

**Registration form**

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**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. \_\_\_\_\_

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

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

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

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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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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 404 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? \_\_\_\_\_

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

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

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

**DISTRIBUTION 404 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? \_\_\_\_\_

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Any other concerns or comments.

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**Please fax the answer key to TLC Western Campus  
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Always call us after faxing the paperwork to ensure that we've received it.

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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.*



## Distribution 404 CEU Training Course Assignment

The Distribution 404 CEU course assignment is available in Word on the Internet for your convenience, please visit [www.ABCTLIC.com](http://www.ABCTLIC.com) and download the assignment and e-mail it back to TLC.

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

Select one answer per question. Please utilize the answer key.

(s) on the answer will indicate either plural and singular tenses.

### Hyperlink to the Glossary and Appendix

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

## Cross-Connection Section

### What is Backflow?

1. 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
2. Which of the following can have two forms-backpressure and backsiphonage?  
A. Backflow                      C. Cross-connection  
B. Backpressure                D. None of the above
3. 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                      C. Cross-connection  
B. Indirect connection        D. None of the above
4. 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                C. Cross-connection  
B. Backpressure                D. None of the above
5. 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
6. 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

7. The principal types of mechanical backflow preventer are the reduced-pressure principle assembly, the \_\_\_\_\_, and the double check valve assembly.
- A. Vacuum breaker    C. Backflow check  
B. Air gaper            D. None of the above
8. Which of the following is a means or mechanism to prevent backflow?
- A. Check device or method            C. Backflow check valve  
B. Backflow preventer                 D. None of the above
9. 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    C. Backflow check  
B. Air gap                D. None of the above
10. 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                C. Cross-connection  
B. Jumper                                 D. None of the above
11. Which of the following is a type of backflow caused by a negative pressure (i.e., a vacuum or partial vacuum) in a public water system or consumer's potable water system?
- A. Backsiphonage                        C. Cross-connection  
B. Backpressure                         D. None of the above
12. Which of the following can occur whenever the amount of water being used exceeds the amount of water being supplied, such as during water line flushing, firefighting, or breaks in water mains?
- A. Backsiphonage                        C. Cross-connection  
B. Backpressure                         D. None of the above

### **Types of Backflow Prevention Methods and Assemblies**

13. 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
14. The type of device selected for a particular backflow installation depends on several factors.
- A. True            B. False
15. 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
16. 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
17. 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

18. An air break is a physical separation between the free flowing discharge end of a potable water supply pipeline, and the overflow rim of an open or non pressure receiving vessel.  
A. True      B. False
19. 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
20. 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
21. 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

**Vacuum Breakers**

22. Which of the following devices can have two primary types: atmospheric and pressure.  
A. Vacuum breaker(s)      C. Hazard application(s)  
B. Atmospheric vacuum breakers      D. None of the above
23. Both vacuum breakers devices are only suitable for?  
A. High hazard installations      C. Low hazard conditions  
B. High pollutional concerns      D. None of the above
24. Which of the following may not be installed downstream of atmospheric vacuum breakers but are allowed on pressure vacuum breakers?  
A. Valve assembly      C. Air inlet valve  
B. Shut offs      D. None of the above
25. The devices must be installed above the highest?  
A. Downstream piping      C. Hazard applications  
B. Vacuum breakers      D. None of the above
26. The double check valve assembly is designed to prevent backflow caused by backpressure and backsiphonage from high health hazards.  
A. True      B. False
27. The double check valve should be installed in an \_\_\_\_\_ and protected from freezing.  
A. Permit Required Confined Space      C. Above the ground room  
B. Accessible location      D. None of the above
28. Reduced Pressure Backflow Assembly (RP) consists of two independently acting spring loaded check valves separated by a Spring loaded differential pressure relief valve, two resilient seated full ported shutoff valves, and four properly located resilient seated test cocks.  
A. True      B. False

29. During normal operation, the pressure between the two check valves, referred to as the air inlet zone, is maintained at a higher pressure than the supply pressure.  
A. True      B. False
30. If either reduced pressure backflow assembly check valve leaks, the differential pressure relief valve maintains a differential pressure of at least two (2) psi between the supply pressure and the zone between the two check valves by discharging water to atmosphere.  
A. True      B. False
31. According to the text, the reduced pressure backflow assembly or RP is designed to prevent backflow caused by backpressure and backsiphonage from low to high health hazards.  
A. True      B. False

## Water Distribution Section

### System Elements

32. In the distribution system, storage reservoirs are structures used to store water and \_\_\_\_\_ the supply or pressure.  
A. Increase water pressure    C. Provide a reserve pressure for  
B. Equalize                      D. None of the above
33. Booster stations are used to \_\_\_\_\_ from storage tanks for low-pressure mains.  
A. Increase water pressure    C. Provide a reserve pressure  
B. Equalize                      D. None of the above
34. Globe valves should only the only valve used in an Arterial system for main line isolation.  
A. True      B. False

