B. Chlorite, Chlorine D. None of the above

134. Modifying water treatment facilities to use _____ can be expensive, and _____ treatment can create other undesirable by-products that may be harmful to health if they are not controlled (e.g., bromate).
A. Ozone, Chlorine C. Ozone, Ozone
B. Chlorite, Chlorine D. None of the above

135. Which term is a weaker disinfectant than chlorine, especially against viruses and protozoa; however, they are very persistent and, as such, can be useful for preventing re-growth of microbial pathogens in drinking water distribution systems?
A. UV C. Chloramines
B. Chlorite D. None of the above

136. Chlorine dioxide can be an effective disinfectant, but it forms?
A. Chlorate and Chlorite C. Chloramines
B. THMS D. None of the above

137. 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

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

Water Chemistry Section

pH Testing Section

138. When an atom loses _____and thus has more protons than electrons, the atom is a positively-charged ion or cation.
A. A proton C. An electron
B. Charge D. None of the above

139. Measurement of pH for aqueous solutions can be done with a glass electrode and a pH meter, or using indicators like strip test paper.
A. True B. False

140. In chemistry, pH is a measure of the acidity or basicity of an aqueous solution. Solutions with a pH greater than 7 are said to be acidic and solutions with a pH less than 7 are basic or alkaline.
A. True B. False

141. Pure water has a pH very close to?
A. 7 C. 7.7
B. 7.5 D. None of the above

142. _____ are determined using a concentration cell with transference, by measuring the potential difference between a hydrogen electrode and a standard electrode such as the silver chloride electrode.
A. Primary pH standard values C. pH measurement(s)
B. Alkalinity D. None of the above

143. Mathematically, pH is the negative logarithm of the activity of the (solvated) hydronium ion, more often expressed as the measure of the?
A. Electron concentration C. Hydronium ion concentration
B. Alkalinity concentration D. None of the above

144. Which of the following terms for aqueous solutions can be done with a glass electrode and a pH meter, or using indicators?
A. Primary sampling C. Determining values
B. Measurement of pH D. None of the above

145. The pH scale is logarithmic and therefore pH is?
A. An universal indicator C. An excess of alkaline earth metal concentrations
B. A dimensionless quantity D. None of the above

146. Measuring alkalinity is important in determining a stream's ability to neutralize acidic pollution from rainfall or wastewater. It is one of the best measures of the sensitivity of the stream to acid inputs. There can be long-term changes in the _____ of rivers and streams in response to human disturbances.
A. Acid C. pH measurement(s)
B. Alkalinity D. None of the above

147. pH is defined as the decimal logarithm of the reciprocal of the_____, a_H+, in a solution.
A. Hydrogen ion activity C. Brønsted–Lowry acid–base theory
B. Acid-base behavior D. None of the above

148. Which of the following terms may be used to measure pH, by making use of the fact that their color changes with pH?
A. Indicators C. A set of non-linear simultaneous equations
B. Spectrophotometer D. None of the above

149. Alkalinity is the name given to the quantitative capacity of an aqueous solution to neutralize an?
A. Acid C. Bond formation
B. Base D. None of the above

150. Which of the following terms of the color of a test solution with a standard color chart provides a means to measure pH accurate to the nearest whole number?
A. Universal indicator C. Visual comparison
B. Colorwheel measurement D. None of the above

151. The pH scale is traceable to a set of standard solutions whose pH is established by US EPA.
A. True B. False

152. The calculation of the pH of a solution containing acids and/or bases is an example of a chemical speciation calculation, that is, a mathematical procedure for calculating the concentrations of all chemical species that are present in the solution. The complexity of the procedure depends on the?
A. Nature of the solution C. Alkaline earth metal concentrations
B. pH D. None of the above

153. Under normal circumstances this means that the concentration of hydrogen ions in acidic solution can be taken to be equal to the concentration of the acid. The pH is then equal to minus the logarithm of?
A. The concentration value C. A set of non-linear simultaneous equations
B. The pH D. None of the above

154. Alkalinity of water is its acid-neutralizing capacity. It is the sum of all the titratable bases. The measured value may vary significantly with the?
A. End-point pH C. pH measurement(s)
B. Alkalinity D. None of the above

155. For strong acids and bases no calculations are necessary except in extreme situations. The pH of a solution containing a weak acid requires the solution of a quadratic equation. The pH of a solution containing a weak base may require the?
A. Solution of a cubic equation C. Excess of alkaline earth metal concentrations
B. Non-linear simultaneous equations D. None of the above

156. Alkalinity is a measure of this missing term and can be interpreted in terms of specific substances only when the chemical composition of the sample is known.
A. Universal indicator C. Excess of alkaline earth metal concentrations
B. An aggregate property of water D. None of the above

157. More precise measurements are possible if the color is measured spectrophotometrically, using a?
A. Universal indicator C. Set of non-linear simultaneous equations
B. Colorimeter of spectrophotometer D. None of the above

158. Because the alkalinity of many surface waters is primarily a function of carbonate, bicarbonate, and hydroxide content, it is taken as an indication of the concentration of these constituents.
A. True B. False

159. For strong acids and bases no calculations are necessary except in extreme situations. The pH of a solution containing a weak acid requires?
A. The concentration value C. Excess of alkaline concentrations
B. The solution of a quadratic equation D. None of the above

160. Alkalinity in excess of which term is significant in determining the suitability of water for irrigation?
A. 8 C. Alkaline earth metal concentrations
B. pH of 7 D. None of the above

161. The calculation of the pH of a solution containing acids and/or bases is an example of a _____ calculation, that is, a mathematical procedure for calculating the concentrations of all chemical species that are present in the solution
A. Chemical speciation C. Visual comparison
B. Spectrophotometer D. None of the above

162. Since pH is a logarithmic scale, a difference of one pH unit is equivalent to _____fold difference in hydrogen ion concentration
A. 1 C. 10
B. .1 D. None of the above

Alkalinity Sub-Section
163. Which of the following terms measurements is used in the interpretation and control of water and wastewater treatment processes?
A. Acid C. Hydrogen bond formation
B. Alkalinity D. None of the above

164. Which of the following terms are compounds that, for practical purposes, are completely dissociated in water.
A. Strong acids and bases C. Strong bases and weak acids
B. Chemical ions in chains D. None of the above

165. The pH of a solution containing a _____ may require the solution of a cubic equation.
A. Strong acids and bases C. Weak base
B. Strong base D. None of the above

166. Sodium hydroxide, NaOH, is an example of a?
A. Weak base C. Strong acid
B. Strong base D. None of the above

167. According to the text, what is the pH of pure water at 50 °C?
A. 7.7 C. 6.55
B. 7.00 D. None of the above

Halogens- Halides

168. What is the negative ion often referred to as?
A. A halide proton C. Diatomic Compound
B. A halide ion D. None of the above

169. Which of the following terms contains ions known as halides?
A. Salts C. Hydrastatic acid
B. Organic halides D. None of the above

170. 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. Salts C. Hydrastatic acid
B. Organic halides D. None of the above

171. Many synthetic organic compounds such as plastic polymers, and a few natural ones, contain halogen atoms; these are known as halogenated compounds or?
A. Salts C. Hydrastatic acid
B. Organic halides D. None of the above

