

**Registration form**

**WATER TREATMENT 202 \$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)**

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***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...**

<http://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



**WT 202 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 or use a felt-tipped pen.***

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

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| 2. A B C D  | 21. A B C D | 40. A B C D | 59. A B C D |
| 3. A B C D  | 22. A B     | 41. A B     | 60. A B C D |
| 4. A B C D  | 23. A B C D | 42. A B C D | 61. A B C D |
| 5. A B C D  | 24. A B     | 43. A B C D | 62. A B C D |
| 6. A B C D  | 25. A B C D | 44. A B C D | 63. A B C D |
| 7. A B C D  | 26. A B     | 45. A B C D | 64. A B C D |
| 8. A B C D  | 27. A B C D | 46. A B C D | 65. A B C D |
| 9. A B      | 28. A B     | 47. A B     | 66. A B C D |
| 10. A B C D | 29. A B C D | 48. A B     | 67. A B C D |
| 11. A B C D | 30. A B C D | 49. A B     | 68. A B C D |
| 12. A B C D | 31. A B C D | 50. A B     | 69. A B C D |
| 13. A B     | 32. A B C D | 51. A B     | 70. A B C D |
| 14. A B     | 33. A B C D | 52. A B C D | 71. A B C D |
| 15. A B     | 34. A B C D | 53. A B C D | 72. A B C D |
| 16. A B C D | 35. A B C D | 54. A B C D | 73. A B C D |
| 17. A B C D | 36. A B C D | 55. A B C D | 74. A B     |
| 18. A B C D | 37. A B C D | 56. A B C D | 75. A B     |
| 19. A B C D | 38. A B     | 57. A B C D | 76. A B     |

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210. A B C D	233. A B	256. A B	279. A B C D
211. A B C D	234. A B C D	257. A B	280. A B
212. A B C D	235. A B C D	258. A B	281. A B
213. A B C D	236. A B	259. A B	282. A B
214. A B C D	237. A B C D	260. A B C D	283. A B
215. A B C D	238. A B C D	261. A B C D	284. A B C D
216. A B C D	239. A B	262. A B	285. A B
217. A B C D	240. A B C D	263. A B	286. A B C D
218. A B	241. A B C D	264. A B C D	287. A B C D
219. A B	242. A B C D	265. A B C D	288. A B C D
220. A B	243. A B C D	266. A B	289. A B C D
221. A B C D	244. A B C D	267. A B	290. A B C D
222. A B	245. A B	268. A B	291. A B C D
223. A B	246. A B	269. A B C D	292. A B C D
224. A B C D	247. A B C D	270. A B C D	293. A B C D
225. A B C D	248. A B	271. A B C D	294. A B C D
226. A B	249. A B	272. A B C D	295. A B C D
227. A B C D	250. A B	273. A B C D	296. A B C D
228. A B C D	251. A B	274. A B C D	297. A B C D
229. A B	252. A B	275. A B C D	298. A B C D
230. A B C D	253. A B C D	276. A B C D	299. A B C D
231. A B C D	254. A B	277. A B C D	300. A B C D

*I understand that I am 100 percent responsible to ensure that TLC receives the Assignment and Registration Key. 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 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. 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.*

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

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**Signature**

## **When Finished with Your Assignment...**

### **REQUIRED DOCUMENTS**

Please scan the **Registration Page, Answer Key, Proctoring report, 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 documents 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.*



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

**WATER TREATMENT 202 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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## Water Treatment 202 CEU Training Course Assignment

The Water Treatment 202 CEU course assignment is available in Word on the Internet for your convenience, please visit [www.abctlc.com](http://www.abctlc.com) and download the assignment and e-mail it back to TLC.

You will have 90 days from 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 Key Words

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

- A. Activated alumina
- B. Fluoride
- C. Aluminum salts
- D. None of the above

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

- A. Activated alumina
- B. Activated carbon
- C. Organic carbon
- D. None of the above

### Three Types of Public Water Systems

3. Provides water to the same population year-round (for example: homes, apartment buildings)

- A. TNCWS
- B. CWSs
- C. NTNCWSs
- D. None of the above

4. Approximately 85,000 systems

- A. TNCWS
- B. CWSs
- C. NTNCWSs
- D. None of the above

5. Provides water where people do not remain for long periods of time (for example: gas stations, campgrounds)

- A. TNCWS
- B. CWSs
- C. NTNCWSs
- D. None of the above

6. Approximately 52,000 systems serving the majority of the U.S. population

- A. TNCWS
- B. CWSs
- C. NTNCWSs
- D. None of the above

7. Provides water to the same people at least six months a year, but not all year (for example: schools, factories, churches, office buildings that have their own water system)

- A. TNCWS
- B. CWSs
- C. NTNCWSs
- D. None of the above

## Water Quality Section

### Surface (Raw) Water Introduction

8. We as 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

9. 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

10. 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

11. 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

12. 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

### Managing Water Quality at the Source

13. 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

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

- A. True
- B. False

15. 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

16. Algae can be controlled in the water supply by using chemicals such as \_\_\_\_\_.

- A. pH and alkalinity
- B. Copper sulfate
- C. Powdered activated carbon and chlorine
- D. None of the above

17. Contingent upon federal regulations and the amount of copper found natural in water, operators have used \_\_\_\_\_, powdered activated carbon and chlorine to control algae blooms.

- A. pH and alkalinity
- B. Metals, and non-metals
- C. Potassium permanganate
- D. None of the above

18. The \_\_\_\_\_ of the water will govern how these chemicals will react.
- A. pH and alkalinity      C. Powdered activated carbon and chlorine  
B. Metals, and non-metals      D. None of the above

### Physical Characteristics of Water

19. 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      C. Powdered activated carbon and chlorine  
B. Sulfides or acids      D. None of the above

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

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

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

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

### Alkalinity

22. 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

23. \_\_\_\_\_ with an overabundance of alkaline earth metal concentrations is significant in determining the suitability of water for irrigation.

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

24. Alkalinity measurements are used in the interpretation and control of water and wastewater treatment processes

- A. True      B. False

### Turbidity Introduction

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

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

26. High levels of turbidity may inhibit with proper water treatment and monitoring. If high quality raw water is low in turbidity, there will be a reduction in water treatment costs. Turbidity is unwanted because it causes health hazards.

- A. True      B. False

27. The turbidity in natural surface waters is composed of a large number of sizes of particles. The sizes of particles can be changing constantly, depending on precipitation and \_\_\_\_\_ factors.

- A. MCL      C. Temperature  
B. Manmade      D. None of the above

28. When heavy rains transpire, runoff into streams, rivers, and reservoirs occurs, causing turbidity levels to increase. In most cases, the particle sizes are relatively large and settle relatively quickly in both the water treatment plant and the source of supply. However, in some instances, fine, colloidal material may be present in the supply, which may cause some difficulty in the coagulation process.

- A. True      B. False

29. Low \_\_\_\_\_ waters can be very difficult to coagulate due to the difficulty in inducing collision between the colloids.

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

30. \_\_\_\_\_ 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      C. Total Dissolved Solids (TDS)  
B. Organic colloids      D. None of the above

### **Turbidity MCL**

31. 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      C. Temperature  
B. Turbidity      D. None of the above

32. The temperature variation of a sample, a scratched or unclean sample tube in the nephelometer and selecting an incorrect wavelength of a light path may be conditions caused by an inaccurate \_\_\_\_\_ measurement.

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

### **Dissolved Oxygen**

33. 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      C. E. coli bacteria  
B. Organic matter      D. None of the above

34. 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      C. Solubility of oxygen  
B. Thermal stratification      D. None of the above

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

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

36. Thermal stratification is possible as water becomes less dense when heated, meaning water weighs less per unit volume. Therefore, warmer water will be lighter and colder water will be heavier. Due to this, there will always be a level of “self-induced” \_\_\_\_\_ in a water storage.

- A. Saturation level(s)
- B. Thermal stratification
- C. Permanent hardness
- D. None of the above

### Secondary Standard

37. 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

38. The Environmental Protection Agency (EPA), which is responsible for drinking water regulations in the United States, has identified TDS as a secondary standard, meaning that it is a voluntary guideline. While the United States set legal standards for many harmful substances, TDS, along with other contaminants that cause aesthetic, cosmetic, and technical effects, has only a guideline.

- A. True
- B. False

### Langelier Saturation Index

39. 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

40. 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

41. Safe Drinking Water Act (SDWA) has been highly effective in protecting public health and has evolved to respond to new and emerging threats to safe drinking water.

- A. True
- B. False

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

- A. Cryptosporidium
- B. E. coli host culture
- C. Protozoa
- D. None of the above

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

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

44. 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)?

45. 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

46. Total trihalomethanes and haloacetic acids are widely occurring \_\_\_\_\_ formed during disinfection with chlorine and chloramine.

- A. Gases
- B. Substances
- C. Classes of DBPs
- D. None of the above

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

47. 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:

48. 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

49. Secondary by-products are also formed when multiple disinfectants are used.

- A. True
- B. False

50. The EPA Surface Water Treatment Rule (SWTR) requires systems using public water supplies from either surface water or groundwater under the direct influence of surface water to disinfect.

- A. True
- B. False

### Public Health Concerns

51. 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

#### The IPCS (IPCS 2000, p. 375) reached similar conclusions:

52. \_\_\_\_\_ 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

53. 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

54. 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

55. 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

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

#### Coagulation and Clarification

56. Most treatment plants optimize their coagulation process for \_\_\_\_\_ removal.
- A. Inorganic coagulants
  - B. Most contaminants
  - C. Turbidity (particle)
  - D. None of the above
57. Coagulation processes can also be optimized for natural organic matter removal with higher doses of \_\_\_\_\_ (such as alum or iron salts), and optimization of pH.
- A. THMs and HAAs
  - B. Inorganic coagulants
  - C. Natural organic matter
  - D. None of the above

#### Absorption

58. 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

59. Other conventional methods of reducing DBP formation include changing the point of chlorination and using \_\_\_\_\_ for residual disinfection.
- A. Free residual disinfection
  - B. Chloramines
  - C. Total residual disinfection
  - D. None of the above
60. EPA predicted that most water systems will be able to achieve compliance with new DBP regulations through the use of one or more of these relatively low cost methods (EPA, 1998). Water system managers may also consider switching from chlorine to alternative disinfectants to reduce formation of \_\_\_\_\_.
- A. THMs and HAAs
  - B. Optimization of pH
  - C. Natural organic matter
  - D. None of the above

#### Organisms Descriptors and Meanings

61. Litho means...
- A. Rock
  - B. Organic
  - C. Light
  - D. None of the above
62. Organo means...
- A. Rock
  - B. Organic
  - C. Light
  - D. None of the above
63. Auto means...
- A. Without air
  - B. With air
  - C. Self (Inorganic carbon)
  - D. None of the above
64. Facultative means...
- A. Without air
  - B. With air or without air
  - C. Self (Inorganic carbon)
  - D. None of the above

65. Aerobic means...
- A. Without air            C. Self (Inorganic carbon)  
 B. With air                D. None of the above
66. Photo means...
- A. Feed or nourish        C. Light  
 B. Other (Organic carbon) D. None of the above
67. Troph means...
- A. Feed or nourish        C. Light  
 B. Other (Organic carbon) D. None of the above
68. Chemo means...
- A. Rock            C. Chemical  
 B. Organic        D. None of the above
69. Hetero means...
- A. Feed or nourish        C. Light  
 B. Other (Organic carbon) D. None of the above
70. Anaerobic means...
- A. Without air            C. Self (Inorganic carbon)  
 B. With air                D. None of the above