### Butterfly Valve

35. Butterfly valves are rotary type of valves usually found on large transmission lines, and may also have an additional valve beside it known as a \_\_\_\_\_ to prevent water hammer.  
A. Regulator                      C. PRV  
B. Bypass                         D. None of the above

### Water Distribution Valves

36. According to the text, at intersections of distribution mains, the number of valves required is normally one less than the number of?  
A. Ties                              C. Depends on customers  
B. Radiating mains    D. None of the above
37. All buried small- and medium-sized valves shall be installed in the sidewalk for safety.  
A. True      B. False
38. For large shutoff valves, it is necessary to surround the valve operator or entire valve within a vault or manhole to allow?  
A. Bluestakes                      C. Repair or replacement  
B. Testing                         D. None of the above

### Gate Valves

39. If the valve is wide open, the gate inside the valve is \_\_\_\_\_ into the valve bonnet.  
A. Fully drawn up                C. Fully closed  
B. Fully down                      D. None of the above

### Ball Valves

40. Ball valves should be either fully-on or fully-off, some ball valves also contain a swing check located within the ball to give the valve a check valve feature.  
A. True                      B. False

### Valve Exercising

41. Valve exercising should be done once per year to locate inoperable valves due to freezing or build-up of rust or corrosion and to detect minimum flow restriction and to prevent valves from becoming frozen or damaged.  
A. True                      B. False

### Water Pressure

42. 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
43. 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
44. 2.31 feet of water is equal to 1 psi, or 1 foot of water is equal to about a half a pound (.433 pounds to be exact).  
A. True                      B. False
45. For ordinary domestic use, water pressure should be between 25 and 45 psi.  
A. True                      B. False

### Water Use or Demand

46. 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
47. The combination of storage reservoirs and distribution lines must be capable of meeting consumers' needs for pressure at all times.  
A. True                      B. False
48. The quantity of water used in any community varies from 100 to 200 gallons per person per day.  
A. True                      B. False
49. 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
50. A common design usage assumption is to plan for the usage of 100 to 150 gallons per person per day for average domestic use.  
A. True                      B. False

51. The maximum daily use is approximately 3 to 5 times the average daily use.

- A. True      B. False

52. 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**

53. 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. Backwater protection      C. Barrier  
B. Compaction protection      D. None of the above

### **Storage and Distribution**

54. Proper construction is important in maintaining system integrity and the distribution system must also protect?

- A. The nearby environment      C. Water quality  
B. Vegetation      D. None of the above

### **Water Storage Facilities**

55. 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      C. Storage reservoirs  
B. Water distribution systems      D. None of the above

56. Which of the following can be converted to pressure potential energy or kinetic energy for delivery to homes?

- A. Hydrostatic power      C. Hydraulic power  
B. Stored energy      D. None of the above

### **Storage Reservoirs**

57. 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      C. Tree systems  
B. Levelers      D. None of the above

### **Steel Reservoirs**

58. Steel reservoirs or tanks generally have higher construction and installation costs than concrete, and require less maintenance.

- A. True      B. False

59. Steel tanks should be inspected once a year and repainted every 5-7 years.

- A. True      B. False

## **Groundwater Treatment/Production System Section**

### **Groundwater and Wells**

60. 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

61. 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
62. 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
63. The area above the water table lies the?  
 A. Unsaturated zone      C. Saturated zone  
 B. Karst      D. None of the above
64. The water in the saturated zone is called?  
 A. Unconfined aquifer(s)      C. Water table  
 B. Groundwater      D. None of the above
65. 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
66. 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
67. 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
68. Unconfined aquifers are those that are bounded by the water table. Some aquifers lie beneath layers of impermeable materials.  
 A. True      B. False

### **Cone of Depression**

69. When well pumping begins, water begins to flow towards the well in contrast to the natural direction of groundwater movement.  
 A. True      B. False
70. 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
71. The movement of water from \_\_\_\_\_ into a well results in the formation of a cone of depression.  
 A. Confined aquifer      C. Water table  
 B. An aquifer      D. None of the above
72. Which of the following describes a three-dimensional inverted cone surrounding the well that represents the volume of water removed as a result of pumping?  
 A. Water table      C. Cone of depression  
 B. Groundwater      D. None of the above

73. 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
  - B. Groundwater
  - C. Cone of depression
  - D. None of the above

74. 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
  - B. An unconfined aquifer
  - C. Water table
  - D. None of the above

### Where Is Ground Water Stored?

75. Areas where ground water exists in sufficient quantities to supply wells or springs are called aquifers, that literally means?
- A. Water table
  - B. Water bearer
  - C. Cone of depression
  - D. None of the above

76. 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
  - B. Aquifer(s)
  - C. Unconfined aquifer
  - D. None of the above

77. Which of the following is regulated largely by its porosity, or the relative amount of open space present to hold water?
- A. Water table
  - B. Groundwater
  - C. An aquifer's storage capacity
  - D. None of the above

78. Which of the following are frequently found at greater depths than unconfined aquifers?
- A. Confined aquifer(s)
  - B. Unconfined aquifer(s)
  - C. Water table
  - D. None of the above

### Does Groundwater Move?

79. Groundwater can move sideways as well as up or down. This movement is in response to gravity, differences in elevation, and?
- A. Permeable zones
  - B. Differences in pressure
  - C. Saturated zone
  - D. None of the above

80. 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)
  - B. Saturated zone
  - C. Water soluble limestone
  - D. None of the above

### Groundwater Quality

81. 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

82. 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?