Chlorine

172. The only halogen is needed in relatively large amounts (as chloride ions) by humans?
A. Chlorine C. Fluoride
B. Iodine D. None of the above

173. This halogen is needed only in very small amounts for the production of thyroid hormones such as thyroxine?
A. Chlorine C. Fluoride
B. Iodine D. None of the above

174. On the other hand, neither fluorine nor bromine are believed to be really essential for humans, although small amounts of _____can make tooth enamel resistant to decay.
A. Chlorine C. Fluoride
B. Iodine D. None of the above

Halogens

175. 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

Chlorine Section

Chlorine Gas Appearance and Odor

176. Chlorine is a greenish-yellow gas it will condense to an amber liquid at about _____F or at high pressures.
A. 32 degrees C. 29 degrees
B. -29.2 degrees D. None of the above

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

177. Lengthy 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 C. Olfactory fatigue
B. Odor thresholds D. None of the above

Reactivity
178. Cylinders of chlorine may burst when exposed to elevated temperatures. When there is Chlorine in solution, this forms?
A. Hydrogen sulfide C. A corrosive material
B. Oxomonosilane D. None of the above

179. What is formed when chlorine is in contact with combustible substances (such as gasoline and petroleum products, hydrocarbons, turpentine, alcohols, acetylene, hydrogen, ammonia, and sulfur), reducing agents, and finely divided metals?
A. Fires and explosions C. Moisture, steam, and water
B. Odor thresholds D. None of the above

180. 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

181. Chlorine reacts with hydrogen sulfide and water to form which substance?
A. Hydrogen sulfide C. Chlorinates
B. Hydrochloric acid D. None of the above

182. Chlorine is also incompatible with?
A. Plastic C. Moisture, steam, and water
B. Palladium D. None of the above

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

184. Keep unnecessary people away; isolate the hazard area and deny entry. For a massive fire in a cargo area, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from the area and let the fire burn. Emergency personnel should stay out of low areas and Ventilate closed spaces before entering.
A. True B. False

What Happens to Chlorine When it Enters the Environment?
185. When chlorine is released to soil, chlorine will react with moisture forming free unstable oxygen radicals.
A. True B. False

186. Chlorine does not store in the?
A. Food chain C. Water
B. Bacteria and viruses D. None of the above

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

188. The hydrochloric acid will raise the pH of the water (makes it more basic).
A. True B. False

Chlorine Exposure Limits
189. OSHA PEL is?
A. 10 PPM C. 1,000 PPM
B. 1 PPM D. None of the above

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

191. Chlorine can be readily compressed into a clear, amber-colored liquid, a _____, and a strong oxidizer.
A. Combustible gas C. Noncombustible gas
B. Combustible liquid D. None of the above

192. Liquid chlorine is about _____ times heavier than water and gaseous chlorine is about 2.5 times heavier than air.
A. 1.5 C. 2.5
C. 0.5 D. None of the above

193. Cl_2 IDLH is?
A. 10 PPM D. 1,000 PPM
C. 0.1 PPM D. None of the above

194. Cl_2 fatal exposure limit is?
A. 10 PPM C. 1,000 PPM
C. 0.1 PPM D. None of the above

195. The current Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL) for chlorine is 10 PPM (3 milligrams per cubic meter (mg/m (^{3}))) as a ceiling limit. A worker's exposure to chlorine shall at no time exceed this ceiling level.
A. True B. False

Disinfectant Qualities
196. 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
197. Because it is highly reactive, chlorine is usually found in nature bound with other elements like sodium, potassium, and magnesium.
A. True B. False

198. In researching and synthesizing organic compounds some compounds that have at least one atom of the element carbon in their molecular structure. All living organisms, including humans, are composed of primarily of _____.
A. Organic compounds C. Inorganic compounds
B. Abundant chemical elements D. None of the above

199. What is a largest reservoir of dissolved chlorine weathered from the continents and transported to the oceans by Earth's rivers?
A. Brine C. Ancient seawater
B. Seawater D. None of the above

200. Chemical elements have their own set of unique properties and chlorine is known as _____--so reactive, in fact, that it is usually found combined with other elements in the form of compounds.
A. Synthesizing organic compound C. One of the most abundant chemical elements
B. A very reactive element D. None of the above

201. Inorganic disinfectants have great usage of removing a wide variety of disease-causing germs from drinking water and wastewater as well as from hospital and food production surfaces.
A. True B. False

202. Various states of chlorine includes when chlorine is isolated as a free element, chlorine is a greenish yellow gas, which is_____. It turns to a liquid state at -34°C (-29°F), and it becomes a yellowish crystalline solid at -103°C (-153°F).
A. 2.5 times heavier than water C. 2.5 times heavier than air
B. 2.5 times lighter than air D. None of the above

Chlorine Gas Introduction
203. When chlorine is added into the water stream, chlorine hydrolyzes into?
A. HCL C. Hypochlorous acid (HOCl), and hydrochloric acid (HCl)
B. Bromoform D. None of the above

204. When chlorine hydrolyzation occurs, it provides an active toxicant, _____, which is pH-dependent. In alkaline cooling systems, it readily dissociates to form the hypochlorite ion (OCl-).
A. HCl C. The hypochlorate ion (OCl-)
B. HOCl D. None of the above

205. In alkaline conditions, _____becomes the predominant species and lacks the biocidal efficacy of the non-dissociated form.
A. HCl C. OCl-
B. HOCl D. None of the above

206. Considerably more _____ is present at a pH of 7.0 than at pH 8.5.
A. HCl C. OCl-
B. HOCl D. None of the above

207. Chlorine can be non-selective, making it very sensitive to contamination from either cooling water makeup or from in-plant process leaks._____, organic acids and organic compounds, sulfides, iron and manganese all easily react with HOCl.
A. Ammonia C. Chlorine gas
B. Sodium hypochlorite D. None of the above

208. The chloride ion (Cl^-) cannot damage or penetrate the passive oxide layer, leading to localized damage of the metal surface as does Hypochlorous acid (HOCl), and hydrochloric acid (HCl).
A. True B. False

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

210. 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 C. Total residual
B. Hypochlorite ion (OCl-) D. None of the above

211. 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

212. Which of the following removes alkalinity, pH depression and system corrosion could occur?
A. HCl C. pH of 7.0 than at pH 8.5
B. HOCl D. None of the above

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

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

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

Mechanism of Activity
216. 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 C. Hypochlorous and hydrochloric acid
B. Chlorine acid D. None of the above

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

218. 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

Solubility Effects
219. Which of the following is highly soluble in water?
A. Hydrochloric acid C. Hypochlorous base
B. H_2SO_4 D. None of the above

220. Because it is highly water soluble, Hypochlorous acid has an injury pattern similar to?
A. Hydrochloric acid C. CO2
B. H_2SO_4 D. None of the above

221. Which of the following may account for the toxicity of elemental chlorine and hydrochloric acid to the human body?
A. Hydrochloric acid C. Hypochlorous acid
B. H_2SO_4 D. None of the above

