

**Registration Form**

**Water Treatment System Survey CEU Training Course \$300.00**  
48 HOUR RUSH ORDER PROCESSING FEE - ADDITIONAL \$50.00

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

**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** \_\_\_\_\_

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

**Please circle/check which certification you are applying the course CEU's.**  
Water Treatment \_\_\_ Water Distribution \_\_\_ Other \_\_\_\_\_

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

**If you've paid on the Internet, please write your Customer#** \_\_\_\_\_

**Please invoice me, my PO#** \_\_\_\_\_

**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 so we need either your fax number or e-mail address. We will e-mail the certificate to you, if no e-mail address; we will fax 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 also understand that this type of study program deals with dangerous conditions and that I will not hold Technical Learning College, Technical Learning Consultants, Inc. (TLC) liable for any errors or omissions or advice contained in this CEU education training course or for any violation or injury caused by this CEU education training course material. I will 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.

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 Do not solely trust our list for it may be outdated.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

**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.

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

## **AFFIDAVIT OF EXAM COMPLETION**

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

## **Grading Information**

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

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

Thank you...

**Do not solely depend on TLC's Approval list for it may be outdated.**

**All downloads are electronically tracked and monitored for security purposes.**

# Water Treatment System Survey Answer Key

Name \_\_\_\_\_

Phone \_\_\_\_\_

You are solely responsible in ensuring that this course is accepted for credit by your State. **No refunds.** Did you check with your State agency to ensure this course is accepted for credit?

*Method of Course acceptance confirmation. Please fill this section*

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

Do not solely depend on TLC's Approval list for it may be outdated.

What is the approval number if Applicable? \_\_\_\_\_

*You are responsible to ensure that TLC receives the Assignment and Registration Key. Please call us to ensure that we received it.*

*You can use Adobe Acrobat DC Program to complete the assignment.*

Please Circle, Underline, or X or Bold One answer per question.

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**Please fax or e-mail the answer key to**

**TLC Western Campus Fax (928) 272-0747.**

*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.*

### **Rush Grading Service**

If you need this assignment graded and the results mailed to you within a 48-hour period, prepare to pay an additional rush service handling fee of \$50.00. This fee may not cover postage costs. If you need this service, simply write RUSH on the top of your Registration Form. We will place you in the front of the grading and processing line. For security purposes, please fax or e-mail a copy of your driver's license and always call us to confirm we've received your assignment and to confirm your identity. Thank you...



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

## WATER TREATMENT SYSTEM SURVEY 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.**

1. Please rate the difficulty of your course.

Very Easy    0    1    2    3    4    5    Very Difficult

2. Please rate the difficulty of the testing process.

Very Easy    0    1    2    3    4    5    Very Difficult

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

Very Similar    0    1    2    3    4    5    Very Different

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

5. What would you do to improve the Course?

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How about the price of the course?

Poor \_\_\_\_\_ Fair \_\_\_\_\_ Average \_\_\_\_\_ Good \_\_\_\_\_ Great \_\_\_\_\_

How was your customer service?

Poor \_\_\_\_\_ Fair \_\_\_\_\_ Average \_\_\_\_\_ Good \_\_\_\_\_ Great \_\_\_\_\_

Any other concerns or comments.

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## WATER TREATMENT SYSTEM SURVEY CEU TRAINING COURSE ASSIGNMENT

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

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

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

1. A public water system that serves \_\_\_\_\_ of service connections used by year-round residents of the area served by the system or regularly serves at least 25 year-round residents.  
A. At least 5                      D. At least 30  
B. At least 15                     E. At least 500  
C. 1,000                            F. None of the Above
2. Class V Underground Injection Control is the process of identifying and inventorying contaminant sources within delineated source water protection areas through recording existing data.  
A. True   B. False
3. Which of the following bugs is a protozoan associated with the disease cryptosporidiosis in humans?  
A. Giardia lamblia                D. Hypoxia  
B. Water bear                      D. Paramecium  
C. Cryptosporidium               E. None of the above
4. Which of the following EPA terms is under section 1452 of the SDWA, the EPA awards capitalization grants to states to develop drinking water revolving loan funds to help finance drinking water system infrastructure improvements?  
A. Drinking Water State Revolving Fund  
B. Contamination Source Inventory  
C. Class V Underground Injection Control  
D. Phase I  
E. Phase II  
F. None of the Above

5. Which of the following substances or compounds is manufactured from aluminum hydroxide by dehydroxylating it in a way that produces a highly porous material?

- A. Activated alumina
- B. Fluoride
- C. Activated carbon
- D. Dissolved organic carbon
- E. Aluminum salts
- F. None of the Above

6. Which of the following substances or compounds has been processed to make it extremely porous and thus to have a very large surface area available for adsorption or chemical reactions?

- A. Activated alumina
- B. Fluoride
- C. Activated carbon
- D. Dissolved organic carbon
- E. Aluminum salts
- F. None of the Above

7. Which of the following substances or compounds has a high degree of microporosity; just one gram has a surface area of approximately 500 m<sup>2</sup>, as determined typically by nitrogen gas adsorption?

- A. Activated alumina
- B. Fluoride
- C. Activated carbon
- D. Dissolved organic carbon
- E. Aluminum salts
- F. None of the Above

8. Which of the following substances or compounds is a broad classification for organic molecules of varied origin and composition within aquatic systems?

- A. Activated alumina
- B. Fluoride
- C. Activated carbon
- D. Dissolved organic carbon
- E. Aluminum salts
- F. None of the Above

9. The "dissolved" fraction of which compound is considered an operational classification?

- A. Activated alumina
- B. Fluoride
- C. Activated carbon
- D. Organic carbon
- E. Aluminum salts
- F. None of the Above

10. EDTA is a widely used abbreviation for the chemical compound Electrodiagnosis acid.

- A. True
- B. False

11. Which of the following substances or compounds forms especially strong complexes with Mn(II), Cu(II), Fe(III), Pb (II) and Co(III)?

- A. Activated alumina
- B. Dissolved organic carbon
- C. Activated carbon
- D. Ethylenediaminetetraacetic acid (EDTA)
- E. B and C
- F. None of the Above

### **SDWA Water Quality Information and MCLs**

#### **Radionuclides**

12. Some people who drink water containing which compound/element in excess of the EPA standard over many years could experience skin damage or problems with their circulatory system, and may have an increased risk of getting cancer?

- A. Lead
- B. Fluoride
- C. Copper
- D. Aluminum
- E. Arsenic
- F. None of the Above

13. Some people who drink water containing which compound/element in excess of the EPA standard over many years may have an increased risk of getting cancer?

- A. Radon gas
- B. Beta/photon emitters
- C. Radioactive mineral
- D. Alpha emitters
- E. Combined Radium 226/228
- F. None of the Above

14. Which compound/element can dissolve and accumulate in underground water sources, such as wells, and in the air in your home?

- A. Radon gas
- B. Beta/photon emitters
- C. Radioactive material
- D. Alpha emitters
- E. Combined Radium 226/228
- F. None of the Above

15. Which compound/element do communities add to their drinking water to promote dental health?

- A. Fluorine
- B. Fluoride
- C. Floc
- D. Chlorine
- E. Arsenic
- F. None of the Above

16. The EPA has set an enforceable drinking water standard for which compound/element of 4 mg/L, because some people who drink water containing an excess of this level over many years could get bone disease, including pain and tenderness of the bones?

- A. Lead
- B. Fluoride
- C. Intestinal illness
- D. Waterborne outbreaks
- E. Arsenic
- F. None of the Above

17. Which compound/element typically leaches into water from plumbing in older buildings?

- A. Lead
- B. Fluoride
- C. Intestinal illness
- D. Waterborne outbreaks
- E. Arsenic
- F. None of the Above

18. Which secondary standard of 2 mg/L is there to protect against dental fluorosis?

- A. Lead
- B. Fluoride
- C. Arsenic
- D. Florentine
- E. Floraslitic
- F. None of the Above

### **SDWA Water Quality**

#### **EPA Rules - Arsenic**

19. Studies have linked long-term exposure of \_\_\_\_\_ in drinking water to a variety of cancers in humans.

- A. Arsenic
- B. Copper
- C. Basalt
- D. THHMMS
- E. Silica
- F. None of the Above

20. In October 2001, the EPA decided to move forward with implementing the 10ppb standard for \_\_\_\_\_ in drinking water.

- A. Arsenic
- B. Trihalomethanes
- C. Disinfection
- D. Copper
- E. Disinfection byproducts (DBPs)
- F. None of the Above

21. Which compound/element/substance is a chemical that occurs naturally in the earth's crust? When rocks, minerals, and soil erode, they release this compound/element/substance into water supplies.

- A. Arsenic
- B. Trihalomethanes
- C. Disinfection byproducts
- D. Basalt
- E. Granite
- F. None of the Above

**ICR**

22. The EPA has collected data required by the Information Collection Rule (ICR) to support future regulation of microbial contaminants, disinfectants, and disinfection byproducts.

- A. True
- B. False

23. The rule is intended to provide EPA with information on chemical byproducts that form when disinfectants used for microbial control react with chemicals already present in source water; disease-causing microorganisms, including Cryptosporidium; and engineering data to control these contaminants.

- A. True
- B. False

**Stage 2 DBP Rule Federal Register Notices**

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

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

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

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

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

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

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

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

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

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

29. Which Rule strengthens public health protection for customers by tightening compliance monitoring requirements for two groups of DBPs, trihalomethanes (TTHM) and haloacetic acids (HAA5)?

- A. Major public health advances
- B. The Stage 3 DBPR
- C. Stage 2 Disinfection Byproducts
- D. Amendments to the SDWA in 1996
- E. Primary or residual disinfectant
- F. None of the Above

30. Which of the following rules targets systems with the greatest risk and builds incrementally on existing rules?

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

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

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

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

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

33. 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
- B. DBP exposure
- C. The Stage 2 DBP rule
- D. Long Term 2 Enhanced Surface Water Treatment Rule
- E. Safe Drinking Water Act (SDWA)
- F. None of the Above

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

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

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

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

### **Bacteriological Monitoring Section**

36. 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
- B. Bacteria tests
- C. Contaminate
- D. Microbiological analysis
- E. Presence of an indicator
- F. None of the Above

37. The \_\_\_\_\_ group is used as an indicator organism to determine the biological quality of your water.

- A. Microbiological analysis
- B. Bac-T
- C. Coliform bacteria
- D. Escherichia coli (E. coli)
- E. Presence of an indicator
- F. None of the Above

38. The presence of an indicator or \_\_\_\_\_ in your drinking water is an important health concern.

- A. Indicator bacteria
- B. Pathogenic bacteria
- C. Contaminate
- D. Microbiological analysis
- E. Presence of an indicator
- F. None of the Above

39. Which of the following terms is used to signal possible fecal contamination, and therefore, the potential presence of pathogens?

- A. Indicator bacteria
- B. Pathogenic bacteria
- C. Contaminate
- D. Microbiological analysis
- E. Presence of an indicator
- F. None of the Above

40. Indicators in common use today for routine monitoring of drinking water include total coliforms, fecal coliforms, and?

- A. Sample container
- B. Bacteria tests
- C. Coliform bacteria
- D. Escherichia coli (E. coli)
- E. Iron bacteria
- F. None of the Above

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

- A. Indicator bacteria
- B. Bacteria tests
- C. Contamination
- D. Coliform bacteria
- E. Presence of an indicator
- F. None of the Above

### **Bacteria Sampling**

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

- A. Indicators
- B. Bacteria tests
- C. Contamination
- D. pH analysis
- E. Presence of an indicator
- F. None of the Above

43. Refrigerate the sample and transport it to the testing laboratory within eight hours (in an ice chest). Many labs will accept bacteria samples on Friday.

- A. True
- B. False

44. Which bug forms an obvious slime on the inside of pipes and fixtures? A water test is not needed for identification. Check for a reddish-brown slime inside a toilet tank or where water stands for several days.

- A. Colonies
- B. Algae
- C. Coliform bacteria
- D. Escherichia coli (E. coli)
- E. Iron bacteria
- F. None of the Above



45. Which of the following are common in the environment and are generally not harmful, however the presence of these bacteria in drinking water is usually a result of a problem with the treatment system or the pipes that distribute water, and indicates that the water may be contaminated with germs that can cause disease.

- A. Diseases
- B. Germs
- C. Coliform bacteria
- D. Escherichia coli (E. coli)
- E. Iron bacteria
- F. None of the Above

### Laboratory Procedures

46. The laboratory may perform the \_\_\_\_\_ in one of four methods approved by the U.S. EPA and your local environmental or health division.

- A. Colilert
- B. Coliform
- C. Sample time
- D. Total coliform analysis
- E. Pathogen test
- F. None of the Above

### Methods

47. 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
- B. Coliform
- C. Sample stuff
- D. Total coliform analysis
- E. Pathogen media
- F. None of the Above

48. If coliforms are present, the laboratory will analyze the sample further to determine if these are \_\_\_\_\_ or \_\_\_\_\_ and report their presence or absence.

