

**Registration form**

**FLOCCULATION \$200.00  
48 HOUR RUSH ORDER PROCESSING FEE ADDITIONAL \$50.00**

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

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

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

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

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

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

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

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

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

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

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

Water Treatment \_\_\_ Water Distribution \_\_\_ Other \_\_\_\_\_

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

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

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

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

***We will stop mailing the certificate of completion so we need either your fax number or e-mail address. We will e-mail the certificate to you, if no e-mail address; we will fax it to you.***

## **DISCLAIMER NOTICE**

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

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

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

## **State Approval Listing URL...**

<https://www.abctlc.com/downloads/PDF/CEU%20State%20Approvals.pdf>

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

## **AFFIDAVIT OF EXAM COMPLETION**

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

## **Grading Information**

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

## **Rush Grading Service**

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

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

## CERTIFICATION OF COURSE PROCTOR

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

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

Name of Course: \_\_\_\_\_

Name of Licensee: \_\_\_\_\_

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

I certify that:

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

Time to complete the entire course and final exam. \_\_\_\_\_

Notation of any problem or concerns:

Name and Telephone of Proctor (please print):

\_\_\_\_\_

\_\_\_\_\_

Signature of Proctor



**Flocculation Answer Key** Name \_\_\_\_\_

Phone \_\_\_\_\_

**Did you check with your State agency to ensure this course is accepted for credit?**

**You are responsible to ensure this course is accepted for credit. No refunds.  
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 course approval number, if applicable? \_\_\_\_\_**

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

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

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| 354. A B     | 369. A B C D | 384. A B C D | 399. A B     |
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I understand that I am 100 percent responsible to ensure that TLC receives the Assignment and Registration Key and that it is accepted for credit by my State or Providence. I understand that TLC has a zero tolerance towards not following their rules, cheating or hostility towards staff or instructors. I need to complete the entire assignment for credit. There is no credit for partial assignment completion. My exam was proctored. I will contact TLC if I do not hear back from them within 2 days of assignment submission. I will forfeit my purchase costs and will not receive credit or a refund if I do not abide with TLC's rules. I will not hold TLC liable for any errors, injury, death or non-compliance with rules. I will abide with all federal and state rules and rules found on page 2.

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

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**Signature**

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

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

**FLOCCULATION 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.***

Please rate the difficulty of your course.

Very Easy 0 1 2 3 4 5 Very Difficult

Please rate the difficulty of the testing process.

Very Easy 0 1 2 3 4 5 Very Difficult

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

Very Similar 0 1 2 3 4 5 Very Different

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

What would you do to improve the Course?

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Any other concerns or comments.

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## **When Finished with Your Assignment**

### **REQUIRED DOCUMENTS**

Please scan the **Registration Page, Answer Key, Survey and Driver's License** and email these documents to [info@TLCH2O.com](mailto:info@TLCH2O.com).

### **IPhone Scanning Instructions**

If you are unable to scan, take a photo of these documents with your **iPhone** and send these photos to TLC, [info@TLCH2O.com](mailto:info@TLCH2O.com).

### **FAX**

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

### **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 course contains general EPA's SDWA federal rule requirements. Please be aware that each state implements water / sampling procedures/ safety / environmental / SDWA regulations that may be more stringent than EPA's regulations. Check with your state environmental/health agency for more information. These rules change frequently and are often difficult to interpret and follow. Be careful to be in compliance with your regulatory agencies and do not follow this course for any compliance concerns.*

## FLOCCULATION CEU Training Course Assignment

The Flocculation CEU course assignment is 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 receipt of this manual to complete it in order to receive your Professional Development Hours (PDHs) or Continuing Education Unit (CEU). A score of 70 % or better is necessary to pass this course. If you should need any assistance, please email or fax all concerns and the completed ANSWER KEY to [info@tlch2o.com](mailto:info@tlch2o.com).

Select one answer per question. Please utilize the answer key. (s) on the answer will indicate either plural and singular tenses.

### Hyperlink to the Glossary and Appendix

<http://www.abctlc.com/downloads/PDF/WTGlossary.pdf>

### Water Quality Section

#### Surface (Raw) Water Introduction

1. Operators need to appropriately treat surface water is never pure of \_\_\_\_\_, it. Most of the earth's water sources obtain their water supplies through precipitation.

- A. Excess nutrients
- B. Biological actions
- C. Pollution
- D. None of the above

2. Water passes runoffs and infiltrates the ground during precipitation; this runoff acquires a wide variety of \_\_\_\_\_ that intensely alters its usefulness.

- A. Excess nutrients
- B. Biological actions
- C. Dissolved or suspended impurities
- D. None of the above

3. \_\_\_\_\_ enhancement and formation of policy measures (administrative and engineering) revolves around most effective types of treatment methods and/or chemicals.

- A. Universal solvent
- B. Water quality
- C. Surface water
- D. None of the above

4. Raw water generally contains varying amounts of dissolved minerals including calcium, magnesium, sodium, chlorides, sulfates and bicarbonates, depending on its source.

- A. True
- B. False

#### Surface Water Properties

5. Water is accepted as the \_\_\_\_\_ because will dissolve most substances that comes in contact.

- A. Universal solvent
- B. Water quality
- C. Surface water
- D. None of the above

6. Depending on the region, some lakes and rivers receive \_\_\_\_\_ from sewer facilities or defective septic tanks.

- A. Excess nutrients
- B. Biological actions
- C. Discharge
- D. None of the above

7. Runoff could produce mud, leaves, decayed vegetation, and human and animal refuse. The discharge from industry could increase \_\_\_\_\_. Some lakes and reservoirs may experience seasonal turnover.

- A. Volatile organic compounds
- B. Water quality
- C. Excess nutrients
- D. None of the above

8. Adjustments in the dissolved oxygen, algae, temperature, suspended solids, turbidity, and carbon dioxide will change because of \_\_\_\_\_.

- A. Excess nutrients
- B. Biological activities
- C. Discharge
- D. None of the above

### Managing Water Quality at the Source

9. Contingent upon the region, source water may have several restrictions of use as part of a Water Shed Management Plan. In some areas, it may be restricted from recreational use, discharge or runoff from agriculture, or \_\_\_\_\_.

- A. Excess nutrients
- B. Biological actions
- C. Industrial and wastewater discharge
- D. None of the above

10. Another characteristic of quality control is aquatic plants. The ecological equilibrium in lakes and reservoirs plays a natural part in purifying and sustaining the life of the lake. Certain vegetation removes the excess nutrients that would promote the growth of algae. Too much algae will imbalance the lake and kill fish.

- A. True
- B. False

11. Algae growth is supplied by the energy of the sun. As algae absorbs this energy, it converts carbon dioxide to oxygen. Algae and rooted aquatic plants are essential in the food chain of fish and birds. Algae growth is the result of photosynthesis.

- A. True
- B. False

12. The absence of dissolved oxygen in water is known as aerobic conditions.

- A. True
- B. False

13. Most treatment plant upsets are such as taste and odor, color, and filter clogging is due to algae. The type of algae determines the problem it will cause, for instance slime, corrosion, color, and toxicity.

- A. True
- B. False

### Physical Characteristics of Water

14. Physical characteristics are the elements found that are considered alkali, metals, and non-metals such as carbonates, fluoride, \_\_\_\_\_. The consumer relates it to scaling of faucets or staining.

- A. pH and alkalinity
- B. Sulfides or acids
- C. Powdered activated carbon and chlorine
- D. None of the above

15. Total Dissolved Solids (TDS) is not a primary pollutant; it is a gauge of appealing water characteristics such as hardness and an indication of an assortment of chemical contaminants that might be present, such as?

- A. Turbidity
- B. Colloids
- C. Arsenic
- D. None of the above

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

16. pH is the negative logarithm of the hydrogen ion concentration,  $[H^+]$ , a measure of the degree to which a solution is \_\_\_\_\_.

- A. Alkalinity
- B. Acidic or alkaline
- C. Hydrogen ion ( $H^+$ )
- D. None of the above

17. \_\_\_\_\_ is a substance that can give up a hydrogen ion ( $H^+$ ); a base is a substance that can accept  $H^+$ .

- A. Acid
- B. Base
- C. Acidic or alkaline
- D. None of the above

18. The more acidic a solution the greater the hydrogen ion concentration and the lower the pH; a pH of 7.0 indicates neutrality, a pH of less than 7 indicates acidity, and a pH of more than 7 indicates \_\_\_\_\_.

- A. Acid
- B. Base
- C. Alkalinity
- D. None of the above

### Alkalinity

19. Alkalinity of water is its acid-neutralizing capacity. It is the sum of all the titratable bases. The measured value may vary significantly with the end-point pH used.

- A. True
- B. False

20. Alkalinity is a measure of \_\_\_\_\_ and can be interpreted in terms of specific substances only when the chemical composition of the sample is known.

- A. Hydrogen ion ( $H^+$ )
- B. Alkaline earth metal
- C. An aggregate property of water
- D. None of the above

21. Alkalinity is substantial in many uses and treatments of natural waters and wastewaters. Because the alkalinity of many surface waters is primarily a function of carbonate, bicarbonate, and hydroxide content, it is taken as an indication of the concentration of these constituents. The measured values also may include contributions from borates, phosphates, silicates or other bases if these are present.

