

**Registration form**

**DISTRIBUTION 303 \$200.00**  
**48 HOUR RUSH ORDER PROCESSING FEE ADDITIONAL \$50.00**

**Start and Finish Dates:** \_\_\_\_\_  
*You will have 90 days from this date in order to complete this course*

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

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

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

**Please circle/check which certification you are applying the course CEU's.**  
Water Distribution \_\_\_ Water Treatment \_\_\_ Other \_\_\_\_\_

**Technical Learning College TLC PO Box 3060, Chino Valley, AZ 86323**  
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*You can obtain a printed version of the course manual from TLC for an additional \$129.95 plus shipping charges.*

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

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

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## Distribution 303 Answer Key

Name \_\_\_\_\_

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

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

***You can electronically complete this assignment in Adobe Acrobat DC.***

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

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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 303 CEU COURSE  
CUSTOMER SERVICE RESPONSE CARD**

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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.

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

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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.*



## Distribution 303 CEU Training Course Assignment

The Distribution 303 CEU course assignment is available in Word on the Internet for your convenience, please visit [www.abctlc.com](http://www.abctlc.com) and download the assignment and e-mail it back to TLC.

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

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

### Hyperlink to the Glossary and Appendix

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

### Water Distribution Section

#### Water Pressure

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

### Groundwater Treatment/Production System Section

#### Groundwater and Wells

- 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
- 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
- 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
- Unconfined aquifers are those that are bounded by the water table. Some aquifers lie beneath layers of impermeable materials.  
A. True                                  B. False

7. 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

8. 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

9. The area above the water table lies the?

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

### **Cone of Depression**

10. When a water well is installed in \_\_\_\_\_, water moves from the aquifer into the well through small holes or slits in the well casing or, in some types of wells, through the open bottom of the well?

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

### **Where Is Ground Water Stored?**

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

- A. True      B. False

12. Which of the following are frequently found at greater depths than unconfined aquifers?

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

### **Does Groundwater Move?**

13. Groundwater can move sideways as well as up or down. This movement is in response to gravity, differences in elevation, and?

- A. Permeable zones      C. Saturated zone
- B. Differences in pressure      D. None of the above

14. Groundwater can move even more quickly in karst aquifers, which are areas in \_\_\_\_\_ and similar rocks where fractures or cracks have been widened by the action of the ground water to form sinkholes, tunnels, or even caves?

- A. Karst aquifer(s)      C. Water soluble limestone
- B. Saturated zone      D. None of the above

### **Groundwater Quality**

15. 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

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

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

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

17. 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)      C. Permeable zones
- B. Groundwater      D. None of the above

### Abandoned Wells

18. If which of the following is 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?

19. 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 Use or Demand

20. Which of the following is highly desired and represents a rather significant demand upon the system?
- A. Fire protection
  - B. Cavitation protection
  - C. Surge protection
  - D. None of the above
21. 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
22. The quantity of water used in any community varies from 100 to 200 gallons per person per day.
- A. True
  - B. False
23. Which of the following is usually encountered during the summer months and can vary widely depending on irrigation practices?
- A. Maximum daily use
  - B. Minimum daily use
  - C. Unavoidable loss and waste
  - D. None of the above

### Nature of the Aquifer

24. 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
25. 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
26. 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

### Hydraulic Head (h)

27. 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)

28. 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

29. 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?

30. 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

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

31. 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

32. 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

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

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

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

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

### Water-Bearing Zones

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

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

### Lithologic Log

36. 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

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

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

### How Wells Are Drilled

38. 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

39. 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

40. 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

41. 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

42. 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

43. 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

### Direct Rotary Method

44. 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

45. 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

46. 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      C. The drilling fluid  
B. The borehole      D. None of the above

### Direct Mud Rotary Method

47. 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**

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

- A. True                      B. False

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

50. Which of the following penetrates into the overburden or formation, the casing driver hammers the casing down, following the drill string?

- A. The drill string                      C. The casing driver method  
B. The cutting shoe                  D. None of the above

51. Which of the following may employ a hammer or roller bit?

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

### **Auger Boring Methods**

52. 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

### **Solid Stem Auger Method**

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

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

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

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

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

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

55. 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**

56. 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

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

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

### Selecting an Optimum Pumping Rate

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

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

### Water Storage Introduction

59. Which of the following prevents contamination of water as it travels to the customer, finished water storage facilities are an important component of the protective distribution system?