- A. Colilert, E. coli
- B. Coliforms, E. coli
- C. Fecal coliforms, E. coli
- D. Total coliform analysis, Pathogens
- E. Pathogens, Total coliform analysis
- F. None of the Above

### Types of Water Samples

49. It is important to properly identify the type of \_\_\_\_\_ you are collecting.

- A. Colilert
- B. Coliforms
- C. Sample
- D. Total coliform analysis
- E. Pathogens
- F. None of the Above

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

50. Repeat samples are 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
- B. Special
- C. QA QC
- D. Total coliform analysis
- E. Routine
- F. None of the Above

51. What type of samples can be collected for other reasons? Examples would be a sample collected after repairs to the system.

- A. Repeat
- B. Special
- C. Sample
- D. Total coliform analysis
- E. Routine
- F. None of the Above

52. What type of samples can be collected on a routine basis to monitor for contamination? Collection should be in accordance with an approved sampling plan.

- A. Repeat
- B. Special
- C. Sample
- D. Total coliform analysis
- E. Routine
- F. None of the Above

**Repeat Sampling**

53. Whenever a \_\_\_\_\_ has total coliform or fecal coliform present, a set of repeat samples must be collected within 24 hours after being notified by the laboratory.

- A. MCL compliance
- B. Distribution system
- C. Routine sample
- D. Original sampling location
- E. Repeat sample(s)
- F. None of the Above

**The follow-up for repeat sampling is:**

54. If only one \_\_\_\_\_ per month or quarter is required, four (4) repeat samples must be collected.

- A. Special Sample
- B. Routine sample
- C. Repeat sample(s)
- D. Coliform present
- E. Original sampling location
- F. None of the Above

55. For systems collecting two (2) or more routine samples per month, three (3) \_\_\_\_\_ must be collected.

- A. Compliance sample
- B. Distribution sample
- C. Routine sample
- D. QA/QC Split
- E. Repeat sample(s)
- F. None of the Above

56. Repeat samples must be collected from: Within five (5) service connections upstream from the?

- A. MCL compliance
- B. Distribution system
- C. Routine sample
- D. Original sampling location
- E. Repeat sample(s)
- F. None of the Above

57. Repeat samples must be collected from: Within five (5) service connections downstream from the?

- A. Special Sample
- B. Routine sample
- C. Repeat sample(s)
- D. Coliform present
- E. Original sampling location
- F. None of the Above

58. Repeat samples must be collected from: If the system has only one service connection, the \_\_\_\_\_ must be collected from the same sampling location over a four-day period or on the same day.

- A. Special Sample
- B. Routine sample
- C. Repeat sample(s)
- D. Coliform present
- E. Original sampling location
- F. None of the Above

59. Repeat samples must be collected from: All \_\_\_\_\_ are included in the MCL compliance calculation.

- A. Special Sample
- B. Routine sample
- C. Repeat sample(s)
- D. Coliform present
- E. Original sampling location
- F. None of the Above

### Sampling Procedures

60. The \_\_\_\_\_ must be followed and all operating staff must be clear on how to follow the sampling plan.

- A. Seal individual samples
- B. Chain of custody
- C. Distribution system
- D. Sample siting plan
- E. Positive for total coliform
- F. None of the Above

61. Staff must be aware of how often sampling must be done, the \_\_\_\_\_ to be used for collecting the samples, and the proper procedures for identification, storage and transport of the samples to an approved laboratory.

- A. Multiple sources
- B. Sample siting plan
- C. Total coliform
- D. Proper procedures and sampling containers
- E. Sampling containers
- F. None of the Above

62. In addition, proper procedures must be followed for repeat sampling whenever a routine sample result is?

- A. Seal individual samples
- B. Chain of custody
- C. Distribution system
- D. Sample siting plan
- E. Positive for total coliform
- F. None of the Above

### Chain of Custody Procedures

63. Which of the following terms begins when the sample containers are obtained from the laboratory? From this point on, a chain of custody record will accompany the sample containers.

- A. Multiple sources
- B. Sample siting plan
- C. Total coliform
- D. Chain of custody record
- E. Sampling containers
- F. None of the Above

64. Each custody sample requires a \_\_\_\_\_ record and may require a seal. If you do not seal individual samples, then seal the containers in which the samples are shipped.

- A. Seal individual samples
- B. Chain of custody
- C. Distribution system
- D. Sample siting plan
- E. Positive for total coliform
- F. None of the Above

65. Because a sample is physical evidence, \_\_\_\_\_ procedures are used to maintain and document sample possession from the time the sample is collected until it is introduced as evidence.

- A. Multiple sources
- B. Sample siting plan
- C. Total coliform
- D. TCR
- E. Chain of custody
- F. None of the Above

66. If both parties involved in the transfer must sign, date and note the time on the chain of custody record, this is known as?

- A. Multiple sources
- B. Sample siting plan
- C. Total coliform
- D. Samples transfer possession
- E. Sampling containers
- F. None of the Above

67. The recipient will then attach the \_\_\_\_\_ showing the transfer dates and times to the custody sheets.

- A. Seal individual samples
- B. Chain of custody
- C. Shipping invoices
- D. Sample siting plan
- E. Positive for total coliform
- F. None of the Above

68. If the samples are delivered to after-hours night drop-off boxes, the custody record should note such \_\_\_\_\_ and be locked with the sealed samples inside sealed boxes.

- A. Multiple sources
- B. Sample siting plan
- C. Total coliform
- D. TCR
- E. A transfer
- F. None of the Above

### Positive or Coliform Present Results

69. According to the text, if you are notified of a positive test result you need to contact either the Drinking Water Program or your local county health department within 24 hours, or by the next business day after the?

- A. Results are reported to you
- B. Positive violation
- C. Repeat sampling immediately
- D. Sample violation
- E. MCL compliance violation
- F. None of the Above

70. The Drinking Water Program contracts with many of the local health departments to provide \_\_\_\_\_ to water systems.

- A. Assistance
- B. Harassment
- C. Hostility
- D. Sample help
- E. Compliance calculation
- F. None of the Above

71. 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. Storage and distribution
- B. Repeat sampling immediately
- C. Upgrading of the wellhead area
- D. Perform routine procedures
- E. Corrective measures
- F. None of the Above

### Heterotrophic Plate Count HPC

72. Heterotrophic Plate Count formerly known as the standard plate count, is a procedure for estimating the number of live heterotrophic bacteria.

- A. True
- B. False

73. Colonies may arise from pairs, chains, clusters, or single cells, all of which are included in the term?

- A. Coliform bacteria units
- B. MCLs units
- C. Standards
- D. HPC units
- E. Colony-forming units
- F. None of the Above

### Spread Plate Method

74. All colonies are on the \_\_\_\_\_ where they can be distinguished readily from particles and bubbles.

- A. Agar surface
- B. Surface growth area
- C. Top
- D. Bottom
- E. Material
- F. None of the Above

75. During the Spread Plate Method, colonies can be transferred quickly, and \_\_\_\_\_ can be easily discerned and compared to published descriptions.

- A. Colonies grow
- B. Surface growth
- C. Low counts
- D. Heterotrophic organisms will grow
- E. Colony morphology
- F. None of the Above

#### Membrane Filter Method

76. This method permits testing large volumes of \_\_\_\_\_ and is the method of choice for low-count waters.

- A. Colonies
- B. Surface water
- C. Low-turbidity water
- D. Heterotrophic organisms
- E. MCL
- F. None of the Above

#### Heterotrophic Plate Count (Spread Plate Method)

77. Which of the following terms use inorganic carbon sources, this is in contrast to Heterotrophic organisms utilize organic compounds as their carbon source?

- A. Colonies
- B. Surface growth
- C. AGAR
- D. Heterotrophic organisms
- E. Autotrophic organisms
- F. None of the Above

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

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

79. The R2A agar provides a medium that will support a large variety of?

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

#### Total Coliforms

80. 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

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

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

82. For systems that collect \_\_\_\_\_ or more samples per month, no more than five (5) percent may be Positive?

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

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

83. A(n) \_\_\_\_\_ to human health violation occurs if either one of the following happens:

Questions #84-87

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

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

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

85. A routine analysis shows total and \_\_\_\_\_ is followed by a repeat analysis that indicates total coliform present.

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

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

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

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

- A. True
- B. False

**Public Notice**

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

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

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

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

90. There shall be certain information, be issued properly and in a timely manner, and contain certain \_\_\_\_\_ on the public notice.

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

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

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

**The following are acute violations:**

92. An acute violation for nitrate is a violation of the \_\_\_\_\_.

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

93. An \_\_\_\_\_ occurs if a routine analysis shows total coliform present and is followed by a repeat analysis which indicates fecal coliforms or E. coli present.

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

94. An acute violation is any outbreak of \_\_\_\_\_, as defined by the rules.

Which is violation of nitrate?

- A. Presence
- B. MCL
- C. MCLG
- D. Count(s)
- E. Acute violation(s)
- F. None of the Above

**Giardia lamblia**

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

- A. HIV infection
- B. Giardia lamblia
- C. Giardiasis
- D. Hepatitis A
- E. Cryptosporidiosis
- F. None of the Above

**Cryptosporidiosis**

96. The mode of transmission of which bug is fecal-oral, either by person-to-person or animal-to-person, there is no specific treatment?

- A. HIV infection
- B. Giardia lamblia
- C. Giardiasis
- D. Hepatitis A
- E. Cryptosporidiosis
- F. None of the Above

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

- A. HIV infection
- B. Giardia lamblia
- C. Giardiasis
- D. Hepatitis A
- E. Cryptosporidiosis
- F. None of the Above

98. Which of the following is an example of a protozoan disease that is common worldwide, but was only recently recognized as causing human disease?

- A. HIV infection
- B. Giardia lamblia symptom
- C. Giardiasis
- D. Hepatitis A
- E. Cryptosporidiosis
- F. None of the Above

99. Which of the following usually come and go, and end in fewer than 30 days in most cases, the incubation period is 1-12 days, with an average of about seven days?

- A. HIV infections
- B. Symptoms
- C. Giardiasis
- D. Hepatitis A
- E. Cryptosporidiosis
- F. None of the Above

100. Which of the following terms including synthetic and volatile organic chemicals, which are by-products of industrial processes and petroleum production?

- A. Viruses and bacteria
- B. Pesticides and herbicides
- C. Radioactive contaminants
- D. Inorganic contaminants
- E. Organic chemical contaminants
- F. None of the Above

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

- A. Viruses and bacteria
- B. Pesticides and herbicides
- C. Radioactive contaminants
- D. Inorganic contaminants
- E. Organic chemical contaminants
- F. None of the Above

102. Microbial contaminants, such as viruses and bacteria, which may come from sewage treatment plants, septic systems and?

- A. Viruses and bacteria
- B. Pesticides and herbicides
- C. Radioactive contaminants
- D. Agricultural livestock operations and wildlife
- E. Organic chemical contaminants
- F. None of the Above

### Background

103. Coliform bacteria and chlorine residual are the only routine sampling and monitoring requirements for small ground water systems with chlorination.

- A. True
- B. False

104. The coliform bacteriological sampling is governed by?

- A. Multiple sources
- B. Sample siting plan
- C. Total coliform
- D. TCB
- E. Total Coliform Rule (TCR)
- F. None of the Above

105. State regulations require \_\_\_\_\_ of those systems that do chlorinate the water.

- A. Seal individual samples
- B. Chain of custody
- C. Chlorine residual monitoring
- D. Sample siting plan
- E. Positive for total coliform
- F. None of the Above

### Water Treatment Section - Preliminary Treatment

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

- A. Screening
- B. Settling
- C. Coagulation
- D. Change source
- E. Pump groundwater
- F. None of the Above

107. Bar screens and wire mesh screens both require \_\_\_\_\_.

- A. Manual cleaning
- B. Automatic cleaning
- C. No cleaning
- D. Replacement
- E. A and B
- F. None of the Above



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

A. True B. False

### Pre-Sedimentation

109. Sand and grit will damage plant equipment and pipes, so it must be removed with either rectangular or round shaped basin prior to?

- A. Filtration
- B. Coagulation
- C. Purification
- D. Flocculation
- E. Sedimentation basin(s)
- F. None of the Above

110. Sedimentation basins are also used after the flocculation process.

A. True B. False

111. A rectangular clarifier has scrapers on the bottom to move the settled sludge to one or more hoppers at the influent end of the tank. It could also have \_\_\_\_\_ or traveling bridge used to collect the sludge.

- A. A screw conveyor
- B. Conveyor belts
- C. Dissolved air floatation
- D. Manual skimmers
- E. Turnstile
- F. None of the Above

112. Most rectangular clarifiers will have baffles to prevent backflow from entering the effluent.

A. True B. False

### Flights and Chains

113. Flights and chains remove the scum from the \_\_\_\_\_ of the basin.

- A. Supernatant
- B. Surface
- C. Scum box
- D. Armature
- E. A and B
- F. None of the Above

114. To prevent damage to the flights and chains due to overloads, a \_\_\_\_\_ is used.

- A. Bearing
- B. Reducer
- C. Shear pin
- D. Safety net
- E. A and B
- F. None of the Above

115. The flights are usually concrete flights mounted on parallel chains and the motor shaft is connected through a shaft that turns the gear.