83. 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

84. 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?

85. 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

86. 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

87. 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

### What Can Be Done After Contamination Has Occurred?

88. Rehabilitate the \_\_\_\_\_ by either restraining or detoxifying the contaminants while they are still in the aquifer.

- A. Aquifer
- B. Contamination
- C. Supplies of clean ground water
- D. None of the above

### Water Well Reports and Hydrogeology

#### Hydrogeologic Data

89. For hydrogeologists to make reliable assessments about the current and future status of ground water, they need to know where ground water occurs in the subsurface, what the properties are of the various geologic units below the surface, and how fast and in what direction ground water is moving.

- A. True
- B. False

#### Nature of the Aquifer

90. An unconfined aquifer has the \_\_\_\_\_ as its upper surface; there are no significant low-permeability layers between the water table and the surface.

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

91. According to the text, the top of the aquifer, can rise or fall depending on water use and amount of recharge to the aquifer and is called?

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

92. 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)

93. 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
94. 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)

95. 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
96. 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?

97. 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
98. 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?

99. 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

100. 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

101. 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

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

102. 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

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

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

104. 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)      C. Recharge and discharge zone(s)  
B. SWL      D. None of the above

### **Water-Bearing Zones**

105. In some cases, the screened or perforated portions of cased wells provide a clue, but all too often, the screened interval is either significantly less than the actual static water level.

- A. True      B. False

106. 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)      C. Recharge and discharge zone(s)  
B. SWL      D. None of the above

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

107. The well report document stresses the importance of data that is recorded on well reports and how that data influences hydrogeologic investigations.

- A. True      B. False

108. 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      C. Local ground water systems  
B. Well report      D. None of the above

### **How Wells Are Drilled**

109. Drilling fluids are often used during drilling in order to keep the drill bit sharp while drilling is done.

- A. True      B. False

### **Basic Rotary Drilling Methods**

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

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

### **The Rotary Drill String**

111. Rotary drilling methods use a drill string, which typically consists of a bit, collar, drill pipe and?

- A. The drill collar      C. A kelly  
B. A Sub      D. None of the above

112. Which of the following is a section of heavy walled pipe that can be hexagonal, square, or rounded with grooves?

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

113. 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

114. 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

### Direct Rotary Method

115. 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

116. The drilling fluid carries cuttings up the annular space between the drill pipe and formation and into mud pits or containment recirculating systems on the surface.

- A. True
- B. False

117. 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

118. 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

119. 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

### Drill through Casing Driver Method

120. The drill through casing driver method drives casing into the borehole as the telescoping kelly advances.

- A. True
- B. False

121. Which of the following is a specially designed hardened steel ring that is installed on the casing end?

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

122. 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
123. 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
124. 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
125. 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
126. 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
127. Which of the following may be used as a puller to remove the temporary casing following well construction?  
 A. The fighting                  C. The casing driver  
 B. The plug                          D. None of the above

**Auger Boring Methods**

128. 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
129. 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 fighting                  C. Down-force applied by the rig  
 B. The plug                          D. None of the above
130. 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
131. Which of the following are capable of boring large diameter holes in excess of four feet in diameter?  
 A. Augers                                  C. The solid stem auger boring method  
 B. Split spoon type sampler(s)                  D. None of the above
132. According to the text, there are three primary types of \_\_\_\_\_: solid stem, bucket, and hollow stem.  
 A. Auger boring method(s)                  C. The casing driver method  
 B. The bucket auger method                  D. None of the above

### Selecting an Appropriate Well Site

133. Before a well can be drilled a permit is normally required. The permit helps to ensure that an appropriate location of the well is selected which reduces the possibility of contamination.

- A. True      B. False

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

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

135. 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)      C. All possible sources of contamination  
B. Preliminary aquifer parameters      D. None of the above

### Common Well Construction Specifications

136. 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      C. A pumping test  
B. The aquifer      D. None of the above

### Choice of Casing

137. 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      C. Gravel pack  
B. The well      D. None of the above

138. According to the text, stainless steel casing and screen may be required for one situation, while PVC or low carbon steel may be acceptable in another.

