

**Registration form**

**WATER TREATMENT FUNDAMENTALS \$200.00**  
**48 HOUR RUSH ORDER PROCESSING FEE ADDITIONAL \$50.00**  
*We will match any other price if you can find equivalent course for less.*

**Start and Finish Dates:** \_\_\_\_\_

*You will have 90 days from this date in order to complete this course*

Please record amount of hours worked on assignment, must match state requirement \_\_\_\_\_

**Name** \_\_\_\_\_ **Signature** \_\_\_\_\_

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

**Address** \_\_\_\_\_

**City** \_\_\_\_\_ **State** \_\_\_\_\_ **Zip** \_\_\_\_\_

**Email** \_\_\_\_\_ **Fax (\_\_\_\_)** \_\_\_\_\_

**Phone:**  
**Home (\_\_\_\_)** \_\_\_\_\_ **Work (\_\_\_\_)** \_\_\_\_\_

**Operator ID #** \_\_\_\_\_ **Exp. Date** \_\_\_\_\_

*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 e-mail address. We will e-mail the certificate to you, if no e-mail address; we will mail it to you.***

## **DISCLAIMER NOTICE**

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

**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.

## **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.

**Do not solely depend on TLC's Approval list for it may be outdated.**

**A second certificate of completion for a second State Agency \$50 processing fee.**

**Many States and employers require the final exam to be proctored.**

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

**Texas Students Only**  
**Acknowledgement of Notice of Potential Ineligibility for License**  
*You are required to sign and return to TLC or your credit will not be reported.*

Name: \_\_\_\_\_

Date of Birth: \_\_\_\_\_

Email Address: \_\_\_\_\_

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

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

Enrollee Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Name of Training Provider/Organization: Technical Learning College

Contact Person: Melissa Durbin      Role/Title: Dean



# Water Treatment Fun 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 \_\_\_\_\_

Did you receive the approval number if Applicable? \_\_\_\_\_

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

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

**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.**

**You can electronically complete this assignment in Adobe Acrobat DC.**

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

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**Additional certificate for another Agency – additional fee \$50**

**Please fax the answer key to TLC Western Campus Fax (928) 272-0747**

**Always call us after faxing the paperwork to ensure that we've received it.**

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

**WATER TREATMENT FUNDAMENTALS CEU 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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*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.

## Water Treatment Fundamentals CEU Course Assignment

*The Assignment (Exam) is also available in Word on the Internet for your Convenience, please visit [www.ABCTLIC.com](http://www.ABCTLIC.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 manual and make copy for yourself. You can e-mail or fax your Answer Key along with the Registration Form to TLC. **(S) Means answer may be plural or singular**

### Chlorination Equipment Requirement Section

- Chlorine gas under pressure shall not be permitted outside the chlorine room. A chlorine room is where chlorine gas cylinders and/or ton containers are?  
A. Under pressure      D. At the point of solution application  
B. In this stage      E. Dosing enough chlorine  
C. Stored      F. None of the Above
- Which of the following shall also be located inside the chlorine room?  
A. Gas vacuum line      D. Mechanical gas proportioning equipment  
B. Vacuum regulators      E. Injectors  
C. Manual chlorine feed systems      F. None of the Above
- Which is the mechanical gas proportioning equipment that may or may not be located inside the chlorine room?  
A. Gas vacuum line      D. The chlorinator  
B. Vacuum regulators      E. Injectors  
C. Manual chlorine feed systems      F. None of the Above
- Which of the following should be located to minimize the length of pressurized chlorine solution lines?  
A. Gas vacuum line      D. Mechanical gas proportioning equipment  
B. Vacuum regulators      E. Injectors  
C. Manual chlorine feed systems      F. None of the Above
- Which of the following shall be included in the gas vacuum line between the vacuum regulator(s) and the chlorinator(s) to ensure that pressurized chlorine gas does not enter the gas vacuum lines leaving the chlorine room?  
A. Gas vacuum line      D. Mechanical gas proportioning equipment  
B. A gas pressure relief system      E. Post chlorination  
C. Manual chlorine feed systems      F. None of the Above

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

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

7. Anti-siphon valves shall be incorporated in the \_\_\_\_\_ or in the discharge piping.

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

### Capacity

8. 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

9. 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

### Standby Provision

10. 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

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

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

### Weigh Scales

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

- A. True
- B. False

### Securing Cylinders

13. 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

14. 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

15. 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

### Chlorine Room Design Requirements

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

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

### Ventilation

17. Which chlorine safety related equipment term should be outside the room at all entrance or viewing points, and a clear wire-reinforced glass window shall be installed in such a manner as to allow the operator to inspect from the outside of the room?

- A. Gas chlorine room
- B. The chlorine room
- C. Chlorine room ventilation system
- D. Automatic chlorine leak detection
- E. Separate switches for fans and lights
- F. None of the Above

### Storage of Chlorine Cylinders

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

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

### Scrubbers

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

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

### Chlorine's Gas Appearance and Odor

20. Chlorine is a greenish-yellow gas it will condense to an amber liquid at approximately \_\_\_\_\_ F or at high pressures.

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

21. Prolonged exposures to chlorine gas may result in?

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

### Reactivity

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

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

### Chlorine Exposure Limits

23. OSHA's PEL?

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

24. This can be readily compressed into a clear, amber-colored liquid, a \_\_\_\_\_, and a strong oxidizer.

- A. Cl<sub>2</sub>
- B. Cl
- C. HOCl and OCl<sup>-</sup>
- D. Combined Available Chlorine
- E. Noncombustible gas
- F. None of the Above

25. 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

26. 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

27. Which of the following terms when added to water, rapidly hydrolyzes, the chemical equations best describe this reaction is Cl<sub>2</sub> + H<sub>2</sub>O --> H<sup>+</sup> + Cl<sup>-</sup> + HOCl?

- A. Chlorine gas
- B. Cl
- C. HOCl and OCl<sup>-</sup>
- D. Combined Available Chlorine
- E. Monochloramine
- F. None of the Above

28. \_\_\_\_\_ 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



### Chlorine Gas Mechanism of Activity

29. The mechanisms of cellular injury are believed to result from the oxidation of functional groups in cell components, from reactions with tissue water to form \_\_\_\_\_, and from the generation of free oxygen radicals.

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

30. 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

### Early Response to Chlorine Gas

31. 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

32. 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

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

- A. True
- B. False

### Exposure

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

- A. True
- B. False

### Routes of Exposure Inhalation

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

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

### Chemistry of Chlorination

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

- A. True      B. False

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

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

38. 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

39. \_\_\_\_\_ is all chlorine that is available for disinfection.