A. True B. False

### Circular Clarifiers

116. Filtration occurs only within the last few inches of the courser materials at the bottom of the bed.

A. True B. False

117. The media becomes progressively finer and denser in the lower layers.

A. True B. False

118. As suspended particles accumulate in a filter bed, the pressure drop through the filter increases.

A. True B. False

119. The most common type of Circular Clarifier has a center pier or column.

- A. True            B. False

120. The \_\_\_\_\_ process uses alum (aluminum sulfate) and cationic polymer to neutralize the charge.

- A. Filtration            D. Flocculation  
B. Reconditioning      E. Conventional  
C. Purification         F. None of the Above

121. Which of the following compounds combines with alkalinity in the raw water to form a white precipitate that neutralizes suspended particles' electrical charge?

- A. Activated sodium      D. Dissolved organic carbon  
B. PAC                      E. Alum  
C. Activated carbon      F. None of the Above

122. \_\_\_\_\_ uses a 30 to 50 mg/L alum dosage to form a large floc that requires extensive retention time to permit settling.

- A. Conventional technology    D. All of the above except C  
B. Reconditioning cycle        E. Chemical pretreatment  
C. Traditional sand filter       F. None of the Above

#### **Direct Filtration Plant vs. Conventional Plant**

123. The only difference between the Direct Filtration plant and the Conventional plant is that the \_\_\_\_\_ or step is omitted from the Direct Filtration plant.

- A. Conventional technology    D. Fast rinse  
B. Reconditioning cycle        E. Chemical pretreatment  
C. Sedimentation process      F. None of the Above

#### **Rapid Sand Filtration**

124. \_\_\_\_\_ is the most prevalent form of water treatment technology in use today.

- A. Conventional technology    D. Rapid Sand filtration  
B. Reconditioning cycle        E. Chemical pretreatment  
C. Sedimentation process      F. None of the Above

125. The Rapid Sand filtration process employs a combination of \_\_\_\_\_ in order to achieve maximum effectiveness.

- A. Filtration                 D. Sedimentation process  
B. Aluminum Sulfate         E. Physical and chemical processes  
C. Chemical pretreatment     F. None of the Above

#### **Coagulation**

126. At the Water Treatment Plant, alum is added to the water in the "flash mix" to cause microscopic impurities in the water to clump together.

- A. True            B. False

127. The alum and the water are mixed rapidly by the?

- A. Cationic polymers            D. Shaker  
B. Flash mixer                  E. All of the Above  
C. Coagulant chemicals         F. None of the Above

128. What is the process of joining together particles in water to help remove organic matter called?

- A. Cationic polymers
- B. Coagulation
- C. Coagulant chemicals
- D. Flocculation
- E. All of the Above
- F. None of the Above

129. Aluminum Sulfate is also excellent for removing nutrients such as phosphorous in wastewater treatment.

- A. True
- B. False

130. Fine particles must be coagulated, or "stuck together" to form larger particles that can be filtered, this is achieved through the use of?

- A. Sedimentation
- B. Coagulation
- C. Coagulant chemicals
- D. Flocculation
- E. All of the Above
- F. None of the Above

131. Which of the following terms are required since colloidal particles by themselves have the tendency to stay suspended in water and not settle out?

- A. Cationic polymers
- B. Coagulation
- C. Coagulant chemicals
- D. Flocculation
- E. All of the Above
- F. None of the Above

132. Which of the following terms are so small, their charge per volume is significant?

- A. Cationic polymers
- B. Colloidal particles
- C. Coagulant chemicals
- D. Aluminum Sulfate molecules
- E. All of the Above
- F. None of the Above

133. Coagulation is necessary to meet the current regulations for almost all potable water plants using surface water.

- A. True
- B. False

134. Coagulant chemicals such as "alum" work by neutralizing the negative charge, which allows the particles to come together.

- A. True
- B. False

135. Which coagulants can be thought of as positively charged strings that attract the particles to them, and in the process, form a larger particle?

- A. Cationic polymers
- B. Coagulation helpers
- C. Salts
- D. Lime
- E. All of the Above
- F. None of the Above

### **Flocculation**

136. Flocculation is the process of bringing together destabilized or coagulated particles to form larger masses that can be settled and/or filtered out of the water being treated.

- A. True
- B. False

137. Flocculation is the process where the suspended particles can collide, \_\_\_\_\_, and form heavier particles called "floc".

- A. Equalization
- B. Agitation of the water
- C. Agglomerate
- D. Destabilized or coagulated particles
- E. All of the Above
- F. None of the Above

138. Gentle \_\_\_\_\_ and appropriate detention times (the length of time water remains in the basin) help facilitate the flocculation process.

- A. Equalizing
- B. Agitation of the water
- C. Agglomerating
- D. Settling
- E. All of the Above
- F. None of the Above

139. The water is slowly mixed in contact chambers allowing the coagulated particles, now, called "floc," to become larger and stronger.

- A. True
- B. False

140. As these \_\_\_\_\_ in the water, bacteria and other microorganisms are caught in the floc structure.

- A. Equalize the basin
- B. Agitate the water
- C. Floc particles mix
- D. Coagulated particles
- E. All of the Above
- F. None of the Above

### Pre-Sedimentation

141. Depending on the quality of the source water, some plants have pre-sedimentation, which allows larger \_\_\_\_\_ in a reservoir or lake reducing solid removal loads.

- A. Equalize the basin
- B. Agitate the water
- C. Floc particles mix
- D. Coagulated particles
- E. Particles time to settle
- F. None of the Above

### Sedimentation

142. Once settled, the \_\_\_\_\_ that is later removed from the bottom of the basin.

- A. Basin is equalized
- B. Water is agitated
- C. Floc particles mix
- D. Particles combine to form a sludge
- E. Particles settle over time
- F. None of the Above

143. Sedimentation is the process of destabilizing coagulated particles in water.

- A. True
- B. False

144. Following \_\_\_\_\_, a sedimentation step may be used. During sedimentation, the velocity of the water is decreased so that the suspended material, including flocculated particles, can settle out by gravity.

- A. Conventional technology
- B. Flocculation
- C. Sedimentation process
- D. Rapid Sand filtration
- E. Chemical pretreatment
- F. None of the Above

### Filtration

145. At a rate of between 2 and 10 gpm per square foot, the water is filtered through an approximate 36" depth of graded sand.

- A. True
- B. False

146. The water flows by gravity through large filters of \_\_\_\_\_, silica sand, garnet and gravel.

- A. Activated carbon filters
- B. Cartridge filters
- C. Anthracite coal
- D. Rapid-sand filters
- E. All of the Above
- F. None of the Above

147. Filtration is a water treatment process step used to remove turbidity, dissolved organics, odor, taste and color.

- A. True            B. False

148. According to the text, the filter is periodically cleaned by a reversal of flow and the \_\_\_\_\_ into a drain.

- A. Activated carbon filters            D. Rapid-sand filters  
B. Cartridge filters                    E. Discharge of back-flushed water  
C. Anthracite coal                      F. None of the Above

149. Which of the following terms are made of fabric, paper, or plastic?

- A. Activated carbon filters            D. Rapid-sand filters  
B. Cartridge filters                    E. Granular synthetic filters  
C. Anthracite filters                    F. None of the Above

150. Which of the following terms will also remove turbidity, but would not be recommended for that purpose only?

- A. Activated carbon filters            D. Rapid-sand filters  
B. Cartridge filters                    E. Granular synthetic material  
C. Anthracite coal                      F. None of the Above

151. Water filters for suspended particle removal can also be made of graded sand, \_\_\_\_\_, screens of various materials, and fabrics.

- A. Activated carbon filters            D. Rapid-sand filters  
B. Cartridge filters                    E. Granular synthetic material  
C. Anthracite coal                      F. None of the Above

152. The most widely used filters are \_\_\_\_\_ in tanks. In these units, gravity holds the material in place and the flow is downward.

- A. Activated carbon filters            D. Rapid-sand filters  
B. Cartridge filters                    E. Granular synthetic material  
C. Anthracite coal                      F. None of the Above

153. For the removal of organic contaminants and taste and odor problems, Anthracite coal or \_\_\_\_\_ may also be included in the sand to improve the filtration process.

- A. Sand                                    D. Post-disinfection  
B. Garnet                                E. All of the Above  
C. Activated carbon                    F. None of the Above

154. Evaluation of overall \_\_\_\_\_ should be conducted on a routine basis, at least once per day.

- A. Wall scum                              D. Post-disinfection  
B. Gate position                        E. Filtration process performance  
C. Effluent control measurement      F. None of the Above

155. Good chemical treatment management can often result in either early turbidity breakthrough or rapid head loss buildup.

- A. True            B. False

### Declining Rate Filters

156. The flow rate will vary with?

- A. Head loss
- B. Uniform media
- C. Effluent control
- D. Post-disinfection
- E. All of the Above
- F. None of the Above

157. Declining Rate Filters system requires \_\_\_\_\_ to provide adequate media submergence.

- A. Head loss
- B. Uniform media
- C. Effluent control structure
- D. Post-disinfection
- E. Flocculation
- F. None of the Above

### Detention Time

158. Detention time is the actual time required for a small amount of water to pass through a sedimentation basin at a given rate of flow, or the calculated time required for a small amount of liquid to pass through a tank at a given rate of flow.

- A. True
- B. False

### Disinfection

159. Chlorine is added to the water at the flash mix for pre-disinfection. The chlorine kills or inactivates harmful microorganisms.

- A. True
- B. False

160. Chlorine is added again after filtration for?

- A. Residual
- B. Control THMS
- C. Contact time
- D. Post-disinfection
- E. Pre-disinfection
- F. None of the Above

### Jar Testing

161. Jar testing traditionally has been done on a monthly basis in most water treatment plants to control THMs.

- A. True
- B. False

### pH

162. According to the text, pH is an expression of a basic or acid condition of a liquid. The range is from 0-14, zero being the most acid and 14 being the most alkaline. A pH of 7 is considered to be neutral.

- A. True
- B. False

### Caustic

163. NaOH is a strong chemical used in the treatment process to neutralize acidity, and to lower the pH value.

- A. True
- B. False

### Polymer

164. Polymer is a water treatment chemical that when combined with other types of coagulants, aids in binding small \_\_\_\_\_ to larger particles to help in the settling and filtering processes.

- A. Excess floc
- B. Coagulants
- C. Suspended particles
- D. Color
- E. Solids
- F. None of the Above

**Post-Chlorine**

165. The operator should make sure that the chlorinated water holds a residual in the distribution system.  
A. True      B. False

**Pre-Chlorination**

166. The addition of chlorine before the filtration process will help control fish and vegetation.  
A. True      B. False

**Hydrofluosilicic Acid**

167. H<sub>2</sub>SiF<sub>6</sub> is a clear \_\_\_\_\_, with a pH ranging from 1 to 1.5 and is used in water treatment to fluoridate drinking water.  
A. Gas    D. Fuming corrosive liquid  
B. But colored liquid                              E. Dark pleasant liquid  
C. Fluoridating drinking water liquid      F. None of the Above

**Corrosion Control**

168. The pH of the water is adjusted with?  
A. Acid    E. Soda base  
B. Sodium carbonate                              D. Subsequent treatment processes  
C. Fluoride acid                                      F. None of the Above

169. Which of the following chemicals is fed into the water after filtration?  
A. Acid    E. Soda ash  
B. Sodium Chloride                              D. Subsequent treatment processes  
C. Fluoride acid                                      F. None of the Above

**Taste and Odor Control**

170. Which of the following chemicals is occasionally added for taste and odor control?  
A. Turbidity powder                              D. HOCL  
B. Powdered activated carbon (PAC)                              E. All of the Above  
C. Fluoride    F. None of the Above

**Water Quality**

171. Water quality testing is conducted throughout the water treatment process.  
A. True      B. False

172. Water quality testing needs to analyze turbidity, pH, and chlorine residual continuously.  
A. True      B. False

173. Some water quality items are tested several times per day, some once per quarter and others once per year.  
A. True      B. False

**Chemical Feed and Rapid Mix**

174. To improve the subsequent treatment processes, chemicals are added to the water, and may include pH adjusters and coagulants.  
A. True      B. False

175. Coagulants are chemicals, such as alum, that neutralize positive or negative charges on small particles, allowing them to stick together and form larger particles that are more easily removed by sedimentation or filtration.

- A. True            B. False

**Short-Circuiting**

176. Short-Circuiting is a condition that occurs in tanks or basins when some of the water travels faster than the rest of the flowing water.

- A. True            B. False

177. Short-Circuiting is usually undesirable, since it may result in shorter contact, reaction, or settling times in comparison with the?

