

**Registration form**

**Water Treatment Fundamentals CEU Training Course \$200.00  
48 HOUR RUSH ORDER PROCESSING FEE ADDITIONAL \$40.00**

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

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

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

*(This will appear on your certificate as above)*

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

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

**Phone:**

**Home** ( ) \_\_\_\_\_ **Work** ( ) \_\_\_\_\_ **Fax** ( ) \_\_\_\_\_

**Operator ID#** \_\_\_\_\_ **Expiration Date** \_\_\_\_\_

**Class/Grade** \_\_\_\_\_

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

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

Water Treatment   Water Distribution   Wastewater Collection   Wastewater Treatment

Onsite Installer   Other \_\_\_\_\_

**Technical Learning College**  
Western Campus  
PO Box 420, Payson AZ 85547-0420  
(928) 468-0665 Fax (928) 272-0747  
Toll Free (866) 557-1746  
[info@tlch2o.com](mailto:info@tlch2o.com)

**3 digit code on back of card** \_\_\_\_\_

**American Express**

**Visa or MasterCard #** \_\_\_\_\_ **Exp. Date** \_\_\_\_\_

**If you've paid on the Internet, Please write your customer#** \_\_\_\_\_

**Referral's Name** \_\_\_\_\_

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

**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 \$40.00. 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.**

**Thank you...**

## Treatment 2 Answer Key

Name \_\_\_\_\_

Phone Number \_\_\_\_\_

Address \_\_\_\_\_

Please circle or X

- |               |               |                |                |
|---------------|---------------|----------------|----------------|
| 1. A B C D E  | 42. A B C D E | 83. A B C D E  | 124. A B C D E |
| 2. A B C D E  | 43. A B C D E | 84. A B C D E  | 125. A B C D E |
| 3. A B C D E  | 44. A B C D E | 85. A B C D E  | 126. A B C D E |
| 4. A B C D E  | 45. A B C D E | 86. A B C D E  | 127. A B C D E |
| 5. A B C D E  | 46. A B C D E | 87. A B C D E  | 128. A B C D E |
| 6. A B C D E  | 47. A B C D E | 88. A B C D E  | 129. A B C D E |
| 7. A B C D E  | 48. A B C D E | 89. A B C D E  | 130. A B C D E |
| 8. A B C D E  | 49. A B C D E | 90. A B C D E  | 131. A B C D E |
| 9. A B C D E  | 50. A B C D E | 91. A B C D E  | 132. A B C D E |
| 10. A B C D E | 51. A B C D E | 92. A B C D E  | 133. A B C D E |
| 11. A B C D E | 52. A B C D E | 93. A B C D E  | 134. A B C D E |
| 12. A B C D E | 53. A B C D E | 94. A B C D E  | 135. A B C D E |
| 13. A B C D E | 54. A B C D E | 95. A B C D E  | 136. A B C D E |
| 14. A B C D E | 55. A B C D E | 96. A B C D E  | 137. A B C D E |
| 15. A B C D E | 56. A B C D E | 97. A B C D E  | 138. A B C D E |
| 16. A B C D E | 57. A B C D E | 98. A B C D E  | 139. A B C D E |
| 17. A B C D E | 58. A B C D E | 99. A B C D E  | 140. A B C D E |
| 18. A B C D E | 59. A B C D E | 100. A B C D E | 141. A B C D E |
| 19. A B C D E | 60. A B C D E | 101. A B C D E | 142. A B C D E |
| 20. A B C D E | 61. A B C D E | 102. A B C D E | 143. A B C D E |
| 21. A B C D E | 62. A B C D E | 103. A B C D E | 144. A B C D E |
| 22. A B C D E | 63. A B C D E | 104. A B C D E | 145. A B C D E |
| 23. A B C D E | 64. A B C D E | 105. A B C D E | 146. A B C D E |
| 24. A B C D E | 65. A B C D E | 106. A B C D E | 147. A B C D E |
| 25. A B C D E | 66. A B C D E | 107. A B C D E | 148. A B C D E |
| 26. A B C D E | 67. A B C D E | 108. A B C D E | 149. A B C D E |
| 27. A B C D E | 68. A B C D E | 109. A B C D E | 150. A B C D E |
| 28. A B C D E | 69. A B C D E | 110. A B C D E | 151. A B C D E |
| 29. A B C D E | 70. A B C D E | 111. A B C D E | 152. A B C D E |
| 30. A B C D E | 71. A B C D E | 112. A B C D E | 153. A B C D E |
| 31. A B C D E | 72. A B C D E | 113. A B C D E | 154. A B C D E |
| 32. A B C D E | 73. A B C D E | 114. A B C D E | 155. A B C D E |
| 33. A B C D E | 74. A B C D E | 115. A B C D E | 156. A B C D E |
| 34. A B C D E | 75. A B C D E | 116. A B C D E | 157. A B C D E |
| 35. A B C D E | 76. A B C D E | 117. A B C D E | 158. A B C D E |
| 36. A B C D E | 77. A B C D E | 118. A B C D E | 159. A B C D E |
| 37. A B C D E | 78. A B C D E | 119. A B C D E | 160. A B C D E |
| 38. A B C D E | 79. A B C D E | 120. A B C D E | 161. A B C D E |
| 39. A B C D E | 80. A B C D E | 121. A B C D E | 162. A B C D E |
| 40. A B C D E | 81. A B C D E | 122. A B C D E | 163. A B C D E |
| 41. A B C D E | 82. A B C D E | 123. A B C D E | 164. A B C D E |

165. A B C D E      214. A B C D E      263. A B C D E      312. A B C D E  
166. A B C D E      215. A B C D E      264. A B C D E      313. A B C D E  
167. A B C D E      216. A B C D E      265. A B C D E      314. A B C D E  
168. A B C D E      217. A B C D E      266. A B C D E      315. A B C D E  
169. A B C D E      218. A B C D E      267. A B C D E      316. A B C D E  
170. A B C D E      219. A B C D E      268. A B C D E      317. A B C D E  
171. A B C D E      220. A B C D E      269. A B C D E      318. A B C D E  
172. A B C D E      221. A B C D E      270. A B C D E      319. A B C D E  
173. A B C D E      222. A B C D E      271. A B C D E      320. A B C D E  
174. A B C D E      223. A B C D E      272. A B C D E      321. A B C D E  
175. A B C D E      224. A B C D E      273. A B C D E      322. A B C D E  
176. A B C D E      225. A B C D E      274. A B C D E      323. A B C D E  
177. A B C D E      226. A B C D E      275. A B C D E      324. A B C D E  
178. A B C D E      227. A B C D E      276. A B C D E      325. A B C D E  
179. A B C D E      228. A B C D E      277. A B C D E      326. A B C D E  
180. A B C D E      229. A B C D E      278. A B C D E      327. A B C D E  
181. A B C D E      230. A B C D E      279. A B C D E      328. A B C D E  
182. A B C D E      231. A B C D E      280. A B C D E      329. A B C D E  
183. A B C D E      232. A B C D E      281. A B C D E      330. A B C D E  
184. A B C D E      233. A B C D E      282. A B C D E      331. A B C D E  
185. A B C D E      234. A B C D E      283. A B C D E      332. A B C D E  
186. A B C D E      235. A B C D E      284. A B C D E      333. A B C D E  
187. A B C D E      236. A B C D E      285. A B C D E      334. A B C D E  
188. A B C D E      237. A B C D E      286. A B C D E      335. A B C D E  
189. A B C D E      238. A B C D E      287. A B C D E      336. A B C D E  
190. A B C D E      239. A B C D E      288. A B C D E      337. A B C D E  
191. A B C D E      240. A B C D E      289. A B C D E      338. A B C D E  
192. A B C D E      241. A B C D E      290. A B C D E      339. A B C D E  
193. A B C D E      242. A B C D E      291. A B C D E      340. A B C D E  
194. A B C D E      243. A B C D E      292. A B C D E      341. A B C D E  
195. A B C D E      244. A B C D E      293. A B C D E      342. A B C D E  
196. A B C D E      245. A B C D E      294. A B C D E      343. A B C D E  
197. A B C D E      246. A B C D E      295. A B C D E      344. A B C D E  
198. A B C D E      247. A B C D E      296. A B C D E      345. A B C D E  
199. A B C D E      248. A B C D E      297. A B C D E      346. A B C D E  
200. A B C D E      249. A B C D E      298. A B C D E      347. A B C D E  
201. A B C D E      250. A B C D E      299. A B C D E      348. A B C D E  
202. A B C D E      251. A B C D E      300. A B C D E      349. A B C D E  
203. A B C D E      252. A B C D E      301. A B C D E      350. A B C D E  
204. A B C D E      253. A B C D E      302. A B C D E      351. A B C D E  
205. A B C D E      254. A B C D E      303. A B C D E      352. A B C D E  
206. A B C D E      255. A B C D E      304. A B C D E      353. A B C D E  
207. A B C D E      256. A B C D E      305. A B C D E      354. A B C D E  
208. A B C D E      257. A B C D E      306. A B C D E      355. A B C D E  
209. A B C D E      258. A B C D E      307. A B C D E      356. A B C D E  
210. A B C D E      259. A B C D E      308. A B C D E      357. A B C D E  
211. A B C D E      260. A B C D E      309. A B C D E      358. A B C D E  
212. A B C D E      261. A B C D E      310. A B C D E      359. A B C D E  
213. A B C D E      262. A B C D E      311. A B C D E      360. A B C D E

- 361. A B C D E
- 362. A B C D E
- 363. A B C D E
- 364. A B C D E
- 365. A B C D E
- 366. A B C D E
- 367. A B C D E
- 368. A B C D E
- 369. A B C D E
- 370. A B C D E
- 371. A B C D E
- 372. A B C D E
- 373. A B C D E
- 374. A B C D E
- 375. A B C D E
- 376. A B C D E
- 377. A B C D E
- 378. A B C D E
- 379. A B C D E
- 380. A B C D E
- 381. A B C D E
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- 393. A B C D E
- 394. A B C D E
- 395. A B C D E
- 396. A B C D E
- 397. A B C D E
- 398. A B C D E
- 399. A B C D E
- 400. A B C D E

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

**Rush Grading Service**

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

## **WATER TREATMENT FUNDAMENTALS COURSE CUSTOMER SERVICE RESPONSE CARD**

DATE: \_\_\_\_\_

NAME: \_\_\_\_\_

ADDRESS: \_\_\_\_\_

E-MAIL \_\_\_\_\_ PHONE \_\_\_\_\_

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

1. Please rate the difficulty of your course.

Very Easy    0       1       2       3       4       5    Very Difficult

2. Please rate the difficulty of the testing process.

Very Easy    0       1       2       3       4       5    Very Difficult

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

Very Similar   0       1       2       3       4       5    Very Different

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

5. What would you do to improve the Course?

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Any other concerns or comments.

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## Water Treatment Fundamentals CEU Training Assignment

*The Water Treatment Fundamentals 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).

1. Where the water is chlorinated to make sure to hold a residual in the distribution system.
  - A. Polymer
  - B. Pre-Chlorine
  - C. Prechlorination
  - D. Post Chlorine
2. A pH of 7 is considered to be \_\_\_\_\_. Most natural water has a pH between 6.0 and 8.5.
  - A. Base
  - B. Alkaline
  - C. Raise
  - D. Neutral
3. The addition of chlorine before the filtration process will help control algae and slime growth
  - A. Post Chlorine
  - B. Polymer
  - C. Prechlorination
  - D. None of the Above
4. Solids that have been removed from the raw water by the coagulation and settling processes.
  - A. Zinc Orthophosphate
  - B. Settled Solids
  - C. Corrosion Control
  - D. Taste and Odor Control
  - E. None of the Above
5. Caustic NaOH (also called Sodium Hydroxide) is a strong chemical used in the treatment process to neutralize acidity, increase alkalinity or \_\_\_\_\_ the pH value.
  - A. Neutral
  - B. Raise
  - C. Alkaline

6. Where the raw water is dosed with a large concentration of chlorine.
- A. Pre-Chlorine
  - B. Polymer
  - C. Chlorine
  - D. Prechlorination
7. The condition of turbidity of the water coming to the treatment plant from the raw water source is \_\_\_\_\_.
- A. Zinc Orthophosphate
  - B. Settled Solids
  - C. Corrosion Control
  - D. Taste and Odor Control
  - E. None of the Above
8. As with \_\_\_\_\_, it is important to remember that activities many miles away from you may affect the quality of ground water. Review Statements around page 123-127
- A. Well
  - B. Surface water
  - C. Community
  - D. Reservoirs
  - E. Aquifers
9. Your annual drinking \_\_\_\_\_ will tell you where your water supplier gets your water.
- A. Contaminants
  - B. Contaminated
  - C. Dissolved minerals
  - D. Discharge
  - E. None of the Above
10. Your water will normally contain chlorine and varying amounts of \_\_\_\_\_ including calcium, magnesium, sodium, chlorides, sulfates and bicarbonates, depending on its source.
- A. Contaminants
  - B. Contaminated
  - C. Dissolved minerals
  - D. Discharge
  - E. Insecticides
11. It is also not uncommon to find traces of iron, manganese, copper, aluminum, nitrates, \_\_\_\_\_ and herbicides.
- A. Contaminants
  - B. Contaminated
  - C. Dissolved minerals
  - D. Discharge
  - E. Insecticides

12. Although the maximum amounts of all these substances as mentioned above, are strictly limited by the regulations. These are usually referred to as \_\_\_\_\_.

- A. Contaminants
- B. Contaminated
- C. Dissolved minerals

13. Surface water is usually \_\_\_\_\_ and unsafe to drink.

- A. Contaminants
- B. Contaminated
- C. Dissolved minerals
- D. Discharge
- E. Insecticides

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

- A. Contaminants
- B. Contaminated
- C. Dissolved minerals
- D. Discharge
- E. Insecticides

15. \_\_\_\_\_ could produce mud, leaves, decayed vegetation, and human and animal refuse.

- A. Contaminants
- B. Contaminated
- C. Dissolved minerals
- D. Discharge
- E. Runoff

16. The discharge from industry could increase \_\_\_\_\_.

- A. Contaminants
- B. Contaminated
- C. Volatile organic compounds
- D. Discharge
- E. Insecticides

17. Some lakes and \_\_\_\_\_ may experience seasonal turnover.

- A. Biological characteristics
- B. Chemical characteristics
- C. Physical characteristics
- D. Reservoirs

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

- A. Biological characteristics
- B. Chemical characteristics
- C. Physical characteristics
- D. Biological activities
- E. Reservoirs

19. \_\_\_\_\_ such as taste, odor, temperature, and turbidity; this is how the consumer judges how well the provider is treating the water.