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

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

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

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

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

42. Once chlorine molecules are combined with these interfering agents, they are not capable of disinfection. It is \_\_\_\_\_ that is much more effective as a disinfecting agent.

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

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

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

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

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

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

### Calculation and Reporting of CT Data

45. 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

46. 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

### Chlorine (DDBP)

#### Introduction to Chlorine (DDBP)

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

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

48. A typical chlorine residual is 2 ppm for which type of chlorine residual?

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

### Chlorine By-Products

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

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

### The Principal Trihalomethanes are:

50. 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

51. 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

52. 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

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

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

54. 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

55. 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

### Safe Drinking Water Act Terms Chapter 3

56. Which of the following bugs is a protozoan associated with the disease cryptosporidiosis in humans?

- A. Giardia lamblia
- B. Water bear
- C. Cryptosporidium
- D. Hypoxia
- E. None of the above

57. 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

### National Drinking Water Regulations

#### Contaminant Selection

58. P.L. 104-182 establishes a new process for the EPA to select contaminants for regulatory consideration based on occurrence, health effects, and meaningful opportunity for health risk reduction.

- A. True
- B. False

59. P.L. 104-182 directs the EPA to evaluate contaminants that present the greatest health concern and to regulate contaminants that occur at concentration levels and frequencies of public health concern.

- A. True
- B. False

#### Standard Setting

60. For each contaminant that the EPA has determined merits regulation, the EPA must set a non-enforceable action level at a level at which no known or anticipated recommended health effects occur, and which allows an adequate margin of safety.

- A. True
- B. False

61. The primary enforcement responsibility for public water systems lies with the states, provided they adopt regulations as stringent as the national requirements, adopt authority for administrative penalties, develop adequate procedures for enforcement, maintain records, and create a plan for providing emergency water supplies.

- A. True      B. False

### Water Quality Key Words

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

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

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

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

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

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

### SDWA Water Quality Information and MCLs Radionuclides

67. 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      D. Aluminum  
B. Fluoride      E. Arsenic  
C. Copper      F. None of the Above

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

69. 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

70. 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

71. 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

### Microbial Regulations

72. Which rule specifies treatment criteria to assure that these performance requirements are met; they include turbidity limits, disinfectant residual, and disinfectant contact time conditions?

- A. Long Term 1 Rule
- B. Maximum Contaminant Level Goal (MCLG)
- C. Stage 1 Byproducts Rule
- D. Surface Water Treatment Rule
- E. Interim Enhanced Surface Water
- F. None of the Above

73. The \_\_\_\_\_ was established in December 1998 to control Cryptosporidium, and to maintain control of pathogens while systems lower disinfection byproduct levels to comply with the Stage 1 Disinfectants/Disinfection Byproducts.

- A. Long Term 1 Enhanced Surface Water Treatment Rule
- B. Maximum Contaminant Level Goal (MCLG)
- C. Stage 1 Disinfectants/Disinfection Byproducts Rule
- D. Surface Water Treatment Rule
- E. Interim Enhanced Surface Water Treatment Rule
- F. None of the Above

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

- A. True
- B. False

75. Color is an indicator of the physical removal of particulates, including pathogens.

- A. True
- B. False

76. Which rule improves physical removal of Cryptosporidium, and to maintain control of pathogens?

- A. Long Term 1 Enhanced Surface Water Treatment Rule
- B. Maximum Contaminant Level Goal (MCLG)
- C. Stage 1 Disinfectants/Disinfection Byproducts Rule
- D. Surface Water Treatment Rule
- E. Interim Enhanced Surface Water Treatment Rule

## **Bromate**

77. Fill in the missing information in order. \_\_\_\_\_ is a chemical that is formed when \_\_\_\_\_ used to disinfect drinking water reacts with naturally occurring \_\_\_\_\_ found in source water.
- A. Bromate, Ozone, Chlorite
  - B. Bromide, Bromate, Ozone
  - C. Bromate, Bromate, Bromate
  - D. Hydrogen sulfide, Water, Nitrogen
  - E. Bromate, Ozone, Bromide
  - F. None of the Above

## **Chlorite**

78. According to the Stage 1 Disinfectants/Disinfection Byproducts Rule, what is the monthly average level of chlorite in drinking water?
- A. 1 part per million
  - B. 10 parts per billion
  - C. 100 parts per billion
  - D. 10 parts per million
  - E. 500 parts per million
  - F. None of the Above

## **Chapter 4**

### **Bacteriological Monitoring Section**

79. 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
80. 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
81. 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**

82. Water samples for \_\_\_\_\_ must always be collected in a sterile container.
- A. Indicator bacteria
  - B. Bacteria tests
  - C. Contamination
  - D. Microbiological analysis
  - E. Presence of an indicator
  - F. None of the Above
83. 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. Mailing Indicator bacteria is not recommended because laboratory analysis results are not as reliable.
- A. True
  - B. False
84. 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

85. 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

86. 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

87. 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

88. 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

89. 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:

90. 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

91. If a \_\_\_\_\_ is 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:**

92. 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

93. 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

94. 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

95. 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

**Sampling Procedures**

96. Which term 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

97. 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

98. 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**

99. 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

100. 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

### **New EPA Rules**

#### **Arsenic**

101. 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

102. 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

103. 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. Lead
- E. Radon
- F. None of the Above

#### **ICR**

104. 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

105. 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 (disinfection byproducts (DBPs)); disease-causing microorganisms (pathogens), including Cryptosporidium; and engineering data to control these contaminants.

- A. True
- B. False

#### **Repeat Sampling (1 Example)**

106. Samples should be taken elsewhere in the \_\_\_\_\_ or at the wellhead, if necessary.

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

107. In a very small system if the system has only \_\_\_\_\_, the repeat samples must be collected from the same sampling location over a four-day period or on the same day.

- A. Routine water
- B. Surface water
- C. One sampling location
- D. One service connection
- E. MCL compliance zone
- F. None of the Above

108. If a repeat sample is necessary, all repeat samples are included in the?

- A. Routine sample
- B. Surface water
- C. Original sampling location
- D. Sample
- E. MCL compliance calculation
- F. None of the Above

### Positive or Coliform Present Results

109. Hopefully 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

### Some examples of typical corrective measures to coliform problems are:

110. Shock chlorination of a ground water well. The recommended dose of 5% household bleach is 2 cups per 100 gallons of water in the well. This should be done anytime the well is opened for repair (pump replacement, etc.). If you plan to \_\_\_\_\_, calculate the total gallonage of storage and distribution.

