

**Registration form**

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

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

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

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

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

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

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

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

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

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

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**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.

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*You can obtain a printed version of the course manual from TLC for an additional \$129.95 plus shipping charges.*

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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.

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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.

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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.

# Distribution Operations Answer Key

Name \_\_\_\_\_

Phone \_\_\_\_\_

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

You are responsible to ensure this course is accepted for credit. No refunds.  
Method of Course acceptance confirmation. Please fill this section

Website \_\_\_ Telephone Call \_\_\_ Email \_\_\_ Spoke to \_\_\_\_\_

Did you receive the approval number, if applicable? \_\_\_\_\_

What is the course approval number, if applicable? \_\_\_\_\_

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

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**Signature**

**Please fax the answer key to TLC Western Campus  
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*This course contains general EPA's SDWA federal rule requirements. Please be aware that each state implements water / sampling procedures/ safety / environmental / 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*

**DISTRIBUTION OPERATIONS CEU COURSE  
CUSTOMER SERVICE RESPONSE CARD**

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

Please rate the difficulty of your course.

Very Easy    0    1    2    3    4    5    Very Difficult

Please rate the difficulty of the testing process.

Very Easy    0    1    2    3    4    5    Very Difficult

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

Very Similar    0    1    2    3    4    5    Very Different

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

What would you do to improve the Course?

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Any other concerns or comments.

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## Distribution Operations CEU Training Course Assignment

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

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

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

### Hyperlink to the Glossary and Appendix

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

## Water Distribution Section

### Water Pressure

- 20 psi is the minimum pressure required at any point in the water system, so that \_\_\_\_\_ is prevented.  
A. Cavitation                      C. Backflow and infiltration  
B. Back pressure                  D. None of the above
- Which of the following is provided from the direct force of the water, or by the height of the water?  
A. Pressure                          C. Maximum daily use  
B. System integrity                D. None of the above

### Water Use or Demand

- Water system demand comes from many sources including residential, commercial, industrial and public consumers as well as waste and some?  
A. Pressure                          C. Unavoidable loss  
B. System integrity                D. None of the above
- Which of the following is highly desired and represents a rather significant demand upon the system?  
A. Fire protection                      C. Surge protection  
B. Cavitation protection              D. None of the above
- Which of the following is usually encountered during the summer months and can vary widely depending on irrigation practices?  
A. Maximum daily use                      C. Unavoidable loss and waste  
B. Minimum daily use                      D. None of the above

### Water Storage Introduction

- Which of the following prevents contamination of water as it travels to the customer, finished water storage facilities are an important component of the protective distribution system?  
A. Cathodic protection                      C. Barrier  
B. Corrosion protection                      D. None of the above

### Storage and Distribution

7. Proper construction is important in maintaining system integrity and the distribution system must also protect?
- A. Cathodic protection
  - B. Corrosion protection
  - C. Water quality
  - D. None of the above

### Water Storage Facilities

8. Water storage facilities and tanks vary in different types that are used in the water distribution systems, such as stand pipes, elevated tanks and reservoirs, hydropneumatic tanks and?
- A. Surge tanks
  - B. Water distribution systems
  - C. Storage reservoirs
  - D. None of the above
9. Which of the following can be converted to pressure potential energy or kinetic energy for delivery to homes?
- A. Hydrostatic power
  - B. Stored energy
  - C. Hydraulic power
  - D. None of the above

### Storage Reservoirs

10. The text recommends that \_\_\_\_\_ be located at a high enough elevation to allow the water to flow by gravity to the distribution system.
- A. Storage reservoirs
  - B. Levelers
  - C. Tree systems
  - D. None of the above

## Cross-Connection Section

### What is Backflow?

11. Which of the following is a means or mechanism to prevent backflow?
- A. Check device or method
  - B. Backflow preventer
  - C. Backflow check valve
  - D. None of the above
12. According to the text, basic means of preventing backflow is a(n) \_\_\_\_\_, which either eliminates a cross-connection or provides a barrier to backflow.
- A. Vacuum breaker
  - B. Air gap
  - C. Backflow check
  - D. None of the above
13. Which of the following is any temporary or permanent connection between a public water system or consumer's potable water system and any source or system containing nonpotable water or other substances?
- A. Indirect connection
  - B. Jumper
  - C. Cross-connection
  - D. None of the above
14. Backflow is the undesirable reversal of flow of nonpotable water or other substances through a \_\_\_\_\_ and into the piping of a public water system or consumer's potable water system.
- A. Backflow
  - B. Indirect connection
  - C. Cross-connection
  - D. None of the above
15. Which of the following can occur when there is a stoppage of water supply due to nearby firefighting, a break in a water main?
- A. Backsiphonage
  - B. Backpressure
  - C. Cross-connection
  - D. None of the above

16. Which of the following is a type of backflow caused by a downstream pressure that is greater than the upstream or supply pressure in a public water system or consumer's potable water system?
- A. Backflow                      C. Indirect connection  
B. Backpressure                D. None of the above
17. Which of the following can result from an increase in downstream pressure, a reduction in the potable water supply pressure, or a combination of both?
- A. Backflow                      C. Backsiphonage  
B. Backpressure                D. None of the above
18. Which of the following can have two forms-backpressure and backsiphonage?
- A. Backflow                      C. Cross-connection  
B. Backpressure                D. None of the above
19. The basic mechanism for preventing backflow is a mechanical \_\_\_\_\_, which provides a physical barrier to backflow.
- A. Air gap                        C. Backflow  
B. Backflow preventer        D. None of the above