- A. Biological characteristics
- B. Chemical characteristics
- C. Physical characteristics
- D. Biological activities
- E. Reservoirs

20. \_\_\_\_\_ are the elements found that are considered alkali, metals, and non metals such as fluoride, sulfides or acids. The consumer relates it to scaling of faucets or staining.

- A. Biological characteristics
- B. Chemical characteristics
- C. Physical characteristics
- D. Biological activities
- E. Reservoirs

21. \_\_\_\_\_ are the presence of living or dead organisms.

- A. Biological characteristics
- B. Chemical characteristics
- C. Physical characteristics
- D. Biological activities
- E. Reservoirs

22. \_\_\_\_\_ will also interact with the chemical composition of the water. The consumer will become sick or complain about hydrogen sulfide odors, the rotten egg smell.

- A. Biological characteristics
- B. Chemical characteristics
- C. Physical characteristics
- D. Biological activities
- E. Reservoirs

23. \_\_\_\_\_ are the result of water coming in contact with radioactive materials. This could be associated with atomic energy.

- A. Biological characteristics
- B. Chemical characteristics
- C. Radiological characteristics
- D. Biological activities
- E. Reservoirs

24. Most of these substances are of \_\_\_\_\_ and are picked up as water passes around the water cycle.

- A. Natural origin
- B. Treatment processes
- C. Relatively low level
- D. May enter the water cycle
- E. To remove color

25. Some are present due to the \_\_\_\_\_ which are used make the water suitable for drinking and cooking.
- A. Natural origin
  - B. Treatment processes
  - C. Relatively low level
  - D. May enter the water cycle
  - E. To remove color
26. The water will also contain a \_\_\_\_\_ of bacteria, which are not generally a risk to health.
- A. Natural origin
  - B. Treatment processes
  - C. Relatively low level
  - D. May enter the water cycle
  - E. To remove color
27. Insecticides and herbicides (sometimes referred to as pesticides) are widely used in agriculture, industry, leisure facilities and gardens to control weeds and insect pests and \_\_\_\_\_ in many ways.
- A. Natural origin
  - B. Treatment processes
  - C. Relatively low level
  - D. May enter the water cycle
  - E. To remove color
28. Aluminum salts are added during water treatment \_\_\_\_\_ and suspended solids.
- A. Natural origin
  - B. Treatment processes
  - C. Relatively low level
  - D. May enter the water cycle
  - E. To remove color
29. Lead does not usually occur naturally in water supplies but is derived from lead distribution and domestic \_\_\_\_\_ and fittings.
- A. Particles and rust
  - B. Permanent
  - C. Pipework
  - D. Temporary
  - E. Cysts
30. Water suppliers have removed most of the original \_\_\_\_\_ from the mains distribution system, many older properties still have lead service pipes and internal lead pipework.
- A. Particles and rust
  - B. Permanent
  - C. Pipework
  - D. Lead Piping
  - E. Cysts

31. The \_\_\_\_\_ (including the service pipe) within the boundary of the property is the responsibility of the owner of the property, not the water supplier.
- A. Particles and rust
  - B. Permanent
  - C. Pipework
  - D. Temporary
  - E. Cysts
32. There are two types of \_\_\_\_\_: temporary and permanent.
- A. Particles and rust
  - B. Permanent
  - C. Pipework
  - D. Temporary
  - E. None of the Above
33. \_\_\_\_\_ hardness comes out of the water when it's heated and is deposited as scale and fur on kettles, coffee makers and taps and appears as a scum or film on tea and coffee.
- A. Particles and rust
  - B. Permanent
  - C. Pipework
  - D. Temporary
  - E. Cysts
34. \_\_\_\_\_ hardness is unaffected by heating.
- A. Particles and rust
  - B. Permanent
  - C. Pipework
  - D. Temporary
  - E. Cysts
35. \_\_\_\_\_ are associated with the reproductive stages of parasitic micro-organisms (protozoans) which can cause acute diarrhea type illnesses; they come from farm animals, wild animals and people.
- A. Particles and rust
  - B. Permanent
  - C. Pipework
  - D. Temporary
  - E. Cysts
36. \_\_\_\_\_ are very resistant to normal disinfection processes but can be removed by advanced filtration processes installed in water treatment works.
- A. Particles and rust
  - B. Permanent
  - C. Pipework
  - D. Temporary
  - E. Cysts

37. \_\_\_\_\_ are rarely present in the public water supply.
- A. Particles and rust
  - B. Permanent
  - C. Pipework
  - D. Temporary
  - E. Cysts
38. \_\_\_\_\_ come from the gradual breakdown of the lining of concrete or iron mains water pipes or from sediment which has accumulated over the years and is disturbed in some way. Find in Source water quality section page 126-128
- A. Particles and rust
  - B. Permanent
  - C. Pipework
  - D. Temporary
  - E. Cysts
39. \_\_\_\_\_ contributes most of all of the water that is derived from wells or springs.
- A. Percolates
  - B. Precipitation
  - C. Wells or springs
  - D. Groundwater
  - E. Drinkable water
40. \_\_\_\_\_ occurs in the natural open spaces (e.g., fractures or pore spaces between grains) in sediments and rocks below the surface.
- A. Percolates
  - B. Precipitation
  - C. Wells or springs
  - D. Groundwater
  - E. Drinkable water
41. \_\_\_\_\_ is distributed fairly evenly throughout the crust of the earth, but it is not readily accessible or extractable everywhere.
- A. Percolates
  - B. Precipitation
  - C. Wells or springs
  - D. Groundwater
  - E. Drinkable water
42. More than 90 percent of the world's total supply of \_\_\_\_\_ is groundwater.
- A. Percolates
  - B. Precipitation
  - C. Wells or springs
  - D. Groundwater
  - E. Drinkable water

43. Groundwater originates as \_\_\_\_\_ that sinks into the ground.
- A. Percolates
  - B. Precipitation
  - C. Wells or springs
  - D. Groundwater
  - E. Drinkable water
44. Some of this water \_\_\_\_\_ down to the water table (shallowest surface of the groundwater) and recharges the aquifer.
- A. Percolates
  - B. Precipitation
  - C. Wells or springs
  - D. Groundwater
  - E. Drinkable water
45. For shallow wells (for example less than 50-75 feet), the recharge area is often the immediate vicinity around the well or "wellhead." Some wells are \_\_\_\_\_ in areas that may be a great distance from the well itself.
- A. Percolates
  - B. Precipitation
  - C. Wells or springs
  - D. Groundwater
  - E. None of the Above
46. If the downward percolating \_\_\_\_\_ encounters any source of contamination, at the surface or below it, the water may dissolve some of that contaminant and carry it to the aquifer.
- A. Percolates
  - B. Precipitation
  - C. Wells or springs
  - D. Groundwater
  - E. Drinkable water
47. \_\_\_\_\_ moves from areas where the water table is high to where the water table is low.
- A. Percolates
  - B. Precipitation
  - C. Well
  - D. Groundwater
  - E. Drinkable water
48. Consequently, a contaminant may enter the aquifer some distance upgradient from you and still move towards your \_\_\_\_\_.
- A. Percolates
  - B. Precipitation
  - C. Well
  - D. Groundwater
  - E. Drinkable water

49. When a well is pumping, it lowers the water table in the immediate vicinity of the well, increasing the tendency for water to move towards the \_\_\_\_\_.

- A. Percolates
- B. Precipitation
- C. Well
- D. Groundwater
- E. Drinkable water

50. \_\_\_\_\_ can be conveniently lumped into three categories: microorganisms (bacteria, viruses, Giardia, etc.), inorganic chemicals (nitrate, arsenic, metals, etc.) and organic chemicals (solvents, fuels, pesticides, etc.).

- A. Trichloroethylene
- B. Microbes
- C. Contaminants
- D. Coliform bacteria
- E. Human or animal wastes

51. One gallon of pure \_\_\_\_\_, a common solvent, will contaminate approximately 292 million gallons of water.

- A. Trichloroethylene
- B. Microbes
- C. Contaminants
- D. Coliform bacteria
- E. Human or animal wastes

52. \_\_\_\_\_ are common in the environment and are generally not harmful.

- A. Trichloroethylene
- B. Microbes
- C. Contaminants
- D. Coliform bacteria
- E. Human or animal wastes

53. 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. Trichloroethylene
- B. Microbes
- C. Contaminants
- D. Coliform bacteria
- E. Human or animal wastes

54. Fecal Coliform and E coli are bacteria whose presence indicates that the water may be contaminated with \_\_\_\_\_.

- A. Trichloroethylene
- B. Microbes
- C. Contaminants
- D. Coliform bacteria
- E. Human or animal wastes

55. \_\_\_\_\_ in these wastes can cause short-term effects, such as diarrhea, cramps, nausea, headaches, or other symptoms.
- A. Trichloroethylene
  - B. Microbes
  - C. Contaminants
  - D. Coliform bacteria
  - E. Human or animal wastes
56. \_\_\_\_\_ is a parasite that enters lakes and rivers through sewage and animal waste.
- A. Cryptosporidium
  - B. Cryptosporidiosis
  - C. Giardia lamblia
  - D. Gastrointestinal illness
  - E. None of the Above
57. Cryptosporidium causes \_\_\_\_\_, a mild gastrointestinal disease.
- A. Cryptosporidium
  - B. Cryptosporidiosis
  - C. Giardia lamblia
  - D. Gastrointestinal illness
  - E. None of the Above
58. \_\_\_\_\_ disease can be severe or fatal for people with severely weakened immune systems.
- A. Cryptosporidium
  - B. Cryptosporidiosis
  - C. Giardia lamblia
  - D. Gastrointestinal illness
  - E. None of the Above
59. The EPA and CDC have prepared advice for those with severely compromised immune systems who are concerned about \_\_\_\_\_.
- A. Cryptosporidium
  - B. Cryptosporidiosis
  - C. Giardia lamblia
  - D. Gastrointestinal illness
  - E. None of the Above
60. \_\_\_\_\_ is a parasite that enters lakes and rivers through sewage and animal waste.
- A. Cryptosporidium
  - B. Cryptosporidiosis
  - C. Giardia lamblia
  - D. Gastrointestinal illness
  - E. None of the Above

61. \_\_\_\_\_ causes gastrointestinal illness (e.g. diarrhea, vomiting, and cramps).
- A. Cryptosporidium
  - B. Cryptosporidiosis
  - C. Giardia lamblia
  - D. Gastrointestinal illness
  - E. None of the Above
62. \_\_\_\_\_ are a broad group of bacteria including nonpathogens, pathogens, and opportunistic pathogens; they may be an indicator of poor general biological quality of drinking water. Often referred to as HPC.
- A. Alpha emitters
  - B. Beta/photon emitters
  - C. Opportunistic pathogens
  - D. Combined Radium 226/228
  - E. HPC
63. Certain minerals are radioactive and may emit a form of radiation known as alpha radiation. Some people who drink water containing \_\_\_\_\_ in excess of the EPA standards over many years may have an increased risk of getting cancer.
- A. Alpha emitters
  - B. Beta/photon emitters
  - C. Opportunistic pathogens
  - D. Combined Radium 226/228
  - E. Radon gas
64. Certain minerals are radioactive and may emit forms of radiation known as photons and beta radiation. Some people who drink water containing \_\_\_\_\_ in excess of the EPA standards over many years may have an increased risk of getting cancer.
- A. Alpha emitters
  - B. Beta/photon emitters
  - C. Opportunistic pathogens
  - D. Combined Radium 226/228
65. Some people who drink water containing \_\_\_\_\_ in excess of the EPA standards over many years may have an increased risk of getting cancer.
- A. Alpha emitters
  - B. Beta/photon emitters
  - C. Opportunistic pathogens
  - D. Combined Radium 226/228
  - E. Radon gas
66. \_\_\_\_\_ can dissolve and accumulate in underground water sources, such as wells, and in the air in your home. Breathing radon can cause lung cancer. Drinking water containing radon presents a risk of developing cancer. Radon in air is more dangerous than radon in water.
- A. Alpha emitters
  - B. Beta/photon emitters
  - C. Opportunistic pathogens
  - D. Combined Radium 226/228
  - E. Radon gas

67. Some people who drink water containing \_\_\_\_\_ in excess of the EPA's standard over many years could experience skin damage or problems with their circulatory system, and may have an increased risk of getting cancer.

- A. Alpha emitters
- B. Beta/photon emitters
- C. Opportunistic pathogens
- D. Combined Radium 226/228
- E. Arsenic

68. Many communities add \_\_\_\_\_ to their drinking water to promote dental health. Each community makes its own decision about whether or not to add fluoride.

- A. MCLGs
- B. MCL
- C. Dental fluorosis
- D. Fluoride
- E. Lead

69. The EPA has set an enforceable drinking water standard for \_\_\_\_\_ of 4 mg/L (some people who drink water containing fluoride in excess of this level over many years could get bone disease, including pain and tenderness of the bones).

- A. MCLGs
- B. MCL
- C. Dental fluorosis
- D. Fluoride
- E. Lead

70. The EPA has also set a secondary fluoride standard of 2 mg/L to protect against \_\_\_\_\_.

- A. MCLGs
- B. MCL
- C. Dental fluorosis
- D. Fluoride
- E. Lead

71. \_\_\_\_\_, in its moderate or severe forms, may result in a brown staining and/or pitting of the permanent teeth. This problem occurs only in developing teeth, before they erupt from the gums.

- A. MCLGs
- B. MCL
- C. Dental fluorosis
- D. Fluoride
- E. Lead

72. Children under nine should not drink water that has more than 2 mg/L of \_\_\_\_\_.

- A. MCLGs
- B. MCL
- C. Dental fluorosis
- D. Fluoride
- E. Lead

73. \_\_\_\_\_ typically leaches into water from plumbing in older buildings.
- A. MCLGs
  - B. MCL
  - C. Dental fluorosis
  - D. Fluoride
  - E. Lead
74. \_\_\_\_\_ pipes and plumbing fittings have been banned since August 1998. Children and pregnant women are most susceptible to lead health risks.
- A. MCLGs
  - B. MCL
  - C. Dental fluorosis
  - D. Fluoride
  - E. Lead
75. For advice on avoiding \_\_\_\_\_, see the EPA's lead in your drinking water fact sheet.
- A. MCLGs
  - B. MCL
  - C. Dental fluorosis
  - D. Fluoride
  - E. Lead
76. The maximum level of a contaminant in drinking water at which no known or anticipated adverse effect on the health effect of persons would occur, and which allows for a proper margin of safety.
- A. MCLGs
  - B. MCL
  - C. Dental fluorosis
  - D. Fluoride
  - E. Lead
77. \_\_\_\_\_ are non-enforceable public health goals.
- A. MCLGs
  - B. MCL
  - C. Dental fluorosis
  - D. Fluoride
  - E. Lead
78. The maximum permissible level of a contaminant in water which is delivered to any user of a public water system.
- A. MCLGs
  - B. MCL
  - C. Dental fluorosis
  - D. Fluoride

79. MCLs are enforceable standards. The margins of safety in \_\_\_\_\_ ensure that exceeding the MCL slightly does not pose significant risk to public health.