- A. True
- B. False

### Turbidity Introduction

22. One physical feature of water is turbidity, is a measurement of the cloudiness of water caused by \_\_\_\_\_.

- A. Suspended particles
- B. Variations
- C. Temperature fluctuation
- D. None of the above

23. \_\_\_\_\_ may be existing in a water supply due to pollution, and these colloids can be difficult to remove in the coagulation process. In this situation, higher coagulant dosages are generally required.

- A. Turbidity
- B. Organic colloids
- C. Total Dissolved Solids (TDS)
- D. None of the above

### Turbidity MCL

24. An MCL for turbidity established by the EPA because \_\_\_\_\_ interferes with disinfection. This characteristic of water changes the most rapidly after a heavy rainfall.

- A. Conductivity
- B. Turbidity
- C. Temperature
- D. None of the above

## Dissolved Oxygen

25. The level of dissolved oxygen in natural waters is often a direct indication of quality, since aquatic plants produce oxygen, while microorganisms generally consume it as they feed on \_\_\_\_\_.

- A. Pollutants
- B. Organic matter
- C. E. coli bacteria
- D. None of the above

26. At low temperatures, the \_\_\_\_\_ is increased, so that in winter, concentrations as high as 20 ppm may be found in natural waters; during summer, saturation levels can be as low as 4 or 5 ppm.

- A. Dissolved oxygen
- B. Thermal stratification
- C. Solubility of oxygen
- D. None of the above

27. \_\_\_\_\_ is essential for the support of fish and other aquatic life and aids in the natural decomposition of organic matter.

- A. Dissolved oxygen
- B. Thermal stratification
- C. Solubility of oxygen
- D. None of the above

## Objections to Hard Water

### Scale Formation

28. Hard water forms scale, usually \_\_\_\_\_, which causes a variety of problems. Left to dry on the surface of glassware and plumbing fixtures, including showers doors, faucets, and sink tops; hard water leaves unsightly white scale known as water spots.

- A. Magnesium carbonate
- B. Calcium carbonate
- C. Calcite
- D. None of the above

### Secondary Standard

29. TDS is most often measured in parts per million (ppm) or milligrams per liter of water (mg/L). The normal TDS level ranges from \_\_\_\_\_.

- A. 50 ppm to 1,000 ppm
- B. 5 ppm to 10 ppm
- C. 50 ppm to 100 ppm
- D. None of the above

### Langelier Saturation Index

30. The Langelier Saturation index (LSI) is an evenness scale derived from the theoretical concept of saturation and provides an indicator of the degree of saturation of water with respect to calcium carbonate. It can be shown that the Langelier saturation index (LSI) approximates the base 10 logarithm of the \_\_\_\_\_ saturation level.

- A. Magnesium carbonate
- B. Calcium carbonate
- C. Calcite
- D. None of the above

31. The Langelier saturation level approaches the concept of saturation using pH as a main variable. The LSI can be interpreted as the pH change required to bring water to \_\_\_\_\_.

- A. Saturation level(s)
- B. Stratification
- C. Equilibrium
- D. None of the above

### More on the Stage 2 DBP Rule

32. 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 DBP rule
- B. Stage 1 DBPR
- C. Long Term 2 Enhanced Surface Water Treatment Rule
- D. None of the above

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

- A. Stage 1 DBPR
- B. Stage 2 DBPR
- C. Long Term 2 Enhanced Surface Water Rule
- D. None of the above

**What are Disinfection Byproducts (DBPs)?**

34. Which of the following form when disinfectants used to treat drinking water react with naturally occurring materials in the water?

- A. Chloramines
- B. Humic and fulvic acids
- C. Disinfection byproducts (DBPs)
- D. None of the above

**Are THMs and HAAs the only disinfection byproducts?**

35. The presence of TTHM and HAA5 is representative of the occurrence of many other chlorination DBPs; thus, an increase of TTHM and HAA5 generally indicates an increase of DBPs from chlorination.

- A. True
- B. False

**All disinfectants form DBPs in one of two reactions:**

36. Chlorine and chlorine-based compounds (halogens) react with organics in water causing the hydrogen atom to substitute other atoms, resulting in halogenated by-products.

- A. True
- B. False

**Public Health Concerns**

37. Results from toxicology studies have shown several DBPs (e.g., bromodichloromethane, bromoform, chloroform, dichloroacetic acid, and bromate) to be inert to laboratory animals.

- A. True
- B. False

**Disinfection Byproduct Research and Regulations Summary**

38. \_\_\_\_\_ is unquestionably the most important step in the treatment of water for drinking water supplies.

- A. DBP(s)
- B. Turbidity (particle)
- C. Disinfection
- D. None of the above

39. The \_\_\_\_\_ should not be compromised because of concern over the potential long-term effects of disinfectants and DBPs.

- A. DBP(s)
- B. Turbidity (particle)
- C. Microbial quality of drinking water
- D. None of the above

40. The risk of illness and death resulting from exposure to pathogens in drinking water is very much greater than the risks from \_\_\_\_\_.

- A. Disinfectants and DBPs
- B. Turbidity (particle)
- C. Natural organic matter precursors
- D. None of the above

**Controlling Disinfection Byproducts**

41. Treatment techniques are available that provide water suppliers the opportunity to maximize potable water safety and quality while minimizing the risk of \_\_\_\_\_.

- A. DBP risks
- B. Turbidity (particle)
- C. Disinfectants and DBPs
- D. None of the above

42. Generally, the best approach to reduce \_\_\_\_\_ is to remove natural organic matter precursors prior to disinfection.

- A. DBP(s)
- B. Turbidity (particle)
- C. DBP formation
- D. None of the above

**The EPA guidance discusses three processes to effectively remove natural organic matter prior to disinfection:**

**Coagulation and Clarification**

43. Most treatment plants optimize their coagulation process for \_\_\_\_\_ removal.

- A. Inorganic coagulants
- B. Most contaminants
- C. Turbidity (particle)
- D. None of the above

**Absorption**

44. Activated carbon can be used to absorb \_\_\_\_\_ that react with disinfectants to form byproducts.

- A. Inorganic coagulants
- B. Most contaminants
- C. Soluble organics
- D. None of the above

**Membrane Technology**

45. Membranes, used historically to desalinate brackish waters, have also demonstrated excellent removal of \_\_\_\_\_.

- A. THMs and HAAs
- B. Optimization of pH
- C. Natural organic matter
- D. None of the above

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

46. Which of the following like 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. Radioactive contaminants
- B. Pesticides and herbicides
- C. Inorganic contaminants
- D. Microbial contaminants

47. Which of the following may come from a variety of sources such as agriculture, urban stormwater run-off, and residential uses?

- A. Radioactive contaminants
- B. Pesticides and herbicides
- C. Inorganic contaminants
- D. Microbial contaminants

48. Which of the following, such as viruses and bacteria, which may come from sewage treatment plants, septic systems, agricultural livestock operations and wildlife?

- A. Microbial contaminants
- B. Pesticides and herbicides
- C. Inorganic contaminants
- D. All of the above

**Water Treatment Section - Preliminary Treatment Process**

**Preliminary Treatment**

49. 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. Super settling
- C. Change source
- D. None of the above

50. According to the text, wire mesh screens need maintenance and require?

- A. Manual cleaning
- B. PM cleaning
- C. No cleaning
- D. None of the above

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

- A. True      B. False

### Pre-Sedimentation

52. Sand and grit will damage plant equipment and pipes, so it must be removed with either rectangular or round shaped basin are called?

- A. Filtration basin(s)      C. Sedimentation basin(s)  
B. Coagulation basin(s)      D. None of the above

53. Which of the following treatment terms is used after the flocculation process?

- A. Filtration basin(s)      C. Sedimentation basin(s)  
B. Coagulation basin(s)      D. None of the above

54. Scrapers on the bottom move the settled sludge to one or more hoppers at the influent end of the tank, it may have a \_\_\_\_\_ or traveling bridge used to collect the sludge.

- A. Screw conveyor      C. Manual skimmer  
B. Conveyor belts      D. None of the above

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

- A. True      B. False

### Flights and Chains

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

- A. Scum box      C. Armature  
B. Surface      D. None of the above

### Circular Clarifiers

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

- A. True      B. False

58. Which of the following systems use graded silica sand filter media?

- A. Traditional filter systems      C. Chemical pretreatment  
B. Reconditioning cycle      D. None of the above

59. Filtration occurs only within the last few inches of the coarser materials at the bottom of the bed.

- A. True      B. False

60. The media become progressively finer and denser in the lower layers.

- A. True      B. False

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

- A. True      B. False

62. According to the text, when the pressure difference between filter inlet and outlet increases by 5 - 10 psi from the beginning of the cycle, the filter should be reconditioned. Operating beyond this pressure drop increases the chance of fouling - called " Mud-balling " - within the filter.