Early Response to Chlorine Gas
222. If you mix ammonia with chlorine gas, this compound reacts to form_____.
A. Chloramine gas C. Sulfuric gas
B. Chlorine gas D. None of the Above

223. 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

Pathological Findings
224. Chlorine is a highly reactive gas.
A. True B. False

225. 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

226. 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

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

Chlorine's Effectiveness

228. The effectiveness of chlorination depends on the _____ of the water, the concentration of the chlorine solution added, the time that chlorine is in contact with the organism, and water quality.
A. Chlorine residual C. Breakpoint
B. Chlorine demand D. None of the above

229. Chlorine may not be accessible for disinfection because _____ in the water (like iron, manganese, hydrogen sulfide, and ammonia).
A. pH increases C. Required contact time
B. Part of it combines with other chemicals D. None of the above

230. The amount of chlorine required to attain disinfection and that reacts with the other chemicals is the?
A. Chlorine residual C. Free chlorine residual
B. Chlorine demand D. None of the above

231. Which term is used when disinfection decreases, as the concentration of the chlorine increases?
A. Breakpoint C. Required contact time
B. Chlorine level D. None of the above

232. Chlorination is more effective as?
A. Water temperature increases C. Water cools down
B. Chlorine demand increases D. None of the above

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

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

235. 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 C. Required contact time
B. A free chlorine residual D. None of the above

Potent Germicide

236. Chlorine disinfectants can lower the level of many disease-causing microorganisms in drinking water to almost immeasurable levels.
A. True B. False

237. Chlorine is added to drinking water to destroy pathogenic (disease-causing) organisms. It can be applied in several forms: sodium hypochlorite solution, elemental chlorine (chlorine gas) and dry calcium hypochlorite.
A. True B. False

238. One pound of elemental chlorine delivers approximately as much _____as one gallon of sodium hypochlorite (12.5% solution) or approximately 1.5 pounds of calcium hypochlorite (65% strength).
A. Free available chlorine C. Particular applications
B. Total chlorine D. None of the above

239. While any of these forms of chlorine can effectively disinfect drinking water, each has distinct advantages and limitations for_____. Almost all water systems that disinfect their water use some type of chlorine-based process, either alone or in combination with other disinfectants.
A. Free available chlorine C. Particular applications
B. Total chlorine D. None of the above

Taste and Odor Control
240. Chlorine disinfectants reduce many disagreeable tastes and odors. Chlorine oxidizes many naturally occurring substances such as_____, sulfides and odors from decaying vegetation.
A. Hydrogen sulfide C. Slime bacteria, molds and algae
B. Foul-smelling algae secretions D. None of the above

Biological Growth Control
241. Chlorine disinfectants eliminate _____that commonly grow in water supply reservoirs, on the walls of water mains and in storage tanks.
A. Hydrogen sulfide C. Slime bacteria, molds and algae
B. Foul-smelling algae secretions D. None of the above

Chemical Control
242. Chlorine disinfectants destroy _____ (which has a rotten egg odor) and remove ammonia and other nitrogenous compounds that have unpleasant tastes and hinder disinfection. They also help to remove iron and manganese from raw water.
A. Hydrogen sulfide C. Slime bacteria, molds and algae
B. Algae secretions D. None of the above

Water Treatment
243. Everyday, about 170,000 PWSs treat and convey billions of gallons of water through about 880,000 miles of distribution system piping to U.S. homes, farms and businesses.
A. True B. False

244. Generally speaking, water is treated to render it suitable for human use and consumption. While the primary goal is to produce a biologically (disinfected) and chemically safe product, other objectives also must be met, including: no objectionable taste or odor; _____and chemical stability.
A. Low levels of color and turbidity C. Chemical or biological contamination
B. Sediments D. None of the above

245. Surface water typically presents a greater treatment challenge than groundwater, which is naturally filtered as it percolates through?
A. Low levels of color and turbidity C. Chemical or biological contamination
B. Sediments D. None of the above

246. Surface water is generally safe unlike groundwater that may harbor protozoan parasites such as Cryptosporidium parvum and Giardia lamblia.
A. True B. False

Water Distribution
247. Chlorination is unique in that a pre-determined chlorine concentration may be designed to remain in treated water as a measure of protection against harmful microbes encountered after leaving the treatment facility.
A. True B. False

248. In the event of a significant intrusion of pathogens resulting, for example, from a broken water main, the level of the average "_____" will be insufficient to disinfect contaminated water. In such cases, it is the monitoring of the sudden drop in the chlorine residual that provides the critical indication to water system operators that there is a source of contamination in the system.
A. Chlorine residual C. Breakpoint Chlorination
B. Potential threats D. None of the above

The Challenge of Disinfection Byproducts
249. Which of the following happens when chlorine and other disinfectants react with natural organic matter in water?
A. Microbial contamination C. Chemical compounds formed unintentionally
B. Treatment barrier D. None of the above

250. While the available evidence does not prove that _____in drinking water cause adverse health effects in humans, high levels of these chemicals are certainly undesirable. Cost-effective methods to reduce DBP formation are available and should be adopted where possible.
A. Critical assets C. Vulnerability assessments
B. DBPs D. None of the above

Chlorine and Water System Security
251. The prospect of a terrorist attack has forced all water systems, large and small, to re-evaluate and upgrade chlorination effectiveness procedures.
A. True B. False

252. With passage of the Public Health Security and Bioterrorism Response Act of 2002, Congress required community water systems to assess their vulnerability to a terrorist attack and other intentional acts. As part of these vulnerability assessments, systems assess?
A. Microbial contamination C. The transportation, storage and use of treatment chemicals
B. Cost-effective methods D. None of the above

253. These treatment chemicals are both inert and potential barriers.
A. True B. False

254. Water systems using elemental chlorine, in particular, must determine whether existing protection systems are adequate. If not, they must consider additional measures to reduce the likelihood of an attack or to mitigate the?
A. Potential consequences C. Critical assets
B. Potential threats D. None of the above

255. Which of the following in no way guarantees safety from biological attacks?
A. Inert and potential barriers C. Conventional treatment barriers
B. Potential problems D. None of the above

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

257. pH and temperature affect the ratio of hypochlorous acid to hypochlorite ions. As the temperature is decreased, the _____increases.
A. CT actual C. Ratio of hypochlorous acid
B. Free chlorine residual D. None of the above

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

259. Temperature plays a small part in the acid ratio. Although the ratio of _____is greater at lower temperatures, pathogenic organisms are actually harder to kill.
A. Hypochlorous acid C. Total chlorine
B. Chlorine Demand D. None of the above

260. If all other things were equal, _____ and a lower pH are more conducive to chlorine disinfection.
A. Lower alkali C. Lower water temperature
B. Higher water temperatures D. None of the above

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

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

263. 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
264. Total chlorine residual = free +_____.
A. Chlorine demand C. Combined chlorine residual
B. Free chlorine D. None of the above

265. 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 demand C. Combined chlorine residual
B. Free chlorine D. None of the above

266. According to the text, once chlorine molecules are combined with these interfering agents, they are not capable of disinfection. _____ is much more effective as a disinfecting agent.
A. Chlorine demand C. Combined chlorine residual
B. Free chlorine D. None of the above