- A. MCLGs
- B. MCL
- C. Dental fluorosis
- D. Fluoride
- E. Lead

80. \_\_\_\_\_ were not established before the 1986 Amendments to the Safe Drinking Water Act.

- A. MCLGs
- B. MCL
- C. Dental fluorosis
- D. Fluoride
- E. Lead

81. Lead and copper are regulated in a \_\_\_\_\_ which requires systems to take tap water samples at sites with lead pipes or copper pipes that have lead solder and/or are served by lead service lines.

- A. MCLGs
- B. MCL
- C. Dental fluorosis
- D. Treatment Technique
- E. Lead

82. The \_\_\_\_\_, which triggers water systems into taking treatment steps if exceeded in more than 10% of tap water samples, for copper is 1.3 mg/L, and for lead is 0.015mg/L.

- A. MCLGs
- B. MCL
- C. Dental fluorosis
- D. Action level
- E. Lead

83. Each water system must certify, in writing, to the state (using third-party or manufacturer's certification) that when \_\_\_\_\_ are used in drinking water systems, the combination (or product) of dose and monomer level does not exceed the levels specified, as follows: Acrylamide = 0.05% dosed at 1 mg/L (or equivalent)

- A. Acrylamide
- B. Epichlorohydrin
- C. All of the Above
- D. None of the Above

84. Each water system must certify, in writing, to the state (using third-party or manufacturer's certification) that when acrylamide and epichlorohydrin are used in drinking water systems, the combination (or product) of dose and monomer level does not exceed the levels specified, as follows: \_\_\_\_\_ = 0.01% dosed at 20 mg/L (or equivalent)

- A. Acrylamide
- B. Epichlorohydrin
- C. All of the Above

**The Surface Water Treatment Rule requires systems using surface water or ground water under the direct influence of surface water to (1) disinfect their water, and (2) filter their water or meet criteria for avoiding filtration so that the following contaminants are controlled at the following levels:**

85. \_\_\_\_\_: 99.9% killed/inactivated

- A. Legionella
- B. Viruses
- C. Giardia lamblia
- D. Turbidity
- E. Both B and C

86. No limit, but EPA believes that if \_\_\_\_\_ and viruses are inactivated, Legionella will also be controlled.

- A. Fecal coliform and E. coli
- B. Viruses
- C. Giardia lamblia
- D. Turbidity
- E. HPC

87. At no time can \_\_\_\_\_ (cloudiness of water) go above 5 nephelometric turbidity units (NTU); systems that filter must ensure that the turbidity go no higher than 1 NTU (0.5 NTU for conventional or direct filtration) in at least 95% of the daily samples in any month.

- A. Fecal coliform and E. coli
- B. Viruses
- C. Giardia lamblia
- D. Turbidity
- E. HPC

88. No more than 500 bacterial colonies per milliliter.

- A. Fecal coliform and E. coli
- B. Viruses
- C. Giardia lamblia
- D. Turbidity
- E. HPC

89. \_\_\_\_\_ are bacteria whose presence indicates that the water may be contaminated with human animal wastes. Microbes in these wastes can cause diarrhea, cramps, nausea, headaches, or other symptoms.

- A. Fecal coliform and E. coli
- B. Viruses
- C. Giardia lamblia
- D. Turbidity
- E. HPC

**Let's review some SDWA terms.**

90. A public water system that serves at least 15 service connections used by year-round residents of the area served by the system or regularly serves at least 25 year-round residents.

- A. Sole Source Aquifer (SSA) Designation
- B. Source Water Protection Area (SWPA)
- C. Significant Potential Source of Contamination
- D. Sub watershed
- E. None of the Above

91. An analysis to determine, with a clear understanding of where the significant potential sources of contamination are located, the susceptibility of the public water systems in the source water protection area to contamination from these sources. This analysis will assist the state in determining which potential sources of contamination are "significant."

- A. Susceptibility Analysis
- B. State Management Plan (SMP) Program
- C. Significant Potential Source of Contamination
- D. Surface Water Treatment Rule (SWTR)
- E. None of the Above

92. A facility or activity that stores, uses, or produces chemicals or elements, and that has the potential to release contaminants identified in a state program (contaminants with MCLs plus any others a state considers a health threat) within a source water protection area in an amount which could contribute significantly to the concentration of the contaminants in the source waters of the public water supply.

- A. Sole Source Aquifer (SSA) Designation
- B. Source Water Protection Area (SWPA)
- C. Significant Potential Source of Contamination
- D. Sub watershed
- E. None of the Above

93. The surface area above a sole source aquifer and its recharge area.

- A. Sole Source Aquifer (SSA) Designation
- B. Source Water Protection Area (SWPA)
- C. Significant Potential Source of Contamination
- D. Sub watershed
- E. None of the Above

94. The area delineated by the state for a PWS or including numerous PWSs, whether the source is ground water or surface water or both, as part of the state SWAP approved by the EPA under section 1453 of the SDWA.

- A. Sole Source Aquifer (SSA) Designation
- B. Source Water Protection Area (SWPA)
- C. Significant Potential Source of Contamination
- D. Sub watershed
- E. None of the Above

95. A topographic boundary that is the perimeter of the catchment area of a tributary of a stream.
- A. Sole Source Aquifer (SSA) Designation
  - B. Source Water Protection Area (SWPA)
  - C. Significant Potential Source of Contamination
  - D. Sub watershed
  - E. None of the Above
96. A state program implemented in accordance with the statutory language at section 1454 of the SDWA to establish local voluntary incentive-based partnerships for SWP and remediation.
- A. Sole Source Aquifer (SSA) Designation
  - B. Source Water Protection Area (SWPA)
  - C. Significant Potential Source of Contamination
  - D. Sub watershed
  - E. None of the Above
97. A state management plan under FIFRA required by the EPA to allow states (e.g. states, tribes and U.S. territories) the flexibility to design and implement approaches to manage the use of certain pesticides to protect ground water.
- A. Susceptibility Analysis
  - B. State Management Plan (SMP) Program
  - C. Significant Potential Source of Contamination
  - D. Surface Water Treatment Rule (SWTR)
  - E. None of the Above
98. Generally used in expressions of water use, gallons per capita per day (gpcd).
- A. Exposure Contact
  - B. Point-of-Use Water Treatment
  - C. Point-of-Entry Water Treatment
  - D. Per capita Per person
  - E. None of the Above
99. Refers to devices used in the home or office on a specific tap to provide additional drinking water treatment.
- A. Exposure Contact
  - B. Point-of-Use Water Treatment
  - C. Point-of-Entry Water Treatment
  - D. Per capita Per person
  - E. None of the Above
100. Refers to devices used in the home where water pipes enter to provide additional treatment of drinking water used throughout the home.
- A. Exposure Contact
  - B. Point-of-Use Water Treatment
  - C. Point-of-Entry Water Treatment
  - D. Per capita Per person
  - E. None of the Above

101. Contact between a person and a chemical. Exposures are calculated as the amount of chemical available for absorption by a person.

- A. Exposure
- B. Point-of-Use Water Treatment
- C. Point-of-Entry Water Treatment
- D. Per capita Per person
- E. None of the Above

102. A protozoan, which can survive in water for 1 to 3 months, associated with the disease giardiasis. Ingestion of this protozoan in contaminated drinking water, exposure from person-to-person contact, and other exposure routes may cause giardiasis.

- A. Exposure Contact
- B. Point-of-Use Water Treatment
- C. Point-of-Entry Water Treatment
- D. Per capita Per person
- E. None of the Above

103. Chemical molecules that contain carbon and other elements such as hydrogen.

- A. Nitrates
- B. Phase I Contaminants
- C. Organics
- D. Nephelometric Turbidity Units
- E. Radionuclides

104. \_\_\_\_\_ contaminants of concern to drinking water include chlorohydrocarbons, pesticides, and others.

- A. Nitrates
- B. Phase I Contaminants
- C. Organic(s)
- D. Nephelometric Turbidity Units
- E. Radionuclides

105. The Phase I Rule became effective on January 9, 1989. This rule, also called the Volatile Organic Chemical Rule, or VOC Rule, set water quality standards for 8 VOCs and required all community and Non-Transient, Non-Community water systems to monitor for and, if necessary, treat their supplies for these chemicals.

- A. Nitrates
- B. Phase I Contaminants
- C. Organics
- D. Nephelometric Turbidity Units
- E. Radionuclides

106. The 8 VOCs regulated under this rule are: Benzene, Carbon Tetrachloride, para-dichlorobenzene, trichloroethylene, vinyl chloride, 1,1, 2-trichloroethane, 1,1-dichloroethylene, and 1,2-dichloroethane.

- A. Nitrates
- B. Phase I Contaminants
- C. Organics
- D. Nephelometric Turbidity Units
- E. Radionuclides

107. A unit of measure used to describe the turbidity of water.

- A. Nitrates
- B. Phase I Contaminants
- C. Organics
- D. Nephelometric Turbidity Units
- E. Radionuclides

108. Turbidity is the cloudiness in water.

- A. Nitrates
- B. Phase I Contaminants
- C. Organics
- D. Nephelometric Turbidity Units
- E. Radionuclides

109. Inorganic compounds that can enter water supplies from fertilizer runoff and sanitary wastewater discharges.

- A. Nitrates
- B. Phase I Contaminants
- C. Organics
- D. Nephelometric Turbidity Units
- E. Radionuclides

110. \_\_\_\_\_ in drinking water are associated with methemoglobinemia, or blue baby syndrome, which results from interferences in the blood's ability to carry oxygen.

- A. Nitrates
- B. Phase I Contaminants
- C. Organics
- D. Nephelometric Turbidity Units
- E. Radionuclides

111. Elements that undergo a process of natural decay. As radionuclides decay, they emit radiation in the form of alpha or beta particles and gamma photons.

- A. Nitrates
- B. Phase I Contaminants
- C. Organics
- D. Nephelometric Turbidity Units
- E. Radionuclides

112. Radiation can cause adverse health effects, such as cancer, so limits are placed on \_\_\_\_\_ concentrations in drinking water.

- A. Nitrates
- B. Phase I Contaminants
- C. Organics
- D. Nephelometric Turbidity Units
- E. Radionuclide(s)

113. \_\_\_\_\_ was first passed in 1974 and established the basic requirements under which the nation's public water supplies were regulated.

- A. Risk
- B. SDWA
- C. Toxicity
- D. To the Extent Practical
- E. None of the Above

114. The \_\_\_\_\_ is responsible for setting the national drinking water regulations while individual states are responsible for ensuring that public water systems under their jurisdiction are complying with the regulations.

- A. Risk
- B. SDWA
- C. Toxicity
- D. To the Extent Practical
- E. None of the Above

115. The \_\_\_\_\_ was amended in 1986 and again in 1996.

- A. Risk
- B. SDWA
- C. Toxicity
- D. To the Extent Practical
- E. None of the Above

116. The potential for harm to people exposed to chemicals. In order for there to be risk, there must be hazard and there must be exposure.

- A. Risk
- B. SDWA
- C. Toxicity
- D. To the Extent Practical
- E. None of the Above

117. Bacteria that are used as indicators of \_\_\_\_\_ in drinking water.

- A. Risk
- B. SDWA
- C. Toxicity
- D. To the Extent Practical
- E. None of the Above

118. The property of a chemical to harm people who come into contact with it.

- A. Risk
- B. SDWA
- C. Toxicity
- D. To the Extent Practical
- E. None of the Above

119. States must inventory sources of contamination to the extent they have the technology and resources to \_\_\_\_\_ delineated as described in the guidance.

- A. Risk
- B. SDWA
- C. Toxicity
- D. To the Extent Practical
- E. None of the Above

120. All information sources may be used, \_\_\_\_\_ Federal and state inventories of sources.

- A. Risk
- B. SDWA
- C. Toxicity
- D. To the Extent Practical
- E. None of the Above

121. The surface and subsurface area surrounding a well or well field, supplying a PWS, through which contaminants are reasonably likely to move toward and reach such water well or well field.

- A. Transient non-community systems
- B. Transient/Non-Transient, Non-Community Water Systems
- C. Treatment Technique
- D. Wellhead Protection Area
- E. Underground Injection Control (UIC) Program

122. Water systems that are non-community systems: transient systems serve 25 non-resident persons per day for 6 months or less per year.

- A. Transient non-community systems
- B. Transient/Non-Transient, Non-Community Water Systems
- C. Treatment Technique
- D. Wellhead Protection Area
- E. Underground Injection Control (UIC) Program

123. \_\_\_\_\_ typically are restaurants, hotels, large stores, etc. Non-transient systems regularly serve at least 25 of the same non-resident persons per day for more than 6 months per year. These systems typically are schools, offices, churches, factories, etc.

- A. Transient non-community systems
- B. Transient/Non-Transient, Non-Community Water Systems
- C. Treatment Technique
- D. Wellhead Protection Area
- E. Underground Injection Control (UIC) Program

124. A specific treatment method required by the EPA to be used to control the level of a contaminant in drinking water. In specific cases where the EPA has determined it is not technically or economically feasible to establish an MCL, the EPA can instead specify a treatment technique.

- A. Transient non-community systems
- B. Transient/Non-Transient, Non-Community Water Systems
- C. Treatment Technique
- D. Wellhead Protection Area

125. A treatment technique is an enforceable procedure or level of \_\_\_\_\_ which public water systems must follow to ensure control of a contaminant.

- A. Transient non-community systems
- B. Transient/Non-Transient, Non-Community Water Systems
- C. Treatment Technique
- D. Wellhead Protection Area
- E. None of the Above

126. A topographic boundary area that is the perimeter of the catchment area of a stream is known by \_\_\_\_\_.

- A. Watershed Approach
- B. Watershed Area
- C. Watershed
- D. None of the Above

127. A \_\_\_\_\_ is a coordinating framework for environmental management that focuses public and private sector efforts to address the highest priority problems within hydrologically-defined geographic areas, taking into consideration both ground and surface water flow.

- A. Watershed Approach
- B. Watershed Area
- C. Watershed
- D. None of the Above

128. A topographic area that is within a line drawn connecting the highest points uphill of a drinking water intake, from which overland flow drains to the intake is known as \_\_\_\_\_.

- A. Watershed Approach
- B. Watershed Area
- C. Watershed
- D. None of the Above

129. The gradual flow or movement of water into and through the pores of the soil.

- A. Evaporation
- B. Condensation
- C. Infiltration
- D. Precipitation
- E. None of the Above

130. The process by which the water or other liquids become a gas.

- A. Evaporation
- B. Condensation
- C. Infiltration
- D. Precipitation
- E. None of the Above

131. The collection of the evaporated water in the atmosphere.

- A. Evaporation
- B. Condensation
- C. Infiltration
- D. Precipitation

132. The process by which atmospheric moisture falls onto the land or water surface as rain, snow, hail or other forms of moisture.