- A. True      B. False

63. Which of the following processes uses alum and cationic polymer to neutralize the charge of colloidal particles?  
 A. Filtration                      C. Flocculation  
 B. Reconditioning              D. None of the above
64. 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              C. Alum  
 B. PAC                                D. None of the above
65. Which of the following systems 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    C. Slow Sand Filtration  
 B. Chemical pretreatment      D. None of the above
66. Which of the following processes lasts about 5 to 10 minutes?  
 A. Filter-to-Waste                C. Fast rinse  
 B. Reconditioning cycle        D. None of the above
67. Which of the following is often used to enhance filter performance?  
 A. Conventional technology    C. Fast rinse  
 B. Chemical pretreatment      D. None of the above
68. Feeding chemicals such as alum, ferric chloride, or a cationic polymer neutralizes the particle charges, allowing the particles to cling to one another and be trapped by the filter media.  
 A. True                                B. False
69. Which of the following terms may increase filtered water clarity, measured in NTU, by 90% compared with filtration alone?  
 A. Chemical pretreatment      C. Fast rinse  
 B. Reconditioning cycle        D. None of the above
70. Water treatment systems use settling tanks unit to allow for \_\_\_\_\_.  
 A. Gravity                            C. Settling time  
 B. Particle(s)                        D. Sedimentation and settling
71. The main aim of tube settlers is to minimize the \_\_\_\_\_ that a small floc particle must settle before agglomerating into larger particles.  
 A. Gravity                            C. Settling time  
 B. Vertical distance                D. Solids
72. Water treatment is a major requirement both for raw water for drinking and wastewater management, both have particles that need to sediment in order to obtain clear water.  
 A. True                                B. False
73. Tube settler design reduces the depth significantly compared to the conventional clarifier. This helps in reduction of \_\_\_\_\_.  
 A. Gravity                            C. Settling time  
 B. Particle(s)                        D. Solids

### Conventional Water Treatment Process Introduction

74. \_\_\_\_\_ along with pre-chlorination for removal of dissolved iron when present with small amounts relative of manganese  
A. Disinfection      C. Pre-treatment  
B. Coagulation      D. Aeration
75. \_\_\_\_\_ to remove particles from water either by passage through a sand bed that can be washed and reused or by passage through a purpose- designed filter that is washable.  
A. Disinfection      C. Pre-treatment  
B. Coagulation      D. Filtration
76. Coagulant aids, also known as polyelectrolytes – to improve \_\_\_\_\_ and for more robust floc formation  
A. Disinfection      C. Pre-treatment  
B. Coagulation      D. Aeration along with pre-chlorination
77. \_\_\_\_\_ for settling and the removal of suspended solids trapped in the floc  
A. Disinfection      C. Pre-treatment  
B. Coagulation      D. Sedimentation

### SWTR Rule

78. Turbidity is caused by particles suspended in water. These particles scatter or reflect light rays, making the water appear cloudy.  
A. True      B. False
79. Turbidity is expressed in nephelometric turbidity units (ntu) and a reading in excess of 5 ntu is generally noticeable to water system customers.  
A. True      B. False
80. Besides the appearance of turbidity being unpleasant to customers, turbidity in water is significant from a public health standpoint because suspended particles could shelter microorganisms from the disinfectant and allow them to still be viable when they reach the customer.  
A. True      B. False
81. EPA regulations direct that, for most water systems, the turbidity of water entering the distribution system must be equal or less than 0.5 ntu in at least 95 percent of the measurements taken each month. At no time may the turbidity exceed 5 ntu.  
A. True      B. False
82. Turbidity changes in the distribution system can indicate developing problems. Increases in turbidity may also be caused by changes in velocity or inadequate flushing following main replacement.  
A. True      B. False

### Zeta Potential Introduction

83. Zeta potential is a physical property exhibited by all solid-liquid and liquid-liquid colloidal systems. Surrounding the surface of all dispersed particles is a thick layer of ions that have the same charge of the particle's surface called the ATP layer.  
A. True      B. False

84. The zeta potential is defined as the voltage at the edge of the slipping (shear) plane with respect to the bulk-dispersing medium, where ions, molecules and other agents are no longer associated with a particle's surface.

A. True      B. False

85. If two adjacent particles have sufficiently high zeta potentials of the same sign, they will agglomerate due to repulsive electrostatic forces between particles with unlike charges.

A. True      B. False

### **Solubility of Substances in Water**

86. Water is an excellent solvent for many compounds. Some dissolve in it as molecules while others, called electrolytes, dissociate and dissolve not as neutral molecules but as charged species called ions.

A. True      B. False

87. Compounds which exist as solid ionic crystals dissolve in water as ions, and most of them are highly soluble in water. "Highly soluble" is a somewhat elastic description, but generally means soluble to at least the extent of forming 0.1 to 1.0 molar aqueous solutions.

A. True      B. False

88. Salts which are very soluble in water than this at room temperature are called highly soluble salts.

A. True      B. False

### **Purpose of Coagulation**

89. Chemical Coagulation in the water/wastewater treatment is the process of bringing suspended matter in untreated water together for the purpose of settling and for the preparation of the water for filtration.

A. True      B. False

### **Turbidity Particles**

90. The ability of particles to remain suspended in water is a function of hydrogen ion activity.

A. True      B. False

91. Turbidity particles can range in size from molecular to 50 microns (a tremendous range).

A. True      B. False

92. Particles that are greater than one micron in diameter are considered silt, and settle out due to their relatively large size and density in a matter of days with the need to coagulation.

A. True      B. False

### **Olation**

93. Olation involves the bridging of two or more of these large molecules to form even larger, positively charged ions. A typical molecule can contain eight aluminum ions, twenty hydroxide ions, and will have a +4 charge.

A. True      B. False

### **Zeta Potential**

94. The Zeta Potential is reduced to zero in order for coagulation to occur, because the forces of attraction are predominant.

A. True      B. False

## Coagulants – Alum and Ferric

### Aluminum Sulfate (Alum)

95. Aluminum Sulfate is also known as alum, filter alum, and alumina sulfate. Alum is the most widely used coagulant. Alum is available in dry form as a powder or in lump form. It can also be purchased and fed as a liquid.

- A. True      B. False

96. Alum has an exact formula due to the constant water molecules of hydration that may be attached to the aluminum sulfate molecule.

- A. True      B. False

97. Once in water, alum can react with hydroxides, carbonates, bicarbonates, and other anions to form \_\_\_\_\_.

- A. pH                      C. Large, positively charged molecules  
B. Alkalinity            D. None of the above

98. Carbon dioxide and sulfate are generally byproducts of these reactions. During the reactions, alum acts as \_\_\_\_\_ to reduce the pH and alkalinity of the water supply. It is important that sufficient alkalinity be present in the water supply for the various reactions to occur.

- A. Inorganic coagulant(s)    C. Byproducts of these reactions  
B. An acid                      D. None of the above

99. Alum can be effective in the pH range of 5.5 to 7.8, but seems to work best in most water supplies in a pH range of 6.8 to 7.5. Below a pH range of 5.5, alkalinity in the water supply is generally insufficient.

- A. True      B. False

100. The aluminum ions become soluble rather than insoluble and do not participate in the hydration and \_\_\_\_\_ necessary to make the alum effective as a coagulant. In these instances the plant may experience higher than normal filtered water turbidities, and much of the aluminum will pass through the filters.

- A. Post filtration alum coagulation    C. Byproducts of these reactions  
B. Olation reaction(s)                  D. None of the above

101. When the pH level of the water is above 7.8 after the addition of the alum, the aluminum ions again become soluble, and the efficiency of coagulation is decreased. Under these conditions, aluminum ions again penetrate the filters, and \_\_\_\_\_ can occur in the clear well and in the distribution system in some cases.

- A. Post filtration alum coagulation    C. Byproducts of these reactions  
B. Olation reaction(s)                  D. None of the above

### Ferric Chloride (Ferric)

102. Ferric chloride is becoming more extensively used as a coagulant due partially to the fact that the material can be purchased as a liquid.

- A. True      B. False

103. Ferric chloride may also be purchased as an anhydrous solid. Liquid ferric chloride is highly corrosive, and must be isolated from all corrodible metals.

- A. True      B. False

104. Like ferric sulfate, ferric chloride exhibits a wide \_\_\_\_\_ range for coagulation, and the ferric ion does not easily become soluble.

- A. pH
- B. Alkalinity
- C. Olation
- D. None of the above

105. As a result, many plants are replacing alum with ferric chloride to eliminate the penetration of aluminum ions through the plant filters. Ferric chloride also reacts as an acid in water to reduce \_\_\_\_\_.

- A. pH
- B. Alkalinity
- C. Olation
- D. None of the above

106. \_\_\_\_\_ are available, such as potash alum, ammonia alum, ferrous sulfate (copperas), and chlorinated copperas.

- A. Other inorganic coagulants
- B. Olation reaction(s)
- C. Byproducts of these reactions
- D. None of the above

107. Typical dosages of the inorganic coagulants range from 50 pounds per million gallons of water treated under ideal conditions to as high as 800 to 1000 pounds per million gallons of water treated under \_\_\_\_\_ conditions.

- A. Worst case
- B. Decreased
- C. Increased
- D. None of the above

### Factors Influencing Coagulation

#### Effects of pH

108. The pH range in which a coagulation process occurs may be the single most important factor in \_\_\_\_\_ coagulation. The vast majority of coagulation problems are related to improper pH levels.