- A. True      B. False

### Selecting an Optimum Pumping Rate

139. Specific capacities for each of the pumping steps are compared. The highest  $S_c$  observed is normally associated with?

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

## Pump and Motor Section

### Common Hydraulic Terms

140. 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

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

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

142. 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

143. 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

144. 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

145. 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

146. 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

147. 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

148. 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

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

- A. True
- B. False

### General Pumping Fundamentals

150. 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

151. 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

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

- A. True
- B. False

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

- A. True
- B. False

### Pumps

154. Pumps are excellent examples of?

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

155. 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

156. 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

157. 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

158. 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

159. 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

160. 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

161. 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

162. According to the text, without an inward force, an object will travel in a straight line and will not complete the?

- A. Circle
- B. Distance
- C. Center
- D. None of the above

163. In a centrifugal pump, the inward force is provided by high-pressure water near the outer edge of the?

- A. Pump housing
- B. Impeller blade(s)
- C. Base
- D. None of the above

164. In the operation of the pump, the water at the edge of the \_\_\_\_\_ inward on the water between the impeller blades and makes it possible for that water to travel in a circle.

- A. Inward force
- B. Pump pushes
- C. Center of the impeller
- D. None of the above

### Types of Water Pumps

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

- A. True
- B. False



166. The most common type of water pumps used for municipal and domestic water supplies are?  
A. Axial flow    C. Rotary pumps  
B. Variable displacement pumps                  D. None of the above
167. 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
168. 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
169. 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
170. 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
171. 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
172. 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
173. 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
174. 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
175. 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
176. The water passing through the column pipe serves as the lubricant for the bearings.  
A. True    B. False
177. 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

## Safety Section

### Confined Space Entry Program - Purpose

178. The Confined Space Entry Program is provided to protect authorized employees that will enter confined spaces from safety or health hazards associated with confined spaces.

- A. True      B. False

### Scope

179. According to the text, you are required to recognize \_\_\_\_\_ associated with confined spaces.

- A. Internal configurations      C. The dangers and hazards  
B. Permit-Required Confined Spaces      D. None of the above

### Definitions

#### Confined space:

180. A confined space is large enough or so configured that an employee can \_\_\_\_\_.

- A. Have sufficient oxygen      C. Recognize serious safety or health hazards  
B. Bodily enter and perform work      D. None of the above

181. A confined space has limited or restricted means for \_\_\_\_\_.

- A. An internal configuration      C. Hazardous atmosphere  
B. Entry or exit      D. None of the above

182. A confined space is not designed for \_\_\_\_\_.

- A. An internal configuration      C. Continuous employee occupancy  
B. Hazardous atmospheres      D. None of the above

183. A permit required confined space (permit space) contains or has a potential to contain a \_\_\_\_\_.

- A. Recognized internal configuration      C. Entry or exit  
B. Hazardous atmosphere      D. None of the above

184. A permit required confined space (permit space) contains a material that has \_\_\_\_\_.

- A. Authorized entrants      C. The potential for engulfing an entrant  
B. Hazardous atmospheres      D. None of the above

185. A permit required confined space (permit space) has an internal configuration such that \_\_\_\_\_ could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section.

- A. An entrant      C. An internal configuration  
B. Hazardous atmosphere      D. None of the above

186. A permit required confined space (permit space) contains any other recognized serious safety or \_\_\_\_\_.

- A. Engulfing an entrant      C. Health hazard  
B. Hazardous atmospheres      D. None of the above

187. Each \_\_\_\_\_ must be marked "Confined Space - Entry Permit Required".

- A. Permit-Required Confined Space      C. Entry or exit  
B. Hazardous atmosphere      D. None of the above

### Confined Space Hazards

188. Fatalities and injuries constantly occur among construction workers who are required to enter \_\_\_\_\_.

- A. An internal configuration
- B. Hazardous atmosphere
- C. Confined spaces
- D. None of the above

189. Workers encounter both inherent and \_\_\_\_\_ within confined workspaces.

- A. An internal configuration
- B. Induced hazards
- C. Hazardous atmosphere
- D. None of the above

### Inherent Hazards

190. \_\_\_\_\_ are associated with specific types of equipment and the interactions among them. These hazards can be electrical, thermal, chemical, mechanical, etc.

- A. Inherent hazards
- B. Hazardous atmospheres
- C. Recognized serious safety or health hazards
- D. None of the above

191. Inherent hazards include high voltage, radiation generated by equipment, \_\_\_\_\_, omission of protective features, high or low temperatures, high noise levels, and high-pressure vessels and lines.

- A. Defective design
- B. Hazardous atmosphere
- C. An internal configuration
- D. None of the above

192. Inherent hazards usually cannot be eliminated without degrading or shutting down the system or equipment. Therefore, emphasis must be placed on \_\_\_\_\_.