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

71. 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            C. Inorganic contaminants  
 B. Pesticides and herbicides            D. Microbial contaminants
72. Which of the following can be synthetic and volatile organic chemicals, which are by-products of industrial processes and petroleum production, and can come from gas stations, urban stormwater run-off, and septic systems?
- A. Organic chemical contaminants        C. Inorganic contaminants  
 B. Pesticides and herbicides                D. Microbial contaminants
73. Which of the following can be naturally occurring or be the result of oil and gas production and mining activities?
- A. Radioactive contaminants            C. Inorganic contaminants  
 B. Pesticides and herbicides            D. Microbial contaminants

**Background**

74. 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**

75. 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

76. The sample sitting plan identifies sampling frequency and locations throughout the distribution system that are selected to be representative of conditions in the entire system.

- A. True      B. False

77. 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**

78. Total coliform samples must be collected by PWSs at sites that 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

79. 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

80. 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**

81. 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

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

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

83. 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

84. 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

85. Which of the following can cause bacillary dysentery?

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

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

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

87. Which of the following are microscopic organisms that live in the intestines of warm-blooded animals? They also live in the waste material, or feces, excreted from the intestinal tract. When fecal coliform bacteria are present in high numbers in a water sample, it means that the water has received fecal matter from one source or another.

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

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

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

89. Which of the following are bacteria whose presence indicates that the water may be contaminated with human or animal wastes? Microbes in these wastes can cause short-term effects, such as diarrhea, cramps, nausea, headaches, or other symptoms.

- A. Fecal Coliform and E. coli
- B. Cryptosporidium
- C. Shigella dysenteriae
- D. None of the above

### **Bacteriological Monitoring Introduction**

90. Which of the following are usually harmless, occur in high densities in their natural environment and are easily cultured in relatively simple bacteriological media?

- A. Indicator bacteria
- B. Amoebas
- C. Viruses
- D. None of the above

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

- A. Cryptosporidium
- B. Protozoa
- C. Escherichia coli (E. coli)
- D. None of the above

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

- A. Contamination
- B. Colloids
- C. Coliform bacteria
- D. None of the above

### **Bacteria Sampling**

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

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

### **Methods**

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

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

### **Microbial Regulations**

95. One of the key regulations developed and implemented by the United States Environmental Protection Agency (USEPA) to counter pathogens in drinking water is the Surface Water Treatment Rule.

- A. True
- B. False

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

**Basic Types of Water Samples**

97. It is important to properly identify the type of sample you are collecting.
- A. True                      B. False

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

98. 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

99. 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

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

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

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

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

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

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

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

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

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

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

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

**Maximum Contaminant Levels (MCLs)**

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

- A. True                      B. False

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

- A. True                      B. False

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

- A. True                      B. False

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

108. 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

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

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

### **Heterotrophic Plate Count HPC**

110. 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)**

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

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

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

112. 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

113. 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

114. 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

115. 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

116. 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
- B. Reduced monitoring
- C. Microbial contamination
- D. Repeat water samples

117. PN is required for violations incurred. Within required timeframes, the PWS must use the required health effects language and notify the public if they did not comply with certain requirements of the RTCR. The type of \_\_\_\_\_ depends on the severity of the violation.

- A. CCR(s)
- B. PN
- C. MCL violation
- D. TC+ routine or repeat sample

118. The RTCR requires public water systems that are vulnerable to microbial contamination to identify and fix problems.

- A. True
- B. False

119. The water provider shall collect repeat samples (at least 3) for each TC+ positive routine sample.

- A. True
- B. False

120. For PWSs on quarterly or annual routine sampling, collect additional routine samples (at least 3) in the month after a \_\_\_\_\_.

- A. CCR(s)
- B. PN
- C. Total coliform positive samples
- D. TC+ routine or repeat sample

121. PWSs incur violations if they do not comply with the requirements of the RTCR. The violation types are essentially the same as under the TCR with few changes. The biggest change is no acute or monthly MCL violation for \_\_\_\_\_ only.

- A. CCR(s)
- B. PN
- C. Total coliform positive samples
- D. TC+ routine or repeat sample

122. Community water systems (CWSs) must use specific language in their CCRs when they must conduct an assessment or if they incur \_\_\_\_\_.

- A. CCR(s)
- B. PN
- C. An E. coli MCL violation
- D. TC+ routine or repeat sample

123. The water provider shall analyze all \_\_\_\_\_ that are total coliform positive (TC+) for E. coli.

- A. Routine or repeat water samples
- B. Reduced monitoring
- C. Microbial contamination
- D. None of the above

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

- A. True
- B. False

125. The RTCR suggests the frequency and timing of required microbial testing based on, public water type and source water type.

- A. True
- B. False

### Disinfection Key

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

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

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

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

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

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

129. The RTCR requires the chlorine residual leaving the plant must be = or \_\_\_\_\_ mg/L and measurable throughout the system.

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

### Waterborne Pathogen Section - Introduction

#### Pathogen Section

130. 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.

131. 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

132. 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

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

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

#### Giardia lamblia

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

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

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



135. All of these diseases, with the exception of \_\_\_\_\_, have one symptom in common: diarrhea. They also have the same mode of transmission, fecal-oral, whether through person-to-person or animal-to-person contact.
- A. HIV infection      C. Hepatitis A  
B. Giardiasis      D. None of the above

### Primary Waterborne Diseases Section

#### Salmonella typhi

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

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

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

- A. True      B. False

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

- A. True      B. False

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

- A. True      B. False

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

- A. True      B. False

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

- A. Hepatitis A virus      C. Pseudomonas  
B. Legionella      D. None of the above

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

- A. True      B. False

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

- A. Internal protection      C. Containment protection  
B. Source protection      D. None of the above

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

- A. True      B. False

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

- A. Pontiac fever      C. Typhoid fever  
B. Yellow fever      D. None of the above

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

- A. 81 to 100      C. 71 and 77  
B. 110 to 210      D. None of the above

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

- A. True      B. False

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

- A. Internal protection      C. Containment protection  
B. Source protection      D. None of the above

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

- A. Swimmer's itch      C. Hemorrhagic colitis  
B. Beaver fever      D. None of the above

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

- A. True      B. False

### **Waterborne Bacterial Diseases**

151. 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**

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

- A. True      B. False

### **Chain of Custody Procedures**

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

- A. TC Plan      C. Samples transfer possession  
B. Sample siting plan      D. None of the above

154. The recipient will then attach the \_\_\_\_\_ showing the transfer dates and times to the custody sheets. If the samples are split and sent to more than one laboratory, prepare a separate chain of custody record for each sample.

- A. Shipping invoices      C. Sample siting plan  
B. Chain of custody release      D. None of the above

### **Factors in Chlorine Disinfection: Concentration and Contact Time**

155. Based on the work of several researchers, CXT values [ final free chlorine concentration (mg/L) multiplied by minimum contact time (minutes)], offer water operators guidance in computing an effective combination of chlorine concentration and \_\_\_\_\_ required to achieve disinfection of water at a given temperature.

- A. Chlorine concentration      C. Higher strength chlorine solutions  
B. Chlorine contact time      D. None of the above

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

156. The CXT formula demonstrates that if an operator chooses to decrease the chlorine concentration, the required \_\_\_\_\_ must be lengthened.

- A. Chlorine concentration
- B. Temperature
- C. Contact time
- D. None of the above

### **Water Treatment Section - Preliminary Treatment Process**

#### **Preliminary Treatment**

157. 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

#### **Pre-Sedimentation**

158. 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)
- B. Coagulation basin(s)
- C. Sedimentation basin(s)
- D. None of the above

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

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

160. 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
- B. Conveyor belts
- C. Manual skimmer
- D. None of the above

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

- A. True
- B. False

#### **Flights and Chains**

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

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

#### **Circular Clarifiers**

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

- A. True
- B. False

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

- A. True
- B. False

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

- A. True
- B. False

166. 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

167. Which of the following processes uses alum and cationic polymer to neutralize the charge of colloidal particles?

- A. Filtration
- B. Reconditioning
- C. Flocculation
- D. None of the above

168. 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
- B. PAC
- C. Alum
- D. None of the above

169. 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
- B. Chemical pretreatment
- C. Slow Sand Filtration
- D. None of the above

170. Which of the following processes lasts about 5 to 10 minutes?

- A. Filter-to-Waste
- B. Reconditioning cycle
- C. Fast rinse
- D. None of the above

171. Which of the following terms is often used to enhance filter performance?

- A. Conventional technology
- B. Chemical pretreatment
- C. Fast rinse
- D. None of the above

172. 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

173. Which of the following terms may increase filtered water clarity, measured in NTU, by 90% compared with filtration alone?

- A. Chemical pretreatment
- B. Reconditioning cycle
- C. Fast rinse
- D. None of the above

174. Water treatment systems use settling tanks unit to allow for \_\_\_\_\_.

- A. Gravity
- B. Particle(s)
- C. Settling time
- D. Sedimentation and settling

175. The main aim of tube settlers is to minimize the \_\_\_\_\_ that a small floc particle must settle before agglomerating into larger particles.

- A. Gravity
- B. Vertical distance
- C. Settling time
- D. Solids

### Conventional Water Treatment Process Introduction

176. \_\_\_\_\_ along with pre-chlorination for removal of dissolved iron when present with small amounts relative of manganese

- A. Disinfection
- B. Coagulation
- C. Pre-treatment
- D. Aeration

177. \_\_\_\_\_ for algae control and arresting biological growth

- A. Sodium hydroxide
- B. UV
- C. Pre-treatment
- D. Ferric Chloride

178. Coagulant aids, also known as polyelectrolytes – to improve \_\_\_\_\_ and for more robust floc formation

- A. Disinfection
- B. Coagulation
- C. Pre-treatment
- D. Aeration along with pre-chlorination

179. \_\_\_\_\_ for settling and the removal of suspended solids trapped in the floc

- A. Disinfection
- B. Coagulation
- C. Pre-treatment
- D. Sedimentation

180. \_\_\_\_\_ 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
- B. Coagulation
- C. Pre-treatment
- D. Filtration

181. \_\_\_\_\_ for killing bacteria viruses and other pathogens.

- A. Disinfection
- B. Coagulation
- C. Pre-treatment
- D. Aeration along with pre-chlorination

182. \_\_\_\_\_ or slow-sand filtration

- A. Disinfection
- B. Coagulation
- C. Pre-treatment
- D. Coagulation or flocculation

### **Treatment Design and Plant Operation**

183. SCADA (Supervisory Control and Data Acquisition) automation of water treatment is common in the US. Source water quality through the seasons, scale, and environmental impact can dictate capital costs and operating costs. End use of the treated water dictates the necessary quality monitoring technologies.

- A. True
- B. False

### **SWTR Rule**

184. Turbidity is caused by particles suspended in water. These particles scatter or reflect light rays, making the water appear cloudy.