- A. Cathodic protection
- B. Corrosion protection
- C. Barrier
- D. None of the above

### Storage and Distribution

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

- A. Cathodic protection
- B. Corrosion protection
- C. Water quality
- D. None of the above

### Water Storage Facilities

61. Water storage facilities and tanks vary in different types that are used in the water distribution systems, such as stand pipes, elevated tanks and reservoirs, hydropneumatic tanks and?

- A. Surge tanks
- B. Water distribution systems
- C. Storage reservoirs
- D. None of the above

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

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

### Storage Reservoirs

63. The text recommends that \_\_\_\_\_ be located at a high enough elevation to allow the water to flow by gravity to the distribution system.

- A. Storage reservoirs
- B. Levelers
- C. Tree systems
- D. None of the above

### Pump and Motor Section

#### Common Hydraulic Terms

64. 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

65. 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

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

- A. True      B. False

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

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

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

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

69. 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      C. Head  
B. Head, Static      D. None of the above

70. 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

### **Pumps**

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

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

72. 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

73. Pumps are excellent examples of?

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

74. 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

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

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

### **Pump Categories**

76. 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



77. 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

78. 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

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

- A. True
- B. False

80. 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

81. 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

### Venturi (Bernoulli's law):

82. The area of the restriction in a venture will have a \_\_\_\_\_ than the enlarged area ahead of it.

- A. Inward force
- B. Lower pressure
- C. Higher pressure
- D. None of the above

83. Which of the following best describes a pump whose impeller has no vanes but relies on fluid contact with a flat rotating plate turning at high speed to move the liquid?

- A. Submersible
- B. Blower
- C. Viscous drag pump
- D. None of the above

### Types of Water Pumps

84. 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

85. 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

86. 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

87. 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

88. 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
89. 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
90. 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
91. 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
92. 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
93. 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
94. 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
95. 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
96. 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

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

97. 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
98. A pair of \_\_\_\_\_ prevents reverse flow of the fluid.  
 A. Return valves    C. Non-return check valves  
 B. Diaphragms    D. None of the above

99. Which of the following moving up once again draws fluid into the Chamber, completing the cycle?

- A. Spring
- B. Diaphragm
- C. Time delay or ratchet assembly
- D. None of the above

### Safety Section

#### Confined space:

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

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

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

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

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

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

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

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

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

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

#### Confined Space Hazards

105. 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

106. \_\_\_\_\_ 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

#### Induced Hazards

107. 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

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

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

### **Vaults**

109. 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

### **Oxygen-Deficient Atmosphere**

110. 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**

111. \_\_\_\_\_ 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

### **Electrical Shock**

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

113. 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**

114. 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

### **Condenser Pits**

115. 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

### **Manholes**

116. 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

### **Pipe Assemblies**

117. 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

### Ventilation Ducts

118. Ventilation ducts create a \_\_\_\_\_ which moves heated and cooled air and exhaust fumes to desired locations in the plant.

- A. Collection place
- B. Complex network
- C. Shortcut to other areas
- D. None of the above

### Tanks

119. Tanks are \_\_\_\_\_ that are used for a variety of purposes, including the storage of water and chemicals.

- A. Nitrogen purge locations
- B. Collection places
- C. Another type of confined workspace
- D. None of the above

### Sumps

120. Workers may encounter \_\_\_\_\_ when entering sumps.

- A. Nitrogen purge or dry air
- B. Problems with pumps
- C. An oxygen-deficient atmosphere
- D. None of the above

### Containment Cavities

121. Welding and other gases may easily collect in containment cavities, creating \_\_\_\_\_.

- A. Toxic atmospheres
- B. Poor ventilation
- C. Confined workspaces
- D. None of the above

### Electrical Transformers

122. Before electrical transformers are opened, they must be \_\_\_\_\_ by pumping in air.

- A. Nitrogen purged
- B. Collection places
- C. Well vented
- D. None of the above

### Unusual Conditions

#### Confined Space within a Confined Space

123. One of the most hazardous confined spaces of all is a confined space within a confined space.

- A. True
- B. False

#### Hazards in One Space Entering another Space

124. According to the text, during an examination of \_\_\_\_\_, situations are often encountered which are not always easy to evaluate or control.

