Registration form

Chlorine & Disinfection CEU Training Course $200.00
48 HOUR RUSH ORDER PROCESSING FEE ADDITIONAL $40.00

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

Name________________________________Signature______________________________
(This will appear on your certificate as above)

Address:____

City___________________________State_________Zip____________Email______________

Phone:
Home (   )________________Work (   )_______________Fax (   )_______________

Operator ID# __________________________________Expiration Date_____________

Class/Grade____________________________________

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

Water Treatment   Water Distribution   Wastewater Collection   Wastewater Treatment

Pretreatment   Groundwater   Other _____________________________
Your certificate will be mailed to you in about two weeks.

Technical Learning College
Western Campus
PO Box 420, Payson AZ 85547-0420
(928) 468-0665   Fax (928) 272-0747
Toll Free (866) 557-1746
info@tlch2o.com

3 Digit code on back of card__________

American Express
Visa or MasterCard #_______________________________________Exp. Date_________

If you've paid on the Internet, please write your customer#__________________

Referral's Name____

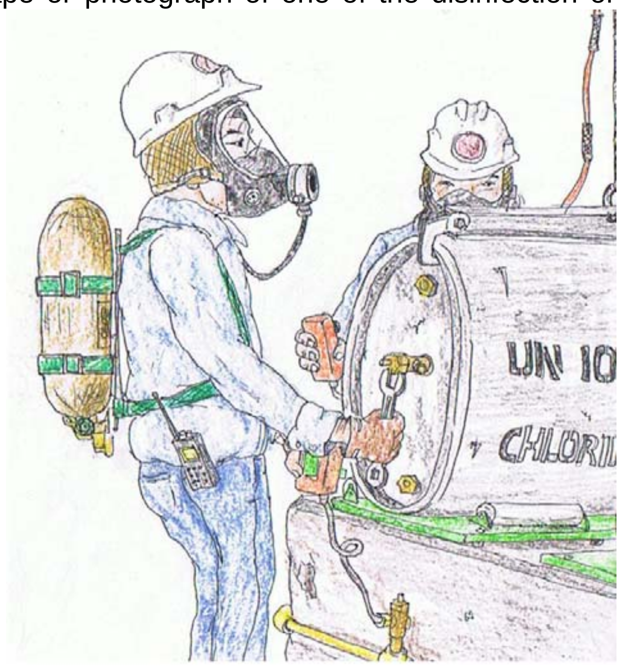
Alternative Assignment Option
ADA Option

Do not complete both assignment options. Choose one or the other.

Depending upon your State's approval or acceptance.
You have two choices in your final assignment, the conventional one found on the next page or the non-conventional found on this page.

You need to write an actual summary, video tape or photograph of one of the disinfection or chlorination procedures.

Any of the following are acceptable processes to photograph or document.
Chlorine, Gas, liquid or solid applications
Chlorimane application.
Any water or wastewater bacteria procedures.
Ozone application and procedures.
UV application and procedures.
Any other disinfection or alternative disinfectant procedure and application.



I require all of your documental and summation in an electronic format and require digital photographs/video. You also need to release all rights to your research and information so that TLC can utilize this information for future research, class projects and instruction. You may be subject for subject matter audit if the material or content does not appear to be sufficient for the CEU awarded.

If you do not have access to a wet lab or a treatment facility.
Write a summation of one of the above procedures and how this course has taught you or impacted your career field or changed your opinion on water quality and the importance of proper water or wastewater treatment. I require all of your documentation and summation be submitted in an electronic format.

You also need to release all rights to your research and information so that TLC can utilize this information for future research and identification class projects and instruction.

All alternative assignments are graded for proper grammar and spelling.

Call us a couple hours after faxing to ensure that we received your paperwork.

Conventional Chlorine and Disinfection CEU Course Answer Key

Name ***Telephone #***

Please select one answer. You can also utilize a Scantron Answer Key.

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Please mail or fax this survey along with your final exam

CHLORINE & DISINFECTANT CEU TRAINING COURSE

CUSTOMER SERVICE RESPONSE CARD

DATE: _______________

NAME: ________________________________

ADDRESS: ____

E-MAIL________________________________PHONE______________________

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

1. Please rate the difficulty of your course.
   Very Easy 0 1 2 3 4 5 Very Difficult
2. Please rate the difficulty of the testing process.
   Very Easy 0 1 2 3 4 5 Very Difficult
3. Please rate the subject matter on the exam to your actual field or work.
   Very Similar 0 1 2 3 4 5 Very Different
4. How did you hear about this Course?_________________________________
5. What would you do to improve the Course?