- A. Improper
- B. Optimum
- C. Proper
- D. None of the above

109. Whenever possible, coagulation should be conducted in \_\_\_\_\_. When this is not done, lower coagulation efficiency results, generally resulting in a waste of chemicals and a lowered water quality.

- A. The optimum pH zone
- B. The coagulation process
- C. Collision between the colloids
- D. None of the above

110. Each of the inorganic salt coagulants has its own characteristic \_\_\_\_\_ pH range.

- A. Improper
- B. Optimum
- C. Little or no effect
- D. None of the above

111. In many plants, it is necessary to adjust the pH level in the coagulation process. In most cases, this involves the addition of lime, caustic soda, or soda ash to maintain a minimum pH level. In some cases, however, acids may be necessary to raise or lower the pH level to an \_\_\_\_\_ range.

- A. Improper
- B. Optimum
- C. Little or no effect
- D. None of the above

112. In some water plants, the acidic reactions of the inorganic salts are taken advantage of when the raw water pH levels are \_\_\_\_\_. In these instances, overfeed of the coagulant is intentionally induced in order for the coagulation process to occur in the optimum range.

- A. Improper
- B. Optimum
- C. Higher than desired
- D. None of the above

### Effects of Salts

113. Since no natural waters are completely pure, each will have various levels of cations and anions such as calcium, sodium, magnesium, iron, manganese, sulfate, chloride, phosphate, and others. Some of these ions may affect the efficiency of \_\_\_\_\_.

- A. All chemical reactions
- B. The coagulation process
- C. Collision between the colloids
- D. None of the above

114. Generally, mono and divalent cations such as sodium, calcium, and magnesium have \_\_\_\_\_ on the coagulation process.

- A. Improper
- B. Optimum
- C. Little or no effect
- D. None of the above

115. Trivalent cations do not have an adverse effect on the process in most instances. In fact, significant concentrations of naturally occurring iron in a water supply has resulted in the ability to feed \_\_\_\_\_ dosages of inorganic salt coagulants.

- A. Improper
- B. Optimum
- C. Lower than normal
- D. None of the above

### Nature of Turbidity

116. Generally, higher turbidity levels require higher coagulant dosages. However, seldom is the relationship between turbidity level and coagulant dosage linear. Usually, the additional coagulant required is \_\_\_\_\_ when turbidities are much higher than normal due to higher collision probabilities of the colloids during high turbidities.

- A. Improper
- B. Optimum
- C. Relatively small
- D. None of the above

117. Conversely, low turbidity waters can be very difficult to coagulate due to the difficulty in inducing \_\_\_\_\_. In this instance, floc formation is poor, and much of the turbidity is carried directly to the filters.

- A. All chemical reactions
- B. The coagulation process
- C. Collision between the colloids
- D. None of the above

118. Organic colloids may be present in a water supply due to pollution, and these colloids can be difficult to remove in the coagulation process. In this situation, \_\_\_\_\_ coagulant dosages are generally required.

- A. Improper
- B. Higher
- C. Slowly
- D. None of the above

### Water Temperature

119. Cold water temperatures can cause two factors which add to the difficulty of the coagulation process. As water temperatures approach freezing, almost all chemical reactions occur more \_\_\_\_\_.

- A. Improper
- B. Higher
- C. Slowly
- D. None of the above

120. It can be difficult to evenly disperse the coagulants into the water. In addition, floc settling characteristics become poor due to the higher density of the water during near freezing temperatures. As a result, the coagulant process becomes less efficient, and higher coagulant dosages are generally used to compensate for these effects.

- A. True
- B. False

### Mixing Effects

121. Poor or inadequate mixing results in an uneven dispersion of the coagulant. Unfortunately, many older plants were designed with mixing facilities that generally do not accomplish mixing in the most efficient manner. As a result, it becomes necessary to use higher than necessary dosages of coagulant to achieve an optimum level of efficiency in the process.

- A. True      B. False

122. The effects of high turbidity and warm water temperatures can tend to aggravate the lack of adequate mixing facilities in some plants.

- A. True      B. False

### Effect of the Coagulant

123. The choice of the proper coagulant for the given conditions is of critical importance in maintaining an efficient coagulation scheme under widely varying conditions. The chemicals most commonly used in the coagulation process are Aluminum Sulfate, Ferric Chloride, Ferric Sulfate, and Cationic Polymers.

- A. True      B. False

### Corrosion Control Introduction

124. Corrosion is the deterioration of a substance by chemical action. Lead, cadmium, zinc, copper and iron might be found in water when metals in water distribution systems corrode. Drinking water contaminated with certain metals (such as \_\_\_\_\_) can harm human health.

- A. Lead                                      C. Lead and cadmium  
B. Lead and copper                      D. None of the above

125. Corrosion also reduces the useful life of water distribution systems and can promote the growth of microorganisms, resulting in disagreeable tastes, odors, slimes and further corrosion. Because it is widespread and highly toxic, lead is the corrosion product of greatest concern.

- A. True      B. False

126. The EPA has banned the use of lead solders, fluxes and pipes in the installation or repair of any public water system. In the past, solder used in plumbing has been \_\_\_\_\_.

- A. 60% lead and 40% tin      C. 50% copper and 50% lead  
B. 50% tin and 50% lead      D. None of the above

127. Using lead-free solders, such as \_\_\_\_\_ is a key factor in lead corrosion control.

- A. 20% lead and 80% tin                      C. Lead and cadmium  
B. Silver-tin and antimony-tin              D. None of the above

128. The highest level of lead in consumers' tap water will be found in water that has been standing in the pipes after periods of usage (Mid-afternoon). This is because running water tends to leach lead or copper out of the metals in the distribution system more readily than does moving water.

- A. True      B. False

129. The simplest short-term or immediate measure that can be taken to reduce exposure to lead in drinking water is to use the water immediately before each use for cooking or drinking. Also, drinking water should be taken from the hot water tap, as hot water tends to not leach lead more readily than cold.

- A. True      B. False

## Coagulation and Flocculation Summary

### Rapid Sand Filtration

130. Which terms is the most prevalent form of water treatment technology in use today?

- A. Conventional technology
- B. Sedimentation process
- C. Rapid Sand filtration
- D. None of the above

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

- A. Filtration
- B. Sedimentation process
- C. Physical and chemical processes
- D. None of the above

### Coagulation

132. 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

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

- A. Cationic polymers
- B. Flash mixer
- C. Shaker
- D. None of the above

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

- A. Cationic binding
- B. Coagulation
- C. Flocculation
- D. None of the above

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

- A. True
- B. False

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

- A. Sedimentation chemicals
- B. Coagulant chemicals
- C. Flocculation chemicals
- D. None of the above

137. 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. Sedimentation chemicals
- B. Coagulant chemicals
- C. Flocculation chemicals
- D. None of the above

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

- A. Aluminum Sulfate molecules
- B. Coagulant chemicals
- C. Colloidal particles
- D. None of the above

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

- A. True
- B. False

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

- A. True
- B. False

141. Liquid \_\_\_\_\_ is usually a 48.86% solution.

- A. Cationic polymers
- B. Soda ash
- C. Aluminum Sulfate
- D. None of the above

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

- A. Cationic polymers
- B. Coagulation helpers
- C. Lime
- D. None of the above

143. Which of the following is the most widely used coagulant in water treatment?

- A. Cationic polymers
- B. Salts
- C. Aluminum Sulfate
- D. None of the above

### Flocculation

144. 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

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

- A. Equalization
- B. Agglomerate
- C. Destabilized or coagulated particles
- D. None of the above

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

- A. Equalizing
- B. Agitation of the water
- C. Settling
- D. None of the above

147. Inside the contact chambers, water is slowly mixed allowing the coagulated particles, called "floc," and the particles become larger and stronger.

- A. True
- B. False

148. Which of the following happens in the water when bacteria and other microorganisms are caught in the floc structure?

- A. Equalize the basin
- B. Floc particles mix
- C. Agitate the water
- D. None of the above

### Pre-Sedimentation

149. Contingent 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. Equalization of the basin
- B. Particles time to settle
- C. Floc particles mix
- D. None of the above

### Sedimentation

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

- A. True
- B. False

151. In which process does the velocity of the water is decreased so that the suspended material, including flocculated particles, can settle out by gravity?

- A. Sedimentation
- B. Flocculation
- C. Rapid Sand filtration
- D. None of the above

## Water Filtration Key Terms

### Declining Rate Filters

152. The filter flow rate will vary with?

- A. Head loss
- B. Uniform media
- C. Effluent control
- D. None of the above

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

- A. Head loss
- B. Uniform media
- C. Effluent control structure
- D. None of the above

### Detention Time

154. Detention time is 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

155. Chlorine kills or "inactivates" harmful microorganisms in water.

- A. True
- B. False

156. Chlorine is added again after filtration for?

- A. Residual
- B. Contact time
- C. Post-disinfection
- D. None of the above

### Jar Testing

157. Jar testing traditionally has been done on an infrequent basis in most water treatment plants to control THMs.

- A. True
- B. False

### pH

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

- A. True
- B. False

159. According to the text, which of the following has a pH between 6.0 and 8.5?

- A. Acids
- B. Disinfectants
- C. Natural water
- D. None of the above

### Caustic

160. A strong chemical - NaOH is used in the treatment process to neutralize acidity, and to lower the pH value.

- A. True
- B. False

### Polymer

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

- A. True
- B. False

### Post-Chlorine

162. The operator should make sure that the chlorinated water holds a residual in the distribution system.

- A. True      B. False

### Pre-Chlorination

163. Before the filtration process, chlorination helps control fish and vegetation.

- A. True      B. False

### Hydrofluosilicic Acid

164.  $\text{H}_2\text{SiF}_6$  a clear fuming corrosive gas, with a pH ranging from 8 to 9 and used in water treatment to fluoridate drinking water.