- A. Shock the entire system
- B. Repeat sampling immediately
- C. Drink the water
- D. Perform routine cleaning
- E. Perform corrective measures
- F. None of the Above

111. Which term is to meet current construction standards as set by your state environmental or health agency?

- A. Install storage tanks
- B. Repeat sampling immediately
- C. Upgrade the wellhead area
- D. Perform routine cleaning
- E. Install air gaps
- F. None of the Above

112. If you \_\_\_\_\_, review your operation and be sure to maintain a detectable residual (0.2 mg/l free chlorine) at all times in the distribution system.

- A. Break out
- B. Repeat sampling
- C. Upgrade the wellhead area
- D. Continuously chlorinate
- E. Corrective measures
- F. None of the Above

### Maximum Contaminant Levels (MCLs)

113. When you as the operator take samples to ensure your water is in compliance with the MCL, there are two types of \_\_\_\_\_ for coliform bacteria.

- A. Coliform bacteria
- B. MCLs
- C. Standards
- D. MCL violations
- E. CFU
- F. None of the Above

114. The first \_\_\_\_\_ for coliform bacteria is for total coliform; the second is an acute risk to health violation characterized by the confirmed presence of fecal coliform or E. coli.

- A. Coliform bacteria
- B. MCLs
- C. Standards
- D. MCL violations
- E. CFU
- F. None of the Above

### **Heterotrophic Plate Count HPC**

115. Heterotrophic Plate Count (HPC) --- formerly known as the standard plate count, is a procedure for estimating the number of live heterotrophic bacteria and measuring changes during water treatment and distribution in water or in swimming pools.

A. True B. False

### **Spread Plate Method**

116. 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

### **Membrane Filter Method**

117. 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)**

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

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

### **Total Coliforms**

119. For systems which collect which amount of or more samples per month, no more than five (5) percent may be Positive, check with your state drinking water section or health department for further instructions?

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

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

120. 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

121. 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

122. 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

123. 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

### Protozoan Diseases

124. \_\_\_\_\_ are larger than bacteria and viruses but still microscopic. They invade and inhabit the gastrointestinal tract.

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

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

- A. Lamblia
- B. Shell
- C. Case
- D. Cyst
- E. Infection
- F. None of the Above

126. Which of the following terms can survive in the environment for long periods of time and is extremely resistant to conventional disinfectants such as chlorine?

- A. HIV
- B. Symptoms
- C. Infection
- D. Hepatitis A cyst
- E. Cyst
- F. None of the Above

127. Which of the following terms is a commonly reported protozoan-caused disease, it has been referred to as backpacker's disease?

- A. Giardia lamblia
- B. Giardiasis
- C. Malaise
- D. Cryptosporidiosis
- E. Anti-water Infection
- F. None of the Above

### Giardia lamblia

128. 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**

129. 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

130. All of these diseases, with the exception of which 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

131. 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

### **General Contaminant Information**

#### **Contaminants that may be present in sources of drinking water include:**

132. 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

133. 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

134. 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

135. Which of the following terms, such as salts and metals, which can be naturally occurring or result from urban stormwater runoff, industrial or domestic wastewater discharges, oil and gas production, mining or farming?

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

136. Which of the following terms may come from a variety of sources such as agriculture, urban stormwater run-off and residential uses?
- A. Viruses and bacteria
  - B. Pesticides and herbicides
  - C. Radioactive contaminants
  - D. Inorganic contaminants
  - E. Organic chemical contaminants
  - F. None of the Above

### Background

137. Coliform bacteria and chlorine residual are the only routine sampling and monitoring requirements for small ground water systems with chlorination.  
A. True B. False

138. 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

139. 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

### Safe Drinking Water Act (SDWA) Review

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

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

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

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

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

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

145. Through the Surface Water Treatment Rule (SWTR), EPA has set treatment requirements to control microbiological contaminants in public water systems using surface water sources (and ground-water sources under the direct influence of surface water).  
A. True B. False

146. Treatment must remove or inactivate at least 99.9% of Giardia lamblia cysts and 99.99% of viruses.

A. True B. False

147. All systems must disinfect, and are not required to filter if certain source water quality criteria and site-specific criteria are met.

A. True B. False

148. The regulations set guidelines for determining if treatment, including turbidity (suspended particulate matter) removal and disinfection recommendations, is adequate for filtered systems.

A. True B. False

### **Water Disinfection Methods Technical Review**

#### **Water Disinfection Methods Review**

149. Water systems add \_\_\_\_\_ to destroy microorganisms that can cause disease in humans.

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

150. S.W.T.R. requires public water systems to disinfect water obtained from surface water supplies or groundwater sources under the influence of?

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

151. The following primary methods of disinfection are chlorination, chloramines, ozone, and ultraviolet light, other disinfection methods include chlorine dioxide?

- A. Alkalinity and pH
- B. Hydrogen peroxide
- C. Hypochlorous acid
- D. Oxidizing and biocidal properties
- E. Potassium permanganate, and nanofiltration
- F. None of the Above

152. Since certain forms of chlorine react with \_\_\_\_\_ naturally present in many water sources to form harmful chemical by-products.

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

### **Physical Methods**

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

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



### Chemical Methods

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

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

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

- A. Ammonia
- B. Sodium chlorite ( $\text{NaClO}_2$ )
- C. Hydrochlorous acid
- D.  $\text{NaOCl}$  and  $\text{HCl}$  in place of chlorine gas
- E. Ozone
- F. None of the Above

156. Ozonation enhances the \_\_\_\_\_ despite its inherent weakness in leaving practically no residual in the distribution system.

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

### Chlorination and Dechlorination

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

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

### pH Scale

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

- A. True
- B. False

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

- A. True
- B. False

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

- A. True
- B. False

### Technical Conclusion

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

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

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

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

### Salmonella Typhi

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

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

164. Prevention strategies for which pathogen include source protection, halogenation of water, and?

- A. Adding chlorine
- B. Adding sodium chlorite
- C. Adding KNO<sub>4</sub>
- D. Adding NH<sub>4</sub>
- E. Boiling water for one minute
- F. None of the Above

### Shigella Species

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

- A. True
- B. False

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

- A. True
- B. False

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

- A. True
- B. False

### Legionella

168. Legionnaire's disease, which causes a severe pneumonia, and the second, \_\_\_\_\_, which is a non-pneumonia illness; it's typically an influenza-like illness, and it's less severe.