- |   |                      |
|---|----------------------|
| A. Presumed detention times                 | D. Up-flow clarifier |
| B. Sedimentation/clarification process      | E. All of the Above  |
| C. Modification of the conventional process | F. None of the Above |

**Tube Settlers**

178. Tube settlers are a modification of the conventional process that contains many metal “tubes” that are placed in?

- |                                     |                         |
|-------------------------------------|-------------------------|
| A. Clearwell                        | D. An up-flow clarifier |
| B. Sedimentation basin or clarifier | E. Filter               |
| C. Flocculation basin               | F. None of the Above    |

**Adsorption Clarifiers**

179. In this sedimentation/clarification process, turbidity is \_\_\_\_\_ of the coagulated and flocculated solids onto the adsorption media and onto the solids already adsorbed onto the media.

- |                            |   |
|----------------------------|---|
| A. Increased by adsorption | D. Decreased                                  |
| B. Reduced by adsorption   | E. A modification of the conventional process |
| C. Destroyed               | F. None of the Above                          |

180. Water scouring cleans adsorption clarifiers followed by air flushing.

- A. True            B. False

181. Cleaning of the clarifier is initiated less often than filter backwashing because the clarifier removes less solids.

- A. True            B. False

182. Tube-settler type of package plant, the Sedimentation/clarification process is followed by mixed-media filtration and disinfection to complete the water treatment.

- A. True            B. False

**Clearwell**

183. The clearwell provides temporary storage for the treated water, which is the final step in the conventional filtration process.

- A. True            B. False



**EPA Filter Backwash Rule**

184. The U.S. Environmental Protection Agency has finalized the Long Term 1 Enhanced Surface Water Treatment Rule and Filter Backwash Rule to \_\_\_\_\_ from contamination by Cryptosporidium and other microbial pathogens.

- A. Enforce standards to protect
- B. Increase filtration and disinfection
- C. Increase protection of finished drinking water supplies
- D. Remove
- E. All of the Above
- F. None of the Above

**Background**

185. The EPA has determined that the presence of microbiological contaminants is a health concern. If finished water supplies contain \_\_\_\_\_, disease outbreaks may result.

- A. Disease symptoms
- B. Cryptosporidium
- C. Waterborne diseases
- D. Microbiological contaminants
- E. All of the Above
- F. None of the Above

**Turbidity**

186. Which of the following terms must comply with specific combined filter effluent turbidity requirements?

- A. Watershed control
- B. Raw water control
- C. Disinfection profile
- D. Disinfection benchmark
- E. Conventional and Direct filtration systems
- F. None of the Above

187. According to the text, conventional and \_\_\_\_\_ must comply with individual filter turbidity requirements.

- A. Groundwater
- B. Direct filtration systems
- C. Disinfection processes
- D. Raw water
- E. A and D
- F. None of the Above

**Disinfection Benchmarking**

188. Public water systems will be required to develop a(n) \_\_\_\_\_ unless they perform applicability monitoring which demonstrates their disinfection byproduct levels are less than 80% of the maximum contaminant levels.

- A. Updated watershed control
- B. Direct filtration system
- C. Disinfection profile
- D. Disinfection benchmark
- E. A and D
- F. None of the Above

**Other Requirements**

189. Finished water reservoirs for which construction begins after the effective date of the rule must be covered; and unfiltered systems must comply with \_\_\_\_\_ requirements that add Cryptosporidium as a pathogen of concern.

- A. Updated watershed control
- B. Direct filtration system
- C. Disinfection profiling
- D. Disinfection benchmarking
- E. A and D
- F. None of the Above

### The Filtration Process

190. Removal of \_\_\_\_\_ plays an important role in the natural treatment of groundwater as it percolates through the soil.

- A. Coagulation and flocculation processes
- B. Coagulation or oxidation processes
- C. Serious problems in filter operation
- D. Suspended solids by filtration
- E. A and D
- F. None of the Above

191. \_\_\_\_\_, especially if coagulation and flocculation of the water before filtration was not properly controlled.

- A. Some coagulation and flocculation may occur in the filter bed
- B. Coagulation or oxidation processes will work
- C. No problems in filter operation
- D. Physical and chemical mechanisms will improve
- E. A and B
- F. None of the Above

### Types of Filters

192. The earliest water filters developed were the slow sand filters; these have filter rates of around 0.05 gpm/ft<sup>2</sup> of surface area. This type of filter requires large filter areas.

- A. True
- B. False

193. What is the term for the mass of growing material that collects on the surface of the filter?

- A. Schmutzdecke
- B. Water moss
- C. Backwash
- D. Mud balls
- E. Zoological growth
- F. None of the Above

194. Most water filters are classified by filtration rate, type of \_\_\_\_\_, or type of operation.

- A. Schmutzdecke
- B. Slow rate filtration
- C. Backwash capabilities
- D. Filter media
- E. Filter size
- F. None of the Above

### Rapid Sand Filters

195. Rapid sand filters can accommodate filter rates 40 times more than?

- A. Fixed film
- B. Slow sand filters
- C. Mixed media
- D. Activated carbon beds
- E. Without sand
- F. None of the Above

196. Filters in large water treatment plants are usually constructed next to each other in a row, allowing the piping from the Sedimentation basins to feed the filters from a central pipe gallery.

- A. True
- B. False

### Filter Sand

197. The filter sand used in rapid sand filters is normal play sand for the purpose of water filtration.

- A. True
- B. False

198. The gravel installed under the sand layer(s) in the filter prevents the \_\_\_\_\_ from being lost during the operation.

- A. Rapid filters
- B. Filter sand
- C. Backwash trough
- D. Sedimentation basin
- E. Mixed media
- F. None of the Above

199. This under-gravel supports the filter sand and is usually graded in three to five layers, each generally 6-18 inches in thickness, depending on the type of underdrain used.

- A. True
- B. False

### Washwater Troughs

200. During the operation of a filter, the upper six-to-ten inches of the filter media remove most of the suspended material from the water. It is important that this layer is thoroughly cleaned during the \_\_\_\_\_.

- A. Rinsing cycle
- B. Method of agitation
- C. Washing
- D. Backwash cycle
- E. Filtered water cycle
- F. None of the Above

201. Normal backwashing does not, in most cases, clean this layer completely; some \_\_\_\_\_ is needed to break up the top layers of the filter and to help the backwash water remove any material caught there.

- A. Rinsing cycle
- B. Method of agitation
- C. Washing
- D. Backwash cycle
- E. Surface wash
- F. None of the Above

202. A newer design of \_\_\_\_\_ uses compressed air to mix the upper layer and loosen the particles from the sand so that the backwash water can remove the particles more easily?

- A. Rinsing cycle
- B. Method of agitation
- C. Washing
- D. Backwash cycle
- E. Surface wash
- F. None of the Above

203. Washwater troughs placed above the filter media collect the \_\_\_\_\_ and carry it to the drain system.

- A. Backwash water
- B. Raw water
- C. Media
- D. Rinsing of the filter or backwash cycle
- E. Rinsate
- F. None of the Above

204. Proper placement of these troughs is very important to ensure that the filter media is not carried into the troughs during the \_\_\_\_\_ and removed from the filter.

- A. Backwash
- B. Raw water
- C. Media
- D. Mudballs
- E. Rinsate
- F. None of the Above

205. Wash troughs must be installed at the same elevation so that they remove the \_\_\_\_\_ evenly from the filter and so that an even head is maintained across the entire filter.

- A. Backwash
- B. Raw water
- C. Media
- D. Mudballs
- E. Rinsate
- F. None of the Above

206. Which of the following filter components are constructed from concrete, plastic, fiberglass, or other corrosion-resistant materials?

- A. Backwash troughs
- B. Surface wash system piping
- C. False floor
- D. Trap door
- E. Center stand
- F. None of the Above

### Filtration Processes

207. In the other type of filtration process “direct filtration” no sedimentation follows the coagulation phase.

- A. True
- B. False

208. Which of the following water treatment terms is designed to filter water with an average turbidity of less than 25 NTU?

- A. Direct Filtration
- B. Dual and multi-media filtration
- C. Conventional Filtration
- D. Flocculation
- E. Pressure Sand Filtration
- F. None of the Above

209. According to the text, dual and multi-media filters are used with Conventional Filtration.

- A. True
- B. False

210. \_\_\_\_\_ plants have a lower capital cost. However, the process cannot handle large variations in raw water turbidity.

- A. Direct Filtration
- B. Dual and multi-media filtration
- C. Conventional Filtration
- D. Flocculation
- E. Sand Filtration
- F. None of the Above

211. The traditional design for many years is conventional filtration; this method provides effective treatment for just about any range of?

- A. Raw-water turbidity
- B. Costs
- C. Microorganisms
- D. Increase plant capacity
- E. All of the Above
- F. None of the above

212. Conventional filtration success is due partially to the sedimentation that precedes filtration and follows the coagulation and flocculation steps.

- A. True
- B. False

213. Many treatment plants have converted rapid sand filters into multi-media filters in an attempt to?

- A. Control raw-water turbidity
- B. Lower capital cost
- C. Kill microorganisms
- D. Increase plant capacity
- E. All of the Above
- F. None of the Above

### High Rate Filters

214. High rate filters, which operate at a rate \_\_\_\_\_, use a combination of different filter media, not just sand.

- A. That finer material are farther down
- B. Faster than 3 feet per second
- C. Of 2 feet per second
- D. Three-to-four times that of rapid sand filters
- E. All of the Above
- F. None of the Above

215. Multi-media or mixed-media filters use three or four different materials, sand, anthracite coal, and garnet.

- A. True      B. False

216. In the design of the high rate filter?

- A. Finer material are farther down      D. The media size increases  
B. The media size decreases      E. Water is treated better  
C. Larger suspended particles are removed first      F. None of the Above

217. In the design of the high rate filter, the top layers consist of a fine material with the course material farther down, allowing the suspended material to penetrate less into the filter.

- A. True      B. False

218. The filter bed material forms layers in the filter, depending on their weight and specific gravities.

- A. True      B. False

### Pressure Sand Filters

219. Pressure filtration rates are twice as good as gravity filters.

- A. True    B. False

220. Which type of filter is used extensively in iron and manganese removal plants?

- A. Slow sand/RO      D. Fast sand  
B. Gravity filters      E. Conventional  
C. Pressure sand filter      F. None of the Above

221. Cracking of the filter bed can occur quite easily in \_\_\_\_\_, allowing the iron and manganese particles to go straight through the filter?

- A. Slow sand/RO      D. Fast sand  
B. Gravity filters      E. Conventional  
C. Pressure filters      F. None of the Above

222. A \_\_\_\_\_ is contained under pressure in a steel tank.

- A. Slow sand/RO      D. Fast sand  
B. Gravity filters      E. Conventional  
C. Pressure sand filter      F. None of the Above

223. The media in a \_\_\_\_\_ is usually sand or a combination of media.

- A. Slow sand/RO      D. Fast sand  
B. Gravity filters      E. Fixed film  
C. Pressure sand filter      F. None of the Above

224. Because the water in a pressure sand filter is under pressure, \_\_\_\_\_ will not occur in the filter.

- A. Gravity      D. Flow  
B. Velocity      E. Heat  
C. Air binding      F. None of the Above

225. \_\_\_\_\_ have a major disadvantage in that the backwash cannot be observed.

- A. Slow sand/RO
- B. Gravity filters
- C. Pressure filters
- D. Fast sand
- E. Conventional
- F. None of the Above

226. According to the text, which of the following terms or methods have limitations, and must not be used to treat surface water?

- A. Slow sand/RO
- B. Gravity filters
- C. Pressure filters
- D. Fast sand
- E. Conventional
- F. None of the Above

### Filtration Operation

227. Filtration operation is divided into three steps: filtering, backwashing, and?

- A. Filter run
- B. Filtering to waste
- C. Return to waste
- D. Drying
- E. Rinsate
- F. None of the Above

228. Which of the following terms is a low-pressure membrane filtration process that removes suspended solids and colloids generally larger than 0.1-micron diameter?

- A. Nanofiltration
- B. Pressure recovery
- C. Microfiltration
- D. Semi-permeable
- E. Declining rate
- F. None of the Above

229. Which of the following terms is a relatively recent membrane process used most often with low total dissolved solids water such as surface water and fresh groundwater?

- A. Nanofiltration
- B. Pressure recovery
- C. Microfiltration
- D. Semi-permeable
- E. Declining rate
- F. None of the Above

### Declining Rate

230. According to the text, which of the following terms or methods of control are used where the head loss through the plant is quite large?

- A. Slow sand/RO
- B. Gravity filters
- C. Pressure filters
- D. Fast sand
- E. Declining Rate
- F. None of the Above

231. The rate through the declining rate filter is much greater in the beginning of a filter run than at the end when the?

- A. Filter run
- B. Filter is dirty
- C. Head loss is low
- D. Flow tube controller is operating
- E. All of the Above
- F. None of the Above

232. According to the text, which of the following terms or methods allows the filter head to increase until the filter becomes plugged with particles and the Head loss is too great to continue operation of the filter?

- A. Slow sand/RO
- B. Gravity filters
- C. Pressure filters
- D. Fast sand
- E. Declining Rate
- F. None of the Above

**Loss of Head Indicator**

233. As filtration proceeds, an increasing amount of pressure, called \_\_\_\_\_ across the filter, is required to force the water through the filter.