**Types of Backflow Prevention Methods and Assemblies**

20. Which of the following must either be physically disconnected or have an approved backflow prevention device installed to protect the public water system?
- A. Indirect connection        C. Cross-connection  
B. Jumper                        D. None of the above
21. When the \_\_\_\_\_ is restricted, such as the case of an air gap located near a wall, the air gap separation must be increased.
- A. Air break                      C. Airflow  
B. Barrier to backflow        D. None of the above
22. An air gap is a physical disconnection between the free flowing discharge end of a potable water pipeline and the top of a(n)?
- A. Open receiving vessel      C. Barrier to backflow  
B. Air break                      D. None of the above
23. Which of the following must be at least two times the diameter of the supply pipe and not less than one inch?
- A. Open receiving vessel      C. Air gap  
B. Air break                      D. None of the above
24. According to the text, air gap separations must be vertically orientated a distance of at least twice the inside diameter of the supply, but never less than?
- A. 1 inch                        C. 12 inches  
B. 2 inches                      D. None of the above
25. An obstruction around or near an \_\_\_\_\_ may restrict the flow of air into the outlet pipe and nullify the effectiveness of the air gap to prevent backsiphonage.
- A. Open receiving vessel      C. Air gap  
B. Air break                      D. None of the above
26. An air gap is acceptable for \_\_\_\_\_ and is theoretically the most effective protection.
- A. High hazard installations    C. Low pollutional hazards  
B. High pollutional concerns   D. None of the above

## Groundwater Treatment/Production System Section

### Groundwater and Wells

27. When toxic substances are spilled or dumped near a well, these can leach into \_\_\_\_\_ and contaminate the groundwater drawn from that well.
- A. Karst                      C. Soil moisture  
B. Aquifer                  D. None of the above
28. Which of the following flows slowly through water-bearing formations at different rates?
- A. Groundwater          C. Soil moisture  
B. Drinking water      D. None of the above
29. The level below which all the spaces in the ground are filled with water is called the?
- A. Unconfined aquifer(s)    C. Well(s)  
B. Water table              D. None of the above
30. The area above the water table lies the?
- A. Unsaturated zone        C. Saturated zone  
B. Karst                      D. None of the above
31. The water in the saturated zone is called?
- A. Unconfined aquifer(s)    C. Water table  
B. Groundwater              D. None of the above
32. Which of the following terms are cracks, joints, or fractures in solid rock, through which groundwater moves?
- A. Fractured aquifer(s)      C. Soil moisture  
B. Karst                      D. None of the above
33. Limestone is often located in which of the following?
- A. Unconfined aquifer(s)    C. Fractured aquifer(s)  
B. Soil moisture              D. None of the above
34. Which of the following may move in different directions below the ground than the water flowing on the surface?
- A. Water table              C. Soil moisture  
B. Groundwater              D. None of the above
35. Which of the following is the level to which the water in an artesian aquifer will rise?
- A. Aquifer                    C. Water table  
B. Piezometric surface      D. None of the above
36. Sandstone may become so highly cemented or recrystallized that all of the original space is filled, in this case, the rock is no longer a porous medium and is known as?
- A. Unconfined aquifer(s)    C. Fractured aquifer(s)  
B. Porous media              D. None of the above
37. Which of the following usually flows downhill along the slope of the water table?
- A. Groundwater              C. Soil moisture  
B. Water table              D. None of the above

### Cone of Depression

38. During pumping, the water level in the well falls below the water table in the?
- A. Water table              C. Unconfined aquifer  
B. Surrounding aquifer      D. None of the above

39. Which of the following is the vertical drop in the height between the water level in the well prior to pumping and the water level in the well during pumping?
- A. Drawdown                      C. Cone of depression  
B. Groundwater                  D. None of the above
40. When a water well is installed in \_\_\_\_\_, water moves from the aquifer into the well through small holes or slits in the well casing or, in some types of wells, through the open bottom of the well?
- A. Confined aquifer                  C. Water table  
B. An unconfined aquifer          D. None of the above

**Where Is Ground Water Stored?**

41. Areas where ground water exists in sufficient quantities to supply wells or springs are called aquifers, that literally means?
- A. Water table                      C. Cone of depression  
B. Water bearer                    D. None of the above
42. Which of the following stores water in the spaces between particles of sand, gravel, soil, and rock as well as cracks, pores, and channels in relatively solid rocks?
- A. Water table                      C. Unconfined aquifer  
B. Aquifer(s)                        D. None of the above
43. Which of the following is regulated largely by its porosity, or the relative amount of open space present to hold water?
- A. Water table                      C. An aquifer's storage capacity  
B. Groundwater                    D. None of the above
44. If the aquifer is sandwiched between layers of comparatively impermeable materials, it is called?
- A. Confined aquifer                  C. Water table  
B. Unconfined aquifer              D. None of the above
45. Which of the following are frequently found at greater depths than unconfined aquifers?
- A. Confined aquifer(s)              C. Water table  
B. Unconfined aquifer(s)          D. None of the above

**Does Groundwater Move?**

46. Groundwater can move sideways as well as up or down. This movement is in response to gravity, differences in elevation, and?
- A. Permeable zones                      C. Saturated zone  
B. Differences in pressure              D. None of the above
47. Groundwater can move even more quickly in karst aquifers, which are areas in \_\_\_\_\_ and similar rocks where fractures or cracks have been widened by the action of the ground water to form sinkholes, tunnels, or even caves?
- A. Karst aquifer(s)                      C. Water soluble limestone  
B. Saturated zone                        D. None of the above

**Groundwater Quality**

48. The layers of soil and particles of sand, gravel, crushed rocks, and larger rocks were thought to act as filters, trapping contaminants before they could reach the ground water.
- A. True                      B. False

49. It is known that some contaminants can pass through all of these filtering layers into \_\_\_\_\_ to contaminate ground water.