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

169. Which pathogen is naturally found in water, both natural and artificial water sources?

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

170. Legionella, prevention. Legionella in water systems. Hot water in tanks should be maintained between \_\_\_\_\_ degrees Centigrade.

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

### **Pseudomonas**

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

A. True B. False

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

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

173. Proper maintenance and disinfection of recreational water systems is important in preventing?

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

### **Hepatitis A**

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

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

### **Hepatitis A, Prevention**

175. Hepatitis A virus is resistant to combined chlorines, so it is important to have an adequate free chlorine residual. Fecal matter can shield \_\_\_\_\_ from chlorine.

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

### **Norovirus**

176. Humans are the reservoir for the Norovirus. Prevention strategies for this pathogen include?

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

### **Cryptosporidium**

177. Cryptosporidium causes diarrheal illness known as?

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

178. Cryptosporidium is typically associated with animals and humans, and it can be acquired through consuming fecally contaminated food, contact with fecally contaminated soil and water.

A. True B. False

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

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

180. Filtration with an "absolute" pore size of one micron or smaller can eliminate \_\_\_\_\_.

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

### Giardia

181. Giardia prevention strategies for this pathogen include \_\_\_\_\_; filtration, coagulation, and halogenation of drinking water.

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

### Schistosomatidae

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

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

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

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

### E-Coli Section

184. Escherichia coli. There are several pathogenic strains of Escherichia coli, which are classified under enterovirulent E. coli. They are enterohemorrhagic, enteroinvasive, enterotoxigenic, enteropathogenic, and enteroaggregative.

- A. True
- B. False

185. Escherichia coli. In its most severe form, it can cause?

- A. Hemorrhagic colitis
- B. Escherichia coli O157:H7
- C. Beaver fever
- D. Pseudomonas
- E. Salmonellosis
- F. None of the Above

186. Prevention strategies for E. coli O157:H7 include \_\_\_\_\_, halogenation of water, or boiling water for one minute.

- A. Primary protection
- B. Source protection
- C. Sodium chlorite
- D. Eliminating snails with a molluscicide
- E. Backflow prevention
- F. None of the Above

187. What is the bacterial disease caused by the Salmonella species that causes diarrheal illness?

- A. Beaver fever
- B. Escherichia coli O157:H7
- C. Bacteria
- D. Pseudomonas
- E. Salmonellosis
- F. None of the Above

188. Prevention strategies for Salmonella include source protection, halogenation of water, and also?

- A. KNMO<sub>4</sub>
- B. Source protection
- C. Chlorine dioxide
- D. Eliminating snails with a molluscicide
- E. Boiling water for one minute
- F. None of the Above

### Disinfection Rule Technical Summary

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

- A. True
- B. False

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

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

191. Oxidation reactions, where chlorine oxidizes \_\_\_\_\_ present in water.

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

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

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

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

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

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

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

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

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

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

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

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

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

198. Which of the following rules require EPA to develop rules to balance the risks between microbial pathogens and disinfection byproducts?

- A. Amendments to the SDWA in 1996
- B. Disinfectants
- C. SDWA in 1996
- D. Stage 1 Byproduct Rule
- E. The LT2 requirements
- F. None of the Above

199. The Stage 1 Disinfectants and Disinfection Byproducts Rule and \_\_\_\_\_, announced in December 1998, are the first of a set of rules under the 1996 SDWA Amendments.

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

### Public Health Concerns

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

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

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

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

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

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

203. Which of the following rules and Disinfection Byproducts Rule applies to all community and nontransient non-community water systems that treat their water with a chemical disinfectant?  
A. Groundwater Rule (GWR) D. Long Term 2 Enhanced Surface Water Treatment Rule B. The Stage 1 Disinfectants E. Interim Enhanced Surface Water Treatment Rule  
C. SDWA in 1996 F. None of the Above

204. Which of the following rules and Disinfection Byproduct Rule updates and supersedes the 1979 regulations for total trihalomethanes?  
A. DBPs D. Stage 1 Disinfectant and Disinfection Byproduct Rule  
B. The Stage 1 Disinfectant E. The LT2 requirements  
C. SDWA in 1996 F. None of the Above

### Stage 2 DBP Rule Federal Register Notices

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

206. 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 D. UV source  
B. The open-channel system E. UV radiation  
C. UV rather than ozone F. None of the Above

207. Which of the following rules has been highly effective in protecting public health and has evolved to respond to new and emerging threats to safe drinking water?  
A. Stage 2 DBPR D. Long Term 2 Enhanced Surface Water Treatment Rule  
B. DBP exposure E. Safe Drinking Water Act (SDWA)  
C. The Stage 2 DBP rule F. None of the Above

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

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

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

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

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

212. Which of the following terms strengthens public health protection for customers by tightening compliance monitoring requirements for two groups of DBPs, trihalomethanes and haloacetic acids?

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

213. 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

214. Which of the following rules is being promulgated simultaneously with the Long Term 2 Enhanced Surface Water Treatment Rule to address concerns about risk tradeoffs between pathogens and DBPs?

- A. Major public health advances
- 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

**What does the rule require?**

215. Under which rule, systems will conduct an evaluation of their distribution systems, known as an Initial Distribution System Evaluation?

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

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

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

217. Which of the following rules also requires each system to determine if they have exceeded an operational evaluation level, which is identified using their compliance monitoring results?

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



**Who must comply with the rule?**

218. Entities potentially regulated by which missing term are community and nontransient noncommunity water systems that produce and/or deliver water that is treated with a primary or residual disinfectant other than ultraviolet light?