267. Either a total or a _____can be read when a chlorine residual test is taken,
A. Chlorine demand C. Combined chlorine residual
B. Free chlorine residual D. None of the above

268. Which of the following 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. Chlorine demand C. Combined chlorine residual
B. Free chlorine residual D. None of the above

269. Which of the following terms is where the chlorine demand has been satisfied, and any additional chlorine will be considered free chlorine?
A. Chlorine residual C. Break-point chlorination
B. "CT" disinfection concept D. None of the above

Residual Concentration/Contact Time (CT) Requirements
270. Since monitoring for very low levels of pathogens in treated water is analytically very difficult, utilizing the _____ is recommended to demonstrate satisfactory treatment.
A. Chlorine residual C. Break-point chlorination
B. "CT" disinfection concept D. None of the above

271. Which of the following term = Concentration (mg/L) x Time (minutes)
A. CT C. TC
B. #C D. None of the above

272. The effective reduction in pathogens can be calculated by reference to standard tables of required?
A. CT's C. TC
B. #C D. None of the above

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

Calculation and Reporting of CT Data
274. Reduction Ratio should be reported, along with the appropriate pH, temperature, and?
A. Reduction Ratio C. Disinfectant residual
B. CT actual D. None of the above

275. Which of the following terms must be greater than 1.0 to be acceptable?
A. Reduction Ratio C. Disinfectant residual
B. CT actual D. None of the above

276. You can also calculate and record actual log reductions. Reduction Ratio = CT actual divide by?
A. Reduction Ratio C. "CT" disinfection concept
B. CT required D. None of the above

277. This 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 C. "CT" disinfection concept
B. Disinfection CT values D. None of the above

Chlorine Review

278. What term describes the minimum amount of Chlorine needed to react in a water purification system; used as a monitoring measurement by system operators.
A. Chlorine demand C. Combined chlorine residual
B. Free chlorine residual D. None of the above

279. Operator may add _____ to chlorinated public water supplies to provide inorganic chloramines.
A. Bromine C. Ammonia
B. Organic amines D. None of the above

280. What term describes the concentration of residual chlorine in water present as dissolved gas (Cl_2), hypochlorous acid (HOCl), and/or hypochlorite ion (OCl-)?
A. Chlorine demand C. Combined chlorine residual
B. Free chlorine D. None of the above

281. What term describes the concentration of chlorine in the water after the chlorine demand has been satisfied, the concentration is normally expressed in terms of total chlorine residual, which includes both the free and combined or?
A. Chlorine demand C. Chlorine residual
B. Free chlorine D. None of the above

282. _____is defined as the residual chlorine existing in water in chemical combination with ammonia or organic amines that can be found in natural or polluted waters.
A. Chlorine Residual C. Combined Chlorine
B. Chlorine Demand D. None of the above

283. What term describes the residual chlorine existing in water in chemical combination with ammonia or organic amines that can be found in natural or polluted waters?
A. Chlorine Demand C. Residual chlorine
B. Combined Chlorine Residual D. None of the above

284. 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 C. Free chlorine residual
B. Chlorine total D. None of the above

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

286. 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 C. Total chlorine
B. Combined chlorine D. None of the above

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

288. When changing the Cl_2 cylinder, clean with wire brush if necessary. If the valve face is smooth, clean proceed with hooking up the cylinder. Check the inlet face of the _____ and clean if necessary.
A. Fusible plug C. Chlorinator
B. Chlorine cylinder D. None of the above

289. 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. Post-chlorination C. Pre-chlorination
B. Chlorine Demand D. None of the above

290. What term best describes the sum of free and combined chlorine?
A. Disinfection C. Total Chlorine
B. Free chlorine D. None of the above

291. 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. The amount of chlorine C. Free chlorine
B. Chlorine Demand D. None of the above

292. 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 C. Breakpoint chlorination
B. Free chlorine D. None of the above

293. Ammonia is sometimes deliberately added to chlorinated public water supplies to provide?
A. Inorganic chloramines C. Increase pH value
B. Chlorine Demand D. None of the above

294. 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. Disinfection C. Total chlorine residual
B. Free chlorine D. None of the above

295. 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 C. Total chlorine
B. Chlorine Demand D. None of the above

296. What term best describes the concentration of chlorine in the water after the chlorine demand has been satisfied?
A. Chlorine Residual C. Breakpoint chlorination
B. Free chlorine D. None of the above

297. _____ which includes both the free and combined or chemically bound chlorine residuals.
A. Disinfection C. Total chlorine residual
B. Free chlorine D. None of the above

298. What term best describes the addition of chlorine after a process or adding chlorine downstream to meet a Demand in the system?
A. Post-chlorination C. Pre-chlorination
C. Chlorine Demand D. None of the above

299. Solid chlorine is about 10 times heavier than water and gaseous chlorine is about 200 times heavier than air.
A. True B. False

300. Atomic number of chlorine is 24.
A. True B. False

301. Cl is the elemental symbol and Cl_2 is the chemical formula.
A. True B. False

Sodium Hypochlorite Exposure
Exposure
302. There is no threshold value for to sodium hypochlorite exposure. Various health effects occur after exposure to sodium hypochlorite.
A. True B. False

303. People are exposed to sodium hypochlorite by inhalation of aerosols. This causes coughing and a sore throat.
A. True B. False

304. After swallowing sodium hypochlorite, the effects are stomach ache, a burning sensation, coughing, diarrhea, a sore throat and vomiting. Sodium hypochlorite on skin or eyes causes redness and pain.
A. True B. False

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

Routes of Exposure
Inhalation
306. Which of the following can liberate toxic gases such as chlorine?
A. Hypochlorite solutions C. Ammonia
B. Higher levels of O_2 D. None of the above

307. Chlorine is lighter than air and may cause asphyxiation in poorly ventilated, enclosed, or high-lying areas.
A. True B. False

Ingestion

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

A. Hypochlorous Acid (HOCl)
B. Household bleach
C. Sodium and calcium
D. None of the above

Sources/Uses

309. Which compounds are manufactured by the chlorination of sodium hydroxide or lime?

A. Sodium hypochlorite
B. Sodium and calcium hypochlorite
C. Hypochlorite solutions, powder, or concentrated vapor
D. None of the above

310. 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 hydroxide or lime
B. Hydrochlorite solutions
C. Sodium and calcium hypochlorite
D. None of the above

Calcium Hypochlorite Section

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

A. Calcium hypochlorite
B. Hypochlorous Acid (HOCl)
C. Sodium hypochlorite
D. None of the above

312. Sodium hypochlorite is generally available as a white powder, pellets, or flat plates; sodium hypochlorite is usually a greenish yellow, aqueous solution, although not flammable, they may react explosively.

A. True B. False

313. Calcium hypochlorite decomposes in water to release chlorine and oxygen; sodium hypochlorite solutions can react with acids or ammonia to release chlorine or chloramine.

A. True B. False

Description

314. Solid chlorine stands alone as the safest form of chlorine disinfection.

A. True B. False

315. Solid chlorine requires only minimal safety equipment for handling, users can breathe easy knowing our tablets are safe for both people and the environment.

