

**Registration form**

**DISTRIBUTION BASICS 2ND EDITION \$250.00  
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*You will have 90 days from this date in order to complete this course*

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

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## Distribution Basics 2nd Ed Answer Key

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**Signature**

***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 BASICS 2<sup>ND</sup> EDITION CEU COURSE  
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**Please fax the answer key to TLC Western Campus  
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*This course contains general EPA's SDWA federal rule requirements. Please be aware that each state implements water / sampling procedures/ safety / environmental / SDWA regulations that may be more stringent than EPA's regulations. Check with your state environmental/health agency for more information. These rules change frequently and are often difficult to interpret and follow. Be careful to be in compliance with your regulatory agencies and do not follow this course for any compliance concerns.*



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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>

## Groundwater Treatment/Production System Section

### Groundwater and Wells

- 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
- The area above the water table lies the?  
A. Unsaturated zone              C. Saturated zone  
B. Karst                                  D. None of the above
- 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
- 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
- The water in the saturated zone is called?  
A. Unconfined aquifer(s)          C. Water table  
B. Groundwater                        D. None of the above
- 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
- 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

8. 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
9. Unconfined aquifers are those that are bounded by the water table. Some aquifers lie beneath layers of impermeable materials.  
 A. True            B. False
10. A well inside an aquifer is an artesian well.  
 A. True            B. False
11. Which of the following is the level to which the water in an artesian aquifer will rise?  
 A. Aquifer                    C. Water table  
 B. Piezometric surface     D. None of the above
12. Sandstone may become so highly cemented or recrystallized that all of the original space is filled, in this case, the rock is no longer a porous medium and is known as?  
 A. Unconfined aquifer(s)    C. Fractured aquifer(s)  
 B. Porous media             D. None of the above
13. Clay has many spaces between its grains, but the spaces are not large enough to permit free movement of water.  
 A. True            B. False
14. Which of the following usually flows downhill along the slope of the water table?  
 A. Groundwater             C. Soil moisture  
 B. Water table              D. None of the above

### **Cone of Depression**

15. When well pumping begins, water begins to flow towards the well in contrast to the natural direction of groundwater movement.  
 A. True            B. False
16. 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
17. 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
18. 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
19. Which of the following is the vertical drop in the height between the water level in the well prior to pumping and the water level in the well during pumping?  
 A. Drawdown                C. Cone of depression  
 B. Groundwater             D. None of the above

20. 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?

21. If the aquifer is sandwiched between layers of comparatively impermeable materials, it is called?

- A. Confined aquifer
- B. Unconfined aquifer
- C. Water table
- D. None of the above

22. 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

23. Areas where ground water exists in sufficient quantities to supply wells or springs are called aquifers, this term that literally means?

- A. Water table
- B. Water bearer
- C. Cone of depression
- D. None of the above

24. 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

25. 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

26. There are two types of aquifers: confined and unconfined.

- A. True
- B. False

### Does Groundwater Move?

27. Groundwater can move down only.

- A. True
- B. False

28. Groundwater 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

29. 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

30. 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

31. 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?

32. 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

33. 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?

34. 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

35. 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

36. 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?

37. 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

38. 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

39. 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

40. 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

41. 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)

42. 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

43. 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)

44. 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

45. 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?

46. 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

47. 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?