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

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

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

**Water Treatment Section Chapter 5**

**Preliminary Treatment**

220. Weeds, leaves, and trash, if not removed, these 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

221. 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

222. 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**

223. 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

**Flights and Chains**

224. 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

**Circular Clarifiers**

225. The most common type of circular clarifier has a center pier or column.

- A. True
- B. False

226. The \_\_\_\_\_ process uses alum and cationic polymer to neutralize the charge.  
A. Filtration                      D. Flocculation  
B. Reconditioning                E. Conventional  
C. Purification                    F. None of the Above

227. 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

228. \_\_\_\_\_ 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

229. Which of the following systems use graded silica sand filter media?  
A. Conventional technology    D. All of the above except C  
B. Reconditioning cycle        E. Chemical pretreatment  
C. Membranes                    F. None of the Above

230. Filtration occurs only within the last few inches of the courser materials at the bottom of the bed.  
A. True B. False

231. The media becomes progressively finer and denser in the lower layers.  
A. True B. False

232. Which of the following terms may increase filtered water clarity, measured in NTU, by 90% compared with filtration alone?  
A. Conventional technology    D. Fast rinse  
B. Reconditioning cycle        E. Chemical pretreatment  
C. Traditional                    F. None of the Above

233. According to the text, if an operator is present to make adjustments for variations in the Sedimentation process, clarity improvements in the range of 93 to 95% are achievable.  
A. True B. False

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

234. 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

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

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

236. The rapid sand filtration process employs a combination of \_\_\_\_\_ in order to achieve maximum effectiveness.

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

### Coagulation

237. 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

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

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

239. 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

240. Aluminum sulfate is also excellent for removing nutrients such as phosphorous in wastewater treatment.

- A. True
- B. False

241. Fine particles must be coagulated, or "stuck together" to form larger particles which 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

242. 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

243. 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

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

A. True B. False

### Flocculation

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

A. True B. False

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

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

### Pre-Sedimentation

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

### Sedimentation

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

A. True B. False

249. 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      D. Rapid Sand filtration  
B. Flocculation                      E. Chemical pretreatment  
C. Sedimentation process      F. None of the Above

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

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

### Filtration

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

A. True B. False

252. 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

253. \_\_\_\_\_ are made of fabric, paper, or plastic material.

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

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

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

255. 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

256. 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

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

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

258. 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
- B. Cartridge filters
- C. Anthracite coal
- D. Rapid-sand filters
- E. Granular synthetic material
- F. None of the Above

### Declining Rate Filters

259. 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

260. 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

261. 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

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

A. True B. False

263. Chlorine is added again after filtration for?

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

### Jar Testing

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

A. True B. False

### Pre-Chlorination

265. The addition of chlorine before the filtration process will help: control fish and vegetation.

A. True B. False

### Hydrofluosilicic Acid

266.  $\text{H}_2\text{SiF}_6$  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

267. The pH of the water is adjusted with?

A. Acid E. Soda pop  
B. Sodium carbonate D. Subsequent treatment processes  
C. Fluoride acid F. None of the Above

268. 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

269. 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

270. Water quality testing is conducted throughout the water treatment process.

A. True B. False

271. Water quality testing needs to analyze turbidity, pH, and chlorine residual continuously.

A. True B. False

272. 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**

273. To improve the subsequent treatment processes, chemicals are added to the water, and may include pH adjusters and coagulants.

- A. True            B. False

274. 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**

275. 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

276. 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**

277. 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

278. The slope of the tubes facilitates gravity settling of the solids to the bottom of the basin, where they can be?

- A. Adjusted for detention times            D. Modified  
B. Sampled            E. Used for the sedimentation/clarification process  
C. Collected and removed            F. None of the Above

279. The large surface settling area also means that adequate clarification can be obtained with detention times of 45 minutes or more.

- A. True            B. False

280. As with conventional treatment, the tube settler sedimentation step is followed by

- A. Filtration through mixed media.            D. Coagulation  
B. Reconditioning cycle            E. Chemical pretreatment  
C. Traditional sand filter            F. None of the Above

### Adsorption Clarifiers

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

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

- A. True
- B. False

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

- A. True
- B. False

284. 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

285. 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

286. 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

287. 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

288. Which of the following statements 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



289. 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

290. 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

291. According to the text, if a system considers making a significant change to their disinfection practice they must develop a(n) \_\_\_\_\_ and receive State approval for implementing the change.

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

### Other Requirements

292. 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

293. 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

294. Groundwater that has been softened or treated through iron and manganese removal will require filtration to remove floc created by?

- A. Coagulation and flocculation
- B. Coagulation or oxidation processes
- C. Serious problems in filter operation
- D. A combination of complex physical and chemical mechanisms
- E. Suspension
- F. None of the Above

295. According to the text, since surface water sources are subject to run-off and do not undergo natural filtration, it must be filtered to?

- A. Aid the coagulation and flocculation processes
- B. Provide coagulation or oxidation processes
- C. Remove particles and impurities
- D. Retain the combination of complex physical and chemical mechanisms
- E. Standards
- F. None of the Above

### Types of Filters

296. The oldest 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

297. 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

298. 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

299. 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

300. 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

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

- A. True
- B. False

302. 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

303. According to the text, the coarser sand in the \_\_\_\_\_ has larger voids that do not fill as easily.

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

### False floor

304. The false floor design of a \_\_\_\_\_ is used together with a porous plate design or with screens that retain the sand when there is no undergravel layer.

- A. Rapid sand filter system
- B. Slow rate filtration system
- C. Backwash system
- D. Filter underdrain
- E. Leopold system
- F. None of the Above

305. Underdrains allows the jet action or open space under the floor to act as the collection area for the filtered water and of the filter backwash water.

- A. True
- B. False

### Leopold System

306. According to the text, the Leopold system consists of a series of clay or plastic blocks that form the channels to remove the filtered water from the filter and distribute the?

- A. Backwash water
- B. Surface wash system
- C. Media
- D. Backwashing of the filter or backwash cycle
- E. Removed filtered water
- F. None of the Above

### Surface Wash

307. During the operation of a filter, the upper six-to-ten inches of the filter media remove most of the suspended material; this layer is cleaned during the \_\_\_\_\_.

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

308. Normal backwashing does not, in most cases, clean this layer completely; therefore, 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

309. 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

### Diatomaceous Earth Filter

310. The diatomaceous earth filter process was developed by the military during World War II to remove microorganisms that cause amoebic dysentery from water used in the field.