A. True B. False

316. Because of solid chlorine, the elimination of costly scrubbers, containment, or hazard response capability, guarantees lower initial costs and reduced operating expense.

A. True B. False

317. 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

318. Calcium hypochlorite is flammable, and acts as an oxidizer with combustible material and does not react explosively with ammonia, amines, or organic sulfides.

A. True B. False

Accuracy

319. 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. Liquid chlorine C. Calcium hypochlorite
B. Solid chlorine D. None of the above

Effectiveness

320. Liquid Sodium hypochlorite and chlorine tablets produce Hypochlorous acid (HOCl) and?

A. Calcium hypochlorite C. Hypochlorite ion (OCl-) in solution
B. Oxygen D. None of the above

321. The ratio of Hypochlorous Acid to _____ increases with acidity.

A. Calcium hypochlorite C. Hypochlorite ion
B. Hypochlorous Acid (HOCl) D. None of the above

322. Liquid chlorine can affect eyes, skin and mucous membranes; it is easily splashed and rots clothing.

A. True B. False

323. Hypochlorous Acid (HOCl) is much less corrosive than liquid chlorine, which is highly corrosive to most metals.

A. True B. False

Comparison

324. Which substance is comparable to sodium dichloroisocyanurate (NaDCC) is their neutralization by organic matter?

A. Hypochlorous Acid C. Sodium hypochlorite (NaOCl)
B. Chloramine D. None of the above

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

A. Calcium hypochlorite C. NaOCL
B. Oxygen and chlorine D. None of the above

326. Hypochlorite powder, solutions, and vapors are irritating and corrosive to the eyes, skin, and respiratory tract.

A. True B. False

327. Ingestion and skin contact with hypochlorite powder, solutions, and vapors produces injury to any exposed tissues.

A. True B. False

328. Exposure to gases released from hypochlorite powder, solutions, and vapors may cause burning of the eyes, nose, and throat; cough as well as constriction and edema of the airway and lungs can occur.

A. True B. False

Sodium Hypochlorite Solutions

329. 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

330. Exposure to toxic gases generated from hypochlorite solutions can lead to reactive airways dysfunction syndrome (RADS), a chemical irritant-induced type of asthma.

A. True B. False

331. 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

Chlorine-Based Disinfectants Chloramines

Chloramine Disadvantages

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

A. Chloramine C. Ammonia and chlorine compounds
B. Dichloramine D. None of the above

Chloramine Section

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

A. Free chlorine C. Monochloramine
B. Dichloramine D. None of the above

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

A. Trichloramine C. Ammonia and chlorine compounds
B. Dichloramine D. None of the above

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

A. Nitrogen gas C. Ammonia
B. Hydrogen D. None of the above

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

A. Trichloramine C. Ammonia and chlorine compounds
B. Dichloramine D. None of the above

337. 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. Trichloramine C. Monochloramine and dichloramine
B. Dichloramine D. None of the above

Post Chlorination

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

A. True B. False

339. 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

Understanding Water Disinfection

Wastewater Disinfection

340. There are several chemicals and processes that will_____, but none are universally applicable as with chlorine.

A. Limit the effects of organic material C. Disinfect wastewater

B. Limit the travel of pathogens D. None of the above

Water Disinfection

341. Disinfection is usually the final stage in the water treatment process in order to limit the effects of organic material, suspended solids and_____.

A. Organic material C. Residual level of disinfection

B. Other contaminants D. None of the above

Chlorate Ion

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

A. Acid/base balance C. Trigonal pyramidal structures

B. Stable perchlorates D. None of the above

343. Chlorates are powerful reducers and should be kept away from organics or easily oxidized materials.

A. True B. False

344. _____were once widely used in pyrotechnics, though their use has fallen due to their instability.

A. Chlorates C. Chlorides

B. Perchlorates D. None of the above

Chloride Ion

345. The chloride ion is formed when elemental chlorine, gains an electron to form an anion (negatively-charged ion) Cl-.

A. True B. False

346. The salts of _____ contain chloride ions and can also be called chlorides.

A. Hydrochloric acid C. Hypochlorous acid

B. H_2SO_4 D. None of the above

347. _____, more commonly called chloromethane, (CH_3Cl) is an organic covalently bonded compound, which does not contain a chloride ion.
A. Chlorate C. Methyl chloride
B. Sodium chloride D. None of the above

348. Which of the following compounds is an example of table salt, which is sodium chloride with the chemical formula?
A. $CaCl_2$ C. ClO_2-.
B. NaCl D. None of the above

349. _____ is also the prosthetic group present in the amylase enzyme. Another example is calcium chloride with the chemical formula $CaCl_2$.
A. $CaCl_2$ C. ClO_4
B. A chloride ion D. None of the above

350. Which of the following compounds is used for maintaining unpaved roads and for sanite fortifying roadbases for new construction?
A. $CaCl_2$ C. ClO2-
B. ClO_4 D. None of the above

351. Chlorine dioxide is a closely monitored constituent of the mud system
A. True B. False

352. 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. Chlorate C. Chlorine dioxide
B. Chloride D. None of the above

Chlorite Ion
353. The chlorite ion is?
A. ClO_2- C. ClO_3-,
B. ClO_4 D. None of the above

354. 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 Chlorine dioxide ClO_2.
A. True B. False

355. Chlorine can assume an additional oxidation state of +4 is seen in the neutral compound_____, which has a similar structure to chlorite ClO_2- and the cation chloryl.
A. Chlorine dioxide ClO_2 C. Chlorite ion of ClO2-
B. Chloride D. None of the above

Chlorine Dioxide
356. Chlorine dioxide is a chemical compound with which formula?
A. $CaCl_2$ C. ClO_2
B. ClO D. None of the above

Haloacetic Acids

357. What type of substances are haloacetic acids in which a halogen atom takes the place of a hydrogen atom in acetic acid?

A. Calcemic acids C. Carboxylic acids
C. Hypochlorite acids D. None of the above

358. 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. Carboxylic acids C. Electronegative halogens
B. Disinfection by-products D. None of the above

Contaminants in Drinking Water

359. 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. Carboxylic acids C. Electronegative halogens
B. Disinfection by-products D. None of the above

Hypochlorites

360. Hypochlorites are calcium or sodium salts of hypochlorous acid and are supplied either dry or in liquid form (as, for instance, in commercial bleach). The same residuals are obtained as with gas chlorine, but the effect on the _____of the treated water is different.

A. Temperature C. Negative charge
B. pH D. None of the above

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

A. Acid C. Hypochlorite compounds
B. Alkali D. None of the above

362. _____is the only liquid hypochlorite disinfectant in current use. There are several grades and proprietary forms available.

A. High-test calcium hypochlorite(s) C. Sodium hypochlorite
B. Calcium hypochlorite tablets D. None of the above

Emergency Procedures

363. Emergency procedures in the case of a large uncontrolled chlorine leak: Notify local emergency response team, warn and evacuate people in adjacent areas, be sure that no one enters the leak area without adequate self-contained breathing equipment.

A. True B. False

364. Safety precautions when using chlorine gas: In addition to protective clothing and goggles, chlorine gas should be used only in a well-ventilated area so that any leaking gas cannot concentrate.