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Any other concerns or comments.

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CHLORINE
B-KIT

Chlorine and Disinfection CEU Training Course Assignment

The Chlorine and Disinfectant CEU Assignment is available in Word on the Internet for your convenience. Please visit www.ABCTLC.com and download the assignment and e mail it back to TLC. You can also find complete assistance under the Assistance Page.

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

We would prefer that you utilize the enclosed answer sheet at the rear of this manual, but if you are unable to do so, type out your own answer key. Please include your name and address on your manual and make copy for yourself.

Multiple Choice Questions please select only one answer per question.

1. Today, most of our drinking water supplies are free of the microorganisms — viruses, bacteria and _________________— that cause serious and life-threatening diseases.
A. Chlorine
B. Ammonia
C. Protozoa
D. Disinfection
E. Halogen(s)

2. The most common chlorination by-products found in U.S. drinking water supplies are the_________________ .
A. Haloacetic acids
B. Bromoform
C. Organic matter
D. Chloroform
E. None of the Above

3. The Principal Trihalomethanes are ________________, bromodichloromethane, chlorodibromomethane and bromoform.
A. Haloacetic acids
B. Bromoform
C. Organic matter
D. Chloroform
E. None of the Above

4. Chlorine present as Cl, HOCl, and OCl^{-} is called **free available chlorine** and that which is bound but still effective is _________________.
A. Chlorine
B. Residual
C. Free Available Chlorine
D. Combined Chlorine
E. Halogen(s)

5. A particularly important group of compounds with combined chlorine is the chloramines formed by reactions with _________________.
A. Chlorine
B. Ammonia
C. Protozoa
D. Disinfection
E. Halogen(s)

6. Use of chloramine or chlorine dioxide in chlorine disinfection produces fewer DBPs than chlorine, but has associated risks. _________________ is not as strong a disinfectant as chlorine, and disinfection with chlorine dioxide produces its own DBPs.
A. Chloramine
B. DBP
C. THM
D. Ozone
E. Disinfected

7. One especially important feature of disinfection using chlorine is the ease of overdosing to create a _________________concentration.
A. Chlorine
B. Residual
C. Free Available Chlorine
D. Combined Chlorine
E. Halogen(s)

8. With _________________, a typical residual is from 0.1 to 0.5 ppm.
A. Chlorine
B. Residual
C. Free Available Chlorine
D. Combined Chlorine
E. Halogen(s)

9. Living cells react with _________________ and reduce its concentration while they die.
A. Chlorine
B. Ammonia
C. Protozoa
D. Disinfection
E. Halogen(s)

10. The organic matter and other substances that are present, convert to chlorinated _________________, some of which are effective killing agents.
A. Chlorine
B. Ammonia
C. Protozoa
D. Derivatives
E. Halogen(s)

11. Because chlorinated organic compounds are less effective, a typical residual is 2 ppm for _________________.

A. Chlorine
B. Residual
C. Free Available Chlorine
D. Combined Chlorine
E. Halogen(s)

12. There will be no chlorine _________________ unless there is an excess over the amount that reacts with the organic matter present. However, reaction kinetics complicates interpretation of chlorination data. The correct excess is obtained in a method called Break Point Chlorination.

A. Chlorine
B. Residual
C. Free Available Chlorine
D. Combined Chlorine
E. Halogen(s)

13. Chlorination by-products are the chemicals formed when the chlorine used to kill disease-causing microorganisms reacts with naturally occurring _________________ (e.g., decay products of vegetation) in the water.

A. Haloacetic acids
B. Bromoform
C. Organic matter
D. Chloroform
E. None of the Above

14. When disinfectants react with other chemicals, new compounds known as disinfectant by-products or "_________________", are created. DBPs associated with chlorine disinfection include trihalomethanes (THMs), such as chloroform.

A. Chloramine
B. DBP
C. THM
D. Ozone
E. Disinfected

15. Because chlorination has been used for almost 100 years to disinfect water supplies, approximately 40 percent of the DBPs from chlorination have been identified and researched. Much less is known about the kind of _________________ produced by other disinfectants because of their relatively recent emergence.