- A. True
- B. False

### Filtration Processes

311. 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

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

A. True B. False

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

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

314. In the other type of filtration process "direct filtration" no sedimentation follows the coagulation phase.

A. True B. False

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

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

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

A. True B. False

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

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

### High Rate Filters

318. 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

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

A. True B. False

320. In rapid sand filters, finer sand grains are at the \_\_\_\_\_ farther down into the filter, in rapid sand filters.

A. Bottom of the sand layer with larger grains D. End of the sand layer with larger grains  
B. Top of the sand layer with larger grains E. Top of the sand layer with finer grains  
C. Front of the sand layer with larger grains F. None of the Above

321. In the high rate filter?

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

322. 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

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

- A. True
- B. False

### Pressure Sand Filters

324. Filtration rates are twice as good as gravity filters.

- A. True
- B. False

325. Which type of filter is commonly used for iron and manganese removal from groundwater?

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

326. 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
- B. Gravity filters
- C. Pressure filters
- D. Fast sand
- E. Conventional
- F. None of the Above

327. Which of the following filtration terms is contained under pressure in a steel tank?

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

328. Which of the following filtration terms is the media usually sand or a combination of media?

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

329. During filtration, the water is under pressure, but \_\_\_\_\_ will not occur in the filter.

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

330. Which of the following terms or methods 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

331. 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

332. 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

333. 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

334. 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

335. According to the text, which of the following terms or methods of control is 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

336. 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

337. 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

338. 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

339. 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

340. 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**

341. 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

342. 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

343. 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

344. 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

345. \_\_\_\_\_ 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**

346. 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

347. Water from the source or, more commonly, from 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

348. When the filtration is started after being backwashed, there will be great head loss.  
A. True B. False

349. Which of the following terms in water is restricted during this time in filters with a control valve installed on the filter effluent pipe?

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

350. 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. Flocc
- E. Breakthrough
- F. None of the Above

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

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

352. A \_\_\_\_\_ is almost fully closed when a filter is clean so that the desired water level on top of the filter is maintained.

- A. Headloss valve
- B. Constant rate flow valve
- C. Flow restrictor
- D. Backwash cycle valve
- E. Variable declining rate flow control
- F. None of the Above

353. As the filter becomes dirty with suspended material, the valve opens gradually until the increase in the water level above the filter indicates that the filter needs \_\_\_\_\_.

- A. Headloss correction
- B. Constant rate flow
- C. Flow restrictor adjusting
- D. Filtration
- E. Backwashing
- F. None of the Above

354. In filters with \_\_\_\_\_, the filters are allowed to take on as much water as they can handle.

- A. Headloss valve
- B. Constant rate flow valve
- C. Flow restrictor
- D. Backwash cycle valve
- E. Variable declining rate flow control
- F. None of the Above

355. As the filter becomes dirty, the flow through the filter becomes less and, if the plant has more than one filter, additional \_\_\_\_\_ across the other filters.

- A. Headloss
- B. Flow redistributes
- C. Flow restricting
- D. Backwash cycle
- E. Media
- F. None of the Above



356. Which of the following terms is placed in the filter effluent pipe to prevent a filter inflow that is too great for the filter?

- A. Headloss
- B. Flow redistributes
- C. Flow
- D. Backwash cycle
- E. Flow restrictor
- F. None of the Above

357. The filter eventually fills with suspended material, at some time usually after 15 to 30 hours; it will need to be \_\_\_\_\_ to clean the media.

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

### Back Washing

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

- A. True
- B. False

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

- A. True
- B. False

360. 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

361. 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

362. 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

363. Filter media 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

364. 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

365. 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

366. During filter backwash, the media expands upwards and around the washing arms.

- A. True
- B. False

367. According to the text, a newer method of surface wash involves using \_\_\_\_\_ before the water wash.

- A. Headloss calculation
- B. Floc(s) scouring
- C. Air scour
- D. Backwash cycle
- E. Air washing
- F. None of the Above

368. The normal design for the \_\_\_\_\_ will be two-to-five cubic feet of air per square foot of filter area.

- A. Headloss calculation
- B. Floc(s) scouring
- C. Air scour
- D. Backwash cycle
- E. Air wash
- F. None of the Above

369. The filter should be backwashed when the \_\_\_\_\_ is so high that the filter no longer produces water at the desired rate.

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

370. The filter should be backwashed when \_\_\_\_\_ starts to break through the filter and the turbidity in the filter effluent increases.

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

371. If a filter is taken out of service for some reason, it does not need to backwashed prior to be putting on line.

- A. True
- B. False

372. If a filter is not backwashed until the headloss exceeds a certain number of feet, the turbidity may break through and cause the filter to exceed the standard of 0.5 NTU of turbidity.

- A. True
- B. False

373. Filter effluent- turbidity alone can cause high head loss and decreased filter flow rate, causing the pressure in the filter to drop below atmospheric pressure and cause the filter to \_\_\_\_\_ and stop filtering.

- A. Prevent headloss
- B. Air bind
- C. Assist the backwash cycle
- D. Lock
- E. Bump
- F. None of the above

374. According to the text, many filters can operate longer than one week before needing to be?  
A. Bumped                      D. Backwashed  
B. Jetted                        E. Flow restrictor  
C. Air scoured                F. None of the Above

375. Long filter runs can cause the filter media to pack down so that it is difficult to \_\_\_\_\_ during the backwash.  
A. Control headloss      D. Backwash cycle  
B. Control floc(s)        E. All of the Above  
C. Expand the bed        F. None of the Above

### **Backwashing Process**

376. 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

377. When the backwash valve is opened, backwash water is allowed to start flowing into the filter and start \_\_\_\_\_.  
A. Control headloss              D. Some means of controlling the media carryover  
B. Crust on the filter            E. Carrying suspended material away from the filter  
C. Expand the bed                F. None of the Above

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

379. When the surface wash is turned on it should be allowed to operate for several minutes to break up?  
A. Control headloss      D. Some means of controlling the media carryover  
B. Crust on the filter      E. Carrying suspended material away from the filter  
C. Expand the bed        F. None of the Above

380. The time elapsed from when the filter wash is started until full flow is applied to the filter should be greater than one minute.  
A. True B. False

381. The filter expansion needed will depend on how much agitation is needed to suspend the filter media to?  
A. Control headloss      D. Some means of controlling the media carryover  
B. Crust on the filter      E. Remove the suspended material trapped in the filter  
C. Expand the bed        F. None of the Above

382. According to the text, with a multi-media filter, the rate must be high enough to scrub the interface between the coal and the sand, where the highest amount of suspended solids will be removed from the media.  
A. True B. False

383. The best way to determine how long the filter should be washed is to measure the turbidity of the?

- A. Backwash water is used
- B. Backwash water leaving the filter
- C. Raw water flow entering the plant
- D. Too much backwash water is used
- E. Serious damage to the filter underdrain
- F. None of the Above

384. Which of the following statements and it must be treated after use, backwash valves must be opened slowly?

- A. Backwash water is used
- B. Backwash water leaving the filter
- C. Raw water flow entering the plant
- D. Too much backwash water is used
- E. Serious damage to the filter underdrain
- F. None of the Above

385. Opening the valves too rapidly can cause \_\_\_\_\_, filter gravel, and filter media.

- A. Backwash water is used
- B. Backwash water leaving the filter
- C. Raw water flow entering the plant
- D. Too much backwash water is used
- E. Serious damage to the filter underdrain
- F. None of the Above

### Disposal of Filter Backwash Water

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

- A. True B. False

387. 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

388. 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

389. 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

390. 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

391. 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

### Filter Aids

392. Which of the following terms are water-soluble, organic compounds that can be purchased in either wet or dry form?

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

393. Which of the following terms expresses that the polymer strengthens the bonds and prevents the shearing forces in the filter from breaking the floc apart when used?