48. 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

49. 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

50. 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

51. 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

52. 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

53. 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

### **Water-Bearing Zones**

54. 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

55. 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

### **Lithologic Log**

56. The well log portion of the well report describes what the driller encountered in the subsurface.

- A. True      B. False

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

57. 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

58. 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**

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

- A. True      B. False

60. Typical drilling fluids are combinations of acids and iron compounds.

- A. True      B. False

### **Basic Rotary Drilling Methods**

61. 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

62. 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
63. Which of the following is a section of heavy walled pipe that can be hexagonal, square, or rounded with grooves?  
A. The flighting              C. A kelly  
B. The plug                  D. None of the above
64. Which of the following is several feet longer than the drill pipe being used and fits into the table drive much like the splines on a drive shaft fit into a transmission?  
A. The drill collar      C. The kelly  
B. The Sub                  D. None of the above
65. Some rotary rigs use a top drive to turn this term and are like a drill press.  
A. The drill collar      C. The drill string  
B. Drag bit(s)              D. None of the above
66. Drill pipe can be used in various lengths but are typically 20-foot sections and may be connected to the drive unit with?  
A. The drill collar      C. A kelly  
B. A Sub                  D. None of the above
67. A sub is a length of pipe used to connect pipes and/or act as shock absorber (between the drill pipes and drive unit, at the end of the drill pipe is)?  
A. The drill collar      C. Shock absorber  
B. Drag bit(s)              D. None of the above
68. Which of the following or stabilizer is typically very heavy and is often gauged close to the diameter of the bit being used?  
A. The drill collar      C. Shock absorber  
B. Drag bit(s)              D. None of the above
69. Which of the following aids in maintaining a consistent borehole diameter and primarily helps to prevent borehole deviation?  
A. The drill collar      C. Shock absorber  
B. Drag bit(s)              D. None of the above
70. Several types of bits may be used; such as drag bits or?  
A. The flighting              C. Roller bits  
B. The plug                  D. None of the above
71. Which of the following are normally used in unconsolidated to semi-consolidated sand, silt, and clay-rich formations?  
A. The drill collar      C. Roller bit(s)  
B. Drag bit(s)              D. None of the above
72. 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              C. Shock absorber (floating sub)  
B. Nozzles or jets in the bit      D. None of the above

73. Roller bits, such as this term, typically utilize interlocking teeth or buttons on individual rotating cones to cut, crush, or chip through the formation.
- A. The flighting                      C. The common tri-cone bit  
B. The plug                            D. None of the above
74. Roller bits can be used in consolidated formations and even hard rock applications if equipped with carbide buttons. These types of bits are often referred to as?
- A. Roller button bits                C. Reamers  
B. The Kelly                          D. None of the above
75. Which of the following are bits that can be utilized to enlarge, straighten, or clean an existing borehole?
- A. Roller button bits                C. Reamers  
B. The Kelly                          D. None of the above
76. Which of the following terms are used to enlarge deeper sections of an existing borehole without requiring the enlargement of the entire upper well bore?
- A. Cutting blades                    C. Reamers  
B. Under reamers                    D. None of the above
77. Under reaming involves the projection of \_\_\_\_\_ beneath permanently installed casing in loosely consolidated sediments.
- A. Cutting blades                    C. Reamers  
B. Under reamers                    D. None of the above

### **Direct Rotary Method**

78. Direct rotary drilling methods utilize a rotating bit at the end of a drilling string with drilling fluid that is circulated from the rig through the drill pipe and jets in the bit.
- A. True                      B. False
79. The drilling fluid that is pumped by \_\_\_\_\_ and/or air compressor is jetted out of ports in the bit.
- A. The drilling fluid                C. The cutting's containment systems  
B. The rig's mud pump                D. None of the above
80. 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
81. Which of the following terms pressurizes the borehole and helps to keep the hole open while removing cuttings?
- A. The drilling fluid                C. The cutting's containment systems  
B. The rig's mud pump                D. None of the above
82. Large drill rigs may utilize this term 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                C. The cutting's containment systems  
B. The rig's mud pump                D. None of the above
83. Mud pits may be dug into the ground adjacent to the rig in order to contain and settle out cuttings from \_\_\_\_\_ before recirculating.
- A. The flighting                      C. The drilling fluid  
B. The borehole                      D. None of the above



### Direct Mud Rotary Method

84. Mud is circulated down the drill string and through the bit at the bottom of the borehole and the mud then carries the cuttings generated by the bit up to the surface and into the mud recirculating system.

- A. True            B. False

### Air Rotary Method

85. Air rotary methods utilize compressed water and derived rock cuttings as the drilling fluid.

- A. True            B. False

86. Which of the following is kept in a pressured condition while drilling, in order to maintain the circulation of drilling fluid to the surface?

- A. The flighting                      C. The drilling fluid  
B. The borehole                      D. None of the above

87. Which of the following is added while drilling with air in order to maintain sufficient hole pressurization so that cuttings may be lifted to the surface efficiently while maintaining hole stability?

- A. Chemical stabilizer                      C. Biodegradable foam or surfactant (soap)  
B. Mud                                      D. None of the above

88. According to the text, the air rotary method is particularly suitable to soft dirt drilling with a down hole air hammer.

- A. True            B. False

89. The air hammer makes use of compressed air to drive a piston up and down which makes \_\_\_\_\_ move up and down while the drill string rotates.

- A. The air rotary method            C. The hammer bit  
B. A roller button bit                D. None of the above

90. Which of the following's action produces great rock breaking force and is very valuable for drilling through solid rock or consolidated formations?

- A. The mud rotary method            C. The combined rotating and hammering  
B. Drilling                                D. None of the above

91. \_\_\_\_\_ in hard rock or consolidated formations, may be used when drilling pressures are too high or borehole sizes are too large for the efficient operation of an air hammer.

- A. The air rotary method            C. The hammer bit  
B. A roller button bit                D. None of the above

### Drill through Casing Driver Method

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

- A. True            B. False

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

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

94. 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

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





119. In a positive displacement pump, supply valve opens when the cylinder \_\_\_\_\_, the delivery valve when the cylinder volume decreases.  
A. Volume increases                      C. Air space increases  
B. Volume decreases                      D. None of the above

120. Diaphragm pumps are force pumps in which the oscillating diaphragm takes the place of the piston.  
A. True                      B. False

### **Pump Categories**

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

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

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

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

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

A. True                      B. False

### **Basic Water Pump**

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

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

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

A. True                      B. False

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

A. True                      B. False

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

A. True                      B. False

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

A. True                      B. False

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

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

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

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

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

131. 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

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

- A. True
- B. False

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

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

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

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

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

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

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

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

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

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

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

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

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

- A. True
- B. False

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

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

141. 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

142. The size of the \_\_\_\_\_ are selected based on the desired pumping rate and lift requirements.

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

143. 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

144. The water passing through the column pipe serves as the lubricant for the bearings.

- A. True      B. False

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

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

146. The oil tube is suspended within the column by \_\_\_\_\_, while the line shaft is supported within the oil tube by brass or redwood bearings.

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

147. A continuous supply of \_\_\_\_\_ lubricates the drive shaft as it proceeds downward through the oil tube.

- A. Grease      C. Water
- B. Oil      D. None of the above

148. Time delays or ratchet assemblies are often installed on these motors to either prevent the motor from turning on before \_\_\_\_\_ stops or simply not allow it to reverse at all.

- A. Reverse rotation      C. Time delay or ratchet assembly
- B. Keyway and nut      D. None of the above

**There are three main types of diaphragm pumps:**

149. In the first type, the \_\_\_\_\_ with one side in the fluid to be pumped, and the other in air or hydraulic fluid.

- A. Vapor bubbles      C. Diaphragm is sealed
- B. Chamber pressure    D. None of the above

150. A pair of \_\_\_\_\_ prevents reverse flow of the fluid.

- A. Return valves      C. Non-return check valves
- B. Diaphragms      D. None of the above

**Water Quality Section**

**Three Types of Public Water Systems**

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

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

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

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

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

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

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

154. Approximately 85,000 systems

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

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

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

156. Approximately 18,000 water systems

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

### Managing Water Quality at the Source

157. 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                    C. Industrial and wastewater discharge
- B. Biological actions                 D. None of the above

158. 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

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

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

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

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

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

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

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

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

163. 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                                        C. Alkalinity
- B. Base                                        D. None of the above

## Alkalinity

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

- A. True      B. False

165. Alkalinity is a measure of \_\_\_\_\_ and can be interpreted in terms of specific substances only when the chemical composition of the sample is known.

- A. Hydrogen ion ( $H^+$ )      C. An aggregate property of water  
B. Alkaline earth metal      D. None of the above

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

- A. True      B. False

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

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

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

- A. True      B. False

## Turbidity Introduction

169. One physical feature of water is turbidity. A measure of the cloudiness of water caused by \_\_\_\_\_. The cloudy appearance of water caused by the presence of tiny particles.

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

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

- A. True      B. False

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

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

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

- A. True      B. False

173. Generally, higher turbidity levels require higher coagulant dosages. However, seldom is the relationship between turbidity level and \_\_\_\_\_ linear.

- A. Coagulant dosage      C. Temperature  
B. Total Dissolved Solids (TDS)      D. None of the above



174. Usually, the extra coagulant required is relatively small when turbidities are much higher than normal due to higher collision probabilities of the \_\_\_\_\_ during high turbidities.

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

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

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

176. \_\_\_\_\_ may be existing in a water supply due to pollution, and these colloids can be difficult to remove in the coagulation process. In this situation, higher coagulant dosages are generally required.

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

### **Turbidity MCL**

177. An MCL for turbidity established by the EPA because \_\_\_\_\_ interferes with disinfection. This characteristic of water changes the most rapidly after a heavy rainfall.

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

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

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

### **Dissolved Oxygen**

179. The level of dissolved oxygen in natural waters is often a direct indication of quality, since aquatic plants produce oxygen, while microorganisms generally consume it as they feed on \_\_\_\_\_.

- A. Pollutants
- B. Organic matter
- C. E. coli bacteria
- D. None of the above

### **pH Testing Section**

180. 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

181. 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

182. 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

183. Pure water has a pH very close to?

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

184. \_\_\_\_\_ 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

185. 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

186. For strong acids and bases no calculations are necessary except in extreme situations. The pH of a solution containing a weak acid requires the solution of a quadratic equation. The pH of a solution containing a weak base may require the?

- A. Solution of a cubic equation
- B. Non-linear simultaneous equations
- C. Excess of alkaline earth metal concentrations
- D. None of the above

187. Alkalinity is a measure of this missing term and can be interpreted in terms of specific substances only when the chemical composition of the sample is known.

- A. Universal indicator
- B. An aggregate property of water
- C. Excess of alkaline earth metal concentrations
- D. None of the above

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

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

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

189. Hard water forms scale, usually \_\_\_\_\_, which causes a variety of problems. Left to dry on the surface of glassware and plumbing fixtures, including showers doors, faucets, and sink tops; hard water leaves unsightly white scale known as water spots.

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

### **Secondary Standard**

190. TDS is most often measured in parts per million (ppm) or milligrams per liter of water (mg/L). The normal TDS level ranges from \_\_\_\_\_

- A. 50 ppm to 1,000 ppm
- B. 5 ppm to 10 ppm
- C. 50 ppm to 100 ppm
- D. None of the above

### **Langelier Saturation Index**

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

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

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

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

### More on the Stage 2 DBP Rule

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

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

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

- A. True
- B. False

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

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

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

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

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

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

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

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

### What are Disinfection Byproducts (DBPs)?

199. 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

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

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

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

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

- A. True
- B. False

### All disinfectants form DBPs in one of two reactions:

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

- A. True
- B. False

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

- A. True
- B. False

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

- A. True      B. False

### Public Health Concerns

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

- A. True      B. False

### Disinfection Byproduct Research and Regulations Summary

206. \_\_\_\_\_ is unquestionably the most important step in the treatment of water for drinking water supplies.

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

207. The \_\_\_\_\_ should not be compromised because of concern over the potential long-term effects of disinfectants and DBPs.

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

208. The risk of illness and death resulting from exposure to pathogens in drinking water is very much greater than the risks from \_\_\_\_\_.

- A. Disinfectants and DBPs      C. Natural organic matter precursors  
B. Turbidity (particle)          D. None of the above

## Bacteriological Monitoring Section

### Organisms Descriptors and Meanings

209. Photo means...

- A. Feed or nourish              C. Light  
B. Other (Organic carbon)      D. None of the above

210. Auto means...

- A. Without air                  C. Self (Inorganic carbon)  
B. With air                      D. None of the above

211. Aerobic means...

- A. Without air                  C. Self (Inorganic carbon)  
B. With air                      D. None of the above

212. Hetero means...

- A. Feed or nourish              C. Light  
B. Other (Organic carbon)      D. None of the above

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

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

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

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

- A. Microbial contaminants      C. Inorganic contaminants  
B. Pesticides and herbicides      D. None of the above

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

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

### **Background**

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

- A. True
- B. False

### **TCR**

217. 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

218. 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

219. 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

### **Routine Sampling Requirements**

220. 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

221. 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

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

- A. True
- B. False

223. 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

224. 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

225. 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**

226. 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

227. Which of the following are not necessarily agents of disease, fecal coliform bacteria may indicate the presence of disease-carrying organisms, which live in the same environment as the fecal coliform bacteria.

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

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

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

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

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

230. Which of the following can cause bacillary dysentery?

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

### **Bacteriological Monitoring Introduction**

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

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

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

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

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

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

### **Bacteria Sampling**

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

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

### **Methods**

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

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

## Microbial Regulations

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

- A. True      B. False

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

- A. True      B. False

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

- A. True      B. False

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

239. 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

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

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

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

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

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

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

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

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

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

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

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

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

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

### Revised Total Coliform Rule (RTCR) Summary

246. 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

247. 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

248. 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

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

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

250. 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      C. Microbial contamination  
B. Reduced monitoring      D. Repeat water samples

### Disinfection Section

#### Chlorine's Appearance and Odor

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

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

252. Prolonged exposures to chlorine gas may result in?

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

#### Chlorine Gas

#### Pathophysiology

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

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

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

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

255. The odor threshold for chlorine gas is approximately?

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

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



### **Mechanism of Activity**

256. 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**

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

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

### **Reactivity**

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

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

259. What is formed when chlorine is in contact with combustible substances (such as gasoline and petroleum products, hydrocarbons, turpentine, alcohols, acetylene, hydrogen, ammonia, and sulfur), reducing agents, and finely divided metals?

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

260. 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

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

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

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

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

### **Flammability**

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

- A. True      B. False

264. 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

265. 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

266. Chlorine may not be available for disinfection because \_\_\_\_\_ in the water (like iron, manganese, hydrogen sulfide, and ammonia).
- A. pH increases  
B. Part of it combines with other chemicals  
C. Required contact time  
D. None of the above
267. The amount of chlorine required to achieve disinfection and that reacts with the other chemicals is the?
- A. Chlorine residual  
B. Chlorine demand  
C. Free chlorine residual  
D. None of the above
268. Which term is used when disinfection decreases, as the concentration of the chlorine increases?
- A. pH increases  
B. Chlorine level and water quality  
C. Required contact time  
D. None of the above
269. Chlorination is more effective as?
- A. Water temperature increases  
B. Chlorine demand  
C. Water cools down  
D. None of the above
270. Chlorination becomes more alkaline and is less effective as the?
- A. Water's pH increases  
B. Water quality increases  
C. Required contact time is maximized  
D. None of the above
271. Chlorination is less effective in?
- A. Clear water  
B. Cloudy (turbid) water  
C. Day time  
D. None of the above
272. 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  
B. A free chlorine residual  
C. Required contact time  
D. None of the above

### Chlorination Chemistry

273. The hypochlorite ion is a much weaker disinfecting agent than Hypochlorous acid, about 100 times less effective.
- A. True  
B. False
274. 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
275. Under normal water conditions, hypochlorous acid will also chemically react and break down into the hypochlorite ion.
- A. True  
B. False
276. 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

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

277. 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

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

- A. True
- B. False

279. 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

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

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

281. Chloramines are formed by reactions with?

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

### Types of Residual

282. 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

283. What is OSHA's PEL?

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

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

- A. True
- B. False

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

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

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

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

### Alternate Disinfectants - Chloramine

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

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

288. 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

289. 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
290. If chlorine dioxide is being used as an oxidant, the preferred method of generation is to entrain this term or substance into a packed reaction chamber with a 25% aqueous solution of sodium chlorite (NaClO<sub>2</sub>).
- A. Chloramine            C. Chlorine dioxide  
B. Chlorine gas            D. None of the above
291. According to the text, which chemical is explosive and can cause fires in feed equipment if leaking solutions or spills are allowed to dry out?
- A. Dry sodium chlorite            C. Ammonia  
B. Chlorine dioxide                D. None of the above
292. 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
293. 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

294. Ozone is a very effective disinfectant for both Giardia and viruses
- A. True            B. False
295. 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
296. 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
297. Ozone does not produce chlorinated byproducts (such as trihalomethanes) but it may cause an increase in such byproduct formation if it is fed ahead of free chlorine; ozone may also produce its own oxygenated byproducts such as Cl<sub>2</sub> + NH<sub>4</sub>.
- A. True            B. False



308. Each \_\_\_\_\_ must be marked "Confined Space - Entry Permit Required".
- A. Permit-Required Confined Space
  - B. Hazardous atmosphere
  - C. Entry or exit
  - D. None of the above

### Confined Space Hazards

309. 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
310. 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

311. \_\_\_\_\_ 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
312. 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
313. 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

314. \_\_\_\_\_ 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
315. 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

316. Confined workspaces in construction contain \_\_\_\_\_.
- A. Purging agents
  - B. Below-grade location
  - C. Both inherent and induced hazards
  - D. None of the above

## **Vaults**

317. 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

318. 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**

319. 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**

320. \_\_\_\_\_ produce toxic fumes that 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

## **Electrical Shock**

321. \_\_\_\_\_ results because the contractor has not provided an approved grounding system or the protection afforded by ground-fault circuit interrupters or low-voltage systems.

- A. Common confined space
- B. Electrical shock
- C. An oxygen-deficient atmosphere
- D. None of the above

## **Purging**

322. Purging agents such as nitrogen and argon may enter a vault from adjacent areas. These agents may displace the oxygen in the vault and asphyxiate workers almost immediately.