- A. Filter run
- B. Filtering to waste
- C. Flow tube controller
- D. Head loss
- E. Head
- F. None of the Above

234. Which of the following parameters should be continuously measured to help determine when the filter should be backwashed?

- A. Filter run
- B. Filtering to waste
- C. Flow tube controller
- D. Head loss
- E. Head
- F. None of the Above

235. Usually the difference in the \_\_\_\_\_ is measured by a piezometer connected to the filter above the media and the effluent line.

- A. Filter run
- B. Filtering to waste
- C. Flow tube controller
- D. Head loss
- E. Head
- F. None of the Above

**In-line Turbidimeter**

236. Continuous turbidity monitors provide information about when the filter is approaching this point so that the operators can start the backwash before the turbidity is too great.

- A. True
- B. False

237. Which of the following terms in water is caused by small suspended particles that scatter or reflect light?

- A. Shelter bacteria
- B. Suspended material
- C. Turbidity
- D. Floc
- E. Breakthrough
- F. None of the Above

238. Which of the following terms of the filtered water may shelter bacteria, preventing chlorine from reaching it?

- A. Shelter bacteria
- B. Suspended material
- C. Turbidity
- D. Floc
- E. Breakthrough
- F. None of the Above

239. The \_\_\_\_\_ of the filtered water is one of the factors that determine the length of a filter run.

- A. Shelter bacteria
- B. Suspended material
- C. Turbidity
- D. Floc
- E. Breakthrough
- F. None of the Above

240. \_\_\_\_\_ measurements will also indicate whether the coagulation and other treatment processes are operating properly.

- A. Shelter bacteria
- B. Suspended material
- C. Turbidity
- D. Floc
- E. Breakthrough
- F. None of the Above

### Filtration Process

241. In filters with a control valve installed on the filter effluent pipe, the \_\_\_\_\_ is restricted during this time (when the filter is started after backwashing).

- A. Shelter bacteria
- B. Suspended material
- C. Turbidity
- D. Filter flow
- E. All of the above except D
- F. None of the Above

242. The control valve prevents filter surges, which could disturb the media and force \_\_\_\_\_ through the filter.

- A. Flow
- B. Suspended material
- C. Dissolved solids
- D. Floc
- E. Breakthrough
- F. None of the Above

243. The rate of \_\_\_\_\_ on a filter depends on the type of filter.

- A. Flow
- B. Suspended material
- C. Turbidity
- D. Floc
- E. Breakthrough
- F. None of the Above

244. A rapid sand filter will have a flow of two-to-three gpm/square foot of filter area. The high rate filter may have four-to-six gpm/square foot applied to the surface.

- A. True
- B. False

245. Water from the source or pre-treatment processes is applied to the top of the filter; it then flows downward. The water level above the filter bed is usually kept at two-to-six feet.

- A. True
- B. False

246. When the filtration is started after being backwashed, there will be great head loss.

- A. True
- B. False

### Back Washing

247. A normal backwash rate is between 1.2 to 1.5 gpm per square foot of filter surface area.

- A. True
- B. False

248. Proper backwashing is a very important step in the operation of a filter.

- A. True
- B. False

249. The filter will eventually develop additional operational problems, if the filter is not \_\_\_\_\_ completely,

- A. Bumped
- B. Jetted
- C. Air scoured
- D. Backwashed
- E. Flow restrictor
- F. None of the Above

250. The filter must be cleaned before the next filter run, treated water from storage is used for the backwash cycle. This treated water is taken from elevated storage tanks or pumped in from the raw water reservoir.

- A. True
- B. False



251. Which of the following terms must be expanded to clean the filter during the backwash?

- A. Headloss
- B. Floc(s)
- C. Flow restricting
- D. Backwash cycle
- E. Media
- F. None of the Above

252. Filter expansion causes the filter grains to violently rub against each other, dislodging the \_\_\_\_\_ from the media.

- A. Headloss
- B. Floc(s)
- C. Flow restricting
- D. Backwash cycle
- E. Media
- F. None of the Above

253. The filter media needs to be agitated by the filter backwash to expand and agitate and suspend the \_\_\_\_\_ in the water for removal.

- A. Headloss
- B. Floc(s)
- C. Flow restricting
- D. Backwash cycle
- E. Media
- F. None of the Above

254. Which of the following filter terms if is too high; media will be washed from the filter into the troughs and out of the filter?

- A. Headloss
- B. Floc(s)
- C. Flow restricting
- D. Backwash rate
- E. Media
- F. None of the Above

### **Backwashing Process**

255. The normal method for opening the filter backwash valve involves draining the water level above the filter to a point six inches above the filter media.

- A. True
- B. False

256. When the backwash valve is opened, backwash water is allowed to start flowing into the filter and start?

- A. Control headloss
- B. Crust on the filter
- C. Expand the bed
- D. Some means of controlling the media carryover
- E. Carrying suspended material away from the filter
- F. None of the Above

257. For a filter with an air wash, the filter backwash water and the air wash should not be used together. This would be possible only if \_\_\_\_\_ is installed.

- A. Control headloss
- B. Crust on the filter
- C. Expand the bed
- D. Some means of controlling the media carryover
- E. Carrying suspended material away from the filter
- F. None of the Above

258. When the surface wash is turned on it should be allowed to operate for several minutes to break up?

- A. Control headloss
- B. Crust on the filter
- C. Expand the bed
- D. Some means of controlling the media carryover
- E. Carrying suspended material away from the filter
- F. None of the Above

### **Disposal of Filter Backwash Water**

259. Water from the filter backwash can be returned directly to the environment.

- A. True
- B. False

260. The supernatant is then pumped back to the head of the treatment plant at a rate not exceeding ten percent of the?

- A. Daily flow
- B. Backwash water
- C. Eliminates the need to obtain
- D. Raw water flow entering the plant
- E. Amount of solids that must be removed
- F. None of the Above

261. The settled material is pumped to a sewer or is treated in the solids-handling process, of the plant. This conserves most of the backwash water and \_\_\_\_\_ a pollution discharge permit for the disposal of the filter backwash water.

- A. Daily flow
- B. Backwash water
- C. Eliminates the need to obtain
- D. Raw water flow entering the plant
- E. Amount of solids that must be removed
- F. None of the Above

262. Backwash is a very high flow operation, the surges that are created from the backwash coming from the filter?

- A. Daily flow
- B. Backwash water
- C. Return
- D. Raw water flow entering the plant
- E. Must not be allowed to enter the head of the plant
- F. None of the Above

263. According to the text, the spent backwash water must be stored in storage tanks and returned slowly to the treatment process.

- A. True
- B. False

#### Filter to Waste

264. When filtration is started after backwash, suspended material remains in the filter media until the turbidity in the effluent meets standards. Depending on the type of filter, this may last from 20-40 minutes.

- A. True
- B. False

265. According to the text, wasting is needed as some \_\_\_\_\_ following the backwash.

- A. Daily flow
- B. Backwash water
- C. Return
- D. Suspended material remains in the filter media
- E. Filtration should always be started
- F. None of the Above

266. Filtration \_\_\_\_\_ after a backwash to prevent breakthrough of suspended material.

- A. Daily flow
- B. Backwash water
- C. Return
- D. Suspended material
- E. Filtration should always be started
- F. None of the Above

#### Filter Aids

267. A normal dose of polymer for filter aiding will be less than 0.1 ppm, but the exact dose will be decided by the result of a jar test and by experimentation in the treatment plant.

- A. True
- B. False

268. \_\_\_\_\_ have very high molecular weight and cause the floc to coagulate and flocculate quickly.

- A. Filter medias
- B. Sand
- C. Filters
- D. Filter aids
- E. Floc
- F. None of the Above

269. More frequent filter backwashing and \_\_\_\_\_ will be required to remove the floc that has penetrated deeply into the filter bed.

- A. Filter backwashing
- B. Backwash water leaving the filter
- C. Raw water flow entering the plant
- D. Use of large volumes of backwash water
- E. Serious damage to the filter underdrain
- F. None of the Above

270. A \_\_\_\_\_ is a material that adds strength to the floc and prevents its breakup.

- A. Filter backwashing
- B. Backwash water leaving the filter
- C. Raw water flow entering the plant
- D. Too much backwash water is used
- E. Filter aid
- F. None of the Above

271. \_\_\_\_\_ are water-soluble, organic compounds that can be purchased in either wet or dry form.

- A. Filter medias
- B. Activated Carbon
- C. Filters
- D. Polymers
- E. Floc
- F. None of the Above

272. When used as a filter aid, the \_\_\_\_\_ strengthens the bonds and prevents the shearing forces in the filter from breaking the floc apart.

- A. Filter media
- B. Lime
- C. Filter
- D. Polymer
- E. Floc
- F. None of the Above

273. Which of the following terms should be added just ahead of the filter?

- A. Filter media
- B. Polymer
- C. Filter
- D. Filter aid
- E. Floc
- F. None of the Above

274. Which of the following terms if too much is added will cause the bonds to become too strong, which may then cause the filter to plug?

- A. Filter media
- B. Polymer
- C. Filter
- D. Filter aid
- E. Floc
- F. None of the Above

### Filter Operating Problems

275. According to the text, there are three major types of filter problems. They can be caused by chemical treatment before the filter, \_\_\_\_\_, and backwashing of filters.

- A. Filter aid
- B. Control of filter flow rate
- C. Filter media process
- D. Turbidity breakthrough
- E. Coagulation and flocculation stages
- F. None of the above

### Chemical Treatment before the Filter

276. The \_\_\_\_\_ of the water treatment must be monitored continuously.

- A. Filter aid
- B. Control of filter flow rate
- C. Filter media process
- D. Turbidity breakthrough
- E. Coagulation and flocculation stages
- F. None of the above

277. Adjustments in the amount of coagulant added must be made frequently to prevent the filter from becoming overloaded, with suspended material. This overload may cause the filter to prematurely reach its \_\_\_\_\_.

- A. Filter aid
- B. Control of filter flow rate
- C. Maximum headloss
- D. Turbidity breakthrough
- E. Coagulation and flocculation stages
- F. None of the above

278. If there is early turbidity breakthrough in the filter effluent, more coagulant may have to be added to the coagulation process.

- A. True
- B. False

279. There may be a need for better mixing during the coagulation or the addition of more?

- A. Filter aid
- B. Control of filter flow rate
- C. Filter media process
- D. Turbidity
- E. Coagulation and flocculation
- F. None of the above

280. If there is a rapid increase in filter head loss, too much coagulant may be clogging the filter.

- A. True
- B. False

### Control of Filter Flow Rate

281. When a filter is subjected to rapid changes in flow rate, the turbidity of the effluent will not be affected; the dirtier the coagulation and flocculation stages, the greater the effect.

- A. True
- B. False

282. According to the text, addition of filter aids may also reduce the impact on the filter effluent.

- A. True
- B. False

283. Backwashing a filter will temporarily take it out of service, the remaining filter(s) must pick up the additional flow, this can cause a change in flow that will cause?

- A. Turbidity breakthrough
- B. Backwash storage basin
- C. Filter media breakthrough
- D. Filter aid breakthrough
- E. Coagulation and flocculation stages
- F. None of the Above

### Hard Water Section

284. Water contains various amounts of \_\_\_\_\_, some of which impart a quality known as hardness.

- A. Water hardness
- B. Carbonate hardness
- C. The calcium-magnesium distinction
- D. Calcium (Ca) and magnesium (Mg)
- E. Dissolved minerals
- F. None of the Above

### Occurrence of Hard Water

285. Hard water is caused by soluble, divalent, \_\_\_\_\_, (positive ions having valence of 2). The principal chemicals that cause water hardness are calcium (Ca) and magnesium (Mg).

- A. Water hardness
- B. Metallic cations
- C. Carbon dioxide (CO<sub>2</sub>)
- D. Calcium (Ca) and magnesium (Mg)
- E. Noncarbonate hardness
- F. None of the Above

### Membrane Filtration Processes

286. In particular, \_\_\_\_\_ enables some water systems having contaminated water sources to meet new, more stringent regulations.

- A. Membrane technology
- B. Macromolecule(s)
- C. Solute(s)
- D. Conventional thermal separation process(es)
- E. Direct filtration
- F. None of the Above

### Description of Membrane Filtration Processes

287. In the simplest \_\_\_\_\_, water is forced through a porous membrane under pressure, while suspended solid, large molecules, or ions are held back or rejected.

- A. The recovery of organic vapor(s)
- B. Fractional distillation
- C. Membrane processes
- D. A selective barrier
- E. Thermal separation method(s)
- F. None of the Above

### Microfiltration

288. The current primary use of MF is by industries to remove very fine particles from process water. In addition, the process has also been used as a pretreatment for \_\_\_\_\_.

- A. Reverse osmosis or RO
- B. Potable water treatment
- C. Other membrane processes
- D. Direct filtration process
- E. Microfiltration or MF
- F. None of the Above

289. RO membranes are susceptible to clogging or filter binding unless the \_\_\_\_\_ being processed is already quite clean.

- A. Process liquid
- B. Chloride and sodium
- C. Total dissolved solids (TDS)
- D. Material
- E. Water
- F. None of the Above

290. Which of the following terms has been proposed as a filtering method for particles resulting from the direct filtration process?

- A. Reverse osmosis or RO
- B. Potable water treatment
- C. Colloids and substances
- D. Direct filtration process
- E. Microfiltration or MF
- F. None of the Above

291. The use of filter aids to improve filtering efficiency, especially for small particles that could contain \_\_\_\_\_ are recommended.

- A. Process liquid
- B. Chloride and sodium
- C. Total dissolved solids (TDS)
- D. Material
- E. Bacterial and protozoan life
- F. None of the Above

### Ultrafiltration

292. The smaller pore size is designed to remove colloids and substances that have larger molecules, which are called \_\_\_\_\_.

- A. Reverse osmosis or RO
- B. Potable water treatment
- C. High-molecular-weight materials
- D. Direct filtration process
- E. Microfiltration or MF
- F. None of the Above

293. UF membranes can be designed to pass material that weigh less than or?

- A. Process liquid
- B. Chloride and sodium
- C. Total dissolved solids (TDS)
- D. Material
- E. Equal to a certain molecular weight
- F. None of the Above

294. Although UF does not generally work well for removal of \_\_\_\_\_, it can be used effectively for removal of most organic chemicals.

- A. Process liquid
- B. Chloride and sodium
- C. Total dissolved solids (TDS)
- D. Material
- E. Salt or dissolved solids
- F. None of the Above

### **Nanofiltration**

295. Nanofiltration (NF) process has been used primarily for water softening and reduction of?

- A. Process liquid
- B. Chloride and sodium
- C. Total dissolved solids (TDS)
- D. Material
- E. Bacterial and protozoan life
- F. None of the Above

296. NF capability will undoubtedly increase the use of \_\_\_\_\_ for potable water treatment.

- A. Reverse osmosis or RO
- B. Potable water treatment
- C. NF
- D. Direct filtration process
- E. Microfiltration or MF
- F. None of the Above

### **Reverse Osmosis**

297. RO membranes have very low pore size that can reject ions at very high rates, including?

- A. Process liquid
- B. Chloride and sodium
- C. Total dissolved solids (TDS)
- D. Material
- E. Bacterial and protozoan life
- F. None of the Above

298. This process works most organic chemicals, and radionuclides and microorganisms.

- A. RO
- B. Potable water treatment
- C. Colloids and substances
- D. Direct filtration process
- E. Microfiltration or MF
- F. None of the Above

### **Microfiltration Specific Process**

299. Microfiltration is a type of physical filtration process where a contaminated fluid is passed through a special pore-sized membrane to separate microorganisms and suspended particles from?

- A. Process liquid
- B. Chloride and sodium
- C. Total dissolved solids (TDS)
- D. Material
- E. Bacterial and protozoan life
- F. None of the Above

300. Which of the following terms works with such as ultrafiltration and reverse osmosis to provide a product stream that is free of undesired contaminants?

- A. Various other separation processes
- B. MF membranes
- C. Ultrafiltration and reverse osmosis
- D. Batch or semi-continuous filtration
- E. Retentate and product streams
- F. None of the Above

301. Microfiltration usually serves as a pre-treatment for other separation processes such as?

- A. Cross flow filtration
- B. Filtration process(es)
- C. Performance of microfiltration
- D. Ultrafiltration
- E. Microfiltration process
- F. None of the Above

### Reverse Osmosis Process Section

302. Osmosis is a natural phenomenon in which a liquid - water in this case - passes through a semi-permeable membrane from a relatively dilute solution toward a more concentrated solution. This flow produces a measurable pressure, called osmotic pressure.

A. True B. False

303. Which of the following is determined by the total dissolved solids content of the saline solution, or contaminated solution on one side of the membrane?

- A. This pressure differential
- B. Osmotic pressure
- C. Higher molecular weights
- D. Virtually 100% of colloidal and suspended matter
- E. Waste (concentrate)
- F. None of the Above

304. The higher the content of dissolved solids, the higher the?

- A. Pressure differential
- B. Osmotic pressure
- C. Higher molecular weights
- D. Virtually 100% of colloidal and suspended matter
- E. Waste (concentrate)
- F. None of the Above

305. Generally speaking, \_\_\_\_\_ result in higher osmotic pressures.

- A. Pressure differential
- B. Osmotic pressure
- C. Higher molecular weights
- D. Colloidal and suspended matter
- E. Waste (concentrate)
- F. None of the Above

306. According to the text, common tap water as found in most areas may have an osmotic pressure of about 10 PSI, or about?

- A. 36,000 PPM
- B. A pressure of 10 PSI
- C. Osmotic pressure(s)
- D. 1.68 Bar
- E. 376 PSI
- F. None of the Above

307. According to the text, Seawater at \_\_\_\_\_ typically has an osmotic pressure of about 376 PSI.

- A. 36,000 PPM
- B. A pressure of 10 PSI
- C. Osmotic pressure(s)
- D. 1.68 Bar
- E. 56 PSI
- F. None of the Above

308. To reach the point at which osmosis stops for tap water, a pressure of 10 PSI would have to be applied to the saline solution, and to stop osmosis in seawater, a pressure of \_\_\_\_\_ would have to be applied to the seawater side of the membrane.

- A. 36,000 PPM
- B. A pressure of 10 PSI
- C. Osmotic pressure(s)
- D. 1.68 Bar
- E. 376 PSI
- F. None of the Above

### Brine Channel

309. Concentrated raw water is called the reject stream or concentrate stream. It may also be called brine if it is coming from a?

- A. Each sheet of membrane material
- B. Microporous support layer
- C. Salt water source
- D. Amount of permeate or product water
- E. Concentrations of TDS
- F. None of the Above

310. Optimum flows and pressures, optimum recovery rates (the \_\_\_\_\_ from a given stream of raw water), prefiltration and other pretreatment considerations, and so forth.

- A. Percentage of permeate
- B. Microporous support layer
- C. Brine channel
- D. Amount of permeate or product water
- E. Concentrations of TDS
- F. None of the Above

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

- A. Chloramine
- B. Liquid Ozone
- C. Ozone
- D. Oxygen and nascent oxygen
- E. O<sub>2</sub>
- F. None of the Above

312. This compound is a light blue gas at room temperature.

- A. Chloramine
- B. Liquid Ozone
- C. Ozone
- D. Oxygen and nascent oxygen
- E. O<sub>2</sub>
- F. None of the Above

313. Ozone has a \_\_\_\_\_ similar to that sometimes noticed during and after heavy electrical storms. In use, ozone breaks down into oxygen and nascent oxygen.

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

314. Ozone does not form chloramines or \_\_\_\_\_, and while it may destroy some THMs, it may produce other byproducts when followed by chlorination.

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

315. Ozone falls into the same category as other disinfectants because it can produce?

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

316. This compound is very unstable and can readily explode. As a result, it is not shipped and must be manufactured on-site.

- A. Chloramine
- B. Liquid Ozone
- C. Ozone
- D. Oxygen and nascent oxygen
- E. O<sub>2</sub>
- F. None of the Above

317. 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 in determining the ozone demand..

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



### Chlorine Section Pathophysiology

318. As far as chlorine safety and respiratory protection, the intermediate \_\_\_\_\_ of chlorine accounts for its effect on the upper airway and the lower respiratory tract.

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

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

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

320. The odor threshold for chlorine is approximately?

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

### Mechanism of Activity

321. 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

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

- A. True
- B. False

### Solubility Effects

323. Which of the following terms is highly soluble in water?

- A. Hydrochloric acid
- B. H<sub>2</sub>SO<sub>4</sub>
- C. Hypochloric acid
- D. Sodium hypochlorite solution
- E. Sulfuric Acid
- F. None of the Above

324. Because it is highly water soluble, Hypochlorous acid has an injury pattern similar to?

- A. Hydrochloric acid
- B. H<sub>2</sub>SO<sub>4</sub>
- C. Hypochloric acid
- D. Sodium hypochlorite solution
- E. Sulfuric Acid
- F. None of the Above

325. Which of the following terms may account for the toxicity of elemental chlorine and hydrochloric acid to the human body?

- A. Hydrochloric acid
- B. H<sub>2</sub>SO<sub>4</sub>
- C. Hypochloric acid
- D. Hypochlorous acid
- E. Sulfuric Acid
- F. None of the Above

### Early Response to Chlorine Gas

326. Chlorine gas, when mixed with ammonia, reacts to form \_\_\_\_\_. In the presence of water, chloramines decompose to ammonia and hypochlorous acid or hydrochloric acid.

- A. Hypochlorous acid
- B. Chlorine gas
- C. Hydrochloric acid
- D. Sulfuric acid
- E. Chloramine gas
- F. None of the Above

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

A. True B. False

### Immediate Effects

328. Which of the following answers is the best choice for the immediate effects of this substance's toxicity include acute inflammation of the conjunctivae, nose, pharynx, larynx, trachea, and bronchi?

- A. Hydrochloric acid
- B. Chlorine gas
- C. Hypochlorous gas
- D. Sulfuric acid
- E. HOCL
- F. None of the Above

### Pathological Findings

329. Chlorine is a highly reactive gas.

A. True B. False

330. According to the text, treatment plants use \_\_\_\_\_ to reduce water levels of microorganisms that can spread disease to humans.

- A. HCl
- B. HOCl
- C. High chlorine concentrations
- D. Chlorine
- E. The hypochlorite ion (OCl<sup>-</sup>)
- F. None of the Above

331. 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.

A. True B. False

332. 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

333. 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.

A. True B. False

### Chemistry of Chlorination

334. The hypochlorite ion is a much weaker disinfecting agent than hypochlorous acid, about 100 times less effective.

A. True B. False

335. According to the text, pH and temperature affect the ratio of hypochlorous acid to hypochlorite ions. As the temperature is decreased, the \_\_\_\_\_ increases.

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

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

A. True B. False

337. Temperature plays a small part in the acid ratio. Although the ratio of \_\_\_\_\_ is greater at lower temperatures, pathogenic organisms are actually harder to kill.

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

338. All other things being equal, \_\_\_\_\_ and a lower pH are more conducive to chlorine disinfection.

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

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

(OCI<sup>-</sup>): HOCl H<sup>+</sup> + OCI<sup>-</sup> Also expressed HOCl → H<sup>+</sup> + OCI<sup>-</sup>  
(hypochlorous acid) (hydrogen) (hypochlorite ion)

- A. True
- B. False

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

- A. True
- B. False

341. 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

342. Which of the following answers is all the chlorine that is available for disinfection?

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

343. Total chlorine residual = free + \_\_\_\_\_.

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

344. In water, there are always other substances such as iron, manganese, turbidity, etc., which will combine chemically with the chlorine, these substances are called the?

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

345. According to the text, what term is much more effective as a disinfecting agent?

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

346. Either a total or a \_\_\_\_\_ can be read when a chlorine residual test is taken,

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

### Residual Concentration/Contact Time (CT) Requirements

347. Since monitoring for very low levels of pathogens in treated water is analytically very difficult, utilizing the \_\_\_\_\_ is recommended to demonstrate satisfactory treatment.

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

348. Which of the following answers = Concentration (mg/L) x Time (minutes)?

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

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

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

350. 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

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

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

352. Which of the following terms must be greater than 1.0 to be acceptable?

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

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

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

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

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

### Introduction to Chlorine (DDBP)

355. These term means that chlorine is present as Cl, HOCl, and  $\text{OCl}^-$  is called \_\_\_\_\_, and that which is bound but still effective is \_\_\_\_\_.

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

356. Chloramines are formed by reactions with?

- A. Acid and  $\text{Cl}_2$
- B. Ammonia and  $\text{Cl}_2$
- C. THMS and  $\text{Cl}_2$
- D. Folic Acid and  $\text{Cl}_2$
- E. THMs and Haploidic acid
- F. None of the Above

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

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

### Chlorine By-Products

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

- A. Chlorate and Chlorite
- B.  $\text{CO}_2$  and  $\text{H}_2\text{SO}_4$
- C. Trihalomethanes (THMs)
- D. Ammonia and THMS
- E. Chloramines
- F. None of the Above

### The Principal Trihalomethanes are:

359. 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

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

- A. True
- B. False

### Health Effects

361. 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

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

- A. Chlorate and Chlorite
- B.  $\text{CO}_2$  and  $\text{H}_2\text{SO}_4$
- C. Trihalomethanes (THMs)
- D. Ammonia and THMS
- E. Chloramines
- F. None of the Above

363. \_\_\_\_\_ 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. 2-part question.

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

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

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

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

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

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

- A. Chlorate and Chlorite
- B. CO<sub>2</sub> and H<sub>2</sub>SO<sub>4</sub>
- C. THMS
- D. Ammonia and THMS
- E. Chloramines
- F. None of the Above

367. 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

### **Chlorination Equipment Requirement Section**

368. A chlorine room is where chlorine gas cylinders and/or ton containers are?

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

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

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

### **Capacity**

370. Which of the following shall have the capacity to dose enough chlorine to overcome the demand and maintain the required concentration of the "free" or "combined" chlorine?