- A. Permeable zones
- B. Unsaturated zone
- C. Saturated zone
- D. None of the above

### How Does Ground Water Become Contaminated?

50. Groundwater contamination can begin on the surface of the ground, in the ground above the water table, or in the ground below the?

- A. Water table
- B. Ground water
- C. Permeable zones
- D. None of the above

51. If the contaminant is introduced straight into the area below \_\_\_\_\_, the primary process that can affect the impact of the contaminant is dilution by the surrounding ground water.

- A. Water table
- B. Saturated zone
- C. Unsaturated zone
- D. None of the above

### What Kinds of Substances Can Contaminate Groundwater, and Where Do They Come from?

52. Substances that can pollute \_\_\_\_\_ can be divided into two basic categories: substances that occur naturally and substances produced or introduced by man's activities.

- A. Synthetic organic chemical(s)
- B. Groundwater
- C. Permeable zones
- D. None of the above

53. A substantial number of today's groundwater contamination problems stem from man's activities and can be introduced into ground water from?

- A. Contaminant(s)
- B. Saturated zone
- C. A variety of sources
- D. None of the above

### Abandoned Wells

54. If which of the following if abandoned without being properly sealed, it can act as a direct channel for contaminants to reach ground water?

- A. A well
- B. Alternative sources of water
- C. Supplies of clean ground water
- D. None of the above

### Nature of the Aquifer

55. Which of the following terms has a low-permeability geologic formation as its upper boundary?

- A. Hydraulic head
- B. Water table
- C. A confined aquifer
- D. None of the above

### Hydraulic Head (h)

56. The hydraulic head is a measure of the water at a certain depth possesses because of its elevation and the pressure exerted through the weight of the water above it.

- A. True
- B. False

57. Which of the following has units of feet, and generally parallels to the elevation of water in the well?

- A. Hydraulic head
- B. Water table
- C. Permeability zone
- D. None of the above

### Permeability of the Aquifer (K)

58. Which of the following \_\_\_\_\_ or the permeability of the aquifer is a measure of how fast ground water can move through the aquifer?

- A. Hydraulic head
- B. Hydraulic conductivity
- C. Storage coefficient of the aquifer
- D. None of the above

59. Which of the following terms has units of distance/time, e.g., feet/day, although it does not represent an actual speed?

- A. Hydraulic head
- B. Hydraulic conductivity
- C. Storage coefficient of the aquifer
- D. None of the above

### **In What Direction Is Groundwater Flowing?**

60. The direction of groundwater flow is from higher to lower?

- A. Hydraulic head
- B. Hydraulic conductivity
- C. Storage coefficient of the aquifer
- D. None of the above

61. Which of the following can be measured by lowering a probe through the observation port of a number of wells, all within the same relative time period?

- A. Hydraulic head
- B. Hydraulic conductivity
- C. Storage coefficient of the aquifer
- D. None of the above

### **What Is the Drawdown Associated with Pumping of a Well?**

62. There is a relationship between the pumping rate of the well, the transmissivity of the aquifer, the distance between wells, \_\_\_\_\_, and the duration of the pumping event.

- A. Hydraulic head
- B. Hydraulic conductivity
- C. Storage coefficient of the aquifer
- D. None of the above

### **Depth to First Water-Bearing Zone**

63. Some report the depth at which water is first encountered in?

- A. The drill hole
- B. Static water level (SWL)
- C. Recharge and discharge zone(s)
- D. None of the above

### **Static Water Level**

64. The driving force for ground water movement is the hydraulic head, and the \_\_\_\_\_ is a measure of that force.

- A. Hydrogeologic investigation(s)
- B. Static water level (SWL)
- C. Recharge and discharge zone(s)
- D. None of the above

65. Identifying where one aquifer ends and another begins is key to identifying the source of the yield for individual wells. Although this often can be determined by careful review of the lithologic log provided by the well constructor, the transition from one aquifer to the next can be indicated by a marked change in the recharge and discharge zones

- A. True
- B. False

66. Which of the following is a better gauge that a different aquifer has been encountered than the lithologic description?

- A. Water-bearing zone(s)
- B. SWL
- C. Recharge and discharge zone(s)
- D. None of the above

67. Which of the following have important effects in groundwater protection and identifying the relation between area groundwater and local streams?

- A. Water-bearing zone(s)
- B. SWL
- C. Recharge and discharge zone(s)
- D. None of the above

### **Water-Bearing Zones**

68. Arriving at accurate approximations of aquifer parameters or calculating ground water velocity requires us to know the thickness of the?

- A. Water-bearing zone(s)
- B. SWL
- C. Recharge and discharge zone(s)
- D. None of the above

### **Contributions of Well Constructors to Hydrogeology**

69. Well constructors can provide important inputs to the science by making careful observations and measurements when recording that data on the?

- A. Static water level
- B. Well report
- C. Local ground water systems
- D. None of the above

### **Basic Rotary Drilling Methods**

70. Rotary drilling uses two methods that include: direct and reverse mud rotary, direct air rotary, and?

- A. Advanced methods
- B. Typical drilling fluid(s)
- C. Drill through casing driver methods
- D. None of the above

### **The Rotary Drill String**

71. Which of the following or stabilizer is typically very heavy and is often gauged close to the diameter of the bit being used?