- A. Hazard control methods
- B. Hazardous atmospheres
- C. Continuous employee occupancy
- D. None of the above

### Induced Hazards

193. \_\_\_\_\_ result from a multitude of incorrect decisions and actions that occur during the actual construction process.

- A. Induced hazards
- B. Below-grade locations
- C. Build-up of explosive gases
- D. None of the above

194. Some examples of induced hazards are: omission of protective features, physical arrangements that may cause unintentional worker contact with electrical energy sources, oxygen-deficient atmospheres created at the bottom of pits or shafts, lack of safety factors in structural strength, and \_\_\_\_\_.

- A. Common confined spaces
- B. Flammable atmospheres
- C. Extreme temperatures
- D. None of the above

### Typical Examples of Confined Workspaces

195. Confined workspaces in construction contain \_\_\_\_\_.

- A. Purging agents
- B. Below-grade location
- C. Both inherent and induced hazards
- D. None of the above

### Vaults

196. Workers must enter \_\_\_\_\_ found on the construction jobsite to perform a number of functions.

- A. Common confined spaces
- B. Hazards
- C. A variety of vaults
- D. None of the above

197. The restricted nature of vaults and their frequently \_\_\_\_\_ are reasons that vaults have an assortment of safety and health problems.
- A. Purged atmosphere
  - B. Below-grade location
  - C. Explosive atmosphere
  - D. None of the above

### Oxygen-Deficient Atmosphere

198. The ever-present possibility of \_\_\_\_\_ is one of the major problems confronting construction workers while working in vaults.
- A. A common confined space
  - B. Vaults
  - C. An oxygen-deficient atmosphere
  - D. None of the above

### Explosive or Toxic Gases, Vapors, or Fumes

199. \_\_\_\_\_ produce toxic fumes which are confined in the limited atmosphere of a confined space.
- A. Purging agents
  - B. Below-grade locations
  - C. Welding and soldering
  - D. None of the above

### Excavation and Trenching Section

200. 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

201. OSHA also revised the \_\_\_\_\_ to clarify the requirements.
- A. Competent rule
  - B. Existing standard
  - C. Protective equipment standard
  - D. None of the above

202. 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

203. 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

204. Professional engineers will be required in some situations to plan or design the excavation and/or method of protecting the worker.
- A. True
  - B. False

### Competent Person

205. 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

206. 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

207. 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

208. 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
209. 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
210. 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
211. 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
212. 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
213. 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

### Scope of Work

214. 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
215. 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
216. \_\_\_\_\_ 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

217. According to the text, employees shall be protected from excavated or other materials or equipment that could pose a hazard by falling or rolling into excavations.  
A. True      B. False
218. In trench excavations that are four (4') feet or more in depth, a stairway, ladder, or ramp shall be used as a \_\_\_\_\_.  
A. Tool      C. Bridge  
B. Means of access or egress      D. None of the above
219. The Ladder(s), stairway(s), or ramp shall be spaced so that no employee in the trench excavation is more than fifty (50') feet from a means of egress.  
A. True      B. False
220. When excavations are made in vehicular traffic areas, \_\_\_\_\_ shall wear a warning vest made with reflective material or highly visibility material.  
A. Competent persons      C. Rescue personnel  
B. Each employee      D. None of the above
221. The air shall be tested in excavations where \_\_\_\_\_ exist, or could be reasonably expected to exist.  
A. Limited visibilities      C. Oxygen deficiency or gaseous conditions  
B. Employees      D. None of the above
222. When the atmosphere contains less than 19.5 percent oxygen, the area must be continuously ventilated until the \_\_\_\_\_.  
A. Excavation is closed      C. Oxygen levels are above 19.5 percent  
B. Employees enter the space      D. None of the above
223. 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      C. Worker encounters fumes  
B. Gaseous condition exists      D. None of the above
224. Whenever \_\_\_\_\_ exist or could reasonably exist, the air must be monitored continuously to assure that workers are protected.  
A. Traffic conditions      C. Oxygen deficiency or gaseous conditions  
B. Excavations      D. None of the above
225. Where the stability of adjoining buildings, walls or other structures are \_\_\_\_\_, shoring, bracing, or underpinning shall be provided to ensure the stability of such structures for the protection of employees.  
A. Not a concern      C. Endangered by excavation operations  
B. Not mentioned in the specifications      D. None of the above
226. In situations where sidewalks, pavement and appurtenant structures may be undermined, a support system such as shoring must be provided to protect \_\_\_\_\_ from the possible collapse of such structures.  
A. Unauthorized persons      C. Vehicles  
B. Employees      D. None of the above