A. True B. False

365. Several symptoms of chlorine exposure: Burning of eyes, nose, and mouth, coughing, sneezing, choking, nausea and vomiting; headaches and dizziness; fatal pulmonary edema, pneumonia, and skin blisters.

A. True B. False

366. When using chlorine gas: In addition to protective clothing and goggles, chlorine gas should be used only in a well-ventilated area so that any leaking gas cannot_____.
A. Concentrate C. Combust
B. Conflagrate D. None of the above

367. HOCl and OCl-: The OCL- is the hypochlorite ion and both of these species are known as free available chlorine, they are the two main chemical species formed by chlorine in water and they are known collectively as _____and the_____.
A. Hypochlorous acid, Cl_2 C. Combined Available Chlorine, Total
B. Hypochlorous acid, Hypochlorite ion D. None of the above

368. Which of the following terms when added to water, rapidly hydrolyzes, the chemical equations best describe this reaction is $Cl_2 + H_2O$ --> H+ + Cl- + HOCl?
A. Chlorine gas C. Combined Available Chlorine
B. Monochloramine D. None of the above

369. Which of the following is the most germicidal of the chlorine compounds with the possible exception of chlorine dioxide?
A. Hydrochlorous acid C. Combined Available Chlorine
B. Hypochlorous acid D. None of the above

370. Monochloramine, Dichloramine, and trichloramine are known as Combined Available Chlorine. $Cl_2 + NH_4$.
A. Hydrochlorous acid C. Combined Available Chlorine
B. Hypochlorous acid D. None of the above

Summary
Disinfection Byproducts
371. Which term represents when disinfectants used in water treatment plants react with bromide and/or natural organic matter present in the source water?
A. Disinfection byproducts C. Occurring organic and inorganic matter in water
B. Naturally occurring bromide D. None of the above

372. Which term represents which regulations have been established have been identified in drinking water, including trihalomethanes, haloacetic acids, bromate, and chlorite?
A. Chlorine dioxide C. Disinfection byproducts
B. HAA5 D. None of the above

Trihalomethanes (THM)
373. Bromide represents a group of four chemicals that are formed along with other disinfection byproducts when chlorine used to control microbial contaminants in drinking water react with naturally occurring organic and inorganic matter in water.
A. True B. False

374. Which term represents are chloroform, bromodichloromethane, dibromochloromethane, and bromoform?
A. Chloroform C. Trihalomethanes
B. HAA5 D. None of the above

Haloacetic Acids (HAA5)

375. Which term represents substances in drinking water react with naturally occurring organic and inorganic matter in water?

A. Disinfection byproducts
B. Microbial contaminants
C. Occurring organic and inorganic matter in water
D. None of the above

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

A. Chlorine dioxide
B. HAA5
C. Chlorite
D. None of the above

377. Bromate is a chemical that is formed when _____ is used to disinfect drinking water reacts with naturally occurring bromide found in source water.

A. Chlorine dioxide
B. Ozone
C. Chlorite
D. None of the above

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

A. Chlorine dioxide
B. HAA5
C. Chlorite
D. None of the above

Chloroform

379. Chloroform is typically the most prevalent _____ measured in chlorinated water, is probably the most thoroughly studied disinfection byproduct.

A. HAA5
B. THM
C. Folic Acid
D. None of the above

Sodium Chlorate

380. 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. None of the above

Chloramines

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

A. Disinfection byproducts
B. Chloramines
C. Trihalomethanes, haloacetic acids, bromate, and chlorite
D. None of the above

382. 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. Disinfection byproducts
B. Chloramines
C. Trihalomethanes, haloacetic acids, bromate, and chlorite
D. None of the above

383. Bromate represents a compound that may be used instead of chlorine in order to reduce chlorinated byproduct formation and to remove some taste and odor problems.

A. True B. False

Chlorine Dioxide

384. Chlorine dioxide (ClO_2) represents a compound that may be generated on-site at water treatment facilities.
A. True B. False

385. In most generators, sodium chlorite and elemental chlorine are mixed in solution, which almost instantaneously forms chlorine dioxide.
A. True B. False

386. Chlorine dioxide characteristics are quite different from _____. In solution, it is a dissolved gas, which makes it largely unaffected by pH but volatile and relatively easily stripped from solution.
A. Chlorine C. Carbon dioxide
B. Sodium hypochlorite D. None of the above

387. _____is also a strong disinfectant and a selective oxidant. While chlorine dioxide does produce a residual, it is only rarely used for this purpose.
A. Chlorine dioxide C. Carbon dioxide
B. Sodium hypochlorite D. None of the above

Factors in Chlorine Disinfection: Concentration and Contact Time

388. Which of the following terms is multiplied by minimum contact time (minutes)], offer water operators guidance in computing an effective combination of chlorine concentration and chlorine contact time required to achieve disinfection of water at a given temperature?
A. CXT concept C. CXT formula
B. CXT values D. None of the above

389. Which term demonstrates that if an operator chooses to decrease the chlorine concentration, the required contact time must be lengthened?
A. CXT formula C. Pound per day
B. CXT values D. None of the above

390. When free available chlorine residuals are desired, the characteristics of the water will determine how this will be accomplished. This may have to be considered:
If the water contains no ammonia or_____, any application of chlorine will yield a free residual once it has reacted with any bacteria, virus and other microorganisms present in the water.
A. Other nitrogen compounds C. Iron, manganese, organic matter
B. Chloramines D. None of the above

391. If the water contains_____, it results in the formation of a combined residual, which must be destroyed by applying an excess of chlorine.
A. Ammonia C. Iron, manganese, organic matter
B. Chloramines D. None of the above

392. Breakpoint chlorination is the name of the process of adding chlorine to water until the chlorine demand has been satisfied.
A. True B. False

Safety and Chlorination EquipmentSection

Chlorination Equipment Requirements

393. Chlorine gas under pressure shall not be permitted outside the chlorine room.
A. True B. False

394. Which of the following shall also be located inside the chlorine room?
A. Gas vacuum line
B. Vacuum regulators
C. Mechanical gas proportioning equipment
D. None of the above

395. Which of the following, which is the mechanical gas proportioning equipment, may or may not be located inside the chlorine room?
A. Gas vacuum line
B. Compound loop
C. The chlorinator
D. None of the above

396. _____ should be located to minimize the length of pressurized chlorine solution lines.
A. Gas vacuum line
B. Injectors
C. Mechanical gas proportioning equipment
D. None of the above

397. 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. Mechanical gas proportioning equipment
D. None of the above

398. Which of the following shall have positive shutdown in the event of a break in the downstream vacuum lines?
A. Gas vacuum line
B. The vacuum regulating valve(s)
C. A gas pressure relief system
D. None of the above

399. Anti-siphon valves shall be incorporated in the _____or in the discharge piping.
A. Gas vacuum line
B. A gas pressure relief system
C. Pump heads
D. None of the above

Capacity

400. 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. Automatic proportional control
C. Constant pre-established dosage
D. None of the above

Methods of Control

401. 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. Constant pre-established dosage
D. None of the above