- A. True      B. False

### Taste and Odor Control

165. Which of the following is occasionally added for taste and odor control?

- A. Turbidity powder      C. Powdered activated carbon (PAC)  
B. Fluoride      D. None of the above

### Water Quality

166. Water quality testing needs to be conducted throughout the water treatment process.

- A. True      B. False

167. Water quality testing procedures should analyze turbidity, pH, and chlorine residual continuously.

- A. True      B. False

168. 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

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

- A. True      B. False

170. Alum is a coagulant chemical, that neutralize 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

171. 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

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

- A. Presumed detention times      C. Modification of the conventional process  
B. Sedimentation/clarification process      D. None of the above

### Tube Settlers

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

- A. Flocculation basin
- B. Sedimentation basin or clarifier
- C. An up-flow clarifier
- D. None of the above

174. The slope of the tube settlers facilitates gravity settling of the solids to the bottom of the basin, where they can be?

- A. Adjusted for detention times
- B. Modified
- C. Collected and removed
- D. None of the above

175. 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

### Adsorption Clarifiers

176. In the sedimentation/clarification process, turbidity is \_\_\_\_\_ of the coagulated and flocculated solids.

- A. Increased by adsorption
- B. Reduced by adsorption
- C. Decreased by adsorption
- D. None of the above

177. Water scouring cleans adsorption clarifiers followed by air flushing is a must.

- A. True
- B. False

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

- A. True
- B. False

179. In the 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

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

- A. True
- B. False

### Sampling

181. Care should be taken not to disturb the bottom of the water source or along the sides. So as not to stir up any settled solids. This would create erroneous results. There are different techniques for both bacteriological and disinfection byproduct samplings. Collect the water sample at least 6 inches under the surface by plunging the container mouth down into the water and turning the mouth towards the current by dragging the container slowly horizontal.

- A. True
- B. False

### Filtration Overview

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

- A. True
- B. False

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

- A. Activated carbon filters
- B. Anthracite coal
- C. Rapid-sand filters
- D. None of the above

### **Anthracite Coal or Activated Carbon**

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

- A. True
- B. False

185. Sodium hydroxide may also be included in the sand to improve the filtration process, especially for the removal of organic contaminants and taste and odor problems.

- A. True
- B. False

186. For a filter which of the following should be conducted on a routine basis, at least once per day?

- A. Filtration process performance
- B. Effluent control measurement
- C. Post-disinfection performance
- D. None of the above

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

- A. True
- B. False

188. All water treatment plants that use surface water are governed by the U.S. EPA's Surface Water Treatment Rules or SWTR.

- A. True
- B. False

189. The rapid sand filter or rapid gravity filter is a type of filter used in water purification and is commonly used in municipal drinking water facilities as part of a \_\_\_\_\_.

- A. Rapid gravity filter(s)
- B. Rapid sand filter(s)
- C. Multiple-stage treatment system(s)
- D. None of the above

### **EPA Filter Backwash Rule**

190. The U.S. Environmental Protection Agency (EPA) has finalized the Long Term 1 Enhanced Surface Water Treatment Rule and Filter Backwash Rule (LT1FBR) to increase protection of finished drinking water supplies from contamination by Cryptosporidium and other microbial pathogens.

- A. True
- B. False

### **Background**

191. If finished water supplies contain microbiological contaminants, disease outbreaks may result. Disease symptoms may include diarrhea, cramps, nausea, possibly jaundice, headaches and fatigue.

- A. True
- B. False

192. The EPA has set enforceable drinking water treatment requirements to reduce the risk of waterborne disease outbreaks. Treatment technologies such as filtration and disinfection remove or inactivate microbiological contaminants.

- A. True
- B. False

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

### LT1FBR Required

193. The LT1FBR provisions does not apply to public water systems using surface water or ground water under the direct influence of surface water systems.

- A. True      B. False

### Turbidity

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

- A. Watershed      C. Conventional and Direct filtration systems  
B. Disinfection profile      D. None of the above

### Disinfection Benchmarking

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

- A. Disinfection profile      C. Disinfection benchmark  
B. Direct filtration system      D. None of the above

196. 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. Disinfection profile      C. Disinfection benchmark  
B. Direct filtration systems      D. None of the above

197. Which of the following that practice direct recycle, employ 20 or fewer filters to meet production requirements during a selected month, and recycle spent filter backwash water, thickener supernatant, and/or liquids from the dewatering process within the treatment process must perform a one month, one-time recycle self-assessment?

- A. Recycle systems      C. Direct filtration systems  
B. Conventional systems      D. None of the above

198. Which of the following will be required to return spent filter backwash water, thickener supernatant, and liquids from the dewatering process prior to the point of primary coagulant addition unless the State specifies an alternative location?

- A. Recycle systems      C. Direct filtration systems  
B. Conventional systems      D. None of the above

### Filtration Process- Detailed

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

- A. Suspended solids by filtration      C. Coagulation and flocculation processes  
B. Serious problems in filter operation      D. None of the above

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

- A. Suspended solids by filtration      C. Coagulation and oxidation processes  
B. Serious problems in filter operation      D. None of the above

201. 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. Remove particles and impurities
- B. Filtration process can be compared to a sieve or microstrainer
- C. Suspended particles can easily pass
- D. None of the above

202. Which of the following traps suspended material between the grains of filter media?

- A. Remove particles and impurities
- B. Filtration process can be compared to a sieve or microstrainer
- C. Suspended particles can easily pass
- D. None of the above

203. Which of the following will easily pass through the spaces between the grains of the filter media, making straining the least important process in filtration?

- A. Remove particles and impurities
- B. Filtration process can be compared to a sieve or microstrainer
- C. Suspended particles can easily pass
- D. None of the above

204. Adsorption is the process of particles sticking onto the surface of the individual filter grains or onto the previously deposited materials. The forces that attract and hold the particles to the grains are the same as those that work in \_\_\_\_\_.

- A. Coagulation and flocculation
- B. Filter operation
- C. Flocculation
- D. None of the above

205. Which of the following may occur in the filter bed will happen especially if coagulation and flocculation of the water before filtration was not properly controlled?

- A. Coagulation and flocculation
- B. Filter operation
- C. Flocculation
- D. None of the above

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

206. The primary difference between Direct Filtration Plant vs. Conventional Plant is that the \_\_\_\_\_ or step is omitted from the Direct Filtration plant.

- A. Sedimentation process
- B. Reconditioning cycle
- C. Fast rinse
- D. None of the above

### **Types of Filters**

207. 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

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

- A. Schmutzdecke
- B. Zoological growth
- C. Mud balls
- D. None of the above

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

- A. Schmutzdecke
- B. Backwash capabilities
- C. Filter media
- D. None of the above

### **Rapid Sand Filters**

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

- A. Fixed film
- B. Slow sand filters
- C. Mixed media
- D. None of the above

211. 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**

212. The filter sand used in rapid sand filters is normally play sand.

- A. True
- B. False

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

- A. True
- B. False

214. Which of the following will contain 24-30 inches of sand, but some newer filters are deeper?

- A. Rapid sand filters
- B. Slow rate filters
- C. Sedimentation basins
- D. None of the above

215. The coarser sand in the \_\_\_\_\_ has larger voids that do not fill as easily.

- A. Rapid filters
- B. Backwash trough
- C. Sedimentation basin
- D. None of the above

### **False floor**

216. 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. Backwash system
- B. Leopold system
- C. Filter underdrain
- D. None of the above

### **Filtration Processes**

217. The traditional design for many years is conventional filtration; this method provides effective treatment for just about any range of tastes and odors.