- A. The drill collar
- B. Drag bit(s)
- C. Shock absorber
- D. None of the above

72. Which of the following aids in maintaining a consistent borehole diameter and primarily helps to prevent borehole deviation?

- A. The drill collar
- B. Drag bit(s)
- C. Shock absorber
- D. None of the above

73. Several types of bits may be used; such as drag bits or?

- A. The flighting
- B. The plug
- C. Roller bits
- D. None of the above

74. Which of the following are normally used in unconsolidated to semi-consolidated sand, silt, and clay-rich formations?

- A. The drill collar
- B. Drag bit(s)
- C. Roller bit(s)
- D. None of the above

75. Drag bits come in many shapes and sizes and cut with a shearing action aided by the jetting of drilling fluids from?

- A. The drill collar
- B. Nozzles or jets in the bit
- C. Shock absorber (floating sub)
- D. None of the above

76. Roller bits, such as \_\_\_\_\_, typically utilize interlocking teeth or buttons on individual rotating cones to cut, crush, or chip through the formation.

- A. The flighting
- B. The plug
- C. The common tri-cone bit
- D. None of the above

77. Roller bits can be used in consolidated formations and even hard rock applications if equipped with carbide buttons. These types of bits are often referred to as?

- A. Roller button bits
- B. The Kelly
- C. Reamers
- D. None of the above

78. Which of the following are bits that can be utilized to enlarge, straighten, or clean an existing borehole?

- A. Roller button bits
- B. The Kelly
- C. Reamers
- D. None of the above

79. Which of the following terms are used to enlarge deeper sections of an existing borehole without requiring the enlargement of the entire upper well bore?

- A. Cutting blades
- B. Under reamers
- C. Reamers
- D. None of the above



80. Under reaming involves the projection of \_\_\_\_\_ beneath permanently installed casing in loosely consolidated sediments.
- A. Cutting blades
  - B. Under reamers
  - C. Reamers
  - D. None of the above

### Direct Rotary Method

81. The drilling fluid that is pumped by \_\_\_\_\_ and/or air compressor is jetted out of ports in the bit.
- A. The drilling fluid
  - B. The rig's mud pump
  - C. The cutting's containment systems
  - D. None of the above

82. Which of the following pressurizes the borehole and helps to keep the hole open while removing cuttings?
- A. The drilling fluid
  - B. The rig's mud pump
  - C. The cutting's containment systems
  - D. None of the above

83. Large drill rigs may utilize \_\_\_\_\_ that separate the cuttings from the drilling fluid before a pickup pump recirculates the drilling fluid back down the borehole, where the process is then repeated.
- A. The drilling fluid
  - B. The rig's mud pump
  - C. The cutting's containment systems
  - D. None of the above

84. Mud pits may be dug into the ground adjacent to the rig in order to contain and settle out cuttings from this missing term before recirculating.
- A. The flighting
  - B. The borehole
  - C. The drilling fluid
  - D. None of the above

### Air Rotary Method

85. Which of the following is kept in a pressured condition while drilling, in order to maintain the circulation of drilling fluid to the surface?
- A. The flighting
  - B. The borehole
  - C. The drilling fluid
  - D. None of the above

86. Which of the following is added while drilling with air in order to maintain sufficient hole pressurization so that cuttings may be lifted to the surface efficiently while maintaining hole stability.
- A. Chemical stabilizer
  - B. Mud
  - C. Biodegradable foam or surfactant (soap)
  - D. None of the above

87. The air hammer makes use of compressed air to drive a piston up and down which makes \_\_\_\_\_ move up and down while the drill string rotates.
- A. The air rotary method
  - B. A roller button bit
  - C. The hammer bit
  - D. None of the above

88. Which of the following's action produces great rock breaking force and is very valuable for drilling through solid rock or consolidated formations?
- A. The mud rotary method
  - B. Drilling
  - C. The combined rotating and hammering
  - D. None of the above

89. \_\_\_\_\_ in hard rock or consolidated formations, may be used when drilling pressures are too high or borehole sizes are too large for the efficient operation of an air hammer.
- A. The air rotary method
  - B. A roller button bit
  - C. The hammer bit
  - D. None of the above

### **Drill through Casing Driver Method**

90. Which of the following is a specially designed hardened steel ring that is installed on the casing end?
- A. Auger boring method(s)                      C. The casing driver method  
B. The cutting shoe                              D. None of the above
91. Which of the following is inserted into the casing and the casing is attached to the casing driver?
- A. A hammer or roller bit                      C. The rig  
B. The drill string                                D. None of the above
92. Which of the following penetrates into the overburden or formation, the casing driver hammers the casing down, following the drill string?
- A. The drill string                                C. The casing driver method  
B. The cutting shoe                              D. None of the above
93. Cuttings rise to the surface with \_\_\_\_\_ through the casing and exit through the casing driver.
- A. The injected air                                C. The casing driver method  
B. The solid stem auger boring method      D. None of the above
94. According to the text as the borehole is drilled, the cuttings are then collected near?
- A. A hammer or roller bit                      C. The rig  
B. The drill string                                D. None of the above
95. Which of the following can continue until competent formation is encountered?
- A. A hammer or roller bit                      C. The addition of casing and drill string  
B. The drill string                                D. None of the above
96. Which of the following is often used to install temporary casing in order to permit the installation of a well in unstable aquifers?
- A. Auger boring method(s)                      C. A rotating blade or spiral flange  
B. The casing driver method                      D. None of the above
97. Which of the following may be used as a puller to remove the temporary casing following well construction?
- A. The flighting                                    C. The casing driver  
B. The plug                                        D. None of the above

### **Auger Boring Methods**

98. Auger boring methods make use of \_\_\_\_\_, which may be attached to a pilot bit and cutter head.
- A. Auger boring method(s)                      C. A rotating blade or spiral flange  
B. The casing driver method                      D. None of the above
99. Which of the following along with the rotating action of the blade and cutting action of the pilot and/or cutter bits facilitates the boring process?
- A. The flighting                                    C. Down-force applied by the rig  
B. The plug                                        D. None of the above
100. Soil samples may be collected as cuttings rise or are brought to the surface, or they may be collected with?
- A. Augers    C. The solid stem auger boring method  
B. Split spoon type sampler(s)                      D. None of the above

101. Which of the following are capable of boring large diameter holes in excess of four feet in diameter?

- A. Augers
- B. Split spoon type sampler(s)
- C. The solid stem auger boring method
- D. None of the above

102. According to the text, there are three primary types of \_\_\_\_\_: solid stem, bucket, and hollow stem.

- A. Auger boring method(s)
- B. The bucket auger method
- C. The casing driver method
- D. None of the above

### **Solid Stem Auger Method**

103. Which of the following terms method uses a spiral flanged drill pipe driven by either a kelly or rotary drive head, like those used on rotary rigs?

- A. Augers
- B. Split spoon type sampler(s)
- C. The solid stem auger boring method
- D. None of the above

### **What is a Significant Deficiency?**

104. Significant deficiencies cause, or have the potential to cause, the introduction of contamination into water delivered to customers include defects in design, operation, or maintenance of?

- A. Well screen
- B. The aquifer
- C. The source, treatment or distribution systems
- D. None of the above

### **Selecting an Appropriate Well Site**

105. The ideal well location has good drainage and is higher than?

- A. The quality of drinking water
- B. The possibility of contamination
- C. The surrounding ground surface
- D. None of the above

106. Which of the following should be at a lower elevation than the well, and the distances to those contamination sources must be in accordance with the State or Local Water Well Construction Codes?

- A. Surface drainage(s)
- B. Preliminary aquifer parameters
- C. All possible sources of contamination
- D. None of the above

### **Common Well Construction Specifications**

107. Which of the following should always be located and constructed in such a manner that they yield safe water at all times and under all conditions?

- A. Water wells
- B. The aquifer
- C. A pumping test
- D. None of the above

### **Choice of Casing**

108. As with casing, the choice of well screen is as important as its placement, the size of the openings in the casing are dependent on the grain size of the filter or?

- A. The anticipated flow rate
- B. The well
- C. Gravel pack
- D. None of the above

### **Selecting an Optimum Pumping Rate**

109. Specific capacities for each of the pumping steps are compared. The highest Sc observed is normally associated with?

- A. The anticipated flow rate
- B. The well
- C. The optimum pumping rate
- D. None of the above

## Pump and Motor Section

### Common Hydraulic Terms

110. 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

111. Which of the following definitions is the engineering science pertaining to liquid pressure and flow?

- A. Hydraulics
- B. Hydrology
- C. Hydrokinetics
- D. None of the above

112. Which of the following definitions is the pressure exported by the atmosphere at any specific location?

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

113. Which of the following definitions is pressure above zero absolute, i.e. the sum of atmospheric and gauge pressure?

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

### Pumps

114. Pumps are excellent examples of?

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

115. More complicated pumps have valves check valves that open to allow \_\_\_\_\_, and close automatically to prevent reverse flow.

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

116. According to the text, the force pump has \_\_\_\_\_ in the cylinder, one for supply and the other for delivery.

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

117. In a positive displacement pump, supply valve opens when the cylinder \_\_\_\_\_, the delivery valve when the cylinder volume decreases.

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

### Pump Categories

118. 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
- B. Impeller force
- C. Diaphragm pressure
- D. None of the above

119. 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
- B. Head
- C. Delivery force
- D. None of the above

### Basic Water Pump

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

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

### Types of Water Pumps

121. The most common type of water pumps used for municipal and domestic water supplies are?

- A. Axial flow
- B. Variable displacement pumps
- C. Rotary pumps
- D. None of the above

122. 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
- B. Atmospheric pressure
- C. Variable displacement pump
- D. None of the above

123. Impellers are rotated by the pump motor, which provides the \_\_\_\_\_ needed to overcome the pumping head.

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

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

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

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

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

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

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

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

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

128. 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
- B. Spider bearings
- C. Lantern ring
- D. None of the above

129. Which of the following terms, provide both a seal at the column pipe joints and keep the shaft aligned within the column?

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

130. 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
- B. Spider bearings
- C. Spider flanges
- D. None of the above

131. 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

132. 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

133. Often an electric motor that is connected to the \_\_\_\_\_ by a keyway and nut.

- A. Drive shaft            C. Sprocket
- B. Rotor                  D. None of the above

134. Where electricity is not readily available, fuel powered engines may be connected to the drive shaft by a?

- A. Gear                    C. Right angle drive gear
- B. Drive shaft            D. None of the above

135. 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

136. 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

## Safety Section

### Permitted Confined Space Entry Program

137. Subpart P (of OSHA's Construction Regulations – refer to page 60) applies to all \_\_\_\_\_ in the earth's surface.

- A. Vaults                    C. Pits
- B. Open excavations      D. None of the above

138. According to the text, all trenches are \_\_\_\_\_.

- A. Too narrow for work      C. Safe for short term work
- B. Excavations              D. None of the above

139. According to the text, all excavations are \_\_\_\_\_.

- A. Permit-required          C. Access passages
- B. Not trenches              D. None of the above

### Oxygen Deprivation

140. The first sign of hypoxia (oxygen deprivation) is deterioration to night vision, which occurs when the \_\_\_\_\_ level falls to 17%.