402. 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 valve C. Automatic proportional control
B. Constant flow rate(s) D. None of the above

403. Which piece if chlorination equipment is the feed rate of the chlorinator controlled by a flow proportional signal and a residual analyzer signal to maintain particular chlorine residual in the water?
A. Manual chlorine feed systems C. Mechanical gas proportioning equipment
B. Compound loop control system D. None of the above

404. Manual chlorine feed systems may be installed for groundwater systems with constant flow rates.
A. True B. False

Standby Provision
405. As a safeguard against_____ , standby chlorination equipment having the capacity to replace the largest unit shall be provided.
A. Uninterrupted chlorination C. Malfunction and/or shut-down
B. Constant flow rate(s) D. None of the above

406. For uninterrupted chlorination, _____shall be equipped with an automatic changeover system. In addition, spare parts shall be available for all chlorinators.
A. Flow valves C. Gas chlorinators
B. Flow regulators D. None of the above

407. Which of the following chlorine alarm equipment shall be installed at all water treatment plants using chlorine gas?
A. Caustic soda solution reaction alarms C. Automatic chlorine leak detection
B. Corrosion detection D. None of the above

408. 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. Chlorine gas leakage alarm C. Chlorine leak detection equipment
B. All chlorine cylinders D. None of the above

409. Leak detection equipment shall not automatically activate the chlorine room ventilation system in such a manner as to discharge chlorine gas.
A. True B. False

410. 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

411. 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

412. 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

413. 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

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

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

Chlorine Room Design Requirements

416. 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 _____ventilated enclosure.
A. Mechanically C. Automatic chlorine leak detection
B. Securely positioned D. None of the above

417. _____ may or may not be located inside the chlorine room.
A. The chlorinator C. Chlorine leak detection equipment
B. All chlorine cylinders D. None of the above

418. Which of the following 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 C. Automatic chlorine leak detection
B. The chlorine room D. None of the above

419. _____should be louvered near the ceiling, the air being of such temperature as to not adversely affect the chlorination equipment.
A. Air inlets C. Automatic chlorine leak detection
B. Ventilation system D. None of the above

420. _____ 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. Separate switches for fans and lights C. Automatic chlorine leak detection
B. Chlorine room ventilation system D. None of the above

421. Chlorine rooms shall have_____, if a forced air system is used to heat the building.
A. Corrosion filters C. Cooling system
B. Separate heating systems D. None of the above

422. _____ shall be protected to ensure that the chlorine maintains its gaseous state when entering the chlorinator.
A. Cylinders or containers C. Equipment
B. Panic system D. None of the above

Storage of Chlorine Cylinders

423. 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. True B. False

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

A. Cylinders or containers access
B. Scrubber(s)
C. The chlorine gas storage room
D. None of the above

425. In very large facilities, entry into the chlorine rooms may be through a_____.

A. Vestibule from inside
B. Chlorine gas storage room
C. Vestibule from outside
D. None of the above

Scrubbers

426. Facilities located within residential or densely populated areas, consideration shall be given to provide _____ for the chlorine room.

A. Plan of attack
B. Scrubber(s)
C. Chlorine dozing plan
D. None of the above

427. Chlorine combines with a wide variety of materials. These side reactions complicate the use of chlorine for disinfecting purposes, their _____must be satisfied before chlorine becomes available to accomplish disinfection.

A. Combined residual
B. Free chlorine residual
C. Demand for chlorine
D. None of the above

428. Which term means the amount of chlorine required to produce a residual of 0.1 mg/l after a contact time of fifteen minutes as measured by Iodometric method of a sample at a temperature of twenty degrees in conformance with Standard methods?

A. Combined residual
B. Free chlorine residual
C. Chlorine Demand
D. None of the above

Chlorine Health Hazard Section

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

A. Rambling
B. Acute exposure
C. Chronic exposure
D. None of the above

430. 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. Acute exposure
C. Chronic exposure
D. None of the above

Inhalation

431. 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. Inhalation
B. Acute exposure
C. Chronic exposure
D. None of the above

432. 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

433. 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

434. Liquid and concentrated gas will produce severe burns and injury on contact.
A. True B. False

435. If you get chlorine in the eye, pour a gentle stream of _____through the affected eye for at least 15 minutes. Contact the poison control center, emergency room or physician right away as further treatment will be necessary.
A. Salt water C. Milk
B. Warm water D. None of the above

436. If you get chlorine on the skin, run _____ over the affected area for 15 minutes.
A. A gentle stream of water C. Cold water
B. Warm water D. None of the above

Chronic
437. Repeated exposures to chlorine gas can result in a loss of ability to detect the odor of chlorine. Long-term exposures may cause damage to teeth and inflammation or?
A. Chlorine gas toxicity C. Ulceration of the nasal passages
B. Plasma exudation D. None of the above

Pre-hospital Management
438. Rescue personnel are at low risk of noncardiogenic pulmonary edema contamination from victims who have been exposed only to gases released from hypochlorite solutions. However, clothing or skin soaked with industrial-strength bleach or similar solutions may be corrosive to rescuers and may release harmful gases.
A. True B. False

439. Ingestion of hydrochlorite solutions rarely causes pain in the mouth or throat, dysphagia, stridor, drooling, odynophagia, and vomiting.
A. True B. False

440. Chronic exposure to gases released from ammonia solutions can cause coughing, eye and nose irritation, lacrimation, and a burning sensation in the chest.
A. True B. False

Hot Zone
441. Which term is the area that rescuers should be trained and appropriately attired before entering?
A. Support Zone C. Decontamination area
B. Hot Zone D. None of the above

Rescuer Protection

442. Hypochlorite is irritating to the skin and eyes and in some cases may release toxic gases.
A. True B. False

443. Positive-pressure, self-contained breathing apparatus (SCBA) is recommended in response to situations that involve exposure to potentially unsafe levels of Chlorine gas.
A. True B. False

444. Chemical-protective clothing is not necessary for direct contact with solid hypochlorite or concentrated solutions.
A. True B. False

ABC Reminders

445. If a person is over taken with chlorine gas exposure, quickly establish a _____, ensure adequate respiration and pulse.
A. Support Zone C. Decontamination Zone
B. Patient airway D. None of the above

Victim Removal

446. During the chlorine evacuation, **i**f victims can walk, lead them out of the?
A. Decontamination area C. Hot Zone to the Decontamination Zone
B. Hot Zone D. None of the above

447. Victims may be transferred immediately to the _____. All others require decontamination.
A. Support Zone C. Chemical free zone
B. Patient Zone D. None of the above

Alternative Disinfection Section

Chlorine Dioxide Section

448. ClO_2 generation uses _____ and chlorine gas.
A. Sodium chlorite ($NaClO_2$) C. Ozone
B. Hypochlorous acid D. None of the above

449. Chlorine gas is educted into a motive water stream in a ClO_2 generator forming?
A HOCl and HCl C. Sodium thiosulfate
B. Chlorine dioxide D. None of the above

450. Which compound is pumped into the stream and allowed to react in a generating column to produce ClO_2?
A. Hypochlorous acid C. Sodium chlorite
B. Chlorine dioxide D. None of the above