- A. True
- B. False

## **Materials Falling In and On**

323. According to the text, a \_\_\_\_\_ normally considered a problem associated with confined spaces is material or equipment which may fall into the vault.

- A. Common confined space
- B. Hazard
- C. Oxygen-deficient atmosphere
- D. None of the above

324. If the \_\_\_\_\_ were removed, materials could fall into the vault, causing injury to the workers inside.

- A. Purging agents
- B. Manhole covers
- C. Explosive gases
- D. None of the above

## **Condenser Pits**

325. Because of their large size, condenser pits found in the construction of nuclear power plants are often overlooked as \_\_\_\_\_.

- A. Common confined spaces
- B. Hazards
- C. Potentially hazardous confined spaces
- D. None of the above

326. Condenser pits create large containment areas for the accumulation of toxic fumes and gases, or for the creation of \_\_\_\_\_ when purging with argon, Freon, and other inert gases.

- A. Purging agents
- B. Oxygen-deficient atmospheres
- C. Build-up of explosive gases
- D. None of the above

327. Workers above will create other \_\_\_\_\_ by dropping equipment, tools, and materials into the condenser pit.

- A. Hazards
- B. Collection places
- C. Problems with the pumps
- D. None of the above

### Manholes

328. Manholes are necessary to provide a means of entry into and exit from vaults, tanks, and pits, but these confined spaces may present \_\_\_\_\_ which could cause injuries and fatalities.

- A. Serious hazards
- B. Ventilation ducts
- C. Sumps
- D. None of the above

329. \_\_\_\_\_ are associated with manholes. For example, workers could fall into manholes when covers are missing.

- A. Nitrogen purges
- B. Collection places
- C. A variety of hazards
- D. None of the above

### Pipe Assemblies

330. The pipe assembly is one of the \_\_\_\_\_ encountered throughout the construction site,

- A. Electrical shock risks
- B. Ventilation ducts
- C. Most frequently unrecognized types of confined spaces
- D. None of the above

331. Once inside a pipe assembly, workers are faced with \_\_\_\_\_, often caused by purging with argon or another inert gas.

- A. Nitrogen purge or dry air
- B. Collection places
- C. Potential oxygen-deficient atmospheres
- D. None of the above

332. The worker in a pipe may be subject to toxic atmospheres from \_\_\_\_\_ generated by the worker in the pipe, or by other workers operating outside the pipe at either end.

- A. Electrical shock
- B. Welding fumes
- C. Sumps
- D. None of the above

333. Pipes have \_\_\_\_\_ which provide little room for the workers to move about and gain any degree of comfort while performing their tasks.

- A. Nitrogen purge or dry air
- B. Collection places
- C. Generally restricted dimensions
- D. None of the above

334. \_\_\_\_\_ is another problem to which the worker is exposed when inside a pipe assembly.

- A. Electrical shock
- B. Ventilation ducts
- C. Welding fumes
- D. None of the above

335. The worker may suffer \_\_\_\_\_ caused by heat within the pipe run.

- A. Heat prostration
- B. Exposure to toxic gases
- C. Problems with the pumps
- D. None of the above



## Excavation and Trenching Section

336. 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

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

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

338. 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

339. 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

340. 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

341. 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

342. 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

343. 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

344. 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

345. 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

346. 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

347. 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

348. 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

349. 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

350. 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

351. 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

352. \_\_\_\_\_ 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

353. 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

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

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

355. 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

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

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

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

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

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

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

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

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

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

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

### **Personnel Protective Systems**

361. 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

362. 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

363. 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

364. 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

365. 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

366. 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

367. 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

368. 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

369. 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

370. 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

371. 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

372. \_\_\_\_\_ 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

373. 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

374. \_\_\_\_\_ 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)

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

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

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

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

377. 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

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

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

379. 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

380. 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

381. 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

382. 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

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

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

### Hazard Controls

384. 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

385. 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

386. \_\_\_\_\_, 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

387. Workers must be supplied with, and wear, any \_\_\_\_\_ deemed necessary to protect them while working in excavations.

- A. Uniforms
- B. Apparel
- C. Personal protective equipment
- D. None of the above

### **Excavation & Trenching Guidelines**

388. 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

389. 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

390. All other employees working in and around the excavation must be trained to recognize the hazards associated with Personal protective equipment.

- A. True
- B. False

### **Excavation Safety Plan**

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

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

### **Soil Classification and Identification**

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

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

393. 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

394. 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

395. 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

396. 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

### Shielding

397. 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

### Inspections

398. 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

399. 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

400. 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