- A. Tanks
- B. Excavations
- C. Confined spaces in construction
- D. None of the above

125. A room that classifies as a confined space may be relatively safe for work. However, access passages from other areas outside or adjacent to the room could at some point, allow the transfer of \_\_\_\_\_ into the "safe" room.

- A. Hazardous agents
- B. Equipment and tools
- C. Unauthorized workers
- D. None of the above

126. Welding fumes and other \_\_\_\_\_ generated in one room may easily travel through a pipe into another area, causing that area to change from a safe to an unsafe workplace.

- A. Toxic materials
- B. Construction debris
- C. Noise
- D. None of the above

127. In a situation where hazards in one space may enter another, a serious problem is that workers working in the "safe" area are not aware of the \_\_\_\_\_.

- A. Oxygen Level
- B. Access passages
- C. Hazards leaking into their area
- D. None of the above

### Permitted Confined Space Entry Program

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

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

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

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

### Irritant (Corrosive) Atmospheres

130. Chlorine, ozone, hydrochloric acid, hydrofluoric acid, sulfuric acid, nitrogen dioxide, ammonia, and sulfur dioxide are examples of \_\_\_\_\_.

- A. Primary irritants
- B. Combustible gases
- C. Detector responses
- D. None of the above

131. \_\_\_\_\_ may produce systemic toxic effects in addition to surface irritation.

- A. A secondary irritant
- B. Evaluation of all serious hazards
- C. Corrosive atmospheres
- D. None of the above

### Oxygen Deprivation

132. Oxygen deprivation is a form of \_\_\_\_\_.

- A. Oxygen deprivation
- B. Asphyxiation
- C. Combustion
- D. None of the above

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

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

### Excavation and Trenching Section

134. 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

135. 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

136. 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

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

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

138. 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

139. 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

140. 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

141. 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

142. 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

143. 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

### Scope of Work

144. 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

145. 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

146. 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

147. 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

148. 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

149. 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

150. 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
- B. Not mentioned in the specifications
- C. Endangered by excavation operations
- D. None of the above

151. 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
- B. Employees
- C. Vehicles
- D. None of the above

### Personnel Protective Systems

152. 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

153. 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

154. 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

155. 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

156. 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

157. 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

158. 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

159. 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

160. 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

161. 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

162. \_\_\_\_\_ 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

163. 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

164. \_\_\_\_\_ 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)

165. 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

166. 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

167. 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**

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

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

169. 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

170. 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

171. 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

172. 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**

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

174. 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

175. 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

176. 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**

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

- A. True
- B. False

178. 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

179. 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

180. \_\_\_\_\_, 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

181. 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
- B. Unauthorized workers
- C. Hazardous atmospheres
- D. None of the above

182. If work is in or around traffic, \_\_\_\_\_ must be utilized to ensure the safety of employees, vehicular traffic, and pedestrians.

- A. Signs and barricades
- B. Soil classifications
- C. Additional personnel
- D. None of the above

### **Excavation Safety Plan**

183. 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**

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

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

### **Soil Test & Identification**

185. 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

186. 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

187. 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

188. 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

### Shielding

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

- A. True
- B. False

190. 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

191. 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

192. 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

193. 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

194. 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

195. 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

196. 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

197. 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

198. 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

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

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

200. Approximately 85,000 systems

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

201. 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

#### Surface Water Properties

202. Water is accepted as the \_\_\_\_\_ because will dissolve most substances that comes in contact.

- A. Universal solvent
- B. Water quality
- C. Surface water
- D. None of the above

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

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

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

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

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

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

#### Managing Water Quality at the Source

206. 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

207. 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

208. 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

209. 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

210. 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

211. \_\_\_\_\_ 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

### Alkalinity

212. 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

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

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

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

- A. True
- B. False

### Turbidity Introduction

215. 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
- B. Variations
- C. Temperature fluctuation
- D. None of the above

216. 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

217. 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
- B. Manmade
- C. Temperature
- D. None of the above

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

219. 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

220. 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**

221. 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

222. At low temperatures, the \_\_\_\_\_ is increased, so that in winter, concentrations as high as 20 ppm may be found in natural waters; during summer, saturation levels can be as low as 4 or 5 ppm.

- A. Dissolved oxygen
- B. Thermal stratification
- C. Solubility of oxygen
- D. None of the above

### **pH Testing Section**

223. 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

224. 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

225. Pure water has a pH very close to?

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

226. \_\_\_\_\_ 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

227. 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

228. 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

229. 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

230. 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

231. 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

232. Which of the following terms of the color of a test solution with a standard color chart provides a means to measure pH accurate to the nearest whole number?

- A. Universal indicator
- B. Colorwheel measurement
- C. Visual comparison
- D. None of the above

233. The pH scale is traceable to a set of standard solutions whose pH is established by US EPA.

- A. True
- B. False

234. Alkalinity in excess of which term is significant in determining the suitability of water for irrigation?

- A. 8
- B. pH of 7
- C. Alkaline earth metal concentrations
- D. None of the above

235. The calculation of the pH of a solution containing acids and/or bases is an example of a \_\_\_\_\_ calculation, that is, a mathematical procedure for calculating the concentrations of all chemical species that are present in the solution

- A. Chemical speciation
- B. Spectrophotometer
- C. Visual comparison
- D. None of the above

236. 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

237. Which of the following terms measurements is used in the interpretation and control of water and wastewater treatment processes?

- A. Acid
- B. Alkalinity
- C. Hydrogen bond formation
- D. None of the above



238. Which of the following terms are compounds that, for practical purposes, are completely dissociated in water.

- A. Strong acids and bases
- B. Chemical ions in chains
- C. Strong bases and weak acids
- D. None of the above

239. The pH of a solution containing a \_\_\_\_\_ may require the solution of a cubic equation.

- A. Strong acids and bases
- B. Strong base
- C. Weak base
- D. None of the above

240. Sodium hydroxide, NaOH, is an example of a?

- A. Weak base
- B. Strong base
- C. Strong acid
- D. None of the above

### Objections to Hard Water

#### Scale Formation

241. 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

242. 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

243. 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

#### More on the Stage 2 DBP Rule

244. 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

245. 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

246. 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)?

247. 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

248. 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?

249. 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:

250. 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

251. Secondary by-products are also formed when multiple disinfectants are used.

- A. True
- B. False

252. 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

253. 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

254. \_\_\_\_\_ 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

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

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

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

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

### Controlling Disinfection Byproducts

257. Treatment techniques are available that provide water suppliers the opportunity to maximize potable water safety and quality while minimizing the risk of \_\_\_\_\_.

- A. DBP risks
- B. Turbidity (particle)
- C. Disinfectants and DBPs
- D. None of the above

258. Generally, the best approach to reduce \_\_\_\_\_ is to remove natural organic matter precursors prior to disinfection.

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

### Bacteriological Monitoring Section Organisms Descriptors and Meanings

259. Aerobic means...

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

260. Photo means...

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

261. Troph means...

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

262. Litho means...

- A. Rock
- B. Organic
- C. Light
- D. None of the above

263. Organo means...

- A. Rock
- B. Organic
- C. Light
- D. None of the above

264. Auto means...

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

265. Chemo means...

- A. Rock
- B. Organic
- C. Chemical
- D. None of the above

266. Hetero means...

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

267. Anaerobic means...

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

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

268. 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

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

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

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

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

### **Background**

271. 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**

272. 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

273. 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

274. 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**

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

- A. True
- B. False

276. 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

277. 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

278. 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

279. 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

280. 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**

281. 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

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

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

### **Bacteriological Monitoring Introduction**

283. 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

284. 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

### **Bacteria Sampling**

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

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

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

286. 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:**

287. 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

288. 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

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

289. A PWS incurs an E. coli MCL violation.
- 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

290. 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

291. 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

### Total Coliforms

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

- A. True
- B. False

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

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

### The following are acute violations:

294. Which determines a violation of nitrate?

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

### Revised Total Coliform Rule (RTCR) Summary

295. 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

296. 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

297. 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

298. 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

299. 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

300. 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

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

- A. True
- B. False

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

- A. True
- B. False

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

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

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

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

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

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

306. 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

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

- A. True
- B. False

308. 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

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

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

310. The RTCR requires 99% or 2 log inactivation of \_\_\_\_\_ .  
 A. Enteric viruses      C. Giardia lamblia cysts  
 B. Crypto                      D. None of the above
311. The RTCR requires 99.9% or 3 log inactivation of \_\_\_\_\_ .  
 A. Enteric viruses      C. Giardia lamblia cysts  
 B. Crypto                      D. None of the above
312. The RTCR requires the chlorine residual leaving the plant must be = or \_\_\_\_\_ mg/L and measurable throughout the system.  
 A. > 0.2                  C. 0.2  
 B. 2.0                      D. None of the above

**Waterborne Pathogen Section - Introduction  
 Pathogen Section**

313. Most pathogens are generally associated with diseases that \_\_\_\_\_ and affect people in a relatively short amount of time, generally a few days to two weeks.  
 A. Cause intestinal illness                  C. Will cause fatalities  
 B. Are mild in nature                          D. None of the above

**How Diseases are Transmitted.**

314. Waterborne pathogens are primarily spread by the?  
 A. Fecal-oral, or feces-to-mouth route      C. Oral to fecal route  
 B. Dermal to fecal route                          D. None of the above

**Protozoan Caused Diseases**

315. Which of the following bugs is larger than bacteria and viruses but still microscopic; they invade and inhabit the gastrointestinal tract?  
 A. Hepatitis A                  C. Protozoan pathogens  
 B. E.coli                          D. None of the above

316. Some of the parasites enter the environment in a dormant form, with a protective cell wall, called a?  
 A. Lamblia      C. Cyst  
 B. Shell              D. None of the above

**Giardia lamblia**

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

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

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

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

**Primary Waterborne Diseases Section**

319. Campylobacter is primarily associated with poultry, animals, and humans.  
 A. True                  B. False



320. *Vibrio cholerae*, the basics. It's a virus. It causes diarrheal illness, also known as cholera. It is typically associated with aquatic environments, shell stocks, and human. *Vibrio cholerae* has also been associated with ship ballast water.  
 A. True      B. False
321. Legionnaire's disease, which causes a severe pneumonia, and the second, \_\_\_\_\_, which is a non-pneumonia illness; it's typically an influenza-like illness, and it's less severe.  
 A. Pontiac fever      C. Typhoid fever  
 B. Yellow fever      D. None of the above
322. Legionella, prevention. Legionella in water systems. Hot water in tanks should be maintained between \_\_\_\_\_ degrees Centigrade.  
 A. 81 to 100      C. 71 and 77  
 B. 110 to 210      D. None of the above
323. Which of the following is typically associated with soil and water?  
 A. Hepatitis A virus      C. Pseudomonas  
 B. Legionella      D. None of the above
324. Humans are the reservoir for the *Salmonella typhi* pathogen, which causes diarrheal illness, and also known as?  
 A. *Campylobacter*      C. Typhoid fever  
 B. *Shigella dysenteriae*      D. None of the above
325. Hepatitis A virus is resistant to combined chlorines, so it is important to have an adequate free chlorine residual. Fecal matter can shield Hepatitis A virus from chlorine.  
 A. True      B. False
326. Humans are the reservoir for the Norovirus. Prevention strategies for this pathogen include?  
 A. Internal protection      C. Containment protection  
 B. Source protection      D. None of the above
327. *Cryptosporidium* is typically associated with animals and humans, and it can be acquired through consuming fecally contaminated food, contact with fecally contaminated soil and water.  
 A. True      B. False
328. *Shigella* species, in the United States two-thirds of the shigellosis in the U.S. is caused by *Shigella dysenteriae* and the remaining one-third is caused by *Shigella Campylobacter*.  
 A. True      B. False
329. *Campylobacter*, the basics. It's a bacterium. It causes diarrheal illness.  
 A. True      B. False
330. *Cryptosporidium*, prevention. Prevention strategies for this pathogen include source protection. A CT value of 50 is required when dealing with fecally accidents. CT equals a concentration, in parts per million, while time equals a contact time in minutes.  
 A. True      B. False
331. *Giardia* prevention strategies for this pathogen include \_\_\_\_\_; filtration, coagulation, and halogenation of drinking water.  
 A. Internal protection      C. Containment protection  
 B. Source protection      D. None of the above

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

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

333. Schistosomatidae prevention strategies for this pathogen include Placing boric acid on berms or interrupting the life cycle of the parasite by treating birds with a lead.