- A. Evaporation
- B. Condensation
- C. Infiltration
- D. Precipitation
- E. None of the Above

133. Water that drains from a saturated or impermeable surface into stream channels or other surface water areas. Most lakes and rivers are formed this way.

- A. Evaporation
- B. Condensation
- C. Infiltration
- D. Runoff
- E. None of the Above

134. Moisture that will come from plants as a byproduct of photosynthesis.

- A. Evaporation
- B. Condensation
- C. Transpiration
- D. Runoff
- E. None of the Above

135. Water rights because property is adjacent to a river or surface water.

- A. Ecological balance
- B. Riparian
- C. Prescriptive
- D. Food chain
- E. Appropriative

136. Acquired water rights for exclusive use.

- A. Ecological balance
- B. Riparian
- C. Prescriptive
- D. Food chain
- E. Appropriative

137. Rights based upon legal prescription or long use or custom.

- A. Ecological balance
- B. Riparian
- C. Prescriptive
- D. Food chain
- E. Appropriative

138. Depending on 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 \_\_\_\_\_ from agriculture, or industrial and wastewater discharge.

- A. Ecological balance
- B. Runoff
- C. Prescriptive

139. Another aspect of quality control is aquatic plants. The \_\_\_\_\_ in lakes and reservoirs plays a natural part in the purification and sustaining the life of the lake.

- A. Ecological balance
- B. Riparian
- C. Prescriptive
- D. Food chain
- E. Appropriative

140. Algae and rooted aquatic plants are essential in the \_\_\_\_\_ of fish and birds.

- A. Ecological balance
- B. Riparian
- C. Prescriptive
- D. Food chain
- E. Appropriative

141. Algae growth is the result of \_\_\_\_\_.

- A. Photosynthesis
- B. Algae
- C. THM
- D. PAC or GAC
- E. None of the Above

142. \_\_\_\_\_ growth is supplied by the energy of the sun, as algae absorb this energy it converts carbon dioxide to oxygen. This creates aerobic conditions that supply fish with oxygen.

- A. pH
- B. Algae
- C. THM
- D. PAC or GAC
- E. None of the Above

143. Without sun light, the \_\_\_\_\_ would consume oxygen and release carbon dioxide.

- A. pH
- B. Algae
- C. THM
- D. PAC or GAC
- E. None of the Above

144. The lack of \_\_\_\_\_ in water is known as anaerobic conditions.

- A. pH
- B. Algae
- C. THM
- D. PAC or GAC
- E. None of the Above

145. Certain vegetation removes the excess nutrients that would promote the growth of \_\_\_\_\_.

- A. pH
- B. Algae
- C. THM
- D. PAC or GAC
- E. None of the Above

146. Too much algae will imbalance the lake and this will result in \_\_\_\_\_.

- A. pH
- B. Algae
- C. THM
- D. PAC or GAC
- E. None of the Above

147. Most treatment plant upsets such as taste and odor, color, and filter clogging is due to \_\_\_\_\_.

- A. pH
- B. Algae
- C. THM
- D. PAC or GAC
- E. None of the Above

148. The type of \_\_\_\_\_ determines the problem it will cause for instance slime, corrosion, color, and toxicity.

- A. pH
- B. Algae
- C. THM
- D. PAC or GAC
- E. None of the Above

149. Algae can be controlled by using chemicals such as \_\_\_\_\_.

- A. pH
- B. Algae
- C. THM
- D. PAC or GAC
- E. None of the Above

150. Depending on federal regulations and the amount of copper found natural in water, operators have used Potassium Permanganate, \_\_\_\_\_ and Chlorine.

- A. pH
- B. Algae
- C. THM
- D. PAC or GAC
- E. None of the Above

151. The \_\_\_\_\_ and alkalinity of the water will determine how these chemicals will react. Most systems no longer use Chlorine because it reacts with the organics in the water to form Trihalomethanes.

- A. pH
- B. Algae
- C. THM
- D. PAC or GAC
- E. None of the Above

152. \_\_\_\_\_ form when disinfectants added to drinking water to kill germs react with naturally-occurring organic matter in water.

- A. pH
- B. Algae
- C. THM
- D. PAC or GAC
- E. None of the Above

153. Some people who drink water containing \_\_\_\_\_ in excess of EPA's standard over many years may experience problems with their liver, kidneys, or central nervous systems, and may have an increased risk of getting cancer.

- A. pH
- B. Algae
- C. THM
- D. PAC or GAC
- E. None of the Above

154. Most lakes and reservoirs are not free of logs, tree limbs, sticks, gravel, sand and rocks, weeds, leaves, and trash. If not removed, these will cause problems to the treatment plant's \_\_\_\_\_.

- A. Mechanical bar screens
- B. Screening
- C. Horizontal bars
- D. Clarifiers
- E. None of the Above

155. The best way to protect the plant is \_\_\_\_\_.

- A. Mechanical bar screens
- B. Screening
- C. Horizontal bars
- D. Clarifiers
- E. None of the Above

156. Bar screens are made of straight steel bars at the intake of the plant. The spacing of the \_\_\_\_\_ will rank the size.

- A. Mechanical bar screens
- B. Screening
- C. Horizontal bars
- D. Clarifiers
- E. None of the Above

157. \_\_\_\_\_ are woven stainless steel material and the opening of the fabric is narrow. Both require manual cleaning.

- A. Mechanical bar screens
- B. Screening
- C. Horizontal bars
- D. Clarifiers
- E. None of the Above

158. \_\_\_\_\_ vary in size and use some type of raking mechanism that travels horizontally down the bars to scrap the debris off.

- A. Mechanical bar screens
- B. Screening
- C. Horizontal bars
- D. Clarifiers
- E. None of the Above

159. The type of \_\_\_\_\_ used depends on the raw water and the size of the intake.

- A. Mechanical bar screens
- B. Screening
- C. Horizontal bars
- D. Clarifiers
- E. None of the Above

160. Once the water passes the bar screens, sand and grit are still present. This will damage plant equipment and pipes, so it must be removed. This is generally done with either \_\_\_\_\_ - shaped clarifiers.

- A. Mechanical bar screens
- B. Screening
- C. Horizontal bars
- D. Clarifiers
- E. None of the Above

161. \_\_\_\_\_ are also used after the flocculation process.

- A. Mechanical bar screens
- B. Screening
- C. Horizontal bars
- D. Clarifiers
- E. None of the Above

162. Most rectangular clarifiers are designed with scrapers on the bottom to move the settled sludge to one or more \_\_\_\_\_ at the influent end of the tank.

- A. Flights and chains
- B. Traveling bridge
- C. Hoppers
- D. Drive chain
- E. Shear pin

163. A clarifier could have a screw conveyor or \_\_\_\_\_ used to collect the sludge. The most common is a chain and flight collector.

- A. Flights and chains
- B. Traveling bridge
- C. Hoppers
- D. Drive chain
- E. Shear pin

164. The \_\_\_\_\_ turns the drive sprockets and the head shafts. The shafts can be located overhead or below.

- A. Flights and chains
- B. Traveling bridge
- C. Hoppers
- D. Drive chain
- E. Shear pin

165. Some clarifiers may not have scum removal equipment so the configuration of the shaft may vary. As the \_\_\_\_\_ travel across the bottom of the clarifier, wearing shoes are used to protect the flights. The shoes are usually metal and travel across a metal track.

- A. Flights
- B. Traveling bridge
- C. Hoppers
- D. Drive chain
- E. Shear pin

166. Most clarifier designs will have baffles to prevent short-circuiting and scum from entering the \_\_\_\_\_.

- A. Flights and chains
- B. Traveling bridge
- C. Effluent
- D. Drive chain
- E. Shear pin

167. The most important thing to consider is the sludge and scum collection mechanism known as the \_\_\_\_\_. They move the settled sludge to the hopper in the clarifier for return and they also remove the scum from the surface of the clarifier.

- A. Flights and chains
- B. Traveling bridge
- C. Hoppers
- D. Drive chain
- E. Shear pin

168. The flights are usually wood or nonmetallic flights mounted on parallel chains. The motor shaft is connected through a gear reducer to a shaft which turns the \_\_\_\_\_.

- A. Flights and chains
- B. Traveling bridge
- C. Hoppers
- D. Drive chain
- E. Shear pin

169. To prevent damage due to overloads, a \_\_\_\_\_ is used.

- A. Flights and chains
- B. Traveling bridge
- C. Hoppers
- D. Drive chain
- E. Shear pin

170. The \_\_\_\_\_ holds the gear solidly on the shaft so that no slippage occurs.

- A. Flights and chains
- B. Traveling bridge
- C. Hoppers
- D. Drive chain
- E. Shear pin

171. The gear moves the drive chain. If a heavy load is put on the sludge collector system then the shear pin should break. This means that the gear would simply slide around the shaft and movement of the \_\_\_\_\_ would stop. The most common type has a center pier or column.

- A. Flights and chains
- B. Traveling bridge
- C. Hoppers
- D. Drive chain
- E. Shear pin

172. Conventional technology uses a 30 to 50 mg/L alum dosage to form a large floc that requires \_\_\_\_\_ to permit settling.

- A. Graded silica sand filter media
- B. On expensive, construction-intensive processes
- C. Extensive retention time
- D. Conventional water treatment process
- E. Form a white precipitate that

173. Traditional filter systems use \_\_\_\_\_.

- A. Graded silica sand filter media
- B. On expensive, construction-intensive processes
- C. Which causes them to repel
- D. Conventional water treatment process
- E. Form a white precipitate that

174. The major mechanic parts of the clarifier are the \_\_\_\_\_; the sludge collector mechanism; and the scum removal system.

- A. Flights and chains
- B. Traveling bridge
- C. Hoppers
- D. Drive Unit
- E. Shear pin

175. Improving the clarity of surface water has always presented a challenge because source quality varies. Traditional treatments rely on \_\_\_\_\_ with lengthy times.

- A. Graded silica sand filter media
- B. On expensive, construction-intensive processes
- C. Which causes them to repel
- D. Conventional water treatment process
- E. Form a white precipitate that

176. Suspended particles carry an electrical charge \_\_\_\_\_ one another.

- A. Graded silica sand filter media
- B. On expensive, construction-intensive processes
- C. Which causes them to repel
- D. Conventional water treatment process
- E. Form a white precipitate that

177. The \_\_\_\_\_ uses alum (aluminum sulfate) and cationic polymer to neutralize the charge. That allows suspended particles to clump together to form more easily filtered particles.

- A. Graded silica sand filter media
- B. On expensive, construction-intensive processes
- C. Which causes them to repel
- D. Conventional water treatment process
- E. Form a white precipitate that

178. Alum combines with alkalinity in the raw water to \_\_\_\_\_ neutralizes suspended particles' electrical charge and forms a base for coagulating those particles.

- A. Graded silica sand filter media
- B. On expensive, construction-intensive processes
- C. Which causes them to repel
- D. Conventional water treatment process
- E. Form a white precipitate that

179. Since the sand \_\_\_\_\_ all have about the same density, larger grains lay toward the bottom of the filter bed and finer grains lay at the top of the filter bed.

- A. Material
- B. Particles
- C. Density
- D. Grains
- E. Media

180. Filtration occurs only within the first few inches of the finer \_\_\_\_\_ at the top of the bed.

- A. Material
- B. Particles
- C. Density
- D. Grains
- E. Media

181. A depth filter has four layers of filtration \_\_\_\_\_, each of different size and density.

- A. Material
- B. Particles
- C. Density
- D. Grains
- E. Media

182. Light, coarse \_\_\_\_\_ lies at the top of the filter bed.

- A. Material
- B. Particles
- C. Density
- D. Grains

183. The \_\_\_\_\_ become progressively finer and denser in the lower layers. Larger suspended particles are removed by the upper layers while smaller particles are removed in the lower layers.

- A. Material
- B. Particles
- C. Density
- D. Grains
- E. Media

184. \_\_\_\_\_ are trapped throughout the bed, not in just the top few inches. That allows a depth filter to run substantially longer and use less backwash water than a traditional sand filter.

- A. Material
- B. Particles
- C. Density
- D. Grains
- E. Media

185. Turbidity washes out of the filter bed as the filter media particles \_\_\_\_\_ one another. The down flow rinse settles the bed before the filter returns to service.

- A. Scour
- B. Cycle
- C. Mud-balling
- D. Backwash
- E. Fast rinse

186. \_\_\_\_\_ lasts about 5 to 10 minutes.

- A. Scour
- B. Cycle
- C. Mud-balling
- D. Backwash
- E. Fast rinse

187. As suspended \_\_\_\_\_ accumulate in a filter bed, the pressure drop through the filter increases.

- A. Material
- B. Particles
- C. Density
- D. Grains
- E. Media

188. When the pressure difference between filter inlet and outlet increases by 5 - 10 psi from the beginning of the \_\_\_\_\_, the filter should be reconditioned.

- A. Scour
- B. Cycle
- C. Mud-balling
- D. Backwash
- E. Fast rinse

189. Operating beyond this pressure drop increases the chance of fouling - called " \_\_\_\_\_ " - within the filter.

- A. Scour
- B. Cycle
- C. Mud-balling
- D. Backwash
- E. Fast rinse

190. The reconditioning cycle consists of an up flow \_\_\_\_\_ followed by a down flow rinse.

- A. Scour
- B. Cycle
- C. Mud-balling
- D. Backwash
- E. Fast rinse

191. \_\_\_\_\_ is an up flow operation, at about 14 gpm per square foot (34m/hr) of filter bed area that lasts about 10 minutes.

- A. Scour
- B. Cycle
- C. Mud-balling
- D. Backwash
- E. Fast rinse

192. Chemical pretreatment is often used to enhance filter performance, particularly when turbidity includes fine \_\_\_\_\_.