### Personnel Protective Systems

227. According to the text, employees in \_\_\_\_\_ shall be protected from cave-ins by an adequate protective system, which shall be inspected by a competent person.
- A. Excavations
  - B. Vehicles
  - C. Protective systems
  - D. None of the above
228. The use of \_\_\_\_\_ is required for all excavations deeper than five (5') feet, except when excavation is within stable rock.
- A. Tables
  - B. Tabulated data
  - C. Protective systems
  - D. None of the above
229. For trench excavations less than five (5') feet deep, the use of \_\_\_\_\_ may not be required unless there is evidence of a potential cave-in. The competent person shall make this determination.
- A. Ladders
  - B. Protective systems
  - C. Ramps
  - D. None of the above
230. Requirements for sloping, benching or protective systems are found in \_\_\_\_\_.
- A. Safety Manuals
  - B. Tabulated data
  - C. CFR 1926.652 (OSHA Construction Standards)
  - D. None of the above
231. Whenever support systems, \_\_\_\_\_, or other protective systems are being used, a written copy of the manufacturer's specifications, recommendations, and limitations sheet shall be available at the job site.
- A. Shield systems
  - B. Tabulated data
  - C. Ramps
  - D. None of the above

### Excavation Protection Systems

232. 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
233. Every employee in an excavation or trench shall be protected from \_\_\_\_\_ by an adequate protective system.
- A. Unauthorized persons
  - B. Cave-ins
  - C. Polluted air
  - D. None of the above

### Sloping and Benching Systems

234. 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
235. Another option for sloping is to first determine the soil type, then use the table provided in Appendix B of the standard to determine the \_\_\_\_\_.
- A. Maximum allowable angle
  - B. Porosity
  - C. Protective system to be used
  - D. None of the above
236. Another option for sloping is to utilize \_\_\_\_\_ prepared by a registered professional engineer.
- A. Instructions
  - B. Tabulated data
  - C. Standards
  - D. None of the above

237. According to the text, a registered professional engineer can design a \_\_\_\_\_ for a specific job.

- A. Table
- B. Sloping plan
- C. Protective system
- D. None of the above

238. \_\_\_\_\_ for excavations five (5) to twenty (20) feet in depth must be constructed in accordance with the instructions of a designated competent person.

- A. Sloping and benching systems
- B. Tabulated data
- C. Trench excavation limits
- D. None of the above

239. A registered professional engineer must design and stamp the sloping and benching systems for excavations \_\_\_\_\_.

- A. Greater than twenty (20) feet deep
- B. In traffic areas
- C. To be made by contractors
- D. None of the above

### Shoring Systems

240. \_\_\_\_\_ 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)

241. 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

242. Shields are designed to \_\_\_\_\_, thereby protecting the employees working inside the structure.

- A. Withstand the soil forces caused by a cave-in
- B. Keep water out of the excavation
- C. Bend but not break
- D. None of the above

243. Design and construction of \_\_\_\_\_ is not covered in the OSHA Standards.

- A. Sloping and benching systems
- B. Shielding
- C. Protective systems
- D. None of the above

### Safety Precautions for Shield Systems

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

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

245. To protect employees from cave-ins when entering and exiting the shield, a ladder within the \_\_\_\_\_ or a properly sloped ramp at the end shall be provided.

- A. Shield
- B. Jobsite
- C. Tabulated data
- D. None of the above

246. According to the text, employees are not allowed in the \_\_\_\_\_ during installation, removal, or during any vertical movement.

- A. Sloping and benching systems
- B. Shield
- C. Vicinity of the excavation
- D. None of the above

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



247. Shields can be installed 2 ft. above the bottom of an excavation, provided that they are designed to \_\_\_\_\_.

- A. Tabulated data
- B. Resist loads at the full depth
- C. Be easily removed
- D. None of the above

248. 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

### Personal Protective Equipment

249. \_\_\_\_\_ requires that employees wear a hard hat, safety glasses, and work boots on the jobsite.

- A. The contractor
- B. OSHA policy
- C. Recommended practice
- D. None of the above

### Excavation & Trenching Guidelines

250. Procedures and guidelines for the protection of employees working in and around excavations and trenches must be in compliance with OSHA Standards described in Subpart P (CFR 1926.650) for the construction industry.

- A. True
- B. False

251. According to the text, the competent person(s) must be trained in accordance with the OSHA Excavation Standard, and all other programs that may apply, and must demonstrate a thorough understanding and knowledge of the programs and the hazards associated.

- A. True
- B. False

252. All other employees working in and around the excavation must be trained to recognize the hazards associated with \_\_\_\_\_.

- A. OSHA Standards
- B. Trenching and excavating
- C. Personal protective equipment
- D. None of the above

### Hazard Controls

253. Knowing the location of underground installations is a good idea because it could make the work go faster.

- A. True
- B. False

254. All overhead hazards (surface encumbrances) must be removed or supported to \_\_\_\_\_.

- A. Meet OSHA Standards
- B. Make trenching and excavating easier
- C. Eliminate the hazard
- D. None of the above

255. If \_\_\_\_\_ will be over 20 feet deep, it must be designed by a registered professional engineer.

- A. An excavation
- B. A means of access or egress
- C. Construction equipment
- D. None of the above

256. \_\_\_\_\_, such as sloping, shoring, or shielding, will be utilized to protect employees.