- A. True
- B. False

### **Waterborne Bacterial Diseases**

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

- A. True
- B. False

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

- A. True
- B. False

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

- A. True
- B. False

### **Chain of Custody Procedures**

337. 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

338. The recipient will then attach the \_\_\_\_\_ showing the transfer dates and times to the custody sheets. If the samples are split and sent to more than one laboratory, prepare a separate chain of custody record for each sample.

- A. Shipping invoices
- B. Chain of custody release
- C. Sample siting plan
- D. None of the above

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

339. 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

340. 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

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

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

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

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

342. 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
- B. Chlorine contact time
- C. Higher strength chlorine solutions
- D. None of the above

### Advanced Water Treatment Section

343. 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

344. 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

345. 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

346. Magnesium is dissolved as water passes over and through \_\_\_\_\_ and other magnesium-bearing minerals.

- A. Hardness ions
- B. Calcium and magnesium
- C. Dolomite
- D. None of the above

### Types of Hardness

347. 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

348. Which of the following is caused by magnesium is called magnesium hardness?

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

### Carbonate-Noncarbonate Distinction

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

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

350. Which of the following is caused primarily by the bicarbonate salts of calcium and magnesium, which are calcium bicarbonate,  $\text{Ca}(\text{HCO}_3)_2$ , and magnesium bicarbonate  $\text{Mg}(\text{HCO}_3)_2$ ?

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

351. Which of the following when combined with carbonate ( $\text{CO}_3$ ) also contribute to carbonate hardness?

- A.  $\text{CaCO}_3$
- B. Calcium and magnesium
- C. Carbonate-noncarbonate
- D. None of the above

352. Which of the following is a measure of calcium and magnesium salts other than carbonate and bicarbonate salts?

- A. Hardness ions
- B. Permanent hardness
- C. Noncarbonate hardness
- D. None of the above

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

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

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

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

355. Because it can be removed by heating, carbonate hardness is sometimes called?

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

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

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

### Types of Processes

357. Which of the following terms operate without heating and therefore use less energy than conventional thermal separation processes such as distillation, sublimation or crystallization?

- A. Thermal separation process(es)
- B. Fractional distillation
- C. Membrane separation processes
- D. None of the above

### Nanofiltration

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

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

### Reverse Osmosis

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

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

### Water Laboratory Analysis Section

#### pH Testing Section

360. 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

361. 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

362. 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

363. Pure water has a pH very close to?

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

### Disinfection Key

364. 99.9% or 3 log inactivation of \_\_\_\_\_

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

365. 99.99% or 4 log inactivation of \_\_\_\_\_

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

### Disinfection Section

#### Chlorine's Appearance and Odor

366. 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

367. 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

368. 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

369. 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

370. The odor threshold for chlorine gas is approximately?

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

##### Mechanism of Activity

371. 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

372. 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

373. 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

374. 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

375. 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

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

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

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

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

### Flammability

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

- A. True
- B. False

379. 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

380. The effectiveness of chlorination depends on the \_\_\_\_\_ of the water, the concentration of the chlorine solution added, the time that chlorine is in contact with the organism, and water quality.

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

381. 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

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

382. 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

383. 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

384. Chlorination is more effective as?

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

385. 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

386. Chlorination is less effective in?

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

387. 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**

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

- A. True
- B. False

389. 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

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

- A. True
- B. False

391. 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**

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

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

### Types of Residual

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

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

### Chlorine Exposure Limits

394. What is OSHA's PEL?

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

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

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

### Alternate Disinfectants - Chloramine

396. 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

### Chlorine Dioxide

397. 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

### Ozone

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

- 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



438. 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

439. Ozonation must include adequate ozone leak detection alarm systems, and an ozone off-gas destruction system.  
A. True      B. False