- A. True
- B. False

218. Conventional filtration success is due partially to the high quality raw water that precedes filtration steps.

- A. True
- B. False

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

- A. Control raw-water turbidity
- B. Lower capital cost
- C. Increase plant capacity
- D. None of the above

220. Direct filtration = no sedimentation follows the coagulation phase.

- A. True
- B. False

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

- A. True
- B. False

222. One of the benefits of this method is that it has a lower capital cost, but this method or process cannot handle large variations in raw water turbidity.
- A. Direct Filtration    C. Flocculation  
B. Sand Filtration    D. None of the above

### High Rate Filters

223. High rate filters, which operate at a rate up to ten times that of a rapid sand filter.
- A. True    B. False
224. Multi-media or mixed-media filters use three or four different materials, sand, anthracite coal, and garnet.
- A. True    B. False
225. 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
226. The filter bed material forms layers in the filter, depending on their weight and specific gravities.
- A. True    B. False

### Pressure Sand Filters

227. Filtration rates are twice as good as gravity filters.
- A. True    B. False
228. Which of the following terms or methods cracking of the filter bed can occur quite easily, allowing the iron and manganese particles to go straight through the filter?
- A. Slow sand/RO    C. Pressure filters  
B. Gravity filters    D. None of the above
229. Which of the following filtration types is contained under pressure in a steel tank?
- A. Slow sand/RO    C. Pressure sand filter  
B. Gravity filters    D. None of the above
230. In which of the following filtration types is the media usually sand or a combination of media?
- A. Slow sand/RO    C. Fast sand  
B. Gravity filters    D. None of the above
231. Which of the following filter types has a major disadvantage in that the backwash cannot be observed?
- A. Slow sand/RO    C. Pressure filters  
B. Gravity filters    D. None of the above
232. Filtration operation is divided into three steps: filtering, backwashing, and?
- A. Filter run    C. Return to waste  
B. Filtering to waste    D. None of the above
233. Which of the following is a low-pressure membrane filtration process that removes suspended solids and colloids generally larger than 0.1-micron diameter?
- A. Nanofiltration    C. Semi-permeable  
B. Microfiltration    D. None of the above

234. Which of the following 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. Microfiltration
  - C. Semi-permeable
  - D. None of the above

### Declining Rate

235. According to the text, which of the following methods of control is used where the largest head loss occurs in the filtration process?

- A. Declining Rate
- B. Gravity filters
- C. Fast sand
- D. None of the above

236. The rate through the declining 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. None of the above

237. According to the text, which of the following 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. Declining Rate
- B. Gravity filters
- C. Fast sand
- D. None of the above

### Loss of Head Indicator

238. Which of the following is required to force the water through the filter?

- A. Filter run
- B. Force
- C. Head loss
- D. None of the above

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

- A. Filter run
- B. Force
- C. Head loss
- D. None of the above

240. Which of the following is measured in the difference by a piezometer connected to the filter above the media and the effluent line?

- A. Filter flow
- B. Force
- C. Head
- D. None of the above

### In-line Turbidimeter

241. 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

### Filtration Process

242. 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

243. 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

244. When the filter is started after being backwashed, there will be great head loss.  
A. True                      B. False
245. Which of the following is restricted in filters with a control valve installed on the filter effluent pipe?  
A. Filter flow              C. Head  
B. Force                      D. None of the above
246. Which of the following is the term for the water rate through the filter depending on the type of media?  
A. Flow                      C. Head  
B. Force                      D. None of the above
247. Which of the following 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              C. Flow restrictor  
B. Constant rate flow valve      D. None of the above
248. As the filter becomes dirty, the valve opens gradually until the increase in the water level above the filter indicates that the filter needs?  
A. Headloss                      C. Backwashing  
B. Flow redistributes              D. None of the above
249. 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                      C. Backwashing  
B. Flow redistributes              D. None of the above
250. Which of the following is placed in the filter effluent pipe to prevent a filter inflow that is too great for the filter?  
A. Headloss valve              C. Flow restrictor  
B. Flow valve                      D. None of the above
251. The filter eventually fills with suspended material, usually after 15 to 30 hours, it will need to be \_\_\_\_\_ to clean the media.  
A. Bumped                      C. Backwashed  
B. Jetted                      D. None of the above

### **Back Washing**

252. A normal backwash rate is between 1.2 to 1.5 gpm per square foot of filter surface area.  
A. True                      B. False
253. Proper backwashing is a very important step in the operation of a filter.  
A. True                      B. False
254. 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
255. Which of the following must be expanded to clean the filter during the backwash?  
A. Media                      C. Backwash rate  
B. Floc(s)                      D. None of the above

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

- A. Media
- B. Floc(s)
- C. Backwash rate
- D. None of the above

257. Which of the following needs two-to-five cubic feet of air per square foot of filter area?

- A. Air washing
- B. Air scour
- C. Backwash cycle
- D. None of the above

258. Which of the following if it is too high that the filter will no longer produce water at the desired rate?

- A. Air washing
- B. Air scour
- C. Backwash rate
- D. None of the above

259. Which of the following starts to break through the filter and the turbidity in the filter effluent increases; and/or a filter run reaches a given hour of operation?

- A. Headloss
- B. Floc(s)
- C. Backwash rate
- D. None of the above

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

- A. True
- B. False

261. 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

262. 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. Lock
- D. None of the above

263. Some filters can operate longer than one week before needing to be?

- A. Bumped
- B. Jetted
- C. Backwashed
- D. None of the above

264. Long filter runs can cause the filter media to pack down so that it is difficult to \_\_\_\_\_ during the backwash.

- A. Control headloss
- B. Control floc(s)
- C. Expand the bed
- D. None of the above

### **Backwashing Process**

265. 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

266. The backwash valve is opened, allowing backwash water to start flowing into the filter and start carrying \_\_\_\_\_ away from the filter.

- A. Headloss
- B. Crust on the filter
- C. Suspended material
- D. None of the above

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

- A. Headloss
- B. Crust on the filter
- C. Suspended material away from the filter
- D. None of the above

268. 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

269. 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

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

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

- A. True
- B. False

271. 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. Raw water flow entering the plant
- D. None of the above

272. 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**

273. 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

274. Wasting is needed as some \_\_\_\_\_ following the backwash.

- A. Daily flow
- B. Backwash water
- C. Suspended material remains in the filter media
- D. None of the above

275. Which of the following terms should be done slowly after a backwash to prevent breakthrough of suspended material?

- A. Daily flow
- B. Backwash water
- C. Filtration should always be started
- D. None of the above

### **Filter Aids**

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

- A. True
- B. False

277. 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
- B. Lime
- C. Filter aid
- D. None of the above

### Filter Operating Problems

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

- A. Filter aid
- B. Control of filter flow rate
- C. Coagulation and flocculation stages
- D. None of the above

### Chemical Treatment before the Filter

279. Which of the following terms of the water treatment must be monitored continuously?

- A. Filter aid
- B. Backwash storage basin
- C. Coagulation and flocculation stages
- D. None of the above

280. Adjustments in the amount of coagulant added must be made as necessary to prevent the filter from becoming overloaded, this may cause the filter to prematurely reach its?

- A. Maximum headloss
- B. Control of filter flow rate
- C. Turbidity breakthrough
- D. None of the above

### Control of Filter Flow Rate

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

- A. True
- B. False

282. 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 might cause?

- A. Turbidity breakthrough
- B. Filter media breakthrough
- C. Coagulation and flocculation stages
- D. None of the above

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

- A. Basin to catch the overflow
- B. Surge to the filter(s)
- C. Turbidity breakthrough
- D. None of the above

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

- A. Basin water
- B. Effluent
- C. Coagulation
- D. None of the above

### Advanced Water Treatment Section

285. Water contains \_\_\_\_\_ of which impart a quality known as hardness?

- A. TDS
- B. Conductivity
- C. Various amounts of dissolved minerals
- D. None of the above

286. The precipitation process is generally known as the?

- A. Softening
- B. Chemical pretreating
- C. Lime process or lime soda process
- D. None of the above

287. Which of the following can be accomplished using membrane technology, electro dialysis, distillation, and freezing. Of these, the membrane methods seem to have the greatest use potential.

- A. Alkalinity
- B. Precipitation
- C. Softening
- D. None of the above

### Occurrence of Hard Water

288. Which of the following is caused by soluble, divalent, metallic cations, (positive ions having valence of 2)?

- A. Hard water
- B. Permanent hardness
- C. Carbonate hardness
- D. None of the above

289. Water hardness varies considerably and is due to different geologic formations, and is also a function of the contact time between water and?

- A. Low pH
- B. Carbonate-noncarbonate
- C. Limestone deposits
- D. None of the above

290. Magnesium is dissolved as water passes over and through \_\_\_\_\_ and other magnesium-bearing minerals.

- A. Hardness ions
- B. Calcium and magnesium
- C. Dolomite
- D. None of the above

### Types of Hardness

291. Hardness can be categorized by either of two methods: calcium versus magnesium hardness and?

- A. Carbonate hardness
- B. Temporary hardness
- C. Carbonate versus non-carbonate hardness
- D. None of the above

### Carbonate-Noncarbonate Distinction

292. According to the text, the carbonate-noncarbonate distinction, is based on hardness from either the bicarbonate salts of calcium or the \_\_\_\_\_ involved in causing water hardness.

- A.  $\text{CaCO}_3$
- B. Water hardness
- C. Normal salts of calcium and magnesium
- D. None of the above

293. Which of the following is caused primarily by the bicarbonate salts of calcium and magnesium, which are calcium bicarbonate,  $\text{Ca}(\text{HCO}_3)_2$ , and magnesium bicarbonate  $\text{Mg}(\text{HCO}_3)_2$ ?

- A. Hardness ions
- B. Permanent hardness
- C. Carbonate hardness
- D. None of the above

294. Which of the following when combined with carbonate ( $\text{CO}_3$ ) also contribute to carbonate hardness?

- A.  $\text{CaCO}_3$
- B. Calcium and magnesium
- C. Carbonate-noncarbonate
- D. None of the above

295. Which of the following is a measure of calcium and magnesium salts other than carbonate and bicarbonate salts?

- A. Hardness ions
- B. Permanent hardness
- C. Noncarbonate hardness
- D. None of the above

296. Which of the following are calcium sulfate, calcium chloride, magnesium sulfate ( $\text{MgSO}_4$ ), and magnesium chloride ( $\text{MgCl}_2$ ) known better as?