- A. True
- B. False

185. 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

186. 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

### **Zeta Potential Introduction**

187. 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

188. 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

189. 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**

190. 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

191. 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

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

A. True      B. False

### **Purpose of Coagulation**

193. 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**

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

A. True      B. False

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

A. True      B. False

196. 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**

197. 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**

198. 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)

199. 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

200. 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

201. 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

202. 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

203. 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

204. 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

205. 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)

206. 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

207. 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

## Factors Influencing Coagulation

### Effects of pH

208. 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

209. 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

210. 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

211. 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

212. 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

213. 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

### Nature of Turbidity

214. 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

215. 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



216. 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**

217. 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

### **Mixing Effects**

218. Poor or inadequate mixing results in an uneven dispersion of the coagulant. Unfortunately, many older plants were designed with mixing facilities which 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

219. 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**

220. 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**

221. 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
- B. Lead and copper
- C. Lead and cadmium
- D. None of the above

222. 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

### **Cathodic Protection**

#### **Sacrificial Anode Systems**

223. Sacrificial anodes are pieces of metal more electrically active than the steel piping system. Because these anodes are more active, the corrosive current will exit from them rather than the piping system.

- A. True
- B. False

## Coagulation and Flocculation Summary

### Rapid Sand Filtration

224. 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

225. 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

226. 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

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

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

228. 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

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

- A. True
- B. False

230. 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

231. 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

232. 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

### Flocculation

233. 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

234. 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

235. 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

236. 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

237. 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**

238. 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**

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

- A. True
- B. False

240. 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**

241. The filter flow rate will vary with?

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

242. 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

#### **Disinfection**

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

- A. True
- B. False

244. Chlorine is added again after filtration for?

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

#### **Jar Testing**

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

- A. True
- B. False

## **pH**

246. 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

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

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

## **Caustic**

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

- A. True                      B. False

## **Polymer**

249. 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**

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

- A. True                      B. False

## **Pre-Chlorination**

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

- A. True                      B. False

## **Hydrofluosilicic Acid**

252.  $\text{H}_2\text{SiF}_6$  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**

253. 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**

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

- A. True                      B. False

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

- A. True                      B. False

256. 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**

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

- A. True                      B. False

258. 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**

259. 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

260. 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

### **Adsorption Clarifiers**

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

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

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

- A. True                      B. False

### **Filtration Overview**

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

- A. True                      B. False

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

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

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

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

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

### **EPA Filter Backwash Rule- Introduction**

266. 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

267. 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

## LT1FBR Required

268. 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

269. 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

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

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

271. 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

## Filtration Process- Detailed

272. 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

273. 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 or oxidation processes  
B. Serious problems in filter operation                      D. None of the above

274. 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

275. 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

### Types of Filters

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

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

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

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

### Rapid Sand Filters

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

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

### False floor

279. 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
- C. Filter underdrain
- B. Leopold system
- D. None of the above

### Filtration Processes

280. 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

### High Rate Filters

281. High rate filters, which operate at a rate up to ten times that of a rapid sand filter.

- A. True
- B. False

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

- A. True
- B. False

### Pressure Sand Filters

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

- A. True
- B. False

284. 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

### Backwashing Process

285. 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

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

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

### Control of Filter Flow Rate

287. 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

### Advanced Water Treatment Section

288. 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

### Occurrence of Hard Water

289. 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

### Types of Hardness

290. 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

291. 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

### Types of Processes

292. 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

293. According to the text, it is impossible to separate the constituents of azeotropic liquids or solutes which form isomorphous crystals by distillation or recrystallization but such separations can be achieved using \_\_\_\_\_.

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

### Reverse Osmosis

294. 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

295. 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



## Water Laboratory Analysis Section

### pH Testing Section

296. 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

297. Pure water has a pH very close to?

- A. 7
- B. 7.5
- C. 7.7
- D. None of the above

298. 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

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

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

300. Sodium hydroxide, NaOH, is an example of a?

- A. Weak base
- B. Strong base
- C. Strong acid
- D. None of the above

## When Finished with Your Assignment...

### REQUIRED DOCUMENTS

Please scan the **Registration Page**, **Answer Key**, **Proctoring report**, **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 documents to TLC, if you fax, call to confirm that we received your paperwork. **(928) 468-0675**