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

**Methods of Control**

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

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

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

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

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

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

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

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

**Standby Provision**

375. As a safeguard against \_\_\_\_\_, standby chlorination equipment having the capacity to replace the largest unit shall be provided.

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

**Weigh Scales**

376. 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.

- A. True B. False

**Securing Cylinders**

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

- A. True B. False

**Chlorine Leak Detection**

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

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

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

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

380. Which of the following related chlorine alarm equipment shall not automatically activate the chlorine room ventilation system in such a manner as to discharge chlorine gas?

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

381. 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

382. 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

383. Chlorine leak detection equipment may not be required for very small chlorine rooms with an exterior door.

- A. True
- B. False

### **Chlorine Room Design Requirements**

384. Where gas chlorination is practiced, the gas cylinders and/or the ton containers up to the vacuum regulators shall be housed in a gas-tight, well illuminated, corrosion resistant and?

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

385. The chlorinator may or may not be located inside?

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

### **Ventilation**

386. Which chlorine safety related equipment term shall have entirely separate exhaust ventilation systems capable of delivering one (1) complete air change per minute during periods of chlorine room occupancy only?

- A. Shut off
- B. The chlorine room
- C. The room
- D. Automatic chlorine leak detection
- E. Chlorine room ventilation system
- F. None of the Above

### **Heating**

387. Chlorine rooms shall have \_\_\_\_\_, if a forced air system is used to heat the building.

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



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

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

**Storage of Chlorine Cylinders**

389. If necessary, \_\_\_\_\_ may be provided to simply store the chlorine gas cylinders, with no connection to the line.

- A. Cylinders or containers
- B. The outside of the room
- C. A separate storage room
- D. Uncontrolled release of spilled gas
- E. Air inlets
- F. None of the Above

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

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

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

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

**Scrubbers**

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

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

**Chlorine Exposure Limits**

393. OSHA PEL?

- A. 10 PPM
- B. 1 PPM
- C. 00.1 PPM
- D. 1,000 PPM
- E. 100 PPM
- F. None of the Above

394. Solid chlorine is about \_\_\_\_\_ times heavier than water and gaseous chlorine is about 2.5 times heavier than air.

- A. 1.5
- B. 1.0
- C. 0.5
- D. 2.5
- E. 3.0
- F. None of the Above

395. Cl<sub>2</sub> IDLH?

- A. 10 PPM
- B. 1 PPM
- C. 00.1 PPM
- D. 1,000 PPM
- E. 100 PPM
- F. None of the Above

396. Cl<sub>2</sub> Fatal Exposure Limit?

- A. 10 PPM
- B. 1 PPM
- C. 00.1 PPM
- D. 1,000 PPM
- E. 100 PPM
- F. None of the Above

397. The current Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL) for chlorine is 10 PPM (3 milligrams per cubic meter (mg/m<sup>3</sup>)) as a ceiling limit. A worker's exposure to chlorine shall at no time exceed this ceiling level.

- A. True
- B. False

398. HOCl and OCl<sup>-</sup>: The OCl<sup>-</sup> 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<sub>2</sub>
- B. Hypochlorous acid, Hypochlorite ion
- C. HOCl<sub>2</sub> and OCl<sub>2</sub>
- D. Combined Available Chlorine, Total
- E. Monochloramine, Cl<sub>2</sub>
- F. None of the Above

399. What is the Atomic number of chlorine?

- A. 17.7
- B. 17
- C. 0.17
- D. 17 PPM
- E. 23
- F. None of the Above

400. \_\_\_\_\_ is the elemental symbol and \_\_\_\_\_ is the chemical formula.

- A. Cl, Cl<sub>2</sub>
- B. Cl<sub>2</sub>, Cl
- C. HOCl and OCl<sup>-</sup>
- D. Chlorine, Cl<sub>2</sub>
- E. Cl<sub>2</sub>, ClH<sub>4</sub>
- F. None of the Above

### **Pump, Motor and Hydraulic Section**

#### **Common Hydraulic Terms**

401. Which of the following definitions is the engineering science pertaining to liquid pressure and flow?

- A. Pressure, Absolute
- B. Pressure
- C. Hydraulics
- D. Hydrokinetics
- E. Pascal's Law
- F. None of the Above

402. Which of the following definitions is the pressure differential above or below ambient atmospheric pressure?

- A. Pressure, Atmospheric
- B. Pressure, Static
- C. Hydraulics
- D. Pressure, Gauge
- E. Pascal's Law
- F. None of the Above

403. Which of the following definitions is height of a column or body of fluid above a given point expressed in linear units?

- A. Head, Friction
- B. Head, static
- C. Head
- D. Hydraulics
- E. Hydrokinetics
- F. None of the Above

404. Which of the following definitions is often used to indicate gauge pressure?

- A. Head, Friction
- B. Head, static
- C. Head
- D. Hydraulics
- E. Hydrokinetics
- F. None of the Above

405. Which of the following definitions is when the pressure is equal to the height times the density of the liquid?

- A. Head, Friction
- B. Head, static
- C. Head
- D. Hydraulics
- E. Hydrokinetics
- F. None of the Above

406. Which of the following definitions is required to overcome the friction at the interior surface of a conductor and between fluid particles in motion?

- A. Head, Friction
- B. Head, static
- C. Head
- D. Hydraulics
- E. Hydrokinetics
- F. None of the Above

407. The head required to overcome the friction at the interior surface of a conductor and between fluid particles in motion is the definition of \_\_\_\_\_.

- A. Head, Friction
- B. Head, static
- C. Head
- D. Hydraulics
- E. Hydrokinetics
- F. None of the Above

408. Which of the following definitions is the engineering science pertaining to the energy of liquid flow and pressure?

- A. Pressure, Absolute
- B. Pressure
- C. Hydraulics
- D. Hydrokinetics
- E. Pascal's Law
- F. None of the Above

409. Which of the following definitions is the pressure applied to a confined fluid at rest is transmitted with equal intensity throughout the fluid?

- A. Pressure, Absolute
- B. Pressure
- C. Hydraulics
- D. Hydrokinetics
- E. Pascal's Law
- F. None of the Above

410. Which of the following definitions is the pressure in a fluid at rest?

- A. Pressure, Atmospheric
- B. Pressure, Static
- C. Hydraulics
- D. Pressure, Gauge
- E. Pascal's Law
- F. None of the Above

### General Pumping Fundamentals

411. According to the text, suction lift is when the level of water to be pumped is below the?

- A. Impeller
- B. Suction
- C. Lift water
- D. Centerline of the pump
- E. Bellows
- F. None of the Above

412. According to the text, the ability of the pump to lift water is the result of a partial vacuum created at the?

- A. Partial vacuum
- B. Suction lift
- C. Center of the pump
- D. Pressure differential
- E. Negative suction head
- F. None of the Above

413. The suction side of pipe should be one diameter smaller than the pump inlet.

- A. True
- B. False

414. The required eccentric reducer should be turned so that the top is flat and the bottom tapered.  
A. True            B. False

**Pump Definitions**

415. Which of the following definitions is a barrier that separates stages of a multi-stage pump?  
A. Gasket                      D. Inter-stage diaphragm  
B. Keyway                      E. Seal  
C. Bearing                      F. None of the Above

416. Which of the following definitions is a rectangular piece of metal that prevents the impeller from rotating on the shaft?  
A. Gasket                      D. Bearing  
B. Key                          E. Seal  
C. Energy                      F. None of the Above

417. Which of the following definitions is the area on the shaft that accepts the key?  
A. Gasket                      D. Inter-stage diaphragm  
B. Keyway                      E. Kinetic energy  
C. Energy                      F. None of the Above

**Pump Categories**

418. The purpose of a pump is to move water and generate the \_\_\_\_\_ we call pressure.  
A. Centrifugal pump(s)            D. Diaphragm pump(s)  
B. Impeller blade(s)            E. Cylindrical pump housing  
C. Delivery force                F. None of the Above

419. Sometimes, pressure is not referred to in pounds per square inch but rather as the equivalent in elevation, called \_\_\_\_\_.  
A. Inward force                D. Center of the impeller  
B. Head                          E. Incompressible fluid  
C. Viscous drag pump        F. None of the Above

420. According to the text, pumps may be classified on the basis of the application they serve.  
A. True            B. False

421. According to the text, all pumps may be divided into two major categories: (1) dynamic and?  
A. Centrifugal                D. Diaphragm  
B. Impeller                    E. Rotary  
C. Displacement              F. None of the Above

**Basic Water Pump**

422. According to the text, the centrifugal pumps work by spinning water around in a circle inside a?  
A. Vortex                        D. Center of the impeller  
B. Cylinder                    E. Cylindrical pump housing  
C. Viscous drag pump        F. None of the Above

423. The pump makes the water spin by pulling it with an impeller.  
A. True            B. False
424. The blades of this impeller project inward from an axle like the arms of a turnstile and, as the impeller spins, the water moves through it.  
A. True            B. False
425. In a centrifugal pump, the water pressure at the edge of the turning impeller rises until it is able to keep water circling with the?  
A. Centrifugal pump(s)            D. Diaphragm pump(s)  
B. Impeller blade(s)            E. Cylindrical pump housing  
C. Bernoulli's equation            F. None of the Above
426. In a centrifugal pump, as water drifts outward between the \_\_\_\_\_ of the pump, it must move faster and faster because its circular path is getting larger and larger.  
A. Centrifugal pump(s)            D. Diaphragm pump(s)  
B. Impeller blade(s)            E. Cylindrical pump housing  
C. Bernoulli's equation            F. None of the Above
427. As the water slows down and its kinetic energy decreases, that water's pressure potential energy increases.  
A. True            B. False
428. As the water spins, the pressure near the outer edge of the pump housing becomes much lower than near the center of the impeller.  
A. True            B. False
429. The impeller blades cause the water to move faster and faster.  
A. True            B. False
430. The impellers may be of either a semi-open or closed type.  
A. True            B. False
431. According to the text, without an inward force, an object will travel in a straight line and will not complete the?  
A. Circle            D. Center of the impeller  
B. Pump pushes            E. Incompressible fluid  
C. Viscous drag pump            F. None of the Above
432. In a centrifugal pump, the inward force is provided by high-pressure water near the outer edge of the?  
A. Centrifugal pump(s)            D. Diaphragm pump(s)  
B. Impeller blade(s)            E. Cylindrical pump housing  
C. Pump housing            F. None of the Above
433. In the operation of the pump, the water at the edge of the \_\_\_\_\_ inward on the water between the impeller blades and makes it possible for that water to travel in a circle.  
A. Inward force            D. Center of the impeller  
B. Pump pushes            E. Incompressible fluid  
C. Viscous drag pump            F. None of the Above

434. In the operation of the pump, when water is actively flowing through the pump, arriving through a hole near the center of the impeller and leaving through a \_\_\_\_\_ near the outer edge of the pump housing.

- A. Centrifugal pump(s)
- B. Impeller blade(s)
- C. Hole
- D. Diaphragm pump(s)
- E. Cylindrical pump housing
- F. None of the Above

**Venturi (Bernoulli's law):**

435. A venturi is a pipe that has a gradual restriction that opens up into a gradual enlargement.

- A. True
- B. False

**Types of Water Pumps**

436. The water production well industry almost exclusively uses Turbine pumps, which are a type of centrifugal pump.

- A. True
- B. False

437. The most common type of water pumps used for municipal and domestic water supplies are?

- A. Axial flow
- B. Submersible
- C. Rotary pump
- D. Turbine pump(s)
- E. Variable displacement pumps
- F. None of the Above

438. Which of the following terms will produce at different rates relative to the amount of pressure or lift the pump is working against?

- A. Variable displacement pump
- B. Drive shaft
- C. Column pipe
- D. Single or multiple bowls
- E. Pump's lifting capacity
- F. None of the Above

439. Impellers are rotated by the pump motor, which provides the \_\_\_\_\_ needed to overcome the pumping head.

- A. Spider bearing(s)
- B. Horsepower
- C. Impeller(s)
- D. Turbine pump(s)
- E. Desired pumping rate
- F. None of the Above

440. The size and number of stages, horsepower of the motor and \_\_\_\_\_ are the key components relating to the pump's lifting capacity.

- A. Pumping head
- B. Drive shaft
- C. Column pipe
- D. Single or multiple bowls
- E. Pump's lifting capacity
- F. None of the Above

441. Which of the following terms are variable displacement pumps that are by far used the most?

- A. Axial flow
- B. Submersible
- C. Rotary pump
- D. Turbine pump(s)
- E. Centrifugal pumps
- F. None of the Above

442. According to the text, the turbine pump utilizes impellers enclosed in single or multiple bowls or stages to?

- A. Lift water
- B. Drive shaft
- C. Column pipe
- D. Single or multiple bowls
- E. Pump's lifting capacity
- F. None of the Above

**Backflow Cross-Connection Section**

**What is backflow? Reverse flow condition**

443. Backflow is the undesirable reversal of flow of nonpotable water or other substances through a \_\_\_\_\_ and into the piping of a public water system or consumer's potable water system.