- A.  $\text{CaCO}_3$
- B. Water hardness
- C. Salts
- D. None of the above

297. When hard water is boiled, \_\_\_\_\_ is driven off, bicarbonate salts of calcium and magnesium then settle out of the water to form calcium and magnesium carbonate precipitates.

- A. Hardness ions
- B. Carbon dioxide (CO<sub>2</sub>)
- C. Carbonate hardness
- D. None of the above

298. Because it can be removed by heating, carbonate hardness is sometimes called?

- A. Carbonate hardness
- B. Water hardness
- C. Temporary hardness
- D. None of the above

299. Because noncarbonated hardness cannot be removed or precipitated by prolonged boiling, it is sometimes called?

- A. Temporary hardness
- B. Permanent hardness
- C. Carbonate hardness
- D. None of the above

### Types of Processes

300. Which of the following terms operate without heating and therefore use less energy than conventional thermal separation processes such as distillation, sublimation or crystallization?

- A. Thermal separation process(es)
- B. Fractional distillation
- C. Membrane separation processes
- D. None of the above

### Membrane Filtration Processes

301. Which of the following enables some water systems having contaminated water sources to meet new, more stringent regulations?

- A. Membrane technology
- B. Macromolecule(s)
- C. Conventional thermal separation process(es)
- D. None of the above

### Microfiltration

302. 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. Water
- D. None of the above

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

- A. Process liquid
- B. Total dissolved solids (TDS)
- C. Bacterial and protozoan life
- D. None of the above

### Ultrafiltration

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

- A. High-molecular-weight materials
- B. Average-molecular-weight materials
- C. Low-molecular-weight materials
- D. None of the above

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

- A. Equal to a certain molecular weight
- B. Average-molecular-weight materials
- C. Low-molecular-weight materials
- D. None of the above

### Nanofiltration

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

- A. Process liquid
- B. Bacterial and protozoan life
- C. Total dissolved solids (TDS)
- D. None of the above

### **Reverse Osmosis**

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

- A. Process liquid
- B. Chloride and sodium
- C. Bacterial and protozoan life
- D. None of the above

### **Microfiltration Specific Process**

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

- A. Various other separation processes
- B. Retentate and product streams
- C. Batch or semi-continuous filtration
- D. None of the above

### **Common Applications**

#### **Water Treatment Process**

309. Which of the following presents a physical means of separation (a barrier) as opposed to a chemical alternative?

- A. Retentate and product streams
- B. MF membranes
- C. Batch or semi-continuous filtration
- D. None of the above

### **Bacteriological Monitoring Section**

310. Coliform bacteria and chlorine residual are the only routine sampling and monitoring requirements for small ground water systems with chlorination. The coliform bacteriological sampling is governed by the Coliform Reduction amendment of the SDWA.

- A. True
- B. False

### **TCR**

311. The TCR recommends most of the Public Water Systems (PWS) to monitor their distribution system for bacteria according to the written sample sitting plan for that system.

- A. True
- B. False

312. Coliform contamination may occur anywhere in the system, possibly due to problems such as; high-pressure conditions, line fluctuations, or wells, and therefore routine monitoring is required.

- A. True
- B. False

### **Routine Sampling Requirements**

313. Total coliform samples must be collected by PWSs at sites which are representative of water quality throughout the distribution system according to a written sample siting plan subject to state review and revision.

- A. True
- B. False

314. For PWSs collecting more than one sample per month, collect total coliform samples at regular intervals throughout the month, except that ground water systems serving 4,900 or fewer people may collect all required samples on a single day if the samples are taken from different sites.

- A. True
- B. False

315. Each total coliform-positive (TC+) routine sample must be tested for the presence of heterotrophic bacteria.

- A. True
- B. False

316. If any TC+ sample is also E. coli-positive (EC+), then the EC+ sample result must be reported to the state by the end of the month that the PWS is notified.

- A. True
- B. False

317. If any routine sample is TC+, repeat samples are required. – PWSs on quarterly or annual monitoring must take a minimum of one additional routine samples (known as additional routine monitoring) the quarter following a TC+ routine or repeat sample.

- A. True      B. False

318. Reduced monitoring is general available for PWSs using only surface water and serving 1,000 or fewer persons that meet certain additional PWS criteria.

- A. True      B. False

### **Dangerous Waterborne Microbes**

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

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

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

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

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

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

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

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

### **Bacteria Sampling**

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

- A. Amoebas                  C. Viruses  
B. Bacteria tests          D. None of the above

### **Methods**

324. The MMO-MUG test, a product marketed as \_\_\_\_\_, is the most common. The sample results will be reported by the laboratories as simply coliforms present or absent.

- A. Colilert                  C. Total coliform analysis  
B. Coliform                D. None of the above

### **Basic Types of Water Samples**

325. It is important to properly identify the type of sample you are collecting.

- A. True                      B. False

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

326. Samples collected following a coliform present routine sample. The number of repeat samples to be collected is based on the number of \_\_\_\_\_ samples you normally collect.

- A. Repeat    C. Routine  
B. Special    D. None of the above

327. A PWS fails to take every required repeat sample after any single TC+ sample

- A. Trigger: Level 1 Assessment    C. All of the above  
B. Trigger: Level 2 Assessment    D. None of the above

328. A PWS incurs an E. coli MCL violation.

- A. Trigger: Level 1 Assessment
- B. Trigger: Level 2 Assessment
- C. All of the above
- D. None of the above

329. A PWS collecting at least 40 samples per month has greater than 5.0 percent of the routine/repeat samples in the same month that are TC+.

- A. Trigger: Level 1 Assessment
- B. Trigger: Level 2 Assessment
- C. All of the above
- D. None of the above

330. A PWS has a second Level 1 Assessment within a rolling 12-month period.

- A. Trigger: Level 1 Assessment
- B. Trigger: Level 2 Assessment
- C. All of the above
- D. None of the above

331. A PWS on state-approved annual monitoring has a Level 1 Assessment trigger in 2 consecutive years.

- A. Trigger: Level 1 Assessment
- B. Trigger: Level 2 Assessment
- C. All of the above
- D. None of the above

332. A PWS collecting fewer than 40 samples per month has 2 or more TC+ routine/ repeat samples in the same month.

- A. Trigger: Level 1 Assessment
- B. Trigger: Level 2 Assessment
- C. All of the above
- D. None of the above

#### **Positive or Coliform Present Results**

333. If you are notified of a positive coliform test result you need to contact either the Drinking Water Program or your local county health department within 72 hours, or by the next business day after the MCL compliance violation

- A. True
- B. False

334. With a positive total coliform sample, after you have contacted an agency for assistance, you will be instructed as to the proper repeat sampling procedures and possible corrective measures for solving the problem. It is very important to initiate the \_\_\_\_\_ as the corrective measures will be based on those results.

- A. Perform routine procedures
- B. Repeat sampling immediately
- C. Corrective measures
- D. None of the above

#### **Heterotrophic Plate Count HPC**

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

- A. True
- B. False

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

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

- A. Colonies
- B. Agar
- C. Heterotrophic Plate Count
- D. None of the above

#### **Total Coliforms**

337. This MCL is based on the presence of total coliforms, and compliance is on a daily or weekly basis, depending on your water system type and state rule.

- A. True
- B. False

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

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

- A. 40                      C. 200
- B. 100                    D. None of the above

**The following are acute violations:**

339. Which determines a violation of nitrate?

- A. Presence              C. MCLG
- B. MCL                    D. None of the above

**Revised Total Coliform Rule (RTCR) Summary**

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

- A. True                    B. False

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

- A. True                    B. False

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

- A. True                    B. False

343. The water provider shall develop and follow a sample-siting plan that designates the PWS's collection schedule. This includes location of \_\_\_\_\_.

- A. Routine and repeat water samples              C. Microbial contamination
- B. Reduced monitoring                                  D. Repeat water samples

344. The water provider shall collect \_\_\_\_\_ on a regular basis (monthly, quarterly, annually). Have samples tested for the presence of total coliforms by a state certified laboratory.

- A. Routine water samples              C. Microbial contamination
- B. Reduced monitoring                  D. Repeat water samples

**Disinfection Key**

345. The RTCR requires 99.99% or 4 log inactivation of \_\_\_\_\_ .

- A. Enteric viruses              C. Giardia lamblia cysts
- B. Crypto                        D. None of the above

346. The RTCR requires 99% or 2 log inactivation of \_\_\_\_\_ .

- A. Enteric viruses              C. Giardia lamblia cysts
- B. Crypto                        D. None of the above

347. The RTCR requires 99.9% or 3 log inactivation of \_\_\_\_\_ .

- A. Enteric viruses              C. Giardia lamblia cysts
- B. Crypto                        D. None of the above

348. The RTCR requires the chlorine residual leaving the plant must be = or > 0.2 mg/L and measurable throughout the system.