- A. Argon                    C. Oxygen
- B. Irritant gases          D. None of the above

141. Increased breathing volume, accelerated heartbeat, very poor muscular coordination, rapid fatigue, and intermittent respiration are \_\_\_\_\_ that occur when oxygen level is between 14-16%.

- A. Problems
- B. Physiologic effects
- C. Reactions
- D. None of the above

142. Nausea, vomiting, \_\_\_\_\_, and unconsciousness are the physiological effects that occur when oxygen level is between 6-10%. Less than 6%, the effects are spasmodic breathing, convulsive movements, and death in minutes.

- A. Oxygen deprivation
- B. Problems
- C. Inability to perform
- D. None of the above

### Excavation and Trenching Section

143. OSHA also revised the \_\_\_\_\_ to clarify the requirements.

- A. Competent rule
- B. Existing standard
- C. Protective equipment standard
- D. None of the above

144. The performance criteria in the new standard provides employers with options when classifying soil and when selecting methods to protect the \_\_\_\_\_ from cave-ins.

- A. Competent person
- B. Employee
- C. Construction equipment
- D. None of the above

145. According to the text, the \_\_\_\_\_ was revised because excavating is the most dangerous of all construction operations.

- A. Competent rule
- B. OSHA excavation standard
- C. Emergency rule
- D. None of the above

146. Although employers have options when meeting some of the requirements, \_\_\_\_\_ must realize that the employee must be protected at all times.

- A. Competent persons
- B. Employers
- C. Contractors
- D. None of the above

### Competent Person

147. Competent person means one who is capable of identifying existing hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees. The \_\_\_\_\_ has authorization to take prompt corrective measures to eliminate identified hazards.

- A. Competent person
- B. Contractor
- C. Watchman
- D. None of the above

148. A \_\_\_\_\_ must have specific training in and be knowledgeable about soils analysis, the use of protective systems and the requirements of 29 CFR Part 1926.650-652 Subpart P.

- A. Competent person
- B. Contractor
- C. Watchman
- D. None of the above

149. Everyone is required to practice \_\_\_\_\_ one a year.

- A. Competent person training
- B. Rescue training exercises
- C. Emergency procedures
- D. None of the above

### Competent Person Duties

150. The competent person performs daily inspections of the protective equipment, \_\_\_\_\_, safety equipment, and adjacent areas.

- A. Work progress
- B. Construction Crew
- C. Trench conditions
- D. None of the above

151. The competent person must have knowledge of \_\_\_\_\_, telephone or radio dispatch.

- A. Personnel assignments
- B. Work schedules
- C. Emergency contact methods
- D. None of the above

152. The competent person removes employees and \_\_\_\_\_ from hazardous conditions and makes all changes necessary to ensure their safety.

- A. Competent persons
- B. All other personnel
- C. Protective equipment
- D. None of the above

153. The competent person makes sure that all \_\_\_\_\_ have proper protective equipment, hard-hats, reflective vests, steel-toed boots, harnesses, eye protection, hearing protection and drinking water.

- A. Competent persons
- B. Contractors
- C. Employees
- D. None of the above

154. The competent person shall make \_\_\_\_\_ prior to the start of work and as needed throughout the shift.

- A. Personnel assignments
- B. Training available
- C. Inspections
- D. None of the above

155. The competent person shall make \_\_\_\_\_ after every rainstorm or other hazard occurrence.

- A. Inspections
- B. Training available
- C. Protective equipment available
- D. None of the above

### Scope of Work

156. According to the text, during excavation work a competent person shall be on the job site at all times when personnel are working within or around the \_\_\_\_\_.

- A. Competent person
- B. Contractors
- C. Excavation
- D. None of the above

157. Prior to opening an excavation, the estimated locations of \_\_\_\_\_ that reasonably may be expected to be encountered during excavation work shall be determined.

- A. Unauthorized persons
- B. Employees
- C. Underground utility installations
- D. None of the above

158. \_\_\_\_\_ shall be taken to protect employees against the hazards posed by water accumulation in the excavation.

- A. Additional care
- B. Adequate precautions
- C. Ladders
- D. None of the above

159. In trench excavations that are four (4') feet or more in depth, a stairway, ladder, or ramp shall be used as a \_\_\_\_\_.

- A. Tool
- B. Means of access or egress
- C. Bridge
- D. None of the above

160. When excavations are made in vehicular traffic areas, \_\_\_\_\_ shall wear a warning vest made with reflective material or highly visibility material.

- A. Competent persons
- B. Each employee
- C. Rescue personnel
- D. None of the above



161. The air shall be tested in excavations where \_\_\_\_\_ exist, or could be reasonably expected to exist.

- A. Limited visibilities
- B. Employees
- C. Oxygen deficiency or gaseous conditions
- D. None of the above

162. When the atmosphere contains less than 19.5 percent oxygen, the area must be continuously ventilated until the \_\_\_\_\_.

- A. Excavation is closed
- B. Employees enter the space
- C. Oxygen levels are above 19.5 percent
- D. None of the above

163. Where a \_\_\_\_\_, the area shall be ventilated until the flammable gas concentration is below 20 percent of the LFL (lower flammable limit).