- A. Colloidal particles
- B. NTU
- C. Electrically charged
- D. Full water treatment
- E. None of the Above

193. Suspended particles are usually \_\_\_\_\_.
- A. Colloidal particles
  - B. NTU
  - C. Electrically charged
  - D. Full water treatment
  - E. None of the Above
194. \_\_\_\_\_ such as alum (aluminum sulfate), ferric chloride, or a cationic polymer neutralizes the charge, allowing the particles to cling to one another and to the filter media.
- A. Colloidal particles
  - B. NTU
  - C. Electrically charged
  - D. Full water treatment
  - E. None of the Above
195. Representing a slight modification of \_\_\_\_\_, package plants are usually built in a factory, mounted on skids, and transported virtually assembled to the operation site.
- A. Colloidal particles
  - B. NTU
  - C. Electrically charged
  - D. Full water treatment
  - E. None of the Above
196. These are appropriate for small community systems where \_\_\_\_\_ is desired, but without the construction costs and space requirements associated with separately constructed sedimentation basins, filter beds, clear wells, etc.
- A. Colloidal particles
  - B. NTU
  - C. Electrically charged
  - D. Full water treatment
  - E. None of the Above
197. Chemical pretreatment may increase filtered water clarity, measured in \_\_\_\_\_, by 90% compared with filtration alone.
- A. Colloidal particles
  - B. NTU
  - C. Electrically charged
  - D. Full water treatment
  - E. None of the Above
198. If an operator is present to make adjustments for variations in the raw water, filtered water \_\_\_\_\_ in the range of 93 to 95% are achievable.
- A. Colloidal particles
  - B. NTU
  - C. Electrically charged
  - D. Full water treatment
  - E. None of the Above

199. In addition to the \_\_\_\_\_ filtration processes, package plants are found as two types: tube-type clarifiers and adsorption clarifiers. This is the most prevalent form of water treatment technology in use today.

- A. Particles
- B. Alum
- C. Conventional
- D. Coagulation
- E. Coagulant

200. This filtration process employs a combination of \_\_\_\_\_ and chemical processes in order to achieve maximum effectiveness.

- A. Particles
- B. Alum
- C. Physical
- D. Coagulation
- E. Coagulant

201. At the Water Treatment Plant, aluminum sulfate, commonly called \_\_\_\_\_, is added to the water in the "flash mix" to cause microscopic impurities in the water to clump together.

- A. Particles
- B. Alum
- C. Conventional
- D. Coagulation
- E. Coagulant

202. The \_\_\_\_\_ and the water are mixed rapidly by the flash mixer. The resulting larger particles will be removed by filtration.

- A. Particles
- B. Alum
- C. Conventional
- D. Coagulation
- E. Coagulant

203. \_\_\_\_\_ is the process of joining together particles in water to help remove organic matter.

- A. Particles
- B. Alum
- C. Conventional
- D. Coagulation
- E. Coagulant

204. When solid matter is too small to be removed by a depth filter, the fine particles must be coagulated, or "stuck together" to form larger particles which can be filtered. This is achieved through the use of \_\_\_\_\_ chemicals.

- A. Particles
- B. Alum
- C. Conventional
- D. Coagulation
- E. Coagulant

205. Coagulant chemicals are required since colloidal particles by themselves have the tendency to stay suspended in water and not settle out. This is primarily due to a negative charge on the surface of the \_\_\_\_\_.

- A. Particles
- B. Alum
- C. Conventional
- D. Coagulation
- E. Coagulant

206. All matter has a residual surface charge to a certain degree. But since colloidal particles are so small, their charge per volume is significant. Therefore, the like charges on the \_\_\_\_\_ repel each other, and they stay suspended in water.

- A. Particles
- B. Alum
- C. Conventional
- D. Coagulation

207. \_\_\_\_\_ chemicals such as "alum" (aluminum sulfate) work by neutralizing the negative charge, which allows the particles to come together. Other coagulants are called "cationic polymers", which can be thought of as positively charged strings that attract the particles to them, and in the process, form a larger particle.

- A. Particles
- B. Alum
- C. Conventional
- D. Coagulation
- E. Coagulant

208. New chemicals have been developed which combine the properties of alum-type coagulants and cationic polymers. Which chemical is used depends on the \_\_\_\_\_, and will usually be chosen by the engineer designing the water treatment system.

- A. Particles
- B. Alum
- C. Application
- D. Coagulation
- E. Coagulant

209. Aluminum Sulfate is the most widely used \_\_\_\_\_ in water treatment.

- A. Particles
- B. Alum
- C. Conventional
- D. Coagulation
- E. Coagulant

210. \_\_\_\_\_ is necessary to meet the current regulations for almost all potable water plants using surface water.

- A. Particles
- B. Aluminum Sulfate
- C. Conventional
- D. Coagulation

211. \_\_\_\_\_ is also excellent for removing nutrients such as phosphorous in wastewater treatment. Liquid Aluminum Sulfate is a 48.86% solution.

- A. Particles
- B. Aluminum Sulfate
- C. Conventional
- D. Coagulation
- E. Coagulant

212. Large microorganisms, including algae and amoebic cysts, are readily removed by \_\_\_\_\_ and filtration. Bacterial removals of 99% are also achievable.

- A. Gravity
- B. Flocculation
- C. Detention times
- D. Destabilized
- E. Coagulation

213. More than 98% of poliovirus type 1 was removed by conventional \_\_\_\_\_ and filtration.

- A. Gravity
- B. Flocculation
- C. Detention times
- D. Destabilized
- E. Coagulation

214. Several recent studies have shown that bacteria and viral agents are attached to organic and inorganic particulates. Hence, removal of these particulates by conventional \_\_\_\_\_ and filtration is a major component of effective treatment for the removal of pathogens.

- A. Gravity
- B. Flocculation
- C. Detention times
- D. Destabilized
- E. Coagulation

215. The process of bringing together \_\_\_\_\_ or coagulated particles to form larger masses which can be settled and/or filtered out of the water being treated.

- A. Gravity
- B. Flocculation
- C. Detention times
- D. Destabilized
- E. Coagulation

216. In this process, which follows the rapid mixing, the chemically treated water is sent into a basin where the suspended particles can collide, agglomerate (stick together), and form heavier particles called \_\_\_\_\_.

- A. Gravity
- B. Flocculation
- C. Detention times
- D. Destabilized
- E. Coagulation

217. Gentle agitation of the water and appropriate \_\_\_\_\_ (the length of time water remains in the basin) help facilitate this process.

- A. Gravity
- B. Floc
- C. Detention times
- D. Destabilized
- E. Coagulation

218. The water is slowly mixed in \_\_\_\_\_ allowing the coagulated particles, now called "floc," to become larger and stronger.

- A. Gravity
- B. Floc
- C. Contact chambers
- D. Destabilized
- E. Coagulation

219. As floc particles mix in the water, bacteria and other microorganisms are caught in the floc \_\_\_\_\_.

- A. Structure
- B. Floc
- C. Detention times
- D. Destabilized
- E. Coagulation

220. Depending on the quality of the \_\_\_\_\_, some plants have pre-sedimentation.

- A. Gravity
- B. Floc
- C. Source Water
- D. Destabilized
- E. Coagulation

221. Pre-sedimentation allows larger particles time to \_\_\_\_\_ in a reservoir or lake (sand, heavy silt) reducing solid removal loads.

- A. Gravity
- B. Floc
- C. Settle
- D. Destabilized
- E. Coagulation

222. Pre-sedimentation provides an \_\_\_\_\_ which evens out fluctuations in concentrations of suspended solids.

- A. Gravity
- B. Floc
- C. Equalization basin
- D. Destabilized
- E. Coagulation

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

- A. Gravity
- B. Floc
- C. Detention times
- D. Destabilized
- E. Coagulation

224. Once settled, the \_\_\_\_\_ combine to form a sludge that is later removed from the bottom of the basin.

- A. Particles
- B. Floc
- C. Detention times
- D. Destabilized
- E. Coagulation

225. A water treatment step used to remove turbidity, \_\_\_\_\_, odor, taste and color.

- A. Gravity
- B. Floc
- C. Dissolved organics
- D. Destabilized
- E. Coagulation

226. The water flows by gravity through large filters of anthracite coal, silica sand, garnet and \_\_\_\_\_.

- A. Gravel
- B. Floc
- C. Detention times
- D. Destabilized
- E. Coagulation

227. The floc particles are \_\_\_\_\_ in these filters. The rate of filtration can be adjusted to meet water consumption needs.

- A. Remove, Removal or Removed
- B. Flushed
- C. Disposable
- D. Settled out
- E. None of the Above

228. Filters for suspended particle \_\_\_\_\_ can also be made of graded sand, granular synthetic material, screens of various materials, and fabrics.

- A. Remove, Removal or Removed
- B. Flushed
- C. Disposable
- D. Settled out
- E. None of the Above

229. The most widely used are rapid-sand filters in tanks. In these units, gravity holds the material in place and the flow is downwards. The filter is periodically cleaned by a reversal of flow and the discharge of back \_\_\_\_\_ water into a drain.

- A. Remove, Removal or Removed
- B. Flushed
- C. Disposable
- D. Settled out
- E. None of the Above

230. Cartridge filters made of fabric, paper, or plastic material are also common and are often much smaller and cheaper, as well as \_\_\_\_\_.

- A. Remove, Removal or Removed
- B. Flushed
- C. Disposable
- D. Settled out
- E. None of the Above

231. Filters are available in several ratings, depending on the size of particles to be \_\_\_\_\_.

- A. Remove, Removal or Removed
- B. Flushed
- C. Disposable
- D. Settled out
- E. None of the Above

232. Activated carbon filters, described earlier, will also \_\_\_\_\_ turbidity, but would not be recommended for that purpose only.

- A. Remove, Removal or Removed
- B. Flushed
- C. Disposable
- D. Settled out
- E. None of the Above

233. With most of the larger particles \_\_\_\_\_, the water now goes to the filtration process. At a rate of between 2 and 10 gpm per square foot, the water is filtered through an approximate 36" bed of graded sand.

- A. Remove, Removal or Removed
- B. Flushed
- C. Disposable
- D. Settled out
- E. None of the Above

234. Anthracite coal or activated carbon may also be included in the sand to improve the filtration process, especially for the \_\_\_\_\_ of organic contaminants, taste, and odor problems.

- A. Remove, Removal or Removed
- B. Flushed
- C. Disposable
- D. Settled out
- E. None of the Above

235. \_\_\_\_\_ of overall filtration process performance should be conducted on a routine basis, at least once per day.

- A. Remove, Removal or Removed
- B. Evaluation
- C. Disposable
- D. Settled out
- E. None of the Above

236. Poor chemical treatment can often result in either early turbidity breakthrough or rapid head loss buildup. The more uniform the media, the \_\_\_\_\_ head loss buildup.

- A. Remove, Removal or Removed
- B. Evaluation
- C. Disposable
- D. Slower
- E. None of the Above

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

- A. Remove, Removal or Removed
- B. Evaluation
- C. Governed
- D. Settled out
- E. None of the Above

238. Direct Filtration Plant vs. Conventional Plant The only difference is that the sedimentation process or step is omitted from the \_\_\_\_\_ plant.

- A. Detention Time
- B. Direct Filtration
- C. Declining Rate Filters
- D. Disinfection
- E. Jar testing

239. The flow rate will vary with head loss. Each filter operates at the same rate, but can have a variable water level.

- A. Detention Time
- B. Direct Filtration plant
- C. Declining Rate Filters
- D. Disinfection
- E. Jar testing

240. This system requires an effluent control structure (weir) to provide adequate media submergence.

- A. Detention Time
- B. Direct Filtration plant
- C. Declining Rate Filters
- D. Disinfection
- E. Jar testing

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

- A. Detention Time
- B. Direct Filtration plant
- C. Declining Rate Filters
- D. Disinfection
- E. Jar testing

242. Chlorine is added to the water at the flash mix for pre-disinfection. The chlorine kills or inactivates harmful microorganisms. Chlorine is added again after filtration for post-disinfection.

- A. Detention Time
- B. Direct Filtration plant
- C. Declining Rate Filters
- D. Disinfection
- E. Jar testing

243. \_\_\_\_\_ traditionally has been done on a routine basis in most water treatment plants to control the coagulant dose.

- A. Detention Time
- B. Direct Filtration plant
- C. Declining Rate Filters
- D. Disinfection
- E. Jar testing

244. Conventional method of jar testing. It is the quickest and most economical way to obtain good reliable data on the many variables which affect the treatment process. These include: Determination of most \_\_\_\_\_ coagulant.

- A. Sequence
- B. Effective
- C. Optimum
- D. Application
- E. Expression

245. Determination of \_\_\_\_\_ coagulation pH for the various coagulants.

- A. Sequence
- B. Effective
- C. Optimum
- D. Application
- E. Expression

246. Optimum point of \_\_\_\_\_ of polymers in the treatment train.

- A. Sequence
- B. Effective
- C. Optimum
- D. Application
- E. Expression

247. Optimum sequence of \_\_\_\_\_ of coagulants, polymers and pH adjustment chemicals.

- A. Sequence
- B. Effective
- C. Optimum
- D. Application
- E. Expression

248. pH \_\_\_\_\_ of a basic or acid condition of a liquid.

- A. Sequence
- B. Effective
- C. Optimum
- D. Application
- E. Expression

249. The pH range is from 0-14, zero being the most acid and 14 being the most \_\_\_\_\_.

- A. Neutral
- B. Alkaline
- C. Raise

250. A type of chemical when combined with other types of coagulants aid in binding small suspended particles to larger particles to help in the settling and filtering processes.

- A. Post Chlorine
- B. Polymer
- C. Pre Chlorine
- D. Prechlorination

251. A chemical used to coat the pipes in the distribution system to inhibit corrosion.

- A. Zinc Orthophosphate
- B. Settled Solids
- C. Corrosion Control
- D. Taste and Odor Control
- E. None of the Above

252. Powdered activated carbon (PAC) is occasionally added for taste and odor control. PAC is added to the flash mix.

- A. Zinc Orthophosphate
- B. Settled Solids
- C. Corrosion Control
- D. Taste and Odor Control
- E. None of the Above

253. The rule specifies maximum contaminant level goals for *Giardia lamblia*, viruses and *Legionella*, and promulgated filtration and disinfection requirements for public water systems using surface water sources or by ground water sources under the direct influence of surface water. The regulations also specify water quality, treatment, and watershed protection criteria under which filtration may be avoided.

- A. Susceptibility Analysis
- B. State Management Plan (SMP) Program
- C. Significant Potential Source of Contamination
- D. Surface Water Treatment Rule (SWTR)
- E. None of the Above

254. A clean, constant supply of drinking water is essential to every community. People in large cities frequently drink water that comes from surface water sources, such as lakes, rivers, and \_\_\_\_\_.

- A. Well
- B. Watershed
- C. Community
- D. Reservoirs
- E. Aquifers

255. The \_\_\_\_\_ is the land area over which water flows into the river, lake, or reservoir.

- A. Well
- B. Watershed
- C. Community
- D. Reservoirs
- E. Aquifers

256. In rural areas, people are more likely to drink ground water that was pumped from a \_\_\_\_\_.

- A. Well
- B. Watershed
- C. Community
- D. Reservoirs

257. These wells tap into \_\_\_\_\_--the natural reservoirs under the earth's surface--that may be only a few miles wide, or may span the borders of many states.

- A. Well
- B. Watershed
- C. Community
- D. Reservoirs
- E. Aquifers

258. Water testing is conducted throughout the treatment process. Items like turbidity, pH and chlorine residual are monitored and recorded continuously. Some items are \_\_\_\_\_ several times per day, some once per quarter and others once per year.