451. Which of the following compound(s) does not hydrolyze in water as chlorine does and with it, no dissociation of ClO_2?
A. Chlorine gas C. NaOCl and HCl
B. Chlorine dioxide or ClO_2 D. None of the above

452. Which of the following compound(s) remains a gas in water, it does not have the corrosive tendencies of chlorine gas?
A. Sodium chlorite ($NaClO_2$) C. Sodium chlorate ($NaClO_3$)
B. Chlorine dioxide or ClO_2 D. None of the above

453. 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 C. NaOCl and HCl in place of chlorine gas
B. $NaClO_2$ D. None of the above

454. 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 C. Sodium chlorite ($NaClO_2$)
B. Hypochlorous acid D. None of the above

455. Which of the following compound(s) is much less aggressive to traditional corrosion inhibitors?
A. Chlorine gas C. NaOCl and HCl
B. Chlorine dioxide or ClO_2 D. None of the above

456. Which compound is a yellow-green gas with an irritating odor not unlike Chlorine?
A. Chlorine C. Ozone
B. Chlorine dioxide D. None of the above

457. Which compound cannot be compressed and shipped in a container, so it must be generated on site?
A. Sodium thiosulfate C. Sodium chlorate ($NaClO_3$)
B. Chlorine dioxide D. None of the above

458. 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 C. Sodium chlorate ($NaClO_3$) and sulfuric acid
B. $NaClO_2$ D. None of the above

459. 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. Hydrochlorous acid C. Hypochlorous Acid
B. Chlorine gas D. None of the above

460. 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.
A. THM precursor(s) C. pH
B. Chlorine dioxide D. None of the above

461. Chlorine dioxide remains completely pH-independent in the range where recirculating and once-through cooling systems are typically operated.
A. True B. False

Ultraviolet Disinfection

462. The microorganisms spend maximum time and contact with the outside of the quartz tube and the source of the?

A. UV rays C. Electromagnetic energy
B. Radiation D. None of the above

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

A. 20 gpm - 15 seconds C. 2.0 gpm - 15 seconds
B. 2.0 gpm - 100 seconds D. None of the above

464. 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 C. Channel
B. Ballasts and shields D. None of the above

465. 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 C. UV reactor
B. Electromagnetic energy D. None of the above

466. 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 C. Ballasts and shields
B. UV Flux D. None of the above

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

A. Sterilizer C. Ultraviolet (UV) radiation
B. Electromagnetic energy D. None of the above

468. In UV, quartz is often used in this case since practically none of the UV rays are absorbed by the quartz, _____cannot be used since it will absorb the UV rays, leaving little for disinfection.

A. Carbon C. Ordinary glass
C. Ozone D. None of the above

469. The _____will consist of a various number of lamps and tubes, depending upon the quantity of water to be treated.

A. UV sterilizer C. UV reactor
B. Electromagnetic energy D. None of the above

470. 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

471. 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. Transfer C. Electromagnetic energy
B. UV disinfection D. None of the above

472. 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 C. CT
B. Disinfection D. None of the above

473. 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

474. 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

475. 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
476. 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. Liquid Ozone C. O_2
B. Ozone D. None of the above

477. Ozone is a _____ gas at room temperature.
A. Reddish C. Light blue
B. Yellowish D. None of the above

478. 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 C. Pleasant odor of rain
B. H_2S odor D. None of the above

479. Ozone does not form chloramines or _____, and while it may destroy some THMs, it may produce others when followed by chlorination.
A. Carcinogens C. Oxygen and nascent oxygen
B. THMs D. None of the above

480. Ozone falls into the same category as other disinfectants in that it can produce?
A. Carcinogens C. Oxygen and nascent oxygen
B. DBPs D. None of the above

481. Liquid Ozone is very unstable and can readily explode. As a result, it is not shipped and must be manufactured on-site.
A. True B. False

482. It is the nascent oxygen that produces the high oxidation and disinfections, and even sterilization. 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. Nascent oxygen C. Ozone demand
B. THMs D. None of the above

483. When determining Ozone CT (contact time) values must be determined for the ozone basin alone; an accurate _____ must be obtained for the contact chamber, and residual levels.
A. Residual C. Contact time
B. T10 value D. None of the above

484. Ozone does not provide a system residual and should be used as a primary disinfectant only in conjunction with?
A. Dry sodium chlorite C. Free and/or combined chlorine
B. Chlorine dioxide D. None of the above

485. Ozone does not produce chlorinated byproducts (such as trihalomethanes) but it may cause an increase in such byproduct formation if it is fed ahead of free chlorine; ozone may also produce its own oxygenated byproducts such as $Cl_2 + NH_4$.
A. True B. False

486. Ozonation must include adequate ozone leak detection alarm systems, and an ozone off-gas destruction system.
A. True B. False

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

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

Chlorine Dioxide
489. Which term provides good Giardia and virus protection but its use is limited by the restriction on the maximum residual of 0.5 mg/L ClO_2/chlorite/chlorate allowed in finished water?
A. Chlorinated byproducts C. Ammonia residual(s)
B. Chlorine dioxide D. None of the above

490. If chlorine dioxide is being used as an oxidant, the preferred method of generation is to entrain this term or substance into a packed reaction chamber with a 25% aqueous solution of sodium chlorite ($NaClO_2$).
A. Chloramine C. Chlorine dioxide
B. Chlorine gas D. None of the above

491. According to the text, which chemical is explosive and can cause fires in feed equipment if leaking solutions or spills are allowed to dry out?
A. Dry sodium chlorite C. Ammonia
B. Chlorine dioxide D. None of the above

492. Chlorine dioxide may be used for either taste or odor control or as a?
A. Chloramine C. Gas
B. Pre-disinfectant D. None of the above

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

Ozone
494. Which term must be determined for the ozone basin alone; an accurate T10 value must be obtained for the contact chamber, residual levels measured through the chamber and an average ozone residual calculated?
A. Ozone CT (Contact time) C. Free and/or combined chlorine
B. Residual levels D. None of the above

495. Ozone does not provide a system residual and should be used as a primary disinfectant only in conjunction with free and/or combined chlorine.
A. True B. False

496. Ozone may also be used as _____for removal of taste and odor, or may be applied as a pre-disinfectant.
A. An oxidant C. System residual
B. Reducer D. None of the above

Lab Analyst Section
497. Turbidity is measured to evaluate the performance of _____.
A. Water treatment plant(s) C. Colloidal to coarse dispersions
B. An aesthetic point D. None of the above

498. Turbidity is caused by wide variety of suspended matter that range in size from colloidal to coarse dispersions, depending upon the_____, and ranges from pure inorganic substances to those that are highly organic in nature.
A. Water treatment plant(s) C. Degree of turbulence
B. An aesthetic point D. None of the above

499. Turbid waters are undesirable from _____ of view in drinking water supplies.
A. Water treatment plant(s) C. Colloidal to coarse dispersions
B. An aesthetic point D. None of the above

Surface Water (SW) System Compliance
500. 0.34 NTU in _____, never to exceed 1.0 NTU spike
A. Individual filter effluent C. Combined filter turbidity
B. 95% of samples D. None of the above