- A. Competent person requires monitoring
- B. Gaseous condition exists
- C. Worker encounters fumes
- D. None of the above

164. Whenever \_\_\_\_\_ exist or could reasonably exist, the air must be monitored continuously to assure that workers are protected.

- A. Traffic conditions
- B. Excavations
- C. Oxygen deficiency or gaseous conditions
- D. None of the above

### **Excavation Protection Systems**

165. There are three basic protective systems for excavations and trenches. They are sloping and benching systems, \_\_\_\_\_, and shields.

- A. Shoring
- B. Ramps
- C. Attendants
- D. None of the above

### **Sloping and Benching Systems**

166. An option for sloping is to slope to the angle required by OSHA Construction Standards for Type C, which is the most \_\_\_\_\_.

- A. Unstable soil type
- B. Stable soil type
- C. Porous soil type
- D. None of the above

### **Shoring Systems**

167. \_\_\_\_\_ is another protective system that utilizes a framework of vertical members, horizontal members, and cross braces to support the sides of the excavation to prevent a cave-in.

- A. Shoring
- B. Tabulated data
- C. Lateral support
- D. None of the above

### **Shield Systems (Trench Boxes)**

168. Shielding is the third method of providing a safe workplace in excavations. Unlike sloping and shoring, \_\_\_\_\_ does not prevent a cave-in.

- A. Shielding
- B. Tabulated data
- C. Soil testing
- D. None of the above

### **Safety Precautions for Shield Systems**

169. There must not be any lateral movement of \_\_\_\_\_ when installed.

- A. Sloping and benching systems
- B. Shields
- C. Ladders
- D. None of the above

170. The exposed excavation wall at the \_\_\_\_\_ must be sloped, shored, or shielded.

- A. Excavation site
- B. Open end of the shield
- C. Traffic side of the excavation
- D. None of the above

### Excavation Safety Plan

171. A written excavation safety plan is required. This plan is to be developed to the level necessary to ensure complete compliance with the \_\_\_\_\_ and state and local safety standards.

- A. Professional engineer's requirements
- B. OSHA Excavation Safety Standard
- C. Protective systems
- D. None of the above

### Soil Classification and Identification

172. The Simplified Soil Classification System defined by OSHA Standards consists of four categories: \_\_\_\_\_, Type A, Type B, and Type C.

- A. Stable rock
- B. Gravel
- C. Stiff clay
- D. None of the above

### Soil Test & Identification

173. The competent person will classify the \_\_\_\_\_ according to the definitions in Appendix A of the OSHA standard based on at least one visual and one manual analysis.

- A. Shields
- B. Soil type
- C. Cohesion tests
- D. None of the above

### Shielding

174. An operation where a contractor excavates just enough trench to install the shield, then sets a joint of pipe, then excavates further, then pulls the shield forward to install another joint while the first is being backfilled, is known as "\_\_\_\_\_".

- A. Shielding
- B. Cut and cover
- C. Standard practice
- D. None of the above

### Inspections

175. The excavations, adjacent areas, and protective systems shall be inspected daily by the \_\_\_\_\_.

- A. Contractor
- B. Employees
- C. Competent person
- D. None of the above

## Water Quality Section

### Three Types of Public Water Systems

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

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

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

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

178. Approximately 18,000 water systems

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

### Managing Water Quality at the Source

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

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

### Physical Characteristics of Water

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

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

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

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

### pH Testing Section

182. 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

183. 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

184. In chemistry, pH is a measure of the acidity or basicity of an aqueous solution. Solutions with a pH greater than 7 are said to be acidic and solutions with a pH less than 7 are basic or alkaline.

- A. True
- B. False

185. Pure water has a pH very close to?

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

### More on the Stage 2 DBP Rule

186. 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

187. 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

### What are Disinfection Byproducts (DBPs)?

188. 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

189. 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

## **Bacteriological Monitoring Section**

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

190. 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

191. 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

### **Background**

192. 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**

193. 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

194. 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

195. 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**

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

- A. True
- B. False

197. 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

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

- A. True
- B. False

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

- A. True
- B. False

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

- A. True      B. False

201. 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

### **Dangerous Waterborne Microbes**

202. 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

### **Bacteriological Monitoring Introduction**

203. 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    C. Viruses  
B. Amoebas              D. None of the above

### **Bacteria Sampling**

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

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

### **Microbial Regulations**

205. 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

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

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

- A. True                  B. False

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

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

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

208. 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

209. 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

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

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

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

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

### Revised Total Coliform Rule (RTCR) Summary

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

- A. True
- B. False

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

- A. True
- B. False

214. 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

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

- A. True
- B. False

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

- A. True
- B. False

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

- A. True
- B. False

218. 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

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

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

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

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

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

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

222. 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

### Advanced Water Treatment Section

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

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

### Occurrence of Hard Water

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

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

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

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

### Types of Hardness

226. 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

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

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

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

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

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

- A. Hardness ions
- B. Carbon dioxide ( $\text{CO}_2$ )
- C. Carbonate hardness
- D. None of the above

230. 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

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

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

### **Types of Processes**

232. 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)
- C. Membrane separation processes
- B. Fractional distillation
- D. None of the above

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

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

### **Membrane Filtration Processes**

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

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

### **Microfiltration**

235. RO membranes are susceptible to clogging or filter binding unless the \_\_\_\_\_ being processed is already quite clean.