- A. Allowing
- B. Tested
- C. Plunging
- D. Improve
- E. None of the Above

259. Collect the water sample at least 6 inches under the surface by \_\_\_\_\_ the container mouth down into the water and turning the mouth towards the current by dragging the container slowly horizontal.

- A. Allowing
- B. Tested
- C. Plunging
- D. Improve
- E. None of the Above

260. Care should be taken not to disturb the bottom of the water source or along the sides so as not to \_\_\_\_\_ any settled solids. This would create erroneous errors.

- A. Allowing
- B. Tested
- C. Plunging
- D. Improve
- E. None of the Above

261. Chemicals are added to the water in order to \_\_\_\_\_ the subsequent treatment processes.

- A. Allowing
- B. Tested
- C. Plunging
- D. Improve
- E. None of the Above

262. Chemicals may \_\_\_\_\_ pH adjusters and coagulants.

- A. Allowing
- B. Tested
- C. Plunging
- D. Improve
- E. None of the Above

263. Coagulants are chemicals, such as alum, that neutralize positive or negative charges on small particles, \_\_\_\_\_ them to stick together and form larger particles that are more easily removed by sedimentation (settling) or filtration.

- A. Allowing
- B. Tested
- C. Plunging
- D. Improve
- E. None of the Above

264. Hydrofluosilicic Acid ( $H_2SiF_6$ ) a clear, fuming corrosive liquid with a pH ranging from 1 to 1.5. Used in water treatment to \_\_\_\_\_.

- A. Zinc Orthophosphate
- B. Settled Solids
- C. Corrosion Control
- D. Taste and Odor Control
- E. None of the Above

265. The pH of the water is adjusted with sodium carbonate, commonly called soda ash. Soda ash is fed into the water after filtration.

- A. Zinc Orthophosphate
- B. Settled Solids
- C. Corrosion Control
- D. Taste and Odor Control
- E. None of the Above

266. A variety of devices, such as baffles, static mixers, impellers, and in-line sprays can be used to mix the water and \_\_\_\_\_ evenly.

- A. Distribute the chemicals
- B. Water flows upwards
- C. Short Circuiting
- D. Conventional process
- E. Gravity settling

267. \_\_\_\_\_ is a condition that occurs in tanks or basins when some of the water travels faster than the rest of the flowing water.

- A. Distribute the chemicals
- B. Water flows upwards
- C. Short Circuiting
- D. Conventional process
- E. Gravity settling

268. \_\_\_\_\_ is usually undesirable since it may result in shorter contact, reaction, or settling times in comparison with the presumed detention times.

- A. Distribute the chemicals
- B. Water flows upwards
- C. Short Circuiting
- D. Conventional process
- E. Gravity settling

269. This modification of the \_\_\_\_\_ contains many metal "tubes" that are placed in the sedimentation basin, or clarifier. These tubes are approximately 1 inch deep and 36 inches long, split-hexagonal shape, and installed at an angle of 60 degrees or less.

- A. Distribute the chemicals
- B. Water flows upwards
- C. Short Circuiting
- D. Conventional process
- E. Gravity settling

270. These tubes provide for a very large surface area upon which particles may settle as the \_\_\_\_\_.

- A. Distribute the chemicals
- B. Water flows upwards
- C. Short Circuiting
- D. Conventional process
- E. Gravity settling

271. The slope of the tubes facilitates \_\_\_\_\_ of the solids to the bottom of the basin, where they can be collected and removed.

- A. Distribute the chemicals
- B. Water flows upwards
- C. Short Circuiting
- D. Conventional process
- E. Gravity settling

272. The large surface settling area also means that adequate clarification can be obtained with detention times of 15 minutes or less. As with \_\_\_\_\_ treatment, this sedimentation step is followed by filtration through mixed media.

- A. Distribute the chemicals
- B. Water flows upwards
- C. Short Circuiting
- D. Conventional
- E. Gravity settling

273. This technology uses an \_\_\_\_\_ with low-density plastic bead media, usually held in place by a screen.

- A. Distribute the chemicals
- B. Up flow clarifier
- C. Short Circuiting
- D. Conventional process
- E. Gravity settling

274. This adsorption media is designed to enhance the \_\_\_\_\_ process by combining flocculation and sedimentation into one step.

- A. Distribute the chemicals
- B. Sedimentation/clarification
- C. Short Circuiting
- D. Conventional process
- E. Gravity settling

275. In this step, turbidity is reduced by \_\_\_\_\_ of the coagulated and flocculated solids onto the adsorption media and onto the solids already adsorbed onto the media.

- A. Distribute the chemicals
- B. Water flows upwards
- C. Short Circuiting
- D. Conventional process
- E. Adsorption

276. Air scouring cleans \_\_\_\_\_ followed by water flushing.

- A. Mixed-media filtration
- B. Filter backwashing
- C. Temporary storage
- D. Filtered water available
- E. Adsorption clarifiers

277. Cleaning of this type of clarifier is initiated more often than \_\_\_\_\_ because the clarifier removes more solids.

- A. Mixed-media filtration
- B. Filter backwashing
- C. Temporary storage
- D. Filtered water available
- E. Adsorption clarifiers

278. As with the tube-settler type of package plant, the sedimentation/clarification process is followed by \_\_\_\_\_ and disinfection to complete the water treatment.

- A. Mixed-media filtration
- B. Filter backwashing
- C. Temporary storage
- D. Filtered water available
- E. Adsorption clarifiers

279. The final step in the conventional filtration process, the clearwell provides \_\_\_\_\_ for the treated water.

- A. Mixed-media filtration
- B. Filter backwashing
- C. Temporary storage
- D. Filtered water available
- E. Adsorption clarifiers

280. The two main purposes for this storage are to have \_\_\_\_\_ for backwashing the filter, and to provide detention time (or contact time) for the chlorine (or other disinfectant) to kill any microorganisms that may remain in the water.

- A. Mixed-media filtration
- B. Filter backwashing
- C. Temporary storage
- D. Filtered water available
- E. Adsorption clarifiers

281. The pathogens must survive in the water. This \_\_\_\_\_ of the water and the length of time the pathogens are in the water.

- A. Caused by bacteria
- B. Depends on the temperature
- C. May survive for months
- D. Inadequately treated
- E. None of the Above

282. Some pathogens will survive for only a short time in water, others, such as Giardia or Cryptosporidium, \_\_\_\_\_.

- A. Caused by bacteria
- B. Depends on the temperature
- C. May survive for months
- D. Inadequately treated
- E. None of the Above

283. The pathogens in the water must enter the water system's intake and in numbers sufficient to infect people. The water is either not treated or \_\_\_\_\_ for the pathogens present. A susceptible person must drink the water that contains the pathogen.

- A. Caused by bacteria
- B. Depends on the temperature
- C. May survive for months
- D. Inadequately treated
- E. None of the Above

284. Illness (disease) will occur. This \_\_\_\_\_ that must occur for the transmission of disease via drinking water.

- A. Caused by bacteria
- B. Depends on the temperature
- C. May survive for months
- D. Inadequately treated
- E. None of the Above

285. By breaking the chain at any point, the \_\_\_\_\_ will be prevented.

- A. Caused by bacteria
- B. Depends on the temperature
- C. May survive for months
- D. Inadequately treated
- E. None of the Above

286. Campylobacteriosis is the most common \_\_\_\_\_ caused by bacteria.

- A. Caused by bacteria
- B. Depends on the temperature
- C. May survive for months
- D. Inadequately treated
- E. None of the Above

287. Symptoms include abdominal pain, malaise, fever, nausea and vomiting; they usually begin three to five days \_\_\_\_\_. The illness is frequently over within two to five days and usually lasts no more than 10 days.

- A. Caused by bacteria
- B. Depends on the temperature
- C. May survive for months
- D. Inadequately treated
- E. None of the Above

288. \_\_\_\_\_ outbreaks have most often been associated with food, especially chicken and unpasteurized milk as well as unchlorinated water.

- A. Hepatitis A
- B. Campylobacteriosis
- C. Yersiniosis
- D. Aseptic meningitis
- E. None of the Above

289. These organisms are also an important cause of “travelers’ diarrhea.” Medical treatment generally is not prescribed for campylobacteriosis because recovery is usually rapid. Cholera, Legionellosis, Salmonellosis, Shigellosis, and \_\_\_\_\_ are other bacterial diseases that can be transmitted through water.

- A. Hepatitis A
- B. Campylobacteriosis
- C. Yersiniosis
- D. Aseptic meningitis
- E. None of the Above

290. All bacteria in water are readily killed or inactivated with \_\_\_\_\_.

- A. Hepatitis A
- B. Campylobacteriosis
- C. Yersiniosis
- D. Aseptic meningitis
- E. None of the Above

291. \_\_\_\_\_ is an example of a common viral disease that may be transmitted through water.

- A. Hepatitis A
- B. Campylobacteriosis
- C. Yersiniosis
- D. Aseptic meningitis
- E. None of the Above

292. \_\_\_\_\_ onset is usually abrupt with fever, malaise, loss of appetite, nausea and abdominal discomfort, followed within a few days by jaundice.

- A. Hepatitis A
- B. Campylobacteriosis
- C. Yersiniosis
- D. Aseptic meningitis
- E. None of the Above

293. The \_\_\_\_\_ disease varies in severity from a mild illness lasting one to two weeks, to a severely disabling disease lasting several months (rare).

- A. Hepatitis A
- B. Campylobacteriosis
- C. Yersiniosis
- D. Aseptic meningitis
- E. None of the Above

294. The incubation period of this disease is 15-50 days and averages 28-30 days.

- A. Hepatitis A
- B. Campylobacteriosis
- C. Yersiniosis
- D. Aseptic meningitis
- E. None of the Above

295. \_\_\_\_\_ outbreaks have been related to fecally contaminated water; food contaminated by infected food handlers, including sandwiches and salads that are not cooked or are handled after cooking and raw or undercooked mollusks harvested from contaminated waters.

- A. Hepatitis A
- B. Campylobacteriosis
- C. Yersiniosis
- D. Aseptic meningitis
- E. None of the Above

296. \_\_\_\_\_, polio and viral gastroenteritis (Norwalk agent) are other viral diseases that can be transmitted through water. Most viruses in drinking water can be inactivated by chlorine or other disinfectants.

- A. Hepatitis A
- B. Campylobacteriosis
- C. Yersiniosis
- D. Aseptic meningitis
- E. None of the Above

297. Protozoan pathogens are larger than bacteria and viruses but still \_\_\_\_\_. They invade and inhabit the gastrointestinal tract.

- A. Hepatitis A
- B. Campylobacteriosis
- C. Yersiniosis
- D. Aseptic meningitis
- E. None of the Above

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

- A. Hepatitis A
- B. Campylobacteriosis
- C. Cyst
- D. Filtration treatment
- E. Giardiasis

299. The \_\_\_\_\_ can survive in the environment for long periods of time and is extremely resistant to conventional disinfectants such as chlorine.

- A. Hepatitis A
- B. Campylobacteriosis
- C. Cyst
- D. Filtration treatment
- E. Giardiasis

300. Effective \_\_\_\_\_ is therefore critical to removing these organisms from water sources.

- A. Hepatitis A
- B. Campylobacteriosis
- C. Cyst
- D. Filtration treatment
- E. Giardiasis

301. \_\_\_\_\_ is a commonly reported protozoan-caused disease.
- A. Hepatitis A
  - B. Campylobacteriosis
  - C. Cyst
  - D. Filtration treatment
  - E. Giardiasis
302. Agglomeration of particles into groups, thereby increasing the effective diameter.
- A. Strong oxidizer
  - B. Flocculation
  - C. Coagulation
  - D. Turbidity
  - E. Chemical composition
303. A chemical technique directed toward destabilization of colloidal particles.
- A. Strong oxidizer
  - B. Flocculation
  - C. Coagulation
  - D. Turbidity
  - E. Chemical composition
304. A measure of the presence of suspended solid material.
- A. Strong oxidizer
  - B. Flocculation
  - C. Coagulation
  - D. Turbidity
  - E. Chemical composition
305. Potassium Permanganate has been used for a number of years in both water & wastewater treatment.  $\text{KMnO}_4$  is a \_\_\_\_\_ which can be used to destroy many organic compounds of both the natural and man made origin.
- A. Strong oxidizer
  - B. Flocculation
  - C. Coagulation
306.  $\text{KMnO}_4$  is also used to oxidize iron, manganese and sulfide compounds and other taste and odor producing substances usually due to the presence of very small quantities of secretions given off by microscopic algae, which develop on the surface waters and on beds of lakes and rivers under certain conditions of temperature and \_\_\_\_\_.
- A. Strong oxidizer
  - B.  $\text{KMnO}_4$
  - C. Coagulation
  - D. Turbidity
  - E. Chemical composition

307.  $\text{KMnO}_4$  must be used with caution, as this material produces an intense purple color when mixed with water. As the \_\_\_\_\_ is reduced during its reaction with compounds that it oxidizes, it changes color from purple to yellow or brown. The final product formed is manganese dioxide ( $\text{MnO}_2$ ), an insoluble precipitate that can be removed by sedimentation and filtration.

- A. Strong oxidizer
- B.  $\text{KMnO}_4$
- C. Coagulation
- D. Turbidity
- E. Permanganate ion

### Chlorine Section

308. Chlorine is a \_\_\_\_\_ gas with a characteristic pungent odor.

- A. Greenish-yellow
- B. Amber liquid
- C. Olfactory fatigue
- D. Chlorine
- E. None of the Above

309. Chlorine condenses to an \_\_\_\_\_ at approximately  $-34$  degrees C ( $-29.2$  degrees F) or at high pressures.

- A. Greenish-yellow
- B. Amber liquid
- C. Olfactory fatigue
- D. Chlorine
- E. None of the Above

310. Chlorine \_\_\_\_\_ ranging from 0.08 to part per million (ppm) parts of air have been reported.

- A. Greenish-yellow
- B. Odor thresholds
- C. Olfactory fatigue
- D. Chlorine

311. Prolonged exposures of Chlorine may result in \_\_\_\_\_.

- A. Greenish-yellow
- B. Amber liquid
- C. Olfactory fatigue
- D. Chlorine

312. Cylinders of chlorine may burst when exposed to \_\_\_\_\_. Chlorine in solution forms a corrosive material.

- A. Greenish-yellow
- B. Amber liquid
- C. Elevated temperatures
- D. Chlorine
- E. None of the Above

313. Flammable gases and vapors form \_\_\_\_\_ with chlorine.
- A. Greenish-yellow
  - B. Explosive mixtures
  - C. Olfactory fatigue
  - D. Chlorine
  - E. None of the Above
314. Contact between \_\_\_\_\_ and many combustible substances (such as gasoline and petroleum products, hydrocarbons, turpentine, alcohols, acetylene, hydrogen, ammonia, and sulfur), reducing agents, and finely divided metals may cause fires and explosions.
- A. Greenish-yellow
  - B. Amber liquid
  - C. Olfactory fatigue
  - D. Chlorine
  - E. None of the Above
315. Contact between chlorine and arsenic, bismuth, boron, calcium, activated carbon, carbon disulfide, glycerol, hydrazine, iodine, methane, oxomonosilane, potassium, propylene, and silicon \_\_\_\_\_.
- A. Combustible materials
  - B. Attack
  - C. Incompatible
  - D. Reacts
  - E. Should be avoided
316. Chlorine \_\_\_\_\_ with hydrogen sulfide and water to form hydrochloric acid, and it reacts with carbon monoxide and sulfur dioxide to form phosgene and sulfuryl chloride.
- A. Combustible materials
  - B. Attack
  - C. Incompatible
  - D. Reacts
  - E. Should be avoided
317. Chlorine is also \_\_\_\_\_ with moisture, steam, and water.
- A. Combustible materials
  - B. Attack
  - C. Incompatible
  - D. Reacts
  - E. Should be avoided
318. Chlorine will \_\_\_\_\_ some forms of plastics, rubber, and coatings.
- A. Combustible materials
  - B. Attack
  - C. Incompatible
  - D. Reacts
  - E. Should be avoided

319. Chlorine is a non-combustible gas. The National Fire Protection Association has assigned a flammability rating of 0 (no fire hazard) to chlorine; however, most \_\_\_\_\_ will burn in chlorine.

- A. Combustible materials
- B. Attack
- C. Incompatible
- D. Reacts
- E. Should be avoided

320. Extinguishant: For small fires use water only; do not use dry chemical or \_\_\_\_\_. Contain and let large fires involving chlorine burn. If fire must be fought, use water spray or fog.

- A. Carbon dioxide
- B. Chlorine
- C. Containers
- D. Low areas
- E. None of the Above

321. Fires involving chlorine should be fought \_\_\_\_\_ from the maximum distance possible.

- A. Carbon dioxide
- B. Chlorine
- C. Containers
- D. Low areas
- E. None of the Above

322. 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 \_\_\_\_\_ burn.

- A. Carbon dioxide
- B. Chlorine
- C. Containers
- D. Low areas
- E. None of the Above

323. Emergency personnel should stay out of \_\_\_\_\_ and ventilate closed spaces before entering.

- A. Carbon dioxide
- B. Chlorine
- C. Containers
- D. Low areas
- E. None of the Above

324. Containers of chlorine may explode in the heat of the fire and should be moved from the fire area if it is possible to do so safely. If this is not possible, cool fire exposed containers from the sides with water until well after the \_\_\_\_\_ is out.

- A. Carbon dioxide
- B. Chlorine
- C. Containers
- D. Low areas
- E. None of the Above

325. Stay away from the ends of \_\_\_\_\_. Firefighters should wear a full set of protective clothing and self-contained breathing apparatus when fighting fires involving chlorine.
- A. Carbon dioxide
  - B. Chlorine
  - C. Containers
  - D. Low areas
  - E. None of the Above

### **Chlorine Exposure Limits**

326. The American Conference of Governmental Industrial Hygienists (ACGIH) has assigned chlorine a threshold limit value (TLV) of 0.5 ppm as a TWA for a normal 8-hour workday and a 40-hour workweek and a short-term exposure limit (STEL) of 1.0 ppm (2.9 mg/m<sup>3</sup>) for periods not to exceed 15 minutes.

- A. OSHA PEL
- B. ACGIH TLV
- C. NIOSH REL
- D. None of the Above

327. Exposures at the STEL concentration should not be repeated more than four times a day and should be separated by intervals of at least 60 minutes.

- A. OSHA PEL
- B. ACGIH TLV
- C. NIOSH REL
- D. None of the Above

328. The current Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL) for chlorine is 1 ppm.

- A. OSHA PEL
- B. ACGIH TLV
- C. NIOSH REL
- D. None of the Above

329. The National Institute for Occupational Safety and Health (NIOSH) has established a recommended exposure limit (REL) for chlorine of 0.5 ppm as a TWA for up to a 10-hour workday and a 40-hour workweek.

- A. OSHA PEL
- B. ACGIH TLV
- C. NIOSH REL
- D. None of the Above

330. Short-term exposure limit (STEL) of 1 ppm.

- A. OSHA PEL
- B. ACGIH TLV
- C. NIOSH REL
- D. None of the Above

331. The organic matter and other substances that are present, convert to \_\_\_\_\_, some of which are effective killing agents.

- A. Free
- B. Residual
- C.  $\text{OCl}^-$
- D. Chlorinated derivatives
- E. None of the Above

332. Chlorine present as  $\text{Cl}$ ,  $\text{HOCl}$ , and \_\_\_\_\_ is called free available chlorine, and that which is bound but still effective is combined chlorine.

- A. Free
- B. Residual
- C.  $\text{OCl}^-$
- D. Trihalomethanes
- E. None of the Above

333. A particularly important group of compounds with combined chlorine is the chloramines formed by reactions with \_\_\_\_\_.

- A. Free
- B. Residual
- C.  $\text{OCl}^-$
- D. Trihalomethanes
- E. None of the Above

334. One especially important feature of disinfection using chlorine is the ease of overdosing to create a \_\_\_\_\_ concentration. There is a constant danger that safe water leaving the treatment plant may become contaminated later.

- A. Free
- B. Residual
- C.  $\text{OCl}^-$
- D. Trihalomethanes
- E. None of the Above

335. There may be breaks in water mains, loss of pressure that permits an inward leak, or plumbing errors. This \_\_\_\_\_ concentration of chlorine provides some degree of protection right to the water faucet.

- A. Free
- B. Residual
- C.  $\text{OCl}^-$
- D. Trihalomethanes
- E. None of the Above

336. A typical residual is from 0.1 to 0.5 ppm. Because chlorinated organic compounds are less effective, a typical residual is 2 ppm for \_\_\_\_\_.

- A. Free
- B. Combined chlorine
- C.  $\text{OCl}^-$
- D. Trihalomethanes
- E. None of the Above

337. There will be no chlorine residual unless there is an excess over the amount that reacts with the organic matter present. However, reaction kinetics complicates interpretation of chlorination data. The correct excess is obtained in a method called \_\_\_\_\_.

- A. Free
- B. Break Point Chlorination
- C.  $\text{OCl}^-$
- D. Trihalomethanes
- E. None of the Above

338. Chlorination by-products are the chemicals formed when the chlorine used to kill disease-causing \_\_\_\_\_ reacts with naturally occurring organic matter (e.g., decay products of vegetation) in the water.

- A. Free
- B. Residual
- C.  $\text{OCl}^-$
- D. Micro-organisms
- E. None of the Above

339. The most common chlorination by-products found in U.S. drinking water supplies are the \_\_\_\_\_.

- A. Free
- B. Residual
- C.  $\text{OCl}^-$
- D. Trihalomethanes
- E. None of the Above

340. The Principal Trihalomethanes are: \_\_\_\_\_, bromodichloromethane, chlorodibromo-methane and bromoform.

- A. Free
- B. Chloroform
- C.  $\text{OCl}^-$
- D. Trihalomethanes
- E. None of the Above

341. Other less common chlorination by-products includes the \_\_\_\_\_ and haloacetonitriles.

- A. Free
- B. Residual
- C.  $\text{OCl}^-$
- D. Haloacetic acids
- E. None of the Above

342. The amount of \_\_\_\_\_ formed in drinking water can be influenced by a number of factors, including the season and the source of the water.

- A. Free
- B. Residual
- C.  $\text{OCl}^-$
- D. Trihalomethanes
- E. None of the Above

343. \_\_\_\_\_ concentrations are generally lower in winter than in summer, because concentrations of natural organic matter are lower and less chlorine is required to disinfect at colder temperatures.

- A. Free
- B. Residual
- C.  $\text{OCl}^-$
- D. Trihalomethanes
- E. None of the Above

344. THM levels are also low when wells or large lakes are used as the drinking water source, because \_\_\_\_\_ concentrations are generally low in these sources.

- A. Free
- B. Residual
- C.  $\text{OCl}^-$
- D. Trihalomethanes
- E. None of the Above

345. The opposite — high organic matter concentrations and high \_\_\_\_\_ levels — is true when rivers or other surface waters are used as the source of the drinking water.

- A. Chlorate and chlorite
- B. Ozone
- C. THMs
- D. Chloramines
- E. None of the Above

346. Laboratory animals exposed to very high levels of \_\_\_\_\_ have shown increased incidences of cancer. Also, several studies of cancer incidence in human populations have reported associations between long-term exposure to high levels of chlorination by-products and an increased risk of certain types of cancer.

- A. Chlorate and chlorite
- B. Ozone
- C. THMs
- D. Chloramines
- E. None of the Above

347. Current evidence indicates that the benefits of chlorinating our drinking water — reduced incidence of water-borne diseases — are much greater than the risks of health effects from \_\_\_\_\_.

- A. Chlorate and chlorite
- B. Ozone
- C. THMs
- D. Chloramines
- E. None of the Above

348. When used with modern water filtration practices, chlorine is effective against virtually all infective agents — bacteria, viruses and protozoa. It is easy to apply and most importantly, small amounts of \_\_\_\_\_ remain in the water and continue to disinfect throughout the distribution system.

- A. Chlorate and chlorite
- B. Ozone
- C. THMs
- D. Chloramines
- E. None of the Above

349. Acute Cl<sub>2</sub> exposure: Acute exposure to \_\_\_\_\_ of chlorine results in eye, nose, and throat irritation, sneezing, excessive salivation, general excitement, and restlessness.

- A. Further exposure
- B. Higher concentrations
- C. Low levels
- D. Cl<sub>2</sub> liquid
- E. Chronic exposure

350. \_\_\_\_\_ of Cl<sub>2</sub> causes difficulty in breathing, violent coughing, nausea, vomiting, cyanosis, dizziness, headache, choking, laryngeal edema, acute tracheo-bronchitis, chemical pneumonia.

- A. Further exposure
- B. Higher concentrations
- C. Low levels
- D. Cl<sub>2</sub> liquid
- E. Chronic exposure

351. Contact with \_\_\_\_\_ can result in frostbite burns of the skin and eyes.

- A. Further exposure
- B. Higher concentrations
- C. Low levels
- D. Cl<sub>2</sub> liquid
- E. Chronic exposure

352. \_\_\_\_\_ to low levels of chlorine gas can result in a dermatitis known as chloracne, tooth enamel corrosion, coughing, severe chest pain, sore throat, hemoptysis and increased susceptibility to tuberculosis.

- A. Further exposure
- B. Higher concentrations
- C. Low levels
- D. Chronic exposure

353. Rescue: Remove an incapacitated worker from further exposure and implement appropriate emergency procedures (e.g., those listed on the Material Safety Data Sheet required by \_\_\_\_\_).

- A. Protective equipment
- B. Emergency procedures
- C. OSHA's Hazard Communication Standard
- D. Special training
- E. None of the Above

354. All workers should be familiar with \_\_\_\_\_, the location and proper use of emergency equipment, and methods of protecting themselves during rescue operations.

- A. Protective equipment
- B. Emergency procedures
- C. OSHA's Hazard Communication Standard
- D. Special training
- E. None of the Above

355. Chlorine should be stored in a cool, dry, well-ventilated area in tightly sealed containers that are labeled in accordance with \_\_\_\_\_.

- A. Protective equipment
- B. Emergency procedures
- C. OSHA's Hazard Communication Standard
- D. Special training
- E. None of the Above

356. Workers handling and operating chlorine containers, cylinders, and tank wagons should receive \_\_\_\_\_ in standard safety procedures for handling compressed corrosive gases.

- A. Protective equipment
- B. Emergency procedures
- C. OSHA's Hazard Communication Standard
- D. Special training
- E. None of the Above

357. All pipes and containment used for chlorine service should be regularly inspected and tested. Empty containers of chlorine should have secured protective covers on their valves and should be \_\_\_\_\_.

- A. Protective equipment
- B. Emergency procedures
- C. OSHA's Hazard Communication Standard
- D. Special training
- E. None of the Above

358. In the event of a spill or leak involving chlorine, persons not wearing \_\_\_\_\_ and fully-encapsulating, vapor-protective clothing should be restricted from contaminated areas until cleanup has been completed.

- A. Protective equipment
- B. Emergency procedures
- C. OSHA's Hazard Communication Standard
- D. Special training
- E. None of the Above

359. The immediate effects of chlorine gas toxicity include acute inflammation of the conjunctivae, nose, pharynx, larynx, trachea, and bronchi. Irritation of the airway mucosa leads to local edema secondary to active \_\_\_\_\_.

- A. Multiple pulmonary thromboses
- B. Pulmonary congestion
- C. Pulmonary edema
- D. Arterial and capillary hyperemia
- E. None of the Above

360. Plasma exudation results in filling the alveoli with edema fluid, resulting in \_\_\_\_\_.

- A. Multiple pulmonary thromboses
- B. Pulmonary congestion
- C. Pulmonary edema
- D. Arterial and capillary hyperemia
- E. None of the Above

361. Pathologic findings of chlorine gas toxicity are nonspecific. They include severe \_\_\_\_\_, pneumonia, hyaline membrane formation, multiple pulmonary thromboses, and ulcerative tracheobronchitis.

- A. Multiple pulmonary thromboses
- B. Pulmonary congestion
- C. Pulmonary edema
- D. Arterial and capillary hyperemia
- E. None of the Above

362. The hallmark of pulmonary injury associated with chlorine toxicity is \_\_\_\_\_, manifested as hypoxia. Noncardiogenic pulmonary edema is thought to occur when there is a loss of pulmonary capillary integrity.

- A. Multiple pulmonary thromboses
- B. Pulmonary congestion
- C. Pulmonary edema
- D. Arterial and capillary hyperemia
- E. None of the Above

363. Chlorine applied to water in its molecular or hypochlorite form initially undergoes hydrolysis to form free chlorine consisting of aqueous molecular chlorine, \_\_\_\_\_, and hypochlorite ion.

- A. Hypochlorous acid
- B. Chlorine
- C. Ammonia
- D. Free
- E. None of the Above

364. The relative proportion of these free chlorine forms is pH- and temperature-dependent. At the pH of most waters, \_\_\_\_\_ and hypochlorite ion will predominate.

- A. Hypochlorous acid
- B. Chlorine
- C. Ammonia
- D. Free

365. Free chlorine reacts readily with \_\_\_\_\_ and certain nitrogenous compounds to form combined chlorine.

- A. Hypochlorous acid
- B. Chlorine
- C. Ammonia
- D. Free
- E. None of the Above

366. With ammonia, chlorine reacts to form the chloramines: monochloramine, dichloramine, and \_\_\_\_\_.

- A. Hypochlorous acid
- B. Chlorine
- C. Ammonia
- D. Free
- E. None of the Above

367. The presence and concentrations of these combined forms depend chiefly on pH, temperature, initial chlorine-to-nitrogen ratio, absolute chlorine demand, and reaction time. Both \_\_\_\_\_ and combined chlorine may be present simultaneously.