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

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

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

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

### Filter Operating Problems

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

### Chemical Treatment before the Filter

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

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

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

399. 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

400. 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

401. 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

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

A. True B. False

403. When backwashing a filter and therefore temporarily taking 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

404. If the plant has a \_\_\_\_\_, this will also prevent surges to the filters.

- 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

405. If the plant is not operated continuously, and the start-up at the beginning of the day will cause a?

- A. Basin to catch the overflow
- B. Surge to the filter(s)
- C. Filter media breakthrough
- D. Turbidity breakthrough
- E. Effluent
- F. None of the Above

406. The filters should be backwashed before putting them back into operation or operated to waste until the \_\_\_\_\_ meets the standards.

- A. Basin water
- B. Surge to the filter(s)
- C. Filter media breakthrough
- D. Turbidity
- E. Effluent
- F. None of the Above

### Hard Water Section

407. Water contains various amounts of \_\_\_\_\_, some of which impart a quality known as hardness. Consumers frequently complain about problems attributed to hard water, such as the formation of scale on cooking utensils and hot water heaters.

- 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

## Membrane Filtration Processes

### Description of Membrane Filtration Processes

408. Which of the following terms 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

409. The current primary use of MF is by industries to remove very fine particles from process water, 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

410. 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

411. 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

412. 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

413. 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

414. 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

415. UF does not generally work well for removal of \_\_\_\_\_, it can be used effectively for removal or 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**

416. 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

417. 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**

418. 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

419. 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**

420. 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

### **Reverse Osmosis**

#### **Reverse Osmosis Process Section**

421. 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

422. Which of the following terms produces high quality water at low cost compared to other purifications processes?

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

423. 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



424. The higher the content of dissolved solids, the higher the?
- A. Pressure differential                      D. Virtually 100% of colloidal and suspended matter  
 B. Osmotic pressure                          E. Waste (concentrate)  
 C. Higher molecular weights              F. None of the Above
425. Generally, \_\_\_\_\_ result in higher osmotic pressures.
- A. Pressure differential                      D. Colloidal and suspended matter  
 B. Osmotic pressure                          E. Waste (concentrate)  
 C. Higher molecular weights              F. None of the Above
426. 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                                  D. 1.68 Bar  
 B. A pressure of 10 PSI                      E. 376 PSI  
 C. Osmotic pressure(s)                      F. None of the Above
427. According to the text, Seawater at \_\_\_\_\_ typically has an osmotic pressure of about 376 PSI.
- A. 36,000 PPM                                  D. 1.68 Bar  
 B. A pressure of 10 PSI                      E. 56 PSI  
 C. Osmotic pressure(s)                      F. None of the Above
428. 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                                  D. 1.68 Bar  
 B. A pressure of 10 PSI                      E. 376 PSI  
 C. Osmotic pressure(s)                      F. None of the Above

**Brine Channel**

429. 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      D. Amount of permeate or product water  
 B. Microporous support layer              E. Concentrations of TDS  
 C. Salt water source                          F. None of the Above
430. Which of the following terms when sufficient flows are maintained, serves to carry away the impurities removed by the membrane, thus keeping the membrane surface clean and functional?
- A. Pressure differential                      D. The concentrate  
 B. Osmotic pressure                          E. Waste (concentrate)  
 C. Higher molecular weights              F. None of the Above
431. The membrane material itself is a special thin film composite (TFC) polyamide material, cast in a microscopically thin layer on another, thicker cast layer of polysulfone called?
- A. Membrane material                      D. Amount of permeate or product water  
 B. Microporous support layer              E. Concentrations of TDS  
 C. Brine material                              F. None of the Above

432. Each sheet of membrane material is inspected at special light tables to ensure the quality of the membrane coating, before being assembled into the?

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

433. To achieve Reverse Osmosis, the \_\_\_\_\_ pressure is generally doubled.

- A. Each sheet of membrane material
- B. Osmotic
- C. Brine channel
- D. Amount of permeate or product water
- E. Concentrations of TDS
- F. None of the Above

434. The inverse occurs with lower temperatures, in that salt passage decreases (reducing the \_\_\_\_\_ in the permeate or product water), while operating pressures increase.

- A. TDS
- B. Raw water
- C. Seawater and brackish water
- D. Salt
- E. Concentrate
- F. None of the Above

### **Clean in Place" (CIP) System**

435. R/O Systems can be designed to deliver virtually any?

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

436. Reverse osmosis, also known as?

- A. Hyperfiltration
- B. Potable water treatment
- C. Nanofiltration
- D. Direct filtration process
- E. Microfiltration or MF
- F. None of the Above

437. Reverse osmosis is used to purify water and remove salts and other impurities in order to improve the color, taste, or properties of the?

- A. Percentage of permeate
- B. Raw water
- C. Seawater and brackish water
- D. Fluid
- E. Concentrate
- F. None of the Above

438. RO can be used to purify fluids such as ethanol and glycol, which will pass through the reverse osmosis membrane, while rejecting?

- A. Percentage of permeate
- B. Raw water
- C. Ions and contaminants
- D. Salt
- E. Concentrate
- F. None of the Above

439. RO is used to produce \_\_\_\_\_ that are currently in place.

- A. Permeate
- B. Raw water
- C. Water
- D. Water that meets the most demanding specifications
- E. Concentrate
- F. None of the Above

440. Reverse osmosis technology uses a process known as \_\_\_\_\_ to allow the membrane to continually clean itself.

- A. Percentage of permeate
- B. Raw water
- C. Seawater and brackish water
- D. Cross-flow
- E. Concentrate
- F. None of the Above

441. Which of the following terms passes through the membrane the rest continues downstream, sweeping the rejected species away from the membrane?

- A. Some of the fluid
- B. The higher the pressure
- C. A driving force
- D. Purify fluid(s)
- E. Cross-flow
- F. None of the Above

442. According to the text, the process of reverse osmosis \_\_\_\_\_ through the membrane, and the most common force is pressure from a pump.