- A. Process liquid
- C. Water
- B. Chloride and sodium
- D. None of the above

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

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

### **Nanofiltration**

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

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

### **Reverse Osmosis**

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

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

### **Microfiltration Specific Process**

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

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

240. Microfiltration usually serves as a pre-treatment for other separation processes such as?

- A. Cross flow filtration
- C. Ultrafiltration
- B. Filtration process(es)
- D. None of the above



## Common Applications

### Driving Force, Retentate Stream and Permeate Streams

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

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

242. Which of the following is pressure driven with suspended particles and water as retentate and dissolved solutes plus water as permeate?

- A. Cross flow filtration
- C. Filtration process(es)
- B. Microfiltration process
- D. None of the above

243. Which of the following terms accelerates the separation process by increasing the flow rate (flux) of the liquid stream but does not affect the chemical composition of the species in the retentate and product streams?

- A. Retentate and product streams
- C. Batch or semi-continuous filtration
- B. The use of hydraulic pressure
- D. None of the above

### Nanofiltration (NF) Section

244. 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
- C. Disinfection by-product precursors
- B. Chloride and sodium
- D. None of the above

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

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

246. Nanofiltration membranes have pore sizes from 1-10 nanometers, smaller than that used in microfiltration and?

- A. Reverse osmosis or RO
- C. Ultrafiltration
- B. Microfiltration or MF
- D. None of the above

### Range of Applications

247. The original uses for nanofiltration were water treatment and?

- A. Gentle molecular separation
- C. Water softening
- B. Method of cleaning water
- D. None of the above

248. Which of the following can “soften” water by retaining scale-forming, hydrated divalent ions (e.g.  $\text{Ca}^{2+}$ ,  $\text{Mg}^{2+}$ ) while passing smaller hydrated monovalent ions?

- A. Nanofilter(s)
- C. Alumina membranes
- B. Membrane(s)
- D. None of the above

### Reverse Osmosis Process Section

249. Osmosis is a natural phenomenon in which a liquid - water in this case - passes through a semi-permeable membrane from a relatively dilute solution toward a more concentrated solution. This flow produces a measurable pressure, called osmotic pressure.

- A. True
- B. False

250. Which of the following is determined by the total dissolved solids content of the saline solution, or contaminated solution on one side of the membrane?

- A. This pressure differential
- C. Higher molecular weights
- B. Osmotic pressure
- D. None of the above

251. The higher the content of dissolved solids, the higher the?  
A. This pressure differential                      C. Higher molecular weights  
B. Osmotic pressure                                D. None of the above

252. Generally, higher molecular weights result in higher osmotic pressures. Hence, the formula for calculating osmotic pressure is very complex.  
A. True                      B. False

253. According to the text, common tap water as found in most areas may have an osmotic pressure of about 10 PSI (Pounds per Square Inch), or about?  
A. 36,000 PPM                      C. 1.68 Bar  
B. 376 PSI                              D. None of the above

254. To reach the point at which osmosis stops for tap water, a pressure of 10 PSI would have to be applied to the saline solution, and to stop osmosis in seawater, a pressure of \_\_\_\_\_ would have to be applied to the seawater side of the membrane.  
A. 36,000 PPM                      C. 1.68 Bar  
B. 376 PSI                              D. None of the above

## Disinfection Section

### Chlorine's Appearance and Odor

255. 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

256. 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

257. 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

258. 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

259. 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

260. 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

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

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

### Reactivity

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

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

263. 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
- B. Odor thresholds
- C. Moisture, steam, and water
- D. None of the above

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

- A. True
- B. False

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

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

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

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

### Flammability

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

- A. True
- B. False

268. 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

269. 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
- B. Chlorine demand
- C. Oxygen
- D. None of the above

270. Chlorine may not be available for disinfection because \_\_\_\_\_ in the water (like iron, manganese, hydrogen sulfide, and ammonia).

- A. pH increases
- B. Part of it combines with other chemicals
- C. Required contact time
- D. None of the above

271. 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
272. 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
273. Chlorination is more effective as?
- A. Water temperature increases      C. Water cools down  
B. Chlorine demand                      D. None of the above
274. 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
275. Chlorination is less effective in?
- A. Clear water                              C. Day time  
B. Cloudy (turbid) water              D. None of the above
276. 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**

277. The hypochlorite ion is a much weaker disinfecting agent than Hypochlorous acid, about 100 times less effective.
- A. True              B. False
278. 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
279. Under normal water conditions, hypochlorous acid will also chemically react and break down into the hypochlorite ion.
- A. True              B. False
280. 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
281. 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
282. All three forms of chlorine produce Sodium hypochlorite when added to water.
- A. True              B. False

283. Hypochlorous acid is a strong acid but a weak disinfecting agent. The amount of hypochlorous acid depends on the pH and temperature of the water.

- A. True      B. False

### Chlorine DDBP

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

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

285. Chloramines are formed by reactions with?

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

### Types of Residual

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

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

### Chlorine Exposure Limits

287. What is OSHA's PEL?

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

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

- A. True      B. False

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

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

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

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

### Alternate Disinfectants - Chloramine

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

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

292. 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            C. Ammonia residual(s)  
B. Chloramines                    D. None of the above

### Chlorine Dioxide

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

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

294. If chlorine dioxide is being used as an oxidant, the preferred method of generation is to entrain or \_\_\_\_\_ into a packed reaction chamber with a 25% aqueous solution of sodium chlorite ( $\text{NaClO}_2$ ).

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

295. 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

296. 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

297. 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

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

- A. True
- B. False

299. 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
- B. T10 value
- C. Contact time
- D. None of the above

300. Ozone does not provide a system residual and should be used as a primary disinfectant only in conjunction with?

- A. Dry sodium chlorite
- B. Chlorine dioxide
- C. Free and/or combined chlorine
- D. None of the above