- A. Adequate protective systems
- B. Soil classifications
- C. Soil testing
- D. None of the above

257. An excavation safety plan must be developed to protect employees.  
A. True      B. False
258. Workers must be supplied with, and wear, any \_\_\_\_\_ deemed necessary to protect them while working in excavations.  
A. Uniforms      C. Personal protective equipment  
B. Apparel      D. None of the above
259. All \_\_\_\_\_ must be stored at least two (2) feet from the sides of the excavation. The spoil pile must not block the safe means of egress.  
A. Safety plans      C. Spoil piles  
B. Barricades      D. None of the above
260. If a trench or excavation is 4 feet or deeper, stairways, ramps, or ladders must be provided as a safe means of access and egress. Employees working in trenches must not have to travel any more than 25 feet laterally to reach a \_\_\_\_\_.  
A. Stairway, ramp, or ladder      C. Benched area  
B. Safe area      D. None of the above
261. No employee will be permitted to work in an excavation where \_\_\_\_\_ is accumulating unless adequate protection measures are used to protect the employees.  
A. Construction debris      C. Spoil  
B. Water      D. None of the above
262. All excavations and trenches must be inspected daily by a \_\_\_\_\_, prior to employee exposure or entry. Trenches and excavations will also be inspected after any rainfall, soil change, or any other time needed during the shift.  
A. Professional engineer      C. Competent person  
B. Supervisor      D. None of the above
263. When excavations and trenches 4 feet or deeper have the potential for toxic substances or \_\_\_\_\_, the air will be tested at least daily.  
A. Cave-ins      C. Hazardous atmospheres  
B. Unauthorized workers      D. None of the above
264. If work is in or around traffic, \_\_\_\_\_ must be utilized to ensure the safety of employees, vehicular traffic, and pedestrians.  
A. Signs and barricades      C. Additional personnel  
B. Soil classifications      D. None of the above

### **Excavation Safety Plan**

265. 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      C. Protective systems  
B. OSHA Excavation Safety Standard      D. None of the above

### **Soil Classification and Identification**

266. The Simplified Soil Classification System defined by OSHA Standards consists of four categories: \_\_\_\_\_, Type A, Type B, and Type C.  
A. Stable rock      C. Stiff clay  
B. Gravel      D. None of the above

267. Type A soils are \_\_\_\_\_ with an unconfined compressive strength of 1.5 tons per square foot (TSF) or greater.

- A. The least stable
- B. Cohesive soils
- C. Field tested
- D. None of the above

268. Examples of Type A soils are \_\_\_\_\_ like caliche and hardpan.

- A. Cemented soils
- B. Soil classifications
- C. Uncommon soils
- D. None of the above

### Soil Test & Identification

269. 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

270. Soil classification tests should be run on freshly excavated samples from the excavation and are designed to determine soil stability based on a number of criteria.

- A. True
- B. False

271. Clay, silt, and sand are \_\_\_\_\_. Clay particles are the smallest, silt particles are intermediate, and sand particles are the largest.

- A. Very cohesive
- B. Corrosive
- C. Size classifications
- D. None of the above

272. The degree of \_\_\_\_\_ and plasticity of a soil depend on the amounts of clay, silt, sand, and water present.

- A. Compatibility
- B. Cohesiveness
- C. Durability
- D. None of the above

273. The soil in an excavation is subject to change several times within the scope of a project and the \_\_\_\_\_ will vary with weather and job conditions.

- A. Shields
- B. Shoring
- C. Moisture content
- D. None of the above

274. According to the text, the competent person must also determine the level of protection based on what conditions exist at the time of the test, and \_\_\_\_\_.

- A. Available equipment
- B. Tabulated data
- C. Allow for changing conditions
- D. None of the above

### Shielding

275. Shielding does not prevent cave-ins. Instead, it protects the workers in the event of a cave-in.

- A. True
- B. False

276. When placed in an excavation, shields have sufficient structural strength to support the \_\_\_\_\_, thereby protecting the employees in the trench.

- A. Nearby structures
- B. Construction vehicles
- C. Force of a cave-in should one occur
- D. None of the above

277. Most \_\_\_\_\_ have two flat, parallel metal walls which are held apart by metal cross braces which are placed at the ends of the "box." This allows for the installation of pipe within the interior dimensions of the shield.

- A. Shields
- B. Reputable manufacturers
- C. Shoring systems
- D. None of the above

278. 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

279. Shields in trenches must be installed so as to prevent \_\_\_\_\_ in the event of a cave-in

- A. Lateral movement
- B. Damage to equipment
- C. Cohesion tests
- D. None of the above

280. According to the text, shields may ride two feet above the bottom of an excavation, provided they are calculated to support the full depth of the excavation and there is no \_\_\_\_\_ under or behind the shield.

- A. Caving
- B. Material
- C. Spoil
- D. None of the above

281. Workers must be protected when entering or leaving the shield by using a \_\_\_\_\_ within the shield or a properly sloped ramp at the end.

- A. Shield
- B. Ladder
- C. Support
- D. None of the above

282. Workers must exit the shield during its installation, removal, or \_\_\_\_\_.

- A. Inclement weather
- B. Soil testing
- C. During vertical movement
- D. None of the above

283. The excavation wall at the \_\_\_\_\_ should be sloped, shored or shielded off to prevent a cave-in from the end.

- A. Side of the shield
- B. End of the job
- C. Open end of the shield
- D. None of the above

284. If the excavation will be deeper than the \_\_\_\_\_, attached shields of the correct specifications may be used. As an alternate, the excavation may be sloped back to the maximum allowable angle from a point 18 inches below the top of the shield.

- A. Planned depth
- B. Shield is tall
- C. Designed depth
- D. None of the above

### Inspections

285. 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

286. During inspections, the competent person shall look for evidence of a situation that could result in a cave-in, indications of \_\_\_\_\_, hazardous atmospheres or other hazardous conditions.

- A. Failure of protective systems
- B. Poor workmanship
- C. OSHA compliance
- D. None of the above

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

287. All \_\_\_\_\_ shall be conducted by the competent person prior to the start of work, as needed throughout the shift, and after every rainstorm or other increasing hazard.
- A. Inspections
  - B. Writing of excavation reports
  - C. OSHA compliance inspections
  - D. None of the above

## Water Quality Section

### Three Types of Public Water Systems

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

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

289. 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

290. Approximately 18,000 water systems

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

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

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

292. Approximately 85,000 systems

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

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

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

### Managing Water Quality at the Source

294. 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

295. 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

### Physical Characteristics of Water

296. 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

297. 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

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

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

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

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

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

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

### pH Testing Section

301. 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

302. 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

303. 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

304. Pure water has a pH very close to?

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

305. \_\_\_\_\_ 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

306. 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

307. 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

308. 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

309. 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

310. 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

### **Objections to Hard Water Scale Formation**

311. 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

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

312. 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

313. 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

### **Disinfection Byproduct Research and Regulations Summary**

314. \_\_\_\_\_ 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

### **Bacteriological Monitoring Section**

#### **TCR**

315. 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

316. 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

317. 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**

318. 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

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

- A. True      B. False

320. 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

321. 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

322. 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

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

- A. True      B. False

### **Dangerous Waterborne Microbes**

324. 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

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

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

- A. True      B. False

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

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

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



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

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

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

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

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

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

### Positive or Coliform Present Results

330. 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

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

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

### Revised Total Coliform Rule (RTCR) Summary

332. 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

333. 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

334. 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

335. 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

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

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

337. 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

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

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

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

- A. True
- B. False

340. 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

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

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

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

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

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

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

344. 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

### Chain of Custody Procedures

345. 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
- B. Sample siting plan
- C. Samples transfer possession
- D. None of the above

346. 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

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

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

347. 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

348. 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

349. As \_\_\_\_\_ are used, contact times may be reduced.

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

### Advanced Water Treatment Section

350. 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

351. 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

352. 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

353. 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

### Disinfection Section

#### Chlorine's Appearance and Odor

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

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

## Chlorine Gas

### Pathophysiology

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

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

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

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

357. The odor threshold for chlorine gas is approximately?

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

### Mechanism of Activity

358. 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

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

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

### Reactivity

360. 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

361. 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

362. 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

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

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

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

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

## Flammability

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

- A. True      B. False

366. 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

367. 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

368. 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

369. 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

370. 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

371. Chlorination is more effective as?

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

372. 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

373. Chlorination is less effective in?

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

374. 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

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

- A. True      B. False

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

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

377. Under normal water conditions, hypochlorous acid will also chemically react and break down into the hypochlorite ion.

- A. True
- B. False

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

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

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

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

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

- A. True
- B. False

381. 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

382. These term means that chlorine is present as Cl, HOCl, and OCl<sup>-</sup> 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

383. Chloramines are formed by reactions with?

- A. Acid and Cl<sub>2</sub>
- B. Ammonia and Cl<sub>2</sub>
- C. Folic Acid and Cl<sub>2</sub>
- D. None of the above

### Types of Residual

384. 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

385. What is OSHA's PEL?

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

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

- A. True                      B. False

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

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

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

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

### **Alternate Disinfectants - Chloramine**

389. 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

390. 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**

391. 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 ClO<sub>2</sub>/chlorite/chlorate allowed in finished water?

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

392. 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 (NaClO<sub>2</sub>).

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

393. 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                      C. Ammonia  
B. Chlorine dioxide                      D. None of the above

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

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

395. 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

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

- A. True      B. False

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

- A. True      B. False

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

- A. True      B. False

399. 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

400. 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