- A. Percentage of permeate
- B. Raw water
- C. A driving force to push the fluid
- D. Salt
- E. Concentrate
- F. None of the Above

### Ozone

443. 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

444. Which 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

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

446. 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

447. 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

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

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

449. 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

**Pump, Motor and Hydraulic Section Chapter 7  
Common Hydraulic Terms**

450. 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

451. 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

452. \_\_\_\_\_ 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

453. 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

454. 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

455. 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

456. \_\_\_\_\_ is the height of a column or body of fluid above a given point?

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

457. Which of the following definitions is the pressure exerted by the atmosphere at any specific location?

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

458. Which of the following definitions is pressure above zone absolute, i.e. the sum of atmospheric and gauge pressure?
- A. Pressure, Absolute
  - B. Pressure
  - C. Hydraulics
  - D. Hydrokinetics
  - E. Pascal's Law
  - F. None of the Above

### Pump Definitions

459. Which of the following definitions is a mechanical device that seals the pump stuffing box?
- A. Packing
  - B. Bearing
  - C. Seal
  - D. Mechanical seal
  - E. Lantern ring
  - F. None of the Above

460. \_\_\_\_\_ is a pump that uses both axial-flow and radial-flow components in one impeller.
- A. Bellows
  - B. Mixed flow pump
  - C. Kinetic energy
  - D. Dynamic
  - E. Diaphragm pump
  - F. None of the Above

461. Which of the following definitions is a flat material that is compressed between two flanges to form a seal?
- A. Gasket
  - B. Keyway
  - C. Packing
  - D. Seal
  - E. Bond
  - F. None of the Above

462. Which of the following definitions are pumps with more than one impeller?
- A. Turbine
  - B. Mixed flow
  - C. Inboard
  - D. Multi-stage pumps
  - E. Outboard
  - F. None of the Above

463. Which of the following definitions is the end of the pump farthest from the motor?
- A. Outlet
  - B. Impeller
  - C. Inboard
  - D. Exit
  - E. Outboard
  - F. None of the Above

464. Which of the following definitions is the soft, pliable material that seals the stuffing box?
- A. Packing
  - B. Rubbers
  - C. Gaskets
  - D. Glands
  - E. Mechanical seal
  - F. None of the Above

465. Which of the following definitions are pumps that move fluids by physically displacing the fluid inside the pump?
- A. Bellows
  - B. Axial
  - C. Dynamic
  - D. Multi-stage pumps
  - E. Positive displacement pumps
  - F. None of the Above

### Pumps

466. Pumps are excellent examples of?
- A. Hydrostatics
  - B. Quasi-static
  - C. Oscillating diaphragm
  - D. Multi-stage pumps
  - E. Complicated part
  - F. None of the Above

467. Pumps are of two general types, \_\_\_\_\_ or positive displacement pumps, and pumps depending on dynamic forces, such as centrifugal pumps.
- A. Hydrostatic
  - B. Quasi-static
  - C. Oscillating diaphragm
  - D. Hydrostatic considerations
  - E. Complicated part
  - F. None of the Above

### Pump Categories

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

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

### Basic Water Pump

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

471. The pump makes the water spin by pulling it with an impeller.
- A. True
  - B. False

472. The impeller blades cause the water to move faster and faster.
- A. True
  - B. False

473. The impellers may be of either a semi-open or closed type.
- A. True
  - B. False

474. According to the text, without an inward force, an object will travel in a straight line and will not complete the?
- A. Circle
  - B. Pump pushes
  - C. Viscous drag pump
  - D. Center of the impeller
  - E. Incompressible fluid
  - F. None of the Above

475. In a centrifugal pump, the inward force is provided by high-pressure water near the outer edge of the?
- A. Centrifugal pump(s)
  - B. Impeller blade(s)
  - C. Pump housing
  - D. Diaphragm pump(s)
  - E. Cylindrical pump housing
  - F. None of the Above

476. 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
  - B. Pump pushes
  - C. Viscous drag pump
  - D. Center of the impeller
  - E. Incompressible fluid
  - F. None of the Above

477. 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):**

478. A venturi is a pipe that has a gradual restriction that opens up into a gradual enlargement.
- A. True
  - B. False

479. The area of the restriction in a venture will have a \_\_\_\_\_ than the enlarged area ahead of it.
- A. Inward force
  - B. Lower pressure
  - C. Viscous drag pump
  - D. Center of the impeller
  - E. Incompressible fluid
  - F. None of the Above

480. Which of the following terms best describes a pump whose impeller has no vanes but relies on fluid contact with a flat rotating plate turning at high speed to move the liquid?
- A. Submersible
  - B. Blower
  - C. Viscous drag pump
  - D. Rotary pump
  - E. Bicycle pump
  - F. None of the Above

**Types of Water Pumps**

481. The water production well industry almost exclusively uses turbine pumps, which are a type of centrifugal pump.
- A. True
  - B. False

482. 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

483. 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

484. 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

485. 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

486. 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

487. 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 Chapter 8**

488. Within a business environment, the pollutant source may involve the unintentional cross-connection of which condition with chemical processes or a heating boiler?

- A. Direct piping
- B. Backflow
- C. Direct connection
- D. Internal or external piping
- E. Air break
- F. None of the Above

489. Which of the following may be an improper cross-connection with a landscape sprinkler system or reserve tank fire protection system?

- A. Internal or external piping
- B. Public and the second is protection
- C. Residential environment the pollutant source
- D. Certainly not usually intentional
- E. Indirect connection
- F. None of the Above

490. The following could be a cause of a cross-connection: A Situation as simple as leaving a garden hose nozzle submerged in a bucket of liquid or attached to a chemical sprayer.

- A. True
- B. False

491. As far as a cross-connection, another potential hazard source within any environment may be a cross-connection of piping?

- A. With an air gap
- B. Backwater
- C. Without a direct connection
- D. Involving a water well located on the property.
- E. Air break
- F. None of the Above

492. The proper control of cross-connections is possible but?

- A. Only through knowledge and vigilance
- B. The key is public safety and the second is protection
- C. Residential environment is always the pollutant source
- D. Certainly not usually intentional
- E. None of the Above

493. According to the text, public education is not essential, for many that are educated in piping and plumbing installations are able to recognize cross-connection dangers.

- A. True
- B. False



**What is backflow? Reverse flow condition**

494. Which of the following terms is a form of backflow 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

495. 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

496. 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

497. \_\_\_\_\_ 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

498. Which of the following terms is 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

499. \_\_\_\_\_ 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

500. 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