- A. Hypochlorous acid
- B. Chlorine
- C. Ammonia
- D. Free
- E. None of the Above

368. Combined chlorine in water supplies may be formed in the treatment of raw waters containing ammonia or by the addition of \_\_\_\_\_ or ammonium salts.

- A. Hypochlorous acid
- B. Chlorine
- C. Ammonia
- D. Free
- E. None of the Above

369. Chlorinated wastewater effluents, as well as certain chlorinated industrial effluents, normally contain only combined chlorine. Historically the principal analytical problem has been to distinguish between \_\_\_\_\_ and combined forms of chlorine.

- A. Hypochlorous acid
- B. Chlorine
- C. Ammonia
- D. Free
- E. None of the Above

370. The term \_\_\_\_\_ originally meant a reaction in which oxygen combines chemically with another substance, but its usage has long been broadened to include any reaction in which electrons are transferred.

- A. Hypochlorous acid
- B. Oxidation
- C. Ammonia
- D. Free
- E. None of the Above

371. \_\_\_\_\_ and reduction always occur simultaneously (redox reactions), and the substance which gains electrons is termed the oxidizing agent

- A. Hypochlorous acid
- B. Oxidation
- C. Ammonia
- D. Free
- E. None of the Above

372. Electrons may also be displaced within the \_\_\_\_\_ without being completely transferred

- A. Hypochlorous acid
- B. Oxidation
- C. Ammonia
- D. Free
- E. None of the Above

373. \_\_\_\_\_ is also a form of oxidation, when two hydrogen atoms, each having one electron, are removed from a hydrogen-containing organic compound by a catalytic reaction with air or oxygen, as in oxidation of alcohol to aldehyde.

- A. Hypochlorous acid
- B. Oxidation
- C. Dehydrogenation
- D. Free
- E. None of the Above

Chlorine can be added as sodium hypochlorite, calcium hypochlorite or chlorine gas. When any of these is added to water, chemical reactions occur as these equations show:

374.  $\text{Cl}_2 + \text{H}_2\text{O} \rightarrow \text{HOCl} + \underline{\hspace{2cm}}$   
(chlorine gas) (water) (hypochlorous acid) (hydrochloric acid)

- A. HCl
- B. Ca(OH)
- C. HOCl
- D.  $\text{OCl}^-$
- E. None of the Above

375.  $\text{CaOCl}_2 + \text{H}_2\text{O} \rightarrow \underline{\hspace{2cm}} + \text{Ca(OH)}_2$   
(calcium hypochlorite) (water) (hypochlorous acid) (calcium hydroxide)

- A. HCl
- B. Ca(OH)
- C. 2HOCl
- D.  $\text{OCl}^-$
- E. None of the Above

376.  $\text{NaOCl} + \text{H}_2\text{O} \rightarrow \underline{\hspace{2cm}} + \text{Na(OH)}$   
(sodium hypochlorite) (water) (hypochlorous acid) (sodium hydroxide)

- A. HCl
- B. Ca(OH)
- C. HOCl
- D.  $\text{OCl}^-$
- E. None of the Above

377. All three forms of chlorine produce \_\_\_\_\_ when added to water. Hypochlorous acid is a weak acid but a strong disinfecting agent. The amount of hypochlorous acid depends on the pH and temperature of the water. Under normal water conditions, hypochlorous acid will also chemically react and break down into a hypochlorite ion.

- A. HCl
- B. Ca(OH)
- C. HOCl
- D. OCl<sup>-</sup>
- E. None of the Above

378. \_\_\_\_\_: HOCl H + + OCl<sup>-</sup> Also expressed HOCl → H + + OCl<sup>-</sup>  
(hypochlorous acid) (hydrogen) (hypochlorite ion)

- A. HCl
- B. Ca(OH)
- C. HOCl
- D. OCl<sup>-</sup>
- E. None of the Above

379. The \_\_\_\_\_ is a much weaker disinfecting agent than hypochlorous acid, about 100 times less effective.

- A. HCl
- B. Ca(OH)
- C. HOCl
- D. OCl<sup>-</sup>
- E. None of the Above

380. Let's now look at how pH and temperature affect the ratio of hypochlorous acid to hypochlorite ions. As the temperature is decreased, the ratio of \_\_\_\_\_ increases.

- A. HCl
- B. Ca(OH)
- C. HOCl
- D. OCl<sup>-</sup>
- E. None of the Above

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

- A. HCl
- B. Ca(OH)
- C. HOCl
- D. OCl<sup>-</sup>
- E. None of the Above

382. All other things being equal, higher water temperatures and \_\_\_\_\_ are more conducive to chlorine disinfection.

- A. HCl
- B. Ca(OH)
- C. HOCl
- D. OCl<sup>-</sup>
- E. None of the Above

383. A number of cities use \_\_\_\_\_ to disinfect their source water and to reduce THM formation.

- A. Chlorate and chlorite
- B. Ozone
- C. THMs
- D. Chloramines
- E. None of the Above

384. Although \_\_\_\_\_ is a highly effective disinfectant, it breaks down quickly, so that small amounts of chlorine or other disinfectants must be added to the water to ensure continued disinfection as the water is piped to the consumer's tap.

- A. Chlorate and chlorite
- B. Ozone
- C. THMs
- D. Chloramines
- E. None of the Above

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

- A. Chlorate and chlorite
- B. Ozone
- C. THMs
- D. Chloramines
- E. None of the Above

386. Examples of other disinfectants include \_\_\_\_\_ and chlorine dioxide.

- A. Chlorate and chlorite
- B. Ozone
- C. THMs
- D. Chloramines
- E. None of the Above

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

- A. Chlorate and chlorite
- B. Ozone
- C. THMs
- D. Chloramines
- E. None of the Above

388. Chlorine dioxide can be an effective disinfectant, but it forms \_\_\_\_\_, compounds whose toxicity has not yet been fully determined.

- A. Chlorate and chlorite
- B. Ozone
- C. THMs
- D. Chloramines
- E. None of the Above

389. Assessments of the health risks from these and other \_\_\_\_\_ disinfectants and chlorination by-products are currently under way.

- A. Chlorate and chlorite
- B. Ozone
- C. THMs
- D. Chloramines
- E. None of the Above

390. In general, the preferred method of controlling chlorination by-products is removal of the naturally occurring \_\_\_\_\_ from the source water so it cannot react with the chlorine to form by-products.

- A. Chlorate and chlorite
- B. Ozone
- C. THMs
- D. Chloramines
- E. None of the Above

391. THM levels may also be reduced through the replacement of chlorine with alternative disinfectants. A third option is removal of the \_\_\_\_\_ by adsorption on activated carbon beds.

- A. Chlorate and chlorite
- B. Ozone
- C. THMs
- D. Chloramines
- E. None of the Above

392. It is extremely important that water treatment plants ensure that methods used to control chlorination by-products do not compromise the effectiveness of \_\_\_\_\_.

- A. Chlorate and chlorite
- B. Ozone
- C. THMs
- D. Chloramines
- E. None of the Above

### **Alternate Disinfectants**

393. \_\_\_\_\_ is a very weak disinfectant for Giardia and virus reduction.

- A. Chlorine dioxide
- B. Chloramine
- C. Dry sodium chlorite
- D. Ozone
- E. None of the Above

394. It is recommended that it be used in conjunction with a stronger disinfectant. It is best utilized as a stable distribution system disinfectant.

- A. Chlorine dioxide
- B. Chloramine
- C. Dry sodium chlorite
- D. Ozone
- E. None of the Above

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

- A. Chlorine dioxide
- B. Chloramine
- C. Dry sodium chlorite
- D. Ozone
- E. None of the Above

396. \_\_\_\_\_ may be used for either taste and odor control or as a pre-disinfectant. Total residual oxidants (including chlorine dioxide and chlorite, but excluding chlorate) shall not exceed 0.30 mg/L during normal operation or 0.50 mg/L (including chlorine dioxide, chlorite and chlorate) during periods of extreme variations in the raw water supply.

- A. Chlorine dioxide
- B. Chloramine
- C. Dry sodium chlorite
- D. Ozone
- E. None of the Above

397. Ozone does not provide a system residual and should be used as a primary disinfectant only in conjunction with \_\_\_\_\_.

- A. Chlorine dioxide
- B. Chloramine
- C. Dry sodium chlorite
- D. Ozone
- E. None of the Above

398. 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 \_\_\_\_\_, ketones or carboxylic acids.

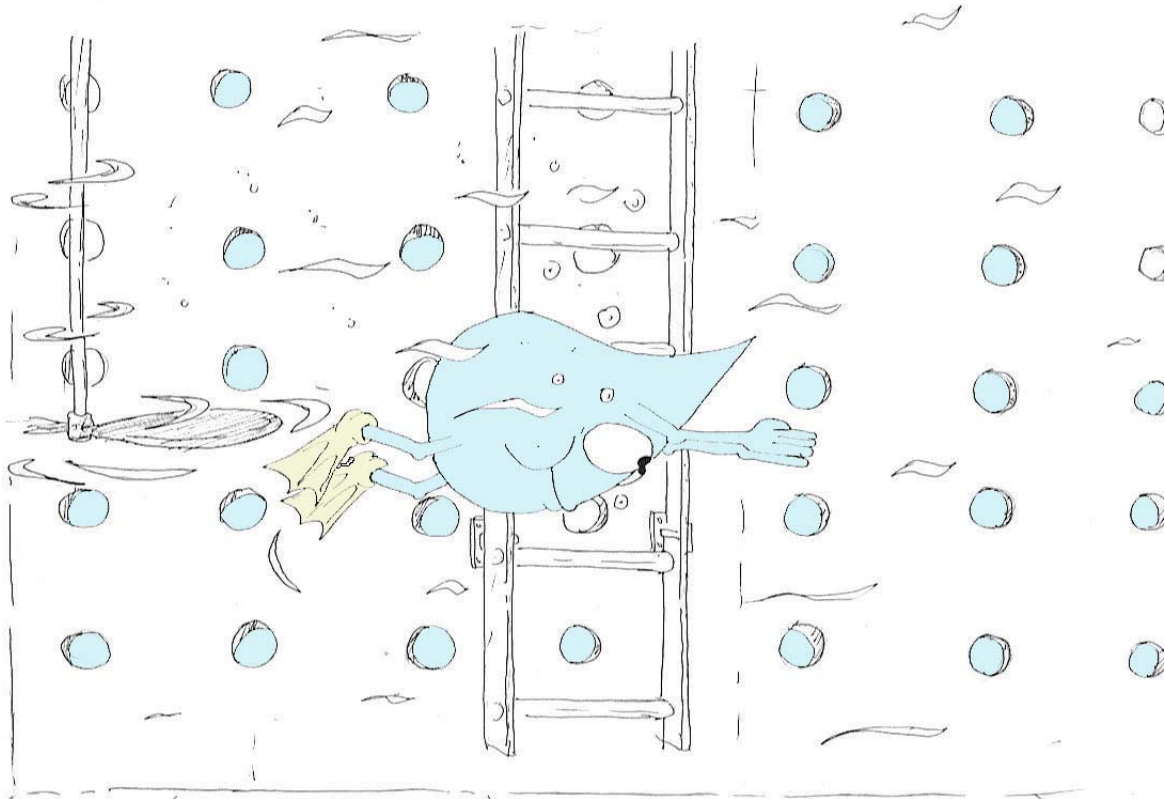
- A. Chlorine dioxide
- B. Chloramine
- C. Dry sodium chlorite
- D. Ozone
- E. None of the Above

399. \_\_\_\_\_ provides good Giardia and virus protection but its use is limited by the restriction on the maximum residual of 0.5 mg/L ClO<sub>2</sub>/chlorite/chlorate allowed in finished water. This limits usable residuals of chlorine dioxide at the end of a process unit to less than 0.5 mg/L.

- A. Chlorine dioxide
- B. Chloramine
- C. Dry sodium chlorite
- D. Ozone
- E. None of the Above

400. Where \_\_\_\_\_ is approved for use as an oxidant, the preferred method of generation is to entrain chlorine gas into a packed reaction chamber with a 25% aqueous solution of sodium chlorite ( $\text{NaClO}_2$ ).

- A. Chlorine dioxide
- B. Chloramine
- C. Dry sodium chlorite
- D. Ozone
- E. None of the Above



**You are finished...**

**Please fax the answer key and registration form to us.**

## ***Special Notice to Help the Less Fortunate***



**Kavi and the believers in his church prayed fervently and lifted up praise to God before digging the well.**

**We here in the U.S. have it very good. Here is a story of and drilling a well just to have drinking water in India.**

Kavi Viresh was accustomed to rejection. A Gospel for Asia missionary, Kavi knew he was laboring in hard soil in his village in Andhra Pradesh, India and the spiritual drought experienced by its people was worse than the physical drought they suffered in the summers. The people of this village lived hard lives focused on daily survival, and most did not have faith in any god.

By God's grace, Kavi has seen a church planted there—and believers who are eager to help him with outreach. Still, the hearts of many in the village have remained hard. Kavi has suffered beatings several times for sharing the Good News of Jesus. One time, a group of 30 people came to his house to attack him. The Gospel tracts he handed out were torn into pieces on many occasions.

**"People told me, 'Your God is a great God.'"**

But Kavi knew the people weren't really rejecting *him*—they were rejecting *Jesus* who sent him. And he knew there just had to be some way to get through to these people whom Jesus loved so much. That way turned out to be a Jesus Well. Before the Jesus Well was dug in this village, the people's only source of water was one government-built water tank that was not nearly enough to meet their basic needs. Kavi knew the Jesus Well would be a tangible way to show the villagers that Jesus loved them.

Sudhir Rao, a new Christian in the village, gladly provided his services as a mason to help with construction. The digging of the Jesus Well was in itself a miracle. Others had attempted to dig a well in the village but not seen water even at depths of 300 feet. So when Kavi saw water at around 100 feet, villagers were amazed.

"People told me, 'Your God is a great God,'" Kavi recalls. Even the village leader expressed heartfelt appreciation to Kavi for providing his people with water—and that he desired to see another well dug in a nearby area. Although the well was just dug in recent months, Kavi has already seen God wash away barriers in the villagers' hearts through its refreshing waters. Hearts have been brought that much closer to being able to receive the message of hope in Christ. And he has a vision of faith for how God will continue to work. "Through this Jesus Well, surely those who have beaten me and are against me will come to know the Lord Jesus," Kavi shared.

**For more information, we welcome you to visit...**

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