- A. > 0.2                    C. 0.2
- B. 2.0                        D. None of the above

## Waterborne Pathogen Section - Introduction

### Pathogen Section

349. Most pathogens are generally associated with diseases that \_\_\_\_\_ and affect people in a relatively short amount of time, generally a few days to two weeks.

- A. Cause intestinal illness
- B. Are mild in nature
- C. Will cause fatalities
- D. None of the above

### How Diseases are Transmitted.

350. Waterborne pathogens are primarily spread by the?

- A. Fecal-oral, or feces-to-mouth route
- B. Dermal to fecal route
- C. Oral to fecal route
- D. None of the above

### Protozoan Caused Diseases

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

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

### Giardia lamblia

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

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

### Primary Waterborne Diseases Section

#### Salmonella typhi

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

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

### Waterborne Bacterial Diseases

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

- A. True
- B. False

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

- A. True
- B. False

### Viruses

#### Coronavirus

356. It looks like the COVID-19 coronavirus is not able to live in water.

- A. True
- B. False

### Water Laboratory Analysis Section

#### pH Testing Section

357. When an atom loses \_\_\_\_\_ and thus has more protons than electrons, the atom is a positively-charged ion or cation.

- A. A proton
- B. Charge
- C. An electron
- D. None of the above

358. Mathematically, pH is the negative logarithm of the activity of the (solvated) hydronium ion, more often expressed as the measure of the?

- A. Electron concentration
- B. Alkalinity concentration
- C. Hydronium ion concentration
- D. None of the above

359. pH is defined as the decimal logarithm of the reciprocal of the \_\_\_\_\_,  $a_{H^+}$ , in a solution.

- A. Hydrogen ion activity
- B. Acid-base behavior
- C. Brønsted–Lowry acid–base theory
- D. None of the above

360. Since pH is a logarithmic scale, a difference of one pH unit is equivalent to \_\_\_\_\_ fold difference in hydrogen ion concentration

- A. 1
- B. .1
- C. 10
- D. None of the above

### Disinfection Section

#### Chlorine's Appearance and Odor

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

- A. -29.2 degrees
- B. - 100 degrees
- C. 29 degrees
- D. None of the above

362. Prolonged exposures to chlorine gas may result in?

- A. Moisture, steam, and water
- B. Odor thresholds
- C. Olfactory fatigue
- D. None of the above

### Chlorine Gas

#### Pathophysiology

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

- A. Effects of Hydrochloric acid
- B. Vapor from Chlorine gas
- C. Water solubility
- D. None of the Above

364. Respiratory exposure to \_\_\_\_\_ may be prolonged because its moderate water solubility may not cause upper airway symptoms for several minutes.

- A. Hydrochloric acid
- B. Chlorine gas
- C. Plasma exudation
- D. None of the Above

365. The odor threshold for chlorine gas is approximately?

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

### Mechanism of Activity

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

- A. True
- B. False

### Early Response to Chlorine Gas

367. If you mix ammonia with chlorine gas, this compound reacts to form \_\_\_\_\_.

- A. Chloramine gas
- B. Chlorine gas
- C. Sulfuric gas
- D. None of the Above

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

## Reactivity

368. Cylinders of chlorine may burst when exposed to elevated temperatures. When there is Chlorine in solution, this forms?

- A. Hydrogen sulfide
- C. A corrosive material
- B. Oxomonosilane
- D. None of the above

369. What is formed when chlorine is in contact with combustible substances (such as gasoline and petroleum products, hydrocarbons, turpentine, alcohols, acetylene, hydrogen, ammonia, and sulfur), reducing agents, and finely divided metals?

- A. Fires and explosions
- C. Moisture, steam, and water
- B. Odor thresholds
- D. None of the above

370. Contact between chlorine and arsenic, bismuth, boron, calcium, activated carbon, carbon disulfide, glycerol, hydrazine, iodine, methane, oxomonosilane, potassium, propylene, and silicon should be avoided.

- A. True
- B. False

371. Chlorine reacts with hydrogen sulfide and water to form this substance?

- A. Hydrogen sulfide
- C. Chlorinates
- B. Hydrochloric acid
- D. None of the above

372. According to the text, chlorine is also incompatible with?

- A. Plastic
- C. Moisture, steam, and water
- B. Palladium
- D. None of the above

## Flammability

373. When there is a fire that involves Chlorine, the firefight should be fought downwind from the minimum distance possible.

- A. True
- B. False

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

- A. True
- B. False

375. The effectiveness of chlorination depends on the \_\_\_\_\_ of the water, the concentration of the chlorine solution added, the time that chlorine is in contact with the organism, and water quality.

- A. Chlorine residual
- C. Oxygen
- B. Chlorine demand
- D. None of the above

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

- A. Chlorine residual
- C. Free chlorine residual
- B. Chlorine demand
- D. None of the above

377. Which term is used when disinfection decreases, as the concentration of the chlorine increases?

- A. pH increases
- C. Required contact time
- B. Chlorine level and water quality
- D. None of the above

378. Chlorination is more effective as?

- A. Water temperature increases
- B. Chlorine demand
- C. Water cools down
- D. None of the above

379. Chlorination becomes more alkaline and is less effective as the?

- A. Water's pH increases
- B. Water quality increases
- C. Required contact time is maximized
- D. None of the above

380. Chlorination is less effective in?

- A. Clear water
- B. Cloudy (turbid) water
- C. Day time
- D. None of the above

381. By adding a little more chlorine to what is already sufficient, this action will generally result in \_\_\_\_\_ that can be measured easily.

- A. pH increases
- B. A free chlorine residual
- C. Required contact time
- D. None of the above

### Chlorination Chemistry

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

- A. True
- B. False

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

- A. Reduction Ratio
- B. Ratio of hypochlorous acid
- C. "CT" disinfection concept
- D. None of the above

384. Although the ratio of \_\_\_\_\_ is greater at lower temperatures, pathogenic organisms are actually harder to kill.

- A. Hypochlorous acid
- B. The amount of chlorine
- C. Total chlorine
- D. None of the above

385. If all other things were equal, \_\_\_\_\_ and a lower pH are more conducive to chlorine disinfection.

- A. Lower pH
- B. Hypochlorous acid
- C. Higher water temperatures
- D. None of the above

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

- A. True
- B. False

387. 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

### Chlorine DDBP

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

- A. Free available chlorine and Total
- B. Free and Residual
- C. Free available chlorine and Combined Chlorine
- D. None of the above

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

389. Chloramines are formed by reactions with?

- A. Acid and  $\text{Cl}_2$
- B. Ammonia and  $\text{Cl}_2$
- C. Folic Acid and  $\text{Cl}_2$
- D. None of the above

### Types of Residual

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

- A. Chlorine residual
- B. Chlorine demand
- C. Total chlorine
- D. None of the Above

### Chlorine Exposure Limits

391. What is OSHA's PEL?

- A. 10 PPM
- B. 1 PPM
- C. 1,000 PPM
- D. None of the above

392. Chlorine's Physical and chemical properties: A yellowish green, nonflammable and liquefied gas with an unpleasant and irritating smell.

- A. True
- B. False

393. Liquid chlorine is about \_\_\_\_\_ times heavier than water

- A. 1.5
- B. 10
- C. 2.5
- D. None of the above

394. Gaseous chlorine is about \_\_\_\_\_ times heavier than air.

- A. 1.5
- B. 10
- C. 2.5
- D. None of the above

### Alternate Disinfectants - Chloramine

395. It is recommended that Chloramine be used in conjunction with a stronger disinfectant. It is best utilized as a?

- A. Chloramine
- B. T10 value disinfectant
- C. Stable distribution system disinfectant
- D. None of the above

396. In the production of \_\_\_\_\_, the ammonia residuals in the finished water, when fed in excess of stoichiometric amount needed, should be limited to inhibit growth of nitrifying bacteria.

- A. Dry sodium chlorite
- B. Chloramines
- C. Ammonia residual(s)
- D. None of the above

### Chlorine Dioxide

397. Which term provides good Giardia and virus protection but its use is limited by the restriction on the maximum residual of 0.5 mg/L  $\text{ClO}_2$ /chlorite/chlorate allowed in finished water?

- A. Chlorinated byproducts
- B. Chlorine dioxide
- C. Ammonia residual(s)
- D. None of the above

### Ozone

398. Ozone is a very effective disinfectant for both Giardia and viruses

- A. True
- B. False

399. Ozone does not produce chlorinated byproducts (such as trihalomethanes) but it may cause an increase in such byproduct formation if it is fed ahead of free chlorine; ozone may also produce its own oxygenated byproducts such as  $\text{Cl}_2 + \text{NH}_4$ .

- A. True
- B. False

400. Ozonation must include adequate ozone leak detection alarm systems, and an ozone off-gas destruction system.

A. *True*                      B. *False*

## **When Finished with Your Assignment**

### **REQUIRED DOCUMENTS**

Please scan the **Registration Page, Answer Key, Survey and Driver's License** and email these documents to [info@TLCH2O.com](mailto:info@TLCH2O.com).

### **IPhone Scanning Instructions**

If you are unable to scan, take a photo of these documents with your **iPhone** and send these photos to TLC, [info@TLCH2O.com](mailto:info@TLCH2O.com).

### **FAX**

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