- A. Backflow
- B. Backpressure
- C. Backsiphonage
- D. Cross-connection
- E. Indirect connection
- F. None of the Above

444. Which of the following terms can occur when there is a stoppage of water supply due to nearby firefighting, a break in a water main?

- A. Backflow
- B. Backpressure
- C. Backsiphonage
- D. Cross-connection
- E. Indirect connection
- F. None of the Above

445. Which of the following terms is when backflow is caused by a downstream pressure that is greater than the upstream or supply pressure in a public water system or consumer's potable water system?

- A. Backflow
- B. Backpressure
- C. Backsiphonage
- D. Cross-connection
- E. Indirect connection
- F. None of the Above

446. Which of the following terms can result from an increase in downstream pressure, a reduction in the potable water supply pressure, or a combination of both?

- A. Backflow
- B. Backpressure
- C. Backsiphonage
- D. Cross-connection
- E. Indirect connection
- F. None of the Above

447. Which of the following terms can have two forms-backpressure and backsiphonage?

- A. Backflow
- B. Backpressure
- C. Backsiphonage
- D. Cross-connection
- E. Indirect connection
- F. None of the Above

448. The basic mechanism for preventing backflow is a mechanical \_\_\_\_\_, which provides a physical barrier to backflow.

- A. High hazard installations
- B. Air gap
- C. Backflow preventer
- D. Backflow
- E. Device or method
- F. None of the Above

449. The principal types of mechanical backflow preventers are the reduced-pressure principle assembly, the \_\_\_\_\_, and the double check valve assembly.

- A. High hazard installations
- B. Air gap
- C. Vacuum breaker
- D. Backflow
- E. Device or method
- F. None of the Above

450. Which of the following terms is a means or mechanism to prevent backflow?

- A. High hazard installations
- B. Air gap
- C. Backflow preventer
- D. Backflow
- E. Device or method
- F. None of the Above

451. According to the text, basic means of preventing backflow is an \_\_\_\_\_, which either eliminates a cross-connection or provides a barrier to backflow.

- A. High hazard installations
- B. Air gap
- C. Backflow preventer
- D. Backflow
- E. Device or method
- F. None of the Above

452. Which of the following terms is any temporary or permanent connection between a public water system or consumer's potable water system and any source or system containing nonpotable water or other substances?

- A. Backflow
- B. Backpressure
- C. Backsiphonage
- D. Cross-connection
- E. Indirect connection
- F. None of the Above

453. Which of the following terms is a form of backflow caused by a negative pressure in a public water system or consumer's potable water system?

- A. Backflow
- B. Backpressure
- C. Backsiphonage
- D. Cross-connection
- E. Indirect connection
- F. None of the Above

454. Which of the following terms can occur whenever the amount of water being used exceeds the amount of water being supplied, such as during water line flushing, firefighting, or breaks in water mains?

- A. Backflow
- B. Backpressure
- C. Backsiphonage
- D. Cross-connection
- E. Reductions
- F. None of the Above

#### **Types of Backflow Prevention Methods and Assemblies**

455. Which of the following terms must either be physically disconnected or have an approved backflow prevention device installed to protect the public water system?

- A. Backflow
- B. Backpressure
- C. Backsiphonage
- D. Cross-connection
- E. Indirect connection
- F. None of the Above

456. The type of device selected for a particular installation depends on several factors.

- A. True
- B. False

457. When the airflow is restricted, such as the case of an air gap located near a wall, the \_\_\_\_\_ separation must be increased.

- A. Open receiving vessel
- B. Backflow preventer
- C. Barrier to backflow
- D. Air gap
- E. Air break
- F. None of the Above

#### **Water Distribution Section System Elements**

458. Distribution mains function is to carry water from the water source or treatment works to users, these are the pipelines that make up the?

- A. Increase water pressure
- B. Distribution tree
- C. Complete gridiron system
- D. Distribution system
- E. Arterial system
- F. None of the Above



459. Arterial mains are interconnected with smaller distribution mains to form a complete gridiron system and are for?

- A. Increasing water pressure
- B. Tree system
- C. Complete gridiron system
- D. Distribution mains of large size
- E. Fire protection
- F. None of the Above

460. Storage reservoirs are structures used to store water and \_\_\_\_\_ the supply or pressure in the distribution system.

- A. Increase water pressure
- B. Equalize
- C. Complete gridiron system
- D. Main line isolation
- E. Provide a reserve pressure
- F. None of the Above

461. Booster stations are used to \_\_\_\_\_ from storage tanks for low-pressure mains.

- A. Increase water pressure
- B. Equalize
- C. Complete gridiron system
- D. Boost flow
- E. Provide a reserve pressure
- F. None of the Above

462. Valves control the flow of water in the distribution system by isolating areas for repair or by?

- A. Increase water pressure
- B. Bypasses
- C. Complete gridiron system
- D. Main line isolation
- E. Regulating system flow or pressure.
- F. None of the Above

463. According to the text, gate valves should be used in the \_\_\_\_\_ for main line isolation.

- A. Increase water pressure
- B. Distribution tree
- C. Complete gridiron system
- D. Distribution system
- E. Arterial system
- F. None of the Above

### **Butterfly Valve**

464. Butterfly valves are rotary type of valves usually found on large transmission lines, and may also have an additional valve beside it known as a \_\_\_\_\_ to prevent water hammer.

- A. Regulator
- B. Bypass
- C. Complete gridiron system
- D. Main line isolation
- E. PRV
- F. None of the Above

### **Water Distribution Valves**

465. One purpose of installing shutoff valves in water mains at various locations within the distribution system is to allow sections of the system to be \_\_\_\_\_ or provide maintenance without significantly curtailing service over large areas.

- A. Feeders as practical
- B. Adjust the pressure
- C. Open or close the valve
- D. Curtail the service
- E. Taken out of service for repairs
- F. None of the Above

466. According to the text, at intersections of distribution mains, the number of valves required is normally one less than the number of?

- A. Ties
- B. Depends
- C. Radiating mains
- D. Throttling purposes
- E. Standardizes
- F. None of the Above

467. All buried small- and medium-sized valves should be installed in the sidewalk.

A. True B. False

468. For large shutoff valves, it may be necessary to surround the valve operator or entire valve within a vault or manhole to allow?

A. Principally D. Minimum flow restriction  
B. Dependability E. Stops or allows  
C. Repair or replacement F. None of the Above

### Gate Valves

469. In the distribution system, gate valves are used when a straight-line flow of fluid and?

A. Principally D. Minimum flow restriction  
B. Dependability E. Stops or allows  
C. Repair or replacement F. None of the Above

470. In the distribution system, or on a residential job, gate valves are so-named because the part that either \_\_\_\_\_ flow through the valve acts somewhat like a gate.

A. Fully drawn up D. Minimum flow restriction  
B. Dependability E. Stops or allows  
C. Repair or replacement F. None of the Above

471. If the valve is wide open, the gate is \_\_\_\_\_ into the valve bonnet.

A. Fully drawn up D. Minimum flow restriction  
B. Dependable E. Stops or allows  
C. Repair or replacement F. None of the Above

472. Gate valves are not suitable for?

A. Copper lines D. Throttling purposes  
B. Dependability E. Pressure drops  
C. PRV F. None of the Above

473. The control of flow is easy because of the gate valve's design.

A. True B. False

### Ball Valves

474. Most ball valves require only a 180-degree turn to either completely open or close the valve.

A. True B. False

475. According to the text, some ball valves are operated by planetary gears.

A. True B. False

476. Ball valves should be either fully-on or fully-off, some ball valves also contain a swing check located within the ball to give the valve a check valve feature.

A. True B. False

### Valve Exercising

477. Valve exercising should be done to locate inoperable due to freezing or build-up of rust or corrosion and done once per year to detect \_\_\_\_\_ and to prevent valves from becoming

- A. Malfunctioning valves
- B. Dependability
- C. Repair or replacement
- D. Minimum flow restriction
- E. Stops or allows
- F. None of the Above

478. A valve inspection should include drawing valve location maps to show distances to the \_\_\_\_\_ from specific reference.

- A. Valve(s)
- B. Stoneline
- C. Monument
- D. House
- E. Telephone pole
- F. None of the Above

479. Service connections are used to \_\_\_\_\_ or other plumbing systems to the distribution system mains.

- A. Be isolated
- B. Connect individual buildings
- C. By laying out
- D. Limits the expansion
- E. Decreases in size
- F. None of the Above

### If Excessive Torque is Needed to Work the Valve

480. One cause of a valve failing to open are variations in the temperature and/or pressure of the?

- A. High pressure side
- B. Working fluid
- C. Closing torque applied
- D. Valve sealing surfaces
- E. Length of exposure
- F. None of the Above

481. Depending on the seat and wedge material, \_\_\_\_\_ and closing torque applied, thermal binding can occur in high temperature situations.

- A. High pressure side
- B. Working fluid
- C. Closing torque applied
- D. Valve sealing surfaces
- E. Length of exposure
- F. None of the Above

482. Over-pressurization is when a valve can \_\_\_\_\_ when high pressure enters the cavity and has no way to escape.

- A. Over-pressurization
- B. Positive pressure differential
- C. Lock in the closed position
- D. Lock in the open position
- E. Break
- F. None of the Above

483. According to the text, a single direction sealing gate valve has a nameplate on the side of the valve that has a relief hole or pressure equalizer.

- A. True
- B. False

484. Tuberculation corrosion is caused by chemical changes produced by?

- A. Closed position
- B. Hard water
- C. Chemical changes
- D. Electricity or electrolysis
- E. Positive pressure differential
- F. None of the Above

485. Corrosion will increase the C-Factor and the carrying capacity in a pipe.

- A. True
- B. False

**Knife Gate Valve**

486. Install the Knife Gate valve so that the arrows on both sides of the body are in the direction of?
- A. Positive pressure differential
  - B. Handwheel pointing up
  - C. Connect individual buildings
  - D. Direction of the service
  - E. Bonnet
  - F. None of the Above

**Common Rotary Valves**

487. Globe valve, a rotary valve is rare to find in most distribution systems, but can be found at treatment plants.
- A. True
  - B. False
488. Most Globes have compact OS & Y type, bolted bonnet, rising stems, with renewable seat rings.
- A. True
  - B. False

**System Layouts**

**Tree System**

489. Newer water systems are frequently expanded with planning and developed into a tree-like system.
- A. True
  - B. False
490. The Tree system consists of a single main that \_\_\_\_\_ as it leaves the source and progresses through the area originally served.
- A. Be isolated
  - B. Connect individual buildings
  - C. By laying out
  - D. Limits the expansion
  - E. Decreases in size
  - F. None of the Above
491. Smaller pipelines \_\_\_\_\_ the main and divide again, much like the trunk and branches of a tree.
- A. Branch off
  - B. Are manifolded to
  - C. Connect
  - D. Limit the expansion
  - E. Decrease
  - F. None of the Above
492. According to the text, there are several advantages gained by laying out water mains in a loop or grid, with feeder and distributor mains interconnecting at roadway intersections and other regular intervals.
- A. True
  - B. False

**Friction Loss**

493. The damaged section can be isolated and the remainder of the system will still carry pressure, water will not be distributed if a single section fails.
- A. True
  - B. False
494. During periods of peak fire flow demand, there will be less impact from \_\_\_\_\_ in water mains as the velocity within any given section of main.
- A. Carrying capacity
  - B. Friction loss
  - C. Pressure
  - D. Static pressure
  - E. Total pressure
  - F. None of the Above

### Types of Pipes Used in the Water Distribution Field

495. Plastic pipe has seen extensive use available in different lengths and sizes; it is lighter than steel or copper and requires no special tools to install.

- A. True            B. False

496. Plastic pipe has complete resistance to corrosion; and, in addition, it can be installed aboveground or below ground, has several advantages over metal pipe: it is flexible; it has superior resistance to?

- A. Ease of installation            D. Rupture from freezing  
B. An excellent combination    E. Complete resistance to corrosion  
C. Chemical resistance            F. None of the Above

497. PVC pipes are made of tough, strong thermoplastic material that has \_\_\_\_\_ of physical and chemical properties.

- A. Ease of installation            D. Array  
B. An excellent combination    E. Complete resistance to corrosion  
C. Chemical resistance            F. None of the Above

498. PVC's chemical resistance and \_\_\_\_\_ make it an excellent material for application in various mechanical systems.

- A. Ease of installation            D. Design strength  
B. Greater resistance            E. Complete resistance to corrosion  
C. Chemical resistance            F. None of the Above

499. According to the text, often polyvinyl chloride is further chlorinated to obtain a stiffer design, a higher level of impact resistance, and a \_\_\_\_\_ to extremes of temperature.

- A. Ease of installation            D. Design strength  
B. Greater resistance            E. Complete resistance to corrosion  
C. Chemical resistance            F. None of the Above

500. A CPVC pipe can be used only in cold-water systems with temperatures up to 110°F.

- A. True            B. False