

Registration form

**WATER TREATMENT FUNDAMENTALS \$250.00
48 HOUR RUSH ORDER PROCESSING FEE ADDITIONAL \$50.00**

Start and Finish Dates: _____

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

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

Name _____ **Signature** _____

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

Address _____

City _____ **State** _____ **Zip** _____

Email _____ **Fax ()** _____

Phone:
Home () _____ **Work ()** _____

Operator ID # _____ **Exp. Date** _____

Class/Grade _____

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

Water Treatment ___ Water Distribution ___ Other _____

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

If you've paid on the Internet, please write your Customer# _____

Please invoice me, my PO# _____

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

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

DISCLAIMER NOTICE

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

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

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

State Approval Listing URL...

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

You can obtain a printed version of the course manual from TLC for an additional \$89.95 plus shipping charges.

AFFIDAVIT OF EXAM COMPLETION

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

Grading Information

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

Rush Grading Service

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

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

Texas Students Only

Acknowledgement of Notice of Potential Ineligibility for License

You are required to sign and return to TLC or your credit will not be reported.

Name: _____

Date of Birth: _____

Email Address: _____

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

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

Enrollee Signature: _____ Date: _____

Name of Training Provider/Organization: Technical Learning College

Contact Person: Melissa Durbin Role/Title: Dean

WT FUNDAMENTALS Answer Key

Name _____

Phone _____

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

You are responsible to ensure this course is accepted for credit.
Method of Course acceptance confirmation. Please fill this section

Website ___ Telephone Call ___ Email ___ Spoke to _____

Did you receive the approval number, if applicable? _____

What is the course approval number, if applicable? _____

You can electronically complete this assignment in Adobe Acrobat DC.

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

- | | | | |
|-------------|-------------|-------------|-------------|
| 1. A B C D | 20. A B C D | 39. A B | 58. A B C D |
| 2. A B C D | 21. A B | 40. A B | 59. A B |
| 3. A B C D | 22. A B C D | 41. A B C D | 60. A B C D |
| 4. A B C D | 23. A B | 42. A B C D | 61. A B |
| 5. A B C D | 24. A B C D | 43. A B | 62. A B C D |
| 6. A B | 25. A B C D | 44. A B | 63. A B C D |
| 7. A B C D | 26. A B C D | 45. A B C D | 64. A B C D |
| 8. A B C D | 27. A B C D | 46. A B C D | 65. A B C D |
| 9. A B C D | 28. A B C D | 47. A B C D | 66. A B C D |
| 10. A B C D | 29. A B C D | 48. A B C D | 67. A B |
| 11. A B | 30. A B | 49. A B C D | 68. A B |
| 12. A B | 31. A B C D | 50. A B C D | 69. A B C D |
| 13. A B C D | 32. A B C D | 51. A B C D | 70. A B |
| 14. A B C D | 33. A B C D | 52. A B C D | 71. A B C D |
| 15. A B C D | 34. A B C D | 53. A B C D | 72. A B |
| 16. A B C D | 35. A B C D | 54. A B C D | 73. A B C D |
| 17. A B C D | 36. A B C D | 55. A B C D | 74. A B |
| 18. A B C D | 37. A B C D | 56. A B C D | 75. A B C D |
| 19. A B C D | 38. A B C D | 57. A B C D | 76. A B C D |

- | | | | |
|--------------|--------------|--------------|--------------|
| 77. A B C D | 110. A B C D | 143. A B C D | 176. A B C D |
| 78. A B C D | 111. A B C D | 144. A B C D | 177. A B C D |
| 79. A B C D | 112. A B C D | 145. A B C D | 178. A B C D |
| 80. A B C D | 113. A B C D | 146. A B C D | 179. A B C D |
| 81. A B C D | 114. A B C D | 147. A B C D | 180. A B C D |
| 82. A B C D | 115. A B C D | 148. A B C D | 181. A B |
| 83. A B C D | 116. A B C D | 149. A B | 182. A B |
| 84. A B C D | 117. A B C D | 150. A B | 183. A B C D |
| 85. A B C D | 118. A B C D | 151. A B | 184. A B |
| 86. A B C D | 119. A B C D | 152. A B | 185. A B C D |
| 87. A B C D | 120. A B | 153. A B C D | 186. A B C D |
| 88. A B C D | 121. A B | 154. A B | 187. A B |
| 89. A B C D | 122. A B | 155. A B C D | 188. A B |
| 90. A B | 123. A B | 156. A B | 189. A B |
| 91. A B C D | 124. A B | 157. A B C D | 190. A B |
| 92. A B C D | 125. A B | 158. A B C D | 191. A B C D |
| 93. A B C D | 126. A B | 159. A B | 192. A B C D |
| 94. A B C D | 127. A B C D | 160. A B C D | 193. A B C D |
| 95. A B C D | 128. A B C D | 161. A B C D | 194. A B C D |
| 96. A B C D | 129. A B C D | 162. A B | 195. A B C D |
| 97. A B | 130. A B C D | 163. A B | 196. A B C D |
| 98. A B | 131. A B C D | 164. A B C D | 197. A B C D |
| 99. A B | 132. A B C D | 165. A B C D | 198. A B C D |
| 100. A B | 133. A B C D | 166. A B C D | 199. A B |
| 101. A B | 134. A B C D | 167. A B C D | 200. A B C D |
| 102. A B | 135. A B C D | 168. A B | 201. A B |
| 103. A B C D | 136. A B C D | 169. A B | 202. A B |
| 104. A B C D | 137. A B C D | 170. A B C D | 203. A B |
| 105. A B C D | 138. A B | 171. A B C D | 204. A B |
| 106. A B C D | 139. A B | 172. A B C D | 205. A B C D |
| 107. A B C D | 140. A B | 173. A B C D | 206. A B C D |
| 108. A B C D | 141. A B | 174. A B C D | 207. A B C D |
| 109. A B C D | 142. A B C D | 175. A B C D | 208. A B C D |

209. A B
210. A B C D
211. A B C D
212. A B C D
213. A B C D
214. A B C D
215. A B
216. A B
217. A B
218. A B
219. A B
220. A B
221. A B
222. A B
223. A B
224. A B
225. A B
226. A B
227. A B
228. A B
229. A B
230. A B
231. A B
232. A B
233. A B C D
234. A B C D
235. A B
236. A B C D
237. A B C D
238. A B
239. A B
240. A B C D
241. A B C D

242. A B C D
243. A B C D
244. A B C D
245. A B C D
246. A B C D
247. A B C D
248. A B C D
249. A B C D
250. A B C D
251. A B C D
252. A B C D
253. A B C D
254. A B C D
255. A B
256. A B
257. A B
258. A B
259. A B C D
260. A B
261. A B C D
262. A B C D
263. A B
264. A B C D
265. A B C D
266. A B
267. A B C D
268. A B C D
269. A B C D
270. A B
271. A B
272. A B C D
273. A B C D
274. A B C D

275. A B
276. A B C D
277. A B C D
278. A B
279. A B C D
280. A B C D
281. A B C D
282. A B C D
283. A B C D
284. A B
285. A B
286. A B C D
287. A B
288. A B
289. A B C D
290. A B
291. A B
292. A B
293. A B
294. A B
295. A B
296. A B
297. A B
298. A B
299. A B C D
300. A B C D
301. A B C D
302. A B
303. A B C D
304. A B
305. A B
306. A B
307. A B

308. A B
309. A B
310. A B C D
311. A B
312. A B
313. A B C D
314. A B
315. A B
316. A B C D
317. A B
318. A B
319. A B
320. A B
321. A B C D
322. A B C D
323. A B C D
324. A B C D
325. A B C D
326. A B C D
327. A B C D
328. A B C D
329. A B C D
330. A B C D
331. A B C D
332. A B C D
333. A B C D
334. A B C D
335. A B
336. A B C D
337. A B C D
338. A B C D
339. A B
340. A B

341. A B
342. A B C D
343. A B C D
344. A B C D
345. A B
346. A B
347. A B C D
348. A B
349. A B
350. A B C D
351. A B
352. A B
353. A B
354. A B
355. A B
356. A B C D
357. A B C D
358. A B C D
359. A B C D
360. A B C D
361. A B C D
362. A B C D
363. A B C D
364. A B C D
365. A B C D
366. A B C D
367. A B C D
368. A B C D
369. A B
370. A B
371. A B
372. A B
373. A B C D

374. A B C D
375. A B C D
376. A B C D
377. A B C D
378. A B C D
379. A B C D
380. A B
381. A B
382. A B
383. A B C D
384. A B C D
385. A B
386. A B C D
387. A B C D
388. A B C D
389. A B C D
390. A B
391. A B
392. A B C D
393. A B C D
394. A B C D
395. A B
396. A B C D
397. A B C D
398. A B
399. A B
400. A B
401. A B C D
402. A B
403. A B
404. A B C D
405. A B C D
406. A B C D

407. A B C D
408. A B C D
409. A B C D
410. A B C D
411. A B C D
412. A B C D
413. A B C D
414. A B C D
415. A B C D
416. A B C D
417. A B C D
418. A B
419. A B C D
420. A B C D
421. A B
422. A B C D
423. A B C D
424. A B C D
425. A B
426. A B C D
427. A B C D
428. A B C D
429. A B C D
430. A B C D
431. A B C D
432. A B C D
433. A B C D
434. A B C D
435. A B
436. A B C D
437. A B C D
438. A B C D
439. A B C D

440. A B C D
441. A B C D
442. A B
443. A B C D
444. A B C D
445. A B C D
446. A B C D
447. A B C D
448. A B C D
449. A B C D
450. A B C D
451. A B C D
452. A B C D
453. A B C D
454. A B C D
455. A B C D
456. A B C D
457. A B C D
458. A B C D
459. A B C D
460. A B
461. A B
462. A B C D
463. A B
464. A B
465. A B C D
466. A B C D
467. A B C D
468. A B C D
469. A B C D
470. A B
471. A B C D
472. A B C D

473. A B
474. A B C D
475. A B
476. A B
477. A B
478. A B
479. A B

480. A B C D
481. A B C D
482. A B C D
483. A B C D
484. A B C D
485. A B
486. A B C D

487. A B
488. A B C D
489. A B C D
490. A B
491. A B C D
492. A B C D
493. A B C D

494. A B C D
495. A B C D
496. A B C D
497. A B C D
498. A B C D
499. A B C D
500. A B

Please write down any questions that you could not find the answers or that have errors.

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

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

Rush Grading Service

If you need this assignment graded and the results mailed to you within a 48-hour period, prepare to pay an additional rush service handling fee of \$50.00.

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

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

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

NAME: _____

E-MAIL _____ PHONE _____

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

Please rate the difficulty of your course.

Very Easy 0 1 2 3 4 5 Very Difficult

Please rate the difficulty of the testing process.

Very Easy 0 1 2 3 4 5 Very Difficult

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

Very Similar 0 1 2 3 4 5 Very Different

How did you hear about this Course? _____

What would you do to improve the Course?

Any other concerns or comments.

Water Treatment Fundamentals CEU Training Course Assignment

The Water Treatment Fundamentals CEU course assignment is available in Word on the Internet for your convenience, please visit www.abctlc.com and download the assignment and e-mail it back to TLC.

You will have 90 days from receipt of this manual to complete it in order to receive your Professional Development Hours (PDHs) or Continuing Education Unit (CEU). A score of 70 % or better is necessary to pass this course. If you should need any assistance, please email or fax all concerns and the completed ANSWER KEY to info@tlch2o.com.

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

Hyperlink to the Glossary and Appendix

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

Because of the dangers of chlorine... we will start with the Disinfection Section

Disinfection Section

Chlorine's Appearance and Odor

1. Chlorine is a greenish-yellow gas it will condense to an amber liquid at approximately _____ F or at high pressures.
A. -29.2 degrees C. 29 degrees
B. - 100 degrees D. None of the above
2. Prolonged exposures to chlorine gas may result in?
A. Moisture, steam, and water C. Olfactory fatigue
B. Odor thresholds D. None of the above

Chlorine Gas

Pathophysiology

3. As far as chlorine safety and respiratory protection, the intermediate _____ of chlorine accounts for its effect on the upper airway and the lower respiratory tract.
A. Effects of Hydrochloric acid C. Water solubility
B. Vapor from Chlorine gas D. None of the Above
4. Respiratory exposure to _____ may be prolonged because its moderate water solubility may not cause upper airway symptoms for several minutes.
A. Hydrochloric acid C. Plasma exudation
B. Chlorine gas D. None of the Above
5. The odor threshold for chlorine gas is approximately?
A. 0.3-0.5 parts per million (ppm) C. 3-5 parts per million (ppm)
B. 3 parts per million (ppm) D. None of the Above

Mechanism of Activity

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

Early Response to Chlorine Gas

7. If you mix ammonia with chlorine gas, this compound reacts to form_____.
- A. Chloramine gas C. Sulfuric gas
B. Chlorine gas D. None of the Above

Reactivity

8. What is formed when chlorine is in contact with combustible substances (such as gasoline and petroleum products, hydrocarbons, turpentine, alcohols, acetylene, hydrogen, ammonia, and sulfur), reducing agents, and finely divided metals?
- A. Fires and explosions C. Moisture, steam, and water
B. Odor thresholds D. None of the above
9. Chlorine reacts with hydrogen sulfide and water to form this substance?
- A. Hydrogen sulfide C. Chlorinates
B. Hydrochloric acid D. None of the above
10. According to the text, chlorine is also incompatible with?
- A. Plastic C. Palladium
B. Moisture, steam, and water D. None of the above

Flammability

11. When there is a fire that involves Chlorine, the fire fight should be fought downwind from the minimum distance possible.
- A. True B. False
12. Keep unnecessary people away; isolate the hazard area and deny entry. For a massive fire in a cargo area, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from the area and let the fire burn. Emergency personnel should stay out of low areas and ventilate closed spaces before entering.
- A. True B. False
13. The effectiveness of chlorination depends on the _____ of the water, the concentration of the chlorine solution added, the time that chlorine is in contact with the organism, and water quality.
- A. Chlorine residual C. Oxygen
B. Chlorine demand D. None of the above
14. Chlorine may not be available for disinfection because _____ in the water (like iron, manganese, hydrogen sulfide, and ammonia).
- A. pH increases C. Required contact time
B. Part of it combines with other chemicals D. None of the above
15. The amount of chlorine required to achieve disinfection and that reacts with the other chemicals is the?
- A. Chlorine residual C. Free chlorine residual
B. Chlorine demand D. None of the above
16. Which term is used when disinfection decreases, as the concentration of the chlorine increases?
- A. pH increases C. Required contact time
B. Chlorine level and water quality D. None of the above
17. Chlorination is more effective as?
- A. Water temperature increases C. Water cools down
B. Chlorine demand D. None of the above

18. Chlorination becomes more alkaline and is less effective as the?
 A. Water's pH increases C. Required contact time is maximized
 B. Water quality increases D. None of the above
19. Chlorination is less effective in?
 A. Clear water C. Day time
 B. Cloudy (turbid) water D. None of the above
20. By adding a little more chlorine to what is already sufficient, this action will generally result in _____ that can be measured easily.
 A. pH increases C. Required contact time
 B. A free chlorine residual D. None of the above

Chlorination Chemistry

21. The hypochlorite ion is a much weaker disinfecting agent than Hypochlorous acid, about 100 times less effective.
 A. True B. False
22. According to the text, pH and temperature affect the ratio of hypochlorous acid to hypochlorite ions. As the temperature is decreased, the _____ increases.
 A. Reduction Ratio C. "CT" disinfection concept
 B. Ratio of hypochlorous acid D. None of the above
23. Under normal water conditions, hypochlorous acid will also chemically react and break down into the hypochlorite ion.
 A. True B. False
24. Although the ratio of _____ is greater at lower temperatures, pathogenic organisms are actually harder to kill.
 A. Hypochlorous acid C. Total chlorine
 B. The amount of chlorine D. None of the above
25. If all other things were equal, _____ and a lower pH are more conducive to chlorine disinfection.
 A. Lower pH C. Higher water temperatures
 B. Hypochlorous acid D. None of the above

Chlorine DDBP

26. These term means that chlorine is present as Cl, HOCl, and OCl⁻ is called _____, and that which is bound but still effective is _____.
 A. Free available chlorine and Total
 B. Free and Residual
 C. Free available chlorine and Combined Chlorine
 D. None of the above
27. Chloramines are formed by reactions with?
 A. Acid and Cl₂ C. Folic Acid and Cl₂
 B. Ammonia and Cl₂ D. None of the above

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

Types of Residual

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

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

Chlorine Exposure Limits

29. What is OSHA's PEL?

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

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

- A. True
- B. False

31. Liquid chlorine is about _____ times heavier than water

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

32. Gaseous chlorine is about _____ times heavier than air.

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

Alternate Disinfectants - Chloramine

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

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

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

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

Chlorine Dioxide

35. Which term provides good Giardia and virus protection but its use is limited by the restriction on the maximum residual of 0.5 mg/L ClO₂/chlorite/chlorate allowed in finished water?

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

36. If chlorine dioxide is being used as an oxidant, the preferred method of generation is to entrain this term or substance into a packed reaction chamber with a 25% aqueous solution of sodium chlorite (NaClO₂).

- A. Chloramine
- B. Chlorine gas
- C. Chlorine dioxide
- D. None of the above

37. According to the text, which chemical is explosive and can cause fires in feed equipment if leaking solutions or spills are allowed to dry out?

- A. Dry sodium chlorite
- B. Chlorine dioxide
- C. Ammonia
- D. None of the above

38. Chlorine dioxide may be used for either taste or odor control or as a?

- A. Chloramine
- B. Pre-disinfectant
- C. Gas
- D. None of the above

39. Total residual oxidants (including chlorine dioxide and chlorite, but excluding Chlorine dioxide) shall not exceed 0.50 mg/L during normal operation or 0.30 mg/L (including chlorine dioxide, chlorite and chlorate) during periods of extreme variations in the raw water supply.
A. True B. False

Ozone

40. Ozone is a very effective disinfectant for both Giardia and viruses
A. True B. False
41. When determining Ozone CT (contact time) values must be determined for the ozone basin alone; an accurate _____ must be obtained for the contact chamber, and residual levels.
A. Residual C. Contact time
B. T10 value D. None of the above
42. Ozone does not provide a system residual and should be used as a primary disinfectant only in conjunction with?
A. Dry sodium chlorite C. Free and/or combined chlorine
B. Chlorine dioxide D. None of the above
43. 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 $Cl_2 + NH_4$.
A. True B. False
44. Ozonation must include adequate ozone leak detection alarm systems, and an ozone off-gas destruction system.
A. True B. False

Water Quality Section

Three Types of Public Water Systems

45. Provides water to the same population year-round (for example: homes, apartment buildings)
A. TNCWS C. NTNCWSs
B. CWSs D. None of the above
46. Approximately 85,000 systems
A. TNCWS C. NTNCWSs
B. CWSs D. None of the above
47. Provides water where people do not remain for long periods of time (for example: gas stations, campgrounds)
A. TNCWS C. NTNCWSs
B. CWSs D. None of the above
48. Approximately 52,000 systems serving the majority of the U.S. population
A. TNCWS C. NTNCWSs
B. CWSs D. None of the above
49. Provides water to the same people at least six months a year, but not all year (for example: schools, factories, churches, office buildings that have their own water system)
A. TNCWS C. NTNCWSs
B. CWSs D. None of the above

50. Approximately 18,000 water systems
A. TNCWS C. NTNCWSs
B. CWSs D. None of the above

Water Quality Key Words

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

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

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

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

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

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

Water Quality Section

Surface (Raw) Water Introduction

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

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

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

- A. True B. False

Surface Water Properties

56. Depending on the region, some lakes and rivers receive _____ from sewer facilities or defective septic tanks.

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

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

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

58. Adjustments in the dissolved oxygen, algae, temperature, suspended solids, turbidity, and carbon dioxide will change because of _____.

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

Managing Water Quality at the Source

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

- A. True B. False

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

A. True B. False

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

A. True B. False

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

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

Physical Characteristics of Water

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

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

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

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

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

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

66. _____ is a substance that can give up a hydrogen ion (H^+); a base is a substance that can accept H^+ .

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

Alkalinity

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

A. True B. False

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

A. True B. False

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

69. _____ with an overabundance of alkaline earth metal concentrations is significant in determining the suitability of water for irrigation.
A. Alkalinity C. Hydrogen ion (H⁺)
B. Acid D. None of the above

70. Alkalinity measurements are used in the interpretation and control of water and wastewater treatment processes
A. True B. False

Turbidity Introduction

71. One physical feature of water is turbidity. A measure of the cloudiness of water caused by _____. The cloudy appearance of water caused by the presence of tiny particles.
A. Suspended particles C. Temperature fluctuation
B. Variations D. None of the above

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

73. The turbidity in natural surface waters is composed of a large number of sizes of particles. The sizes of particles can be changing constantly, depending on precipitation and _____ factors.
A. MCL C. Temperature
B. Manmade D. None of the above

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

75. Generally, higher turbidity levels require higher coagulant dosages. However, seldom is the relationship between turbidity level and _____ linear.
A. Coagulant dosage C. Temperature
B. Total Dissolved Solids (TDS) D. None of the above

76. Usually, the extra coagulant required is relatively small when turbidities are much higher than normal due to higher collision probabilities of the _____ during high turbidities.
A. Turbidity C. Total Dissolved Solids (TDS)
B. Colloids D. None of the above

77. Low _____ waters can be very difficult to coagulate due to the difficulty in inducing collision between the colloids.
A. Turbidity C. Total Dissolved Solids (TDS)
B. Colloids D. None of the above

78. _____ may be existing in a water supply due to pollution, and these colloids can be difficult to remove in the coagulation process. In this situation, higher coagulant dosages are generally required.
- A. Turbidity
 - B. Organic colloids
 - C. Total Dissolved Solids (TDS)
 - D. None of the above

Turbidity MCL

79. An MCL for turbidity established by the EPA because _____ interferes with disinfection. This characteristic of water changes the most rapidly after a heavy rainfall.
- A. Conductivity
 - B. Turbidity
 - C. Temperature
 - D. None of the above

80. The temperature variation of a sample, a scratched or unclean sample tube in the nephelometer and selecting an incorrect wavelength of a light path may be conditions caused by an inaccurate _____ measurement.
- A. Conductivity
 - B. Turbidity
 - C. Temperature
 - D. None of the above

Dissolved Oxygen

81. The level of dissolved oxygen in natural waters is often a direct indication of quality, since aquatic plants produce oxygen, while microorganisms generally consume it as they feed on _____.
- A. Pollutants
 - B. Organic matter
 - C. E. coli bacteria
 - D. None of the above

82. At low temperatures, the _____ is increased, so that in winter, concentrations as high as 20 ppm may be found in natural waters; during summer, saturation levels can be as low as 4 or 5 ppm.
- A. Dissolved oxygen
 - B. Thermal stratification
 - C. Solubility of oxygen
 - D. None of the above

83. _____ is essential for the support of fish and other aquatic life and aids in the natural decomposition of organic matter.
- A. Dissolved oxygen
 - B. Thermal stratification
 - C. Solubility of oxygen
 - D. None of the above

84. Thermal stratification is possible as water becomes less dense when heated, meaning water weighs less per unit volume. Therefore, warmer water will be lighter and colder water will be heavier. Due to this, there will always be a level of “self-induced” _____ in a water storage.
- A. Saturation level(s)
 - B. Thermal stratification
 - C. Permanent hardness
 - D. None of the above

Objections to Hard Water Scale Formation

85. Hard water forms scale, usually _____, which causes a variety of problems. Left to dry on the surface of glassware and plumbing fixtures, including showers doors, faucets, and sink tops; hard water leaves unsightly white scale known as water spots.
- A. Magnesium carbonate
 - B. Calcium carbonate
 - C. Calcite
 - D. None of the above

Secondary Standard

86. TDS is most often measured in parts per million (ppm) or milligrams per liter of water (mg/L). The normal TDS level ranges from _____
- A. 50 ppm to 1,000 ppm
 - B. 5 ppm to 10 ppm
 - C. 50 ppm to 100 ppm
 - D. None of the above

Langelier Saturation Index

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

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

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

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

More on the Stage 2 DBP Rule

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

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

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

- A. True
- B. False

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

- A. Disinfection of drinking water
- B. Water distribution
- C. Amendments to the SDWA
- D. None of the above

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

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

93. The Stage 1 Disinfectants and Disinfection Byproducts Rule and _____, promulgated in December 1998.

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

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

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

What are Disinfection Byproducts (DBPs)?

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

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

96. Total trihalomethanes and haloacetic acids are widely occurring _____ formed during disinfection with chlorine and chloramine.

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

Are THMs and HAAs the only disinfection byproducts?

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

- A. True
- B. False

All disinfectants form DBPs in one of two reactions:

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

- A. True
- B. False

99. Secondary by-products are formed when multiple disinfectants are used.

- A. True
- B. False

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

- A. True
- B. False

Public Health Concerns

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

- A. True
- B. False

102. Other DBPs (e.g., chlorite, bromodichloromethane, and certain haloacetic acids) have also been shown to cause adverse mutations (extra chromosomes) in laboratory animals.

- A. True
- B. False

Disinfection Byproduct Research and Regulations Summary

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

103. _____ is unquestionably the most important step in the treatment of water for drinking water supplies.

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

104. The _____ should not be compromised because of concern over the potential long-term effects of disinfectants and DBPs.

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

105. The risk of illness and death resulting from exposure to pathogens in drinking water is very much greater than the risks from _____.
- A. Disinfectants and DBPs
 - B. Turbidity (particle)
 - C. Natural organic matter precursors
 - D. None of the above

Controlling Disinfection Byproducts

106. Treatment techniques are available that provide water suppliers the opportunity to maximize potable water safety and quality while minimizing the risk of _____.
- A. DBP risks
 - B. Turbidity (particle)
 - C. Disinfectants and DBPs
 - D. None of the above
107. Generally, the best approach to reduce _____ is to remove natural organic matter precursors prior to disinfection.
- A. DBP(s)
 - B. Turbidity (particle)
 - C. DBP formation
 - D. None of the above

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

Coagulation and Clarification

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

Absorption

110. Activated carbon can be used to absorb _____ that react with disinfectants to form byproducts.
- A. Inorganic coagulants
 - B. Most contaminants
 - C. Soluble organics
 - D. None of the above

Membrane Technology

111. Membranes, used historically to desalinate brackish waters, have also demonstrated excellent removal of _____.
- A. THMs and HAAs
 - B. Optimization of pH
 - C. Natural organic matter
 - D. None of the above
112. Membrane processes use hydraulic pressure to force water through a semi-permeable membrane that rejects most _____. Variations of this technology include reverse osmosis (RO), nanofiltration (low pressure RO), and microfiltration (comparable to conventional sand filtration).
- A. Inorganic coagulants
 - B. Contaminants
 - C. Insoluble organics
 - D. None of the above
113. Other conventional methods of reducing DBP formation include changing the point of chlorination and using _____ for residual disinfection.
- A. Free residual disinfection
 - B. Chloramines
 - C. Total residual disinfection
 - D. None of the above

114. EPA predicted that most water systems will be able to achieve compliance with new DBP regulations through the use of one or more of these relatively low cost methods (EPA, 1998). Water system managers may also consider switching from chlorine to alternative disinfectants to reduce formation of _____.

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

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

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

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

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

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

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

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

118. Which of the following can be synthetic and volatile organic chemicals, which are by-products of industrial processes and petroleum production, and can come from gas stations, urban stormwater run-off, and septic systems?

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

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

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

Background

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

- A. True
- B. False

TCR

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

- A. True
- B. False

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

- A. True
- B. False

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

- A. True
- B. False

Routine Sampling Requirements

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

- A. True B. False

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

- A. True B. False

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

- A. True B. False

Dangerous Waterborne Microbes

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

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

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

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

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

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

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

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

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

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

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

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

Bacteriological Monitoring Introduction

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

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

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

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

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

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

Bacteria Sampling

136. Water samples for _____ must always be collected in a sterile container.

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

Methods

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

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

Microbial Regulations

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

- A. True
- B. False

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

- A. True
- B. False

140. The Surface Water Treatment Rule suggests treatment criteria to assure that these performance recommendations are met; they may include turbidity limits, disinfectant residual and disinfectant contact time conditions.

- A. True
- B. False

Basic Types of Water Samples

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

- A. True
- B. False

The three (3) types of samples are:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Maximum Contaminant Levels (MCLs)

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

- A. True B. False

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

- A. True B. False

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

- A. True B. False

Positive or Coliform Present Results

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

- A. True B. False

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

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

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

Heterotrophic Plate Count HPC

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

- A. True
- B. False

Heterotrophic Plate Count (Spread Plate Method)

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

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

Total Coliforms

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

- A. True
- B. False

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

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

The following are acute violations:

158. Which determines a violation of nitrate?

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

Revised Total Coliform Rule (RTCR) Summary

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

- A. True
- B. False

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

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

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

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

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

- A. True B. False

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

- A. True B. False

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

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

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

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

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

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

167. The water provider shall analyze all _____ that are total coliform positive (TC+) for E. coli.

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

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

- A. True B. False

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

- A. True B. False

Disinfection Key

170. The RTCR requires 99.99% or 4 log inactivation of _____.

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

171. The RTCR requires 99% or 2 log inactivation of _____.

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

172. The RTCR requires 99.9% or 3 log inactivation of _____.

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

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

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

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

Waterborne Pathogen Section - Introduction

Pathogen Section

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

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

How Diseases are Transmitted.

175. Waterborne pathogens are primarily spread by the?

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

Protozoan Caused Diseases

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

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

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

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

Giardia lamblia

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

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

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

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

Primary Waterborne Diseases Section

Salmonella typhi

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

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

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

- A. True
- B. False

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

A. True B. False

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

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

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

A. True B. False

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

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

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

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

Waterborne Bacterial Diseases

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

A. True B. False

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

A. True B. False

189. Campylobacteriosis is the most common diarrheal illness caused by bacteria. Other symptoms include abdominal pain, malaise, fever, nausea and vomiting; and begin three to five days after exposure. The illness is frequently over within two to five days and usually lasts no more than 10 days.

A. True B. False

Viruses

Coronavirus

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

A. True B. False

Chain of Custody Procedures

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

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

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

192. The recipient will then attach the _____ showing the transfer dates and times to the custody sheets. If the samples are split and sent to more than one laboratory, prepare a separate chain of custody record for each sample.
- A. Shipping invoices
 - B. Chain of custody release
 - C. Sample siting plan
 - D. None of the above

Factors in Chlorine Disinfection: Concentration and Contact Time

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

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

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

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

195. As _____ are used, contact times may be reduced.

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

Water Treatment Section - Preliminary Treatment Process

Preliminary Treatment

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

- A. Screening
- B. Super settling
- C. Change source
- D. None of the above

Pre-Sedimentation

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

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

Flights and Chains

198. Flights and chains remove the scum from the _____ of the basin.

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

Circular Clarifiers

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

- A. True
- B. False

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

- A. Conventional technology
- B. Reconditioning cycle
- C. Chemical pretreatment
- D. None of the above

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

- A. True
- B. False

202. The media become progressively finer and denser in the lower layers.
A. True B. False
203. As suspended particles accumulate in a Filter bed, the pressure drop through the filter increases.
A. True B. False
204. According to the text, when the pressure difference between filter inlet and outlet increases by 5 - 10 psi from the beginning of the cycle, the filter should be reconditioned. Operating beyond this pressure drop increases the chance of fouling - called " Mud-balling " - within the filter.
A. True B. False
205. Which of the following processes uses alum and cationic polymer to neutralize the charge of colloidal particles?
A. Filtration C. Flocculation
B. Reconditioning D. None of the above
206. Which of the following terms may increase filtered water clarity, measured in NTU, by 90% compared with filtration alone?
A. Chemical pretreatment C. Fast rinse
B. Reconditioning cycle D. None of the above
207. Water treatment systems use settling tanks unit to allow for_____.
A. Gravity C. Settling time
B. Particle(s) D. Sedimentation and settling
208. The main aim of tube settlers is to minimize the _____ that a small floc particle must settle before agglomerating into larger particles.
A. Gravity C. Settling time
B. Vertical distance D. Solids
209. Water treatment is a major requirement both for raw water for drinking and wastewater management, both have particles that need to sediment in order to obtain clear water.
A. True B. False

Conventional Water Treatment Process Introduction

210. _____ along with pre-chlorination for removal of dissolved iron when present with small amounts relative of manganese
A. Disinfection C. Pre-treatment
B. Coagulation D. Aeration
211. _____ to remove particles from water either by passage through a sand bed that can be washed and reused or by passage through a purpose- designed filter that is washable.
A. Disinfection C. Pre-treatment
B. Coagulation D. Filtration
212. _____ for killing bacteria viruses and other pathogens.
A. Disinfection C. Pre-treatment
B. Coagulation D. Aeration along with pre-chlorination
213. _____ or slow-sand filtration
A. Disinfection C. Pre-treatment
B. Coagulation D. Coagulation or flocculation

214. _____ for algae control and arresting biological growth
- A. Sodium hydroxide
 - B. UV
 - C. Pre-treatment
 - D. Ferric Chloride

Treatment Design and Plant Operation

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

SWTR Rule

216. Turbidity is caused by particles suspended in water. These particles scatter or reflect light rays, making the water appear cloudy.
- A. True
 - B. False

217. Besides the appearance of turbidity being unpleasant to customers, turbidity in water is significant from a public health standpoint because suspended particles could shelter microorganisms from the disinfectant and allow them to still be viable when they reach the customer.
- A. True
 - B. False

218. Turbidity changes in the distribution system can indicate developing problems. Increases in turbidity may also be caused by changes in velocity or inadequate flushing following main replacement.
- A. True
 - B. False

Zeta Potential Introduction

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

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

221. If two adjacent particles have sufficiently high zeta potentials of the same sign, they will agglomerate due to repulsive electrostatic forces between particles with unlike charges.
- A. True
 - B. False

Solubility of Substances in Water

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

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

224. Salts which are very soluble in water than this at room temperature are called highly soluble salts.
A. True B. False

Purpose of Coagulation

225. Chemical Coagulation in the water/wastewater treatment is the process of bringing suspended matter in untreated water together for the purpose of settling and for the preparation of the water for filtration.
A. True B. False

Turbidity Particles

226. The ability of particles to remain suspended in water is a function of hydrogen ion activity.
A. True B. False

227. Turbidity particles can range in size from molecular to 50 microns (a tremendous range).
A. True B. False

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

Olation

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

Zeta Potential

230. The Zeta Potential is reduced to zero in order for coagulation to occur, because the forces of attraction are predominant.
A. True B. False

Coagulants – Alum and Ferric Aluminum Sulfate (Alum)

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

232. Alum has an exact formula due to the constant water molecules of hydration that may be attached to the aluminum sulfate molecule.
A. True B. False

233. Once in water, alum can react with hydroxides, carbonates, bicarbonates, and other anions to form _____.
A. pH C. Large, positively charged molecules
B. Alkalinity D. None of the above

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

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

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

- A. True
- B. False

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

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

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

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

Ferric Chloride (Ferric)

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

- A. True
- B. False

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

- A. True
- B. False

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

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

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

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

242. _____ are available, such as potash alum, ammonia alum, ferrous sulfate (copperas), and chlorinated copperas.

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

243. Typical dosages of the inorganic coagulants range from 50 pounds per million gallons of water treated under ideal conditions to as high as 800 to 1000 pounds per million gallons of water treated under _____ conditions.
- A. Worst case
 - B. Decreased
 - C. Increased
 - D. None of the above

Factors Influencing Coagulation

Effects of pH

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

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

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

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

246. Each of the inorganic salt coagulants has its own characteristic _____ pH range.

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

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

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

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

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

Effects of Salts

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

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

250. Generally, mono and divalent cations such as sodium, calcium, and magnesium have _____ on the coagulation process.

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

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

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

Nature of Turbidity

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

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

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

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

Water Temperature

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

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

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

- A. True
- B. False

Mixing Effects

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

- A. True
- B. False

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

- A. True
- B. False

Effect of the Coagulant

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

- A. True
- B. False

Corrosion Control Introduction

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

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

Cathodic Protection

Sacrificial Anode Systems

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

- A. True
- B. False

Coagulation and Flocculation Summary

Rapid Sand Filtration

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

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

262. Rapid Sand filtration process employs a combination of _____ in order to achieve maximum effectiveness.

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

Coagulation

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

- A. True
- B. False

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

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

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

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

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

- A. True
- B. False

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

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

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

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

269. Which of the following terms are so small, their charge per volume is significant?
 A. Aluminum Sulfate molecules C. Colloidal particles
 B. Coagulant chemicals D. None of the above
270. Coagulation is necessary to meet the current regulations for almost all potable water plants using surface water.
 A. True B. False
271. Coagulant chemicals such as alum work by neutralizing the negative charge, which allows the particles to come together.
 A. True B. False
272. Liquid _____ is usually a 48.86% solution.
 A. Cationic polymers C. Aluminum Sulfate
 B. Soda ash D. None of the above
273. Which of the following terms can be thought of as positively charged strings that attract the particles to them, and in the process, form a larger particle?
 A. Cationic polymers C. Lime
 B. Coagulation helpers D. None of the above
274. Which of the following is the most widely used coagulant in water treatment?
 A. Cationic polymers C. Aluminum Sulfate
 B. Salts D. None of the above

Flocculation

275. Flocculation is the process of bringing together destabilized or coagulated particles to form larger masses which can be settled and/or filtered out of the water being treated.
 A. True B. False
276. Flocculation is the process where the suspended particles can collide, _____, and form heavier particles called "floc".
 A. Equalization C. Destabilized or coagulated particles
 B. Agglomerate D. None of the above
277. Gentle _____ and appropriate detention times (the length of time water remains in the basin) help facilitate the flocculation process.
 A. Equalizing C. Settling
 B. Agitation of the water D. None of the above
278. Inside the contact chambers, water is slowly mixed allowing the coagulated particles, called "floc," and the particles become larger and stronger.
 A. True B. False
279. Which of the following happens in the water when bacteria and other microorganisms are caught in the floc structure?
 A. Equalize the basin C. Agitate the water
 B. Floc particles mix D. None of the above

Pre-Sedimentation

280. Contingent on the quality of the source water, some plants have pre-sedimentation, which allows larger _____ in a reservoir or lake reducing solid removal loads.
- A. Equalization of the basin
 - B. Particles time to settle
 - C. Floc particles mix
 - D. None of the above

Sedimentation

281. In which process does the velocity of the water is decreased so that the suspended material, including flocculated particles, can settle out by gravity?
- A. Sedimentation
 - B. Flocculation
 - C. Rapid Sand filtration
 - D. None of the above

Water Filtration Key Terms

Declining Rate Filters

282. The filter flow rate will vary with?
- A. Head loss
 - B. Uniform media
 - C. Effluent control
 - D. None of the above
283. Declining Rate Filters system often requires _____ to provide adequate media submergence.
- A. Head loss
 - B. Uniform media
 - C. Effluent control structure
 - D. None of the above

Detention Time

284. Detention time is actual time required for a small amount of water to pass through a Sedimentation basin at a given rate of flow, or the calculated time required for a small amount of liquid to pass through a tank at a given rate of flow.
- A. True
 - B. False

Disinfection

285. Chlorine kills or "inactivates" harmful microorganisms in water.
- A. True
 - B. False
286. Chlorine is added again after filtration for?
- A. Residual
 - B. Contact time
 - C. Post-disinfection
 - D. None of the above

Jar Testing

287. Jar testing traditionally has been done on an infrequent basis in most water treatment plants to control THMs.
- A. True
 - B. False

pH

288. According to the text, pH is an expression of a basic or acid condition of a liquid. The range is from 0-14, zero being the most acid and 14 being the most alkaline. A pH of 7 is considered to be neutral.
- A. True
 - B. False
289. According to the text, which of the following has a pH between 6.0 and 8.5?
- A. Acids
 - B. Disinfectants
 - C. Natural water
 - D. None of the above

Caustic

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

- A. True B. False

Polymer

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

- A. True B. False

Post-Chlorine

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

- A. True B. False

Pre-Chlorination

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

- A. True B. False

Hydrofluosilicic Acid

294. H_2SiF_6 a clear fuming corrosive gas, with a pH ranging from 8 to 9 and used in water treatment to fluoridate drinking water.

- A. True B. False

Water Quality

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

- A. True B. False

Chemical Feed and Rapid Mix

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

- A. True B. False

297. Alum is a coagulant chemical, that neutralize negative charges on small particles, allowing them to stick together and form larger particles that are more easily removed by sedimentation or filtration.

- A. True B. False

Short-Circuiting

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

- A. True B. False

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

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

Tube Settlers

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

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

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

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

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

- A. True
- B. False

Adsorption Clarifiers

303. In the sedimentation/clarification process, turbidity is _____ of the coagulated and flocculated solids.

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

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

- A. True
- B. False

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

- A. True
- B. False

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

- A. True
- B. False

Clearwell

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

- A. True
- B. False

Sampling

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

- A. True
- B. False

Filtration Overview

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

- A. True
- B. False

310. According to the text, the filter is periodically cleaned by a reversal of flow and the _____ into a drain.

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

Anthracite Coal or Activated Carbon

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

- A. True
- B. False

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

- A. True
- B. False

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

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

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

- A. True
- B. False

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

- A. True
- B. False

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

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

EPA Filter Backwash Rule- Introduction

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

- A. True
- B. False

Background

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

- A. True
- B. False

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

- A. True
- B. False

LT1FBR Required

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

- A. True B. False

Turbidity

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

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

Disinfection Benchmarking

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

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

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

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

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

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

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

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

326. Which of the following recycling to the treatment process must provide detailed recycle treatment information to the State, which may require that modifications to the recycle practice be made?

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

Filtration Process- Detailed

327. Removal of _____ plays an important role in the natural treatment of groundwater as it percolates through the soil.

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

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

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

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

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

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

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

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

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

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

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

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

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

Direct Filtration Plant vs. Conventional Plant

334. The primary difference between Direct Filtration Plant vs. Conventional Plant is that the _____ or step is omitted from the Direct Filtration plant.

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

Types of Filters

335. The oldest water filters developed were the slow sand filters, these have filter rates of around 0.05 gpm/ft² of surface area. This type of filter requires large filter areas.

- A. True
- B. False

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

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

337. Most water filters are classified by filtration rate, type of _____, or type of operation.

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

Rapid Sand Filters

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

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

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

- A. True
- B. False

Filter Sand

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

- A. True
- B. False

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

- A. True
- B. False

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

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

343. The coarser sand in the _____ has larger voids that do not fill as easily.

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

False floor

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

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

Filtration Processes

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

- A. True
- B. False

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

- A. True
- B. False

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

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

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

- A. True
- B. False

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

- A. True
- B. False

350. One of the benefits of this method is that it has a lower capital cost, but this method or process cannot handle large variations in raw water turbidity.

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

High Rate Filters

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

- A. True
- B. False

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

- A. True
- B. False

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

- A. True
- B. False

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

- A. True
- B. False

Pressure Sand Filters

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

- A. True
- B. False

356. Which of the following terms or methods cracking of the filter bed can occur quite easily, allowing the iron and manganese particles to go straight through the filter?

- A. Slow sand/RO
- B. Gravity filters
- C. Pressure filters
- D. None of the above

357. Which of the following filtration types is contained under pressure in a steel tank?

- A. Slow sand/RO
- B. Gravity filters
- C. Pressure sand filter
- D. None of the above

358. In which of the following filtration types is the media usually sand or a combination of media?

- A. Slow sand/RO
- B. Gravity filters
- C. Fast sand
- D. None of the above

359. Which of the following filter types has a major disadvantage in that the backwash cannot be observed?

- A. Slow sand/RO
- B. Gravity filters
- C. Pressure filters
- D. None of the above

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

- A. Filter run
- B. Filtering to waste
- C. Return to waste
- D. None of the above

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

- A. Nanofiltration
- B. Microfiltration
- C. Semi-permeable
- D. None of the above

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

- A. Nanofiltration
- B. Microfiltration
- C. Semi-permeable
- D. None of the above

Declining Rate

363. According to the text, which of the following terms or methods of control is used where the largest head loss through the plant?

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

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

- A. Filter run
- B. Filter is dirty
- C. Head loss is low
- D. None of the above

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

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

Loss of Head Indicator

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

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

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

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

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

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

In-line Turbidimeter

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

- A. True
- B. False

Filtration Process

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

- A. True
- B. False

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

- A. True
- B. False

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

- A. True
- B. False

373. Which of the following is restricted in filters with a control valve installed on the filter effluent pipe?

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

374. Which of the following is the term for the water rate on a filter depending on the type of filter?

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

375. Which of the following is almost fully closed when a filter is clean so that the desired water level on top of the filter is maintained?

- A. Headloss valve
- B. Constant rate flow valve
- C. Flow restrictor
- D. None of the above

376. As the filter becomes dirty, the valve opens gradually until the increase in the water level above the filter indicates that the filter needs?

- A. Headloss
- B. Flow redistributes
- C. Backwashing
- D. None of the above

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

- A. Headloss
- B. Flow redistributes
- C. Backwashing
- D. None of the above

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

- A. Headloss valve
- B. Flow valve
- C. Flow restrictor
- D. None of the above

379. The filter eventually fills with suspended material, usually after 15 to 30 hours, it will need to be _____ to clean the media.

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

Back Washing

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

- A. True
- B. False

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

- A. True
- B. False

382. Treated water from storage is used for the backwash cycle. This treated water is taken from elevated storage tanks or pumped in from the raw water reservoir.

- A. True
- B. False

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

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

384. Filter expansion causes the filter grains to rub actively against each other, dislodging the _____ from the media.
- A. Media C. Backwash rate
B. Floc(s) D. None of the above
385. During filter backwash, the media expands upwards and around the washing arms.
- A. True B. False
386. According to the text, a newer method of surface wash involves using _____ before the water wash.
- A. Air washing C. Backwash cycle
B. Air scour D. None of the above
387. Which of the following terms needs two-to-five cubic feet of air per square foot of filter area?
- A. Air washing C. Backwash cycle
B. Air scour D. None of the above
388. Which of the following if it is too high that the filter will no longer produce water at the desired rate?
- A. Air washing C. Backwash rate
B. Air scour D. None of the above
389. Which of the following starts to break through the filter and the turbidity in the filter effluent increases; and/or a filter run reaches a given hour of operation?
- A. Headloss C. Backwash rate
B. Floc(s) D. None of the above
390. If a filter is taken out of service for some reason, it does not need to be backwashed prior to being put on line.
- A. True B. False
391. If a filter is not backwashed until the headloss exceeds a certain number of feet, the turbidity may break through and cause the filter to exceed the standard of 0.5 NTU of turbidity.
- A. True B. False
392. Filter effluent- turbidity alone can cause high head loss and decreased filter flow rate, causing the pressure in the filter to drop below atmospheric pressure and cause the filter to _____ and stop filtering.
- A. Prevent headloss C. Lock
B. Air bind D. None of the above
393. Some filters can operate longer than one week before needing to be?
- A. Bumped C. Backwashed
B. Jetted D. None of the above
394. Long filter runs can cause the filter media to pack down so that it is difficult to _____ during the backwash.
- A. Control headloss C. Expand the bed
B. Control floc(s) D. None of the above

Backwashing Process

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

- A. True B. False

396. When the backwash valve is opened, which action allows backwash water to start flowing into the filter and start?

- A. Controlling headloss C. Some means of controlling the media carryover
B. Breaking the crust on the filter D. None of the above

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

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

398. The time elapsed from when the filter wash is started until full flow is applied to the filter should be greater than one minute.

- A. True B. False

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

- A. True B. False

Disposal of Filter Backwash Water

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

- A. True B. False

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

- A. Daily flow C. Raw water flow entering the plant
B. Backwash water D. None of the above

Filter to Waste

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

- A. True B. False

Filter Aids

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

- A. True B. False

Filter Operating Problems

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

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

Chemical Treatment before the Filter

405. Which of the following terms of the water treatment must be monitored continuously?
- A. Filter aid
 - B. Backwash storage basin
 - C. Coagulation and flocculation stages
 - D. None of the above

Control of Filter Flow Rate

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

Advanced Water Treatment Section

407. Water contains _____ of which impart a quality known as hardness?
- A. TDS
 - B. Conductivity
 - C. Various amounts of dissolved minerals
 - D. None of the above

408. The precipitation process is generally known as the?
- A. Softening
 - B. Chemical pretreating
 - C. Lime process or lime soda process
 - D. None of the above

409. Which of the following can be accomplished using membrane technology, electrodialysis, distillation, and freezing. Of these, the membrane methods seem to have the greatest use potential.
- A. Alkalinity
 - B. Precipitation
 - C. Softening
 - D. None of the above

Occurrence of Hard Water

410. Magnesium is dissolved as water passes over and through _____ and other magnesium-bearing minerals.
- A. Hardness ions
 - B. Calcium and magnesium
 - C. Dolomite
 - D. None of the above

Types of Hardness

411. Hardness can be categorized by either of two methods: calcium versus magnesium hardness and?
- A. Carbonate hardness
 - B. Temporary hardness
 - C. Carbonate versus non-carbonate hardness
 - D. None of the above

Carbonate-Noncarbonate Distinction

412. Which of the following when combined with carbonate (CO_3) also contribute to carbonate hardness?
- A. CaCO_3
 - B. Calcium and magnesium
 - C. Carbonate-noncarbonate
 - D. None of the above

413. Because it can be removed by heating, carbonate hardness is sometimes called?
- A. Carbonate hardness
 - B. Water hardness
 - C. Temporary hardness
 - D. None of the above

Types of Processes

414. Which of the following terms operate without heating and therefore use less energy than conventional thermal separation processes such as distillation, sublimation or crystallization?
- A. Thermal separation process(es)
 - B. Fractional distillation
 - C. Membrane separation processes
 - D. None of the above

415. Which of the following uses membrane technology and is widely used in the food technology, biotechnology and pharmaceutical industries?

- A. Cold separation
- B. Fractional distillation
- C. Thermal separation method(s)
- D. None of the above

Ultrafiltration

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

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

Driving Force, Retentate Stream and Permeate Streams

417. Which of the following can be distinguished by three major characteristics; Driving force, retentate stream and permeate streams?

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

Fouling

418. Fouling of the membrane during the filtration processes decreases the flux and thus overall efficiency of the operation. This is indicated when the pressure drop increases to a certain point. It occurs even when operating parameters are constant (pressure, flow rate, temperature and concentration)

- A. True
- B. False

Nanofiltration (NF) Section

419. Nanofiltration is a relatively recent membrane filtration process used most often with low total dissolved solids water with the purpose of softening (polyvalent cation removal) and removal of _____ such as natural organic matter and synthetic organic matter.

- A. Process liquid
- B. Chloride and sodium
- C. Disinfection by-product precursors
- D. None of the above

420. Nanofiltration is also becoming more widely used in food processing applications and for _____ and partial (monovalent ion) demineralization.

- A. Process liquid
- B. Simultaneous concentration
- C. Natural organic matter and synthetic organic matter
- D. None of the above

Advantages and Disadvantages

421. One of the main advantages of nanofiltration as a method of softening water is that during the process of retaining calcium and magnesium ions while passing smaller hydrated monovalent ions, filtration is performed without adding extra sodium ions, as used in Ion exchangers.

- A. True
- B. False

422. Anything smaller, reverse osmosis is used and anything larger is used for?

- A. Ultrafiltration
- B. Potable water treatment
- C. Direct filtration process
- D. None of the above

423. Which of the following can also be used in cases where nanofiltration can be used, due to it being more conventional?

- A. Microfiltration or MF
- B. Potable water treatment
- C. Ultrafiltration
- D. None of the above

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

Water Laboratory Analysis Section

pH Testing Section

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

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

425. Measurement of pH for aqueous solutions can be done with a glass electrode and a pH meter, or using indicators like strip test paper.

- A. True
- B. False

426. _____ are determined using a concentration cell with transference, by measuring the potential difference between a hydrogen electrode and a standard electrode such as the silver chloride electrode.

- A. Primary pH standard values
- B. Alkalinity
- C. pH measurement(s)
- D. None of the above

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

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

428. Which of the following terms for aqueous solutions can be done with a glass electrode and a pH meter, or using indicators?

- A. Primary sampling
- B. Measurement of pH
- C. Determining values
- D. None of the above

429. The pH scale is logarithmic and therefore pH is?

- A. An universal indicator
- B. A dimensionless quantity
- C. An excess of alkaline earth metal concentrations
- D. None of the above

430. Measuring alkalinity is important in determining a stream's ability to neutralize acidic pollution from rainfall or wastewater. It is one of the best measures of the sensitivity of the stream to acid inputs. There can be long-term changes in the _____ of rivers and streams in response to human disturbances.

- A. Acid
- B. Alkalinity
- C. pH measurement(s)
- D. None of the above

431. pH is defined as the decimal logarithm of the reciprocal of the _____, a_{H^+} , in a solution.

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

432. Which of the following terms may be used to measure pH, by making use of the fact that their color changes with pH?

- A. Indicators
- B. Spectrophotometer
- C. A set of non-linear simultaneous equations
- D. None of the above

433. Alkalinity is the name given to the quantitative capacity of an aqueous solution to neutralize an?

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

434. Which of the following terms of the color of a test solution with a standard color chart provides a means to measure pH accurate to the nearest whole number?
- A. Universal indicator C. Visual comparison
B. Colorwheel measurement D. None of the above
435. The pH scale is traceable to a set of standard solutions whose pH is established by US EPA.
- A. True B. False
436. The calculation of the pH of a solution containing acids and/or bases is an example of a chemical speciation calculation, that is, a mathematical procedure for calculating the concentrations of all chemical species that are present in the solution. The complexity of the procedure depends on the?
- A. Nature of the solution C. Alkaline earth metal concentrations
B. pH D. None of the above
437. Under normal circumstances this means that the concentration of hydrogen ions in acidic solution can be taken to be equal to the concentration of the acid. The pH is then equal to minus the logarithm of?
- A. The concentration value C. A set of non-linear simultaneous equations
B. The pH D. None of the above
438. Alkalinity of water is its acid-neutralizing capacity. It is the sum of all the titratable bases. The measured value may vary significantly with the?
- A. End-point pH C. pH measurement(s)
B. Alkalinity D. None of the above
439. For strong acids and bases no calculations are necessary except in extreme situations. The pH of a solution containing a weak acid requires the solution of a quadratic equation. The pH of a solution containing a weak base may require the?
- A. Solution of a cubic equation C. Excess of alkaline earth metal concentrations
B. Non-linear simultaneous equations D. None of the above
440. Alkalinity is a measure of this missing term and can be interpreted in terms of specific substances only when the chemical composition of the sample is known.
- A. Universal indicator C. Excess of alkaline earth metal concentrations
B. An aggregate property of water D. None of the above
441. More precise measurements are possible if the color is measured spectro-photometrically, using a?
- A. Universal indicator C. Set of non-linear simultaneous equations
B. Colorimeter of spectrophotometer D. None of the above
442. Because the alkalinity of many surface waters is primarily a function of carbonate, bicarbonate, and hydroxide content, it is taken as an indication of the concentration of these constituents.
- A. True B. False
443. For strong acids and bases no calculations are necessary except in extreme situations. The pH of a solution containing a weak acid requires?
- A. The concentration value C. Excess of alkaline concentrations
B. The solution of a quadratic equation D. None of the above

444. Alkalinity in excess of which term is significant in determining the suitability of water for irrigation?
 A. 8 C. Alkaline earth metal concentrations
 B. pH of 7 D. None of the above
445. The calculation of the pH of a solution containing acids and/or bases is an example of a _____ calculation, that is, a mathematical procedure for calculating the concentrations of all chemical species that are present in the solution
 A. Chemical speciation C. Visual comparison
 B. Spectrophotometer D. None of the above
446. Since pH is a logarithmic scale, a difference of one pH unit is equivalent to _____ difference in hydrogen ion concentration
 A. 1 C. 10
 B. .1 D. None of the above
447. Which of the following terms measurements is used in the interpretation and control of water and wastewater treatment processes?
 A. Acid C. Hydrogen bond formation
 B. Alkalinity D. None of the above
448. Which of the following terms are compounds that, for practical purposes, are completely dissociated in water.
 A. Strong acids and bases C. Strong bases and weak acids
 B. Chemical ions in chains D. None of the above
449. The pH of a solution containing a _____ may require the solution of a cubic equation.
 A. Strong acids and bases C. Weak base
 B. Strong base D. None of the above
450. Sodium hydroxide, NaOH, is an example of a?
 A. Weak base C. Strong acid
 B. Strong base D. None of the above

Pump and Motor Section
Common Hydraulic Terms

451. Which of the following definitions is the engineering science pertaining to liquid pressure and flow?
 A. Hydraulics C. Hydrokinetics
 B. Hydrology D. None of the above
452. Which of the following definitions is the pressure exerted by the atmosphere at any specific location?
 A. Pressure, Atmospheric C. Pressure, Gauge
 B. Pressure, Static D. None of the above
453. Which of the following definitions is pressure above zero absolute, i.e. the sum of atmospheric and gauge pressure?
 A. Pressure, Atmospheric C. Pressure, Gauge
 B. Pressure, Static D. None of the above

454. Which of the following definitions is the force per unit area, usually expressed in pounds per square inch?

- A. Pressure, Absolute
- B. Pressure
- C. Pressure, Gauge
- D. None of the above

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

- A. Pressure, Absolute
- B. Pressure
- C. Pressure, Gauge
- D. None of the above

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

- A. Head, Friction
- B. Head, Static
- C. Head
- D. None of the above

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

- A. Head, Friction
- B. Head, Static
- C. Head
- D. None of the above

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

- A. Head, Friction
- B. Pressure, Static
- C. Head
- D. None of the above

459. Which of the following definitions is the height of a column or body of fluid above a given point?

- A. Head, Friction
- B. Head, Static
- C. Head
- D. None of the above

460. Sea level pressure is approximately 2.31 pounds per square inch absolute, 1 bar = .433psi.

- A. True
- B. False

General Pumping Fundamentals

461. Here are the important points to consider about suction piping when the liquid being pumped is below the level of the pump: Sometimes suction lift is also referred to as 'positive suction head'.

- A. True
- B. False

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

- A. Impeller
- B. Suction
- C. Centerline of the pump
- D. None of the above

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

- A. True
- B. False

464. The required eccentric reducer should be turned so that the top is flat and the bottom tapered.

- A. True
- B. False

Pumps

465. Pumps are excellent examples of?

- A. Hydrostatics
- B. Quasi-static devices
- C. Multi-stage pumps
- D. None of the above

466. Positive displacement pumps have a piston (or equivalent) moving in a closely-fitting cylinder and forces are exerted on the fluid by motion of the piston.

- A. True B. False

467. More complicated pumps have valves check valves that open to allow _____, and close automatically to prevent reverse flow.

- A. Pistons C. Passage in one direction
B. Diaphragms D. None of the above

468. According to the text, the force pump has _____ in the cylinder, one for supply and the other for delivery.

- A. Two check valves C. Rotors
B. Diaphragms D. None of the above

469. In a positive displacement pump, supply valve opens when the cylinder _____, the delivery valve when the cylinder volume decreases.

- A. Volume increases C. Air space increases
B. Volume decreases D. None of the above

470. Diaphragm pumps are force pumps in which the oscillating diaphragm takes the place of the piston.

- A. True B. False

Pump Categories

471. The key to understanding a pump's operation is that a pump is to move water and generate the _____ we call pressure.

- A. Delivery force C. Diaphragm pressure
B. Impeller force D. None of the above

472. With a centrifugal pump the pressure is not referred to in pounds per square inch but rather as the equivalent in elevation, called?

- A. Inward force C. Delivery force
B. Head D. None of the above

473. According to the text, pumps may be classified based on the application they serve.

- A. True B. False

Basic Water Pump

474. The centrifugal pumps work by spinning water around in a circle inside a?

- A. Vortex C. Cylindrical pump housing
B. Cylinder D. None of the above

475. As the water slows down and its kinetic energy decreases, that water's pressure potential energy increases.

- A. True B. False

476. As the water spins, the pressure near the outer edge of the pump housing becomes much lower than near the center of the impeller.

- A. True B. False

477. The impeller blades cause the water to move faster and faster.

- A. True B. False

478. The impellers may be of either a semi-open or closed type.

- A. True B. False

Types of Water Pumps

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

- A. True B. False

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

- A. Pump's lifting capacity C. Variable displacement pump
B. Atmospheric pressure D. None of the above

481. Impellers are rotated by the pump motor, which provides the _____ needed to overcome the pumping head.

- A. Pump's lifting capacity C. Horsepower
B. Atmospheric pressure D. None of the above

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

- A. Pumping head C. Horsepower
B. Atmospheric pressure D. None of the above

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

- A. Axial flow C. Turbine pumps
B. Centrifugal pumps D. None of the above

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

- A. Pump head C. Horsepower
B. Lift water D. None of the above

485. Vertical turbine pumps are commonly used in groundwater wells. These pumps are driven by a shaft rotated by a motor on the surface.

- A. True B. False

486. The shaft turns the impellers within the pump housing while the?

- A. Desired pumping rate is obtained C. Water moves up the column
B. Horsepower turns the shaft D. None of the above

487. The rotating shaft in a line shaft turbine is actually housed within the column pipe that delivers the water to the surface.

- A. True B. False

488. The size of the _____ are selected based on the desired pumping rate and lift requirements.

- A. Impeller(s) C. Column, impeller, and bowls
B. Lantern ring D. None of the above

489. According to the text, column pipe sections can be threaded or coupled together while the drive shaft is coupled and suspended within the column by?

- A. Column pipe C. Lantern ring
B. Spider bearings D. None of the above

490. The water passing through the column pipe serves as the lubricant for the bearings.
A. True B. False
491. The oil tube is suspended within the column by _____, while the line shaft is supported within the oil tube by brass or redwood bearings.
A. Column pipe C. Spider flanges
B. Spider bearings D. None of the above
492. A continuous supply of _____ lubricates _____ the drive shaft as it proceeds downward through the oil tube.
A. Grease C. Water
B. Oil D. None of the above
493. A small hole located at the top of the _____ allows excess oil to enter the well. This results in the formation of an oil film on the water surface within oil-lubricated wells.
A. Pump bow unit C. Column pipe
B. Drive shaft D. None of the above
494. Oil and water lubricated systems will have a strainer attached to the _____ to prevent sediment from entering the pump.
A. Intake C. Inboard
B. Diaphragm D. None of the above
495. Time delays or ratchet assemblies are often installed on these motors to either prevent the motor from turning on before _____ stops or simply not allow it to reverse at all.
A. Reverse rotation C. Time delay or ratchet assembly
B. Keyway and nut D. None of the above
- There are three main types of diaphragm pumps:**
496. In the first type, the _____ with one side in the fluid to be pumped, and the other in air or hydraulic fluid.
A. Vapor bubbles C. Diaphragm is sealed
B. Chamber pressure D. None of the above
497. The diaphragm is flexed, causing the volume of the pump chamber to increase and decrease.
A. True B. False
498. A pair of _____ prevents reverse flow of the fluid.
A. Return valves C. Non-return check valves
B. Diaphragms D. None of the above
499. The second type of diaphragm pump works with volumetric positive displacement, but differs in that the prime mover of the diaphragm is neither oil nor air; but is?
A. Electro-mechanical C. Volumetric positive displacement
B. Chamber pressure D. None of the above
500. The third type of diaphragm pump has one or more springs with the fluid to be pumped on both sides.
A. True B. False