A. Chloramine
B. DBP
C. THM
D. Ozone
E. Disinfected

16. Other less common chlorination by-products includes the _________________and haloacetonitriles.

A. Haloacetic acids
B. Bromoform
C. Organic matter
D. Chloroform
E. None of the Above

17. The amount of _________________ formed in drinking water can be influenced by a number of factors, including the season and the source of the water.
A. Chloramine
B. DBP
C. THM
D. Ozone
E. Disinfected

18. _________________ concentrations are generally lower in winter than in summer, because concentrations of natural organic matter are lower and less chlorine is required to disinfect at colder temperatures.
A. Chloramine
B. DBP
C. THM
D. Ozone
E. Disinfected

19. THM levels are also low when wells or large lakes are used as the drinking water source, because organic matter concentrations are generally low in these sources. The opposite — high organic matter concentrations and high _________________ levels — is true when rivers or other surface waters are used as the source of the drinking water.
A. Chloramine
B. DBP
C. THM
D. Ozone
E. Disinfected

20. Laboratory animals exposed to very high levels of _________________ have shown increased incidences of cancer. Also, several studies of cancer incidence in human populations have reported associations between long-term exposure to high levels of chlorination by-products and an increased risk of certain types of cancer.
A. Chloramine
B. DBP
C. THM
D. Ozone
E. Disinfected

21. _________________ is a naturally existing element that has been used to disinfect drinking water supplies in America for most of the 20^{th} Century.
A. Chlorine
B. Residual
C. Free Available Chlorine
D. Combined Chlorine
E. Halogen(s)

22. Animal research using a high concentration of _________________ found increased occurrence of cancer development, although why this occurs has not yet been determined. Research on the relationship between DBPs and cancer and other health risks is ongoing.
A. Chloramine
B. DBP
C. THM
D. Ozone

23. American drinking water has **very low** concentrations of _________________.
A. Chloramine
B. DBP
C. THM
D. Ozone
E. Disinfected

24. _________________ disinfection has been extremely effective in protecting drinking water resources from bacterial and viral contamination. It has virtually wiped out instances of water-borne diseases like typhoid fever, cholera and dysentery in America and other developed countries.
A. Chlorine
B. Residual
C. Free Available Chlorine
D. Combined Chlorine
E. Halogen(s)

25. Over 200 million Americans currently drink water that has been _________________.
A. Chloramine
B. DBP
C. THM
D. Ozone
E. Disinfected

26. The three primary chemical agents used in chlorine disinfection are: free chlorine, chloramine (chlorine and ammonia bonded together) and chlorine dioxide (_________________ and oxygen bonded together).
A. Chlorine
B. Residual
C. Free Available Chlorine
D. Combined Chlorine
E. Halogen(s)

27. _________________ is also used to disinfect water.
A. Chloroform
B. DBP
C. THM
D. Ozone
E. Disinfected

28. The U.S. Environmental Protection Agency (USEPA) has **not** been able to link exposure to _________________at low concentration levels and the health risks associated with high concentration level exposure.
A. Chloramine
B. DBP
C. THM
D. Ozone
E. Disinfected

29. Disinfectants are very active compounds. When added to a water supply, _________________ not only kill bacteria and viruses, but also react with other chemicals present in the water. These chemicals generally enter the water supply through natural plant and soil breakdown.
A. Chloramine
B. DBP
C. THM
D. Ozone
E. Disinfectants

30. The Safe Drinking Water Act Amendments of 1996 required USEPA to comply with the regulatory timeline it set forth in its initial Disinfectant and Disinfectant-By-Product (DDPB) rule and _________________
A. Haloacetic acids
B. Bromoform
C. Organic matter
D. Chloroform
E. None of the Above

31. Because the research on _________________ and their impact on public health continue, and because serious questions about the actual health risks posed by DBPs still remain.
A. DBPs
B. THMs
C. Chlorine
D. Ozone
E. Chlorine dioxide

32. Current evidence indicates that the benefits of chlorinating our drinking water — reduced incidence of water-borne diseases — are much greater than the risks of health effects from _________________.
A. DBPs
B. THMs
C. Chlorine
D. Ozone
E. Chlorine dioxide

33. Although other disinfectants are available, _________________ continues to be the choice of water treatment experts.
A. DBPs
B. THMs
C. Chlorine
D. Ozone
E. Chlorine dioxide

34. When used with modern water filtration practices, _________________ is effective against virtually all infective agents — bacteria, viruses and protozoa.
A. DBPs
B. THMs
C. Chlorine
D. Ozone
E. Chlorine dioxide

35. A number of cities use _________________ to disinfect their source water and to reduce THM formation.
A. DBPs
B. THMs
C. Chlorine
D. Ozone
E. Chlorine dioxide

36. Although _________________ is a highly effective disinfectant, it breaks down quickly, so that small amounts of chlorine or other disinfectants must be added to the water to ensure continued disinfection as the water is piped to the consumer's tap.
A. DBPs
B. THMs
C. Chlorine
D. Ozone
E. Chlorine dioxide

37. Modifying water treatment facilities to use _________________ can be expensive, and ozone treatment can create other undesirable by-products that may be harmful to health if they are not controlled (e.g., bromate).
A. DBPs
B. THMs
C. Chlorine
D. Ozone
E. Chlorine dioxide

38. Examples of other disinfectants include chloramines and _________________.
A. DBPs
B. THMs
C. Chlorine
D. Ozone
E. Chlorine dioxide

39. _________________ are weaker disinfectants than chlorine, especially against viruses and protozoa; however, they are very persistent and, as such, can be useful for preventing re-growth of microbial pathogens in drinking water distribution systems.
A. Chlorite
B. Chloramines
C. Chlorine
D. Ozone
E. Chlorine dioxide

40. _________________can be an effective disinfectant, but it forms chlorate and chlorite, compounds whose toxicity has not yet been fully determined.
A. Chlorite
B. Chloramines
C. Chlorine
D. Ozone
E. Chlorine dioxide

41. Assessments of the health risks from these and other chlorine-based disinfectants and _________________ by-products are currently under way.
A. Chlorite
B. Chloramines
C. Chlorine
D. Chlorination
E. Chlorine dioxide

42. In general, the preferred method of controlling _________________ by-products is removal of the naturally occurring organic matter from the source water so it cannot react with the chlorine to form by-products.
A. Chlorite
B. Chloramines
C. Chlorine
D. Chlorination
E. Chlorine dioxide

43. THM levels may also be reduced through the replacement of _________________ with alternative disinfectants.
A. Chlorite
B. Chloramines
C. Chlorine
D. Chlorination
E. Chlorine dioxide

44. A third option is removal of the by-products by adsorption on activated carbon beds. It is extremely important that water treatment plants ensure that methods used to control _______________by-products do not compromise the effectiveness of water disinfection.
A. Chlorite
B. Chloramines
C. Chlorine
D. Chlorination
E. Chlorine dioxide

45. A product of the disproportionation of chlorine dioxide, for example by sunlight.
A. Chloride ion (Cl^-)
B. Chlorate ion ($ClO3^-$)
C. Chlorine dioxide (ClO2)
D. CxT value
E. None of the Above

46. A free radical; a powerful, selective oxidant.
A. Chloride ion (Cl^-)
B. Chlorate ion ($ClO3^-$)
C. Chlorine dioxide (ClO2)
D. CxT value
E. None of the Above

47. The principal reduction product of chlorine.
A. Chloride ion (Cl^-)
B. Chlorate ion ($ClO3^-$)
C. Chlorine dioxide (ClO2)
D. CxT value
E. None of the Above

48. A product of the partial reduction of chlorine dioxide.
A. Chloride ion (Cl^-)
B. Chlorate ion ($ClO3^-$)
C. Chlorine dioxide (ClO2)
D. CxT value
E. None of the Above

49. The product of the net residual [concentration] of a disinfectant and [time], used as a measure of the amount of disinfection applied to a system.
A. Chloride ion (Cl^-)
B. Chlorate ion ($ClO3^-$)
C. Chlorine dioxide (ClO2)
D. CxT value
E. None of the Above

50. By-products of chlorination of water containing organics which are suspected carcinogens.
A. Chloride ion (Cl^-)
B. Chlorate ion ($ClO3^-$)
C. Chlorine dioxide (ClO2)
D. CxT value
E. None of the Above

51. By-products of chlorination of water containing organics which are suspected ___________.
A. Stachybotrys
B. Sodium chlorate
C. Sodium chlorite
D. Trihalomethanes
E. Carcinogens

52. The sodium salt of chloric acid; a precursor for chlorine dioxide production, especially for pulp bleaching.
A. Stachybotrys
B. Sodium chlorate
C. Sodium chlorite
D. Trihalomethanes
E. None of the Above

53. The sodium salt of chlorous acid, a precursor for chlorine dioxide production, especially for drinking water treatment.
A. Stachybotrys
B. Sodium chlorate
C. Sodium chlorite
D. Trihalomethanes
E. None of the Above

54. A particularly virulent type of toxic mold.
A. Stachybotrys
B. Sodium chlorate
C. Sodium chlorite
D. Trihalomethanes
E. None of the Above

55. Some people who use drinking water containing chlorine well in excess of EPA's standard could experience ________________to their eyes and nose. Some people who drink water containing chlorine well in excess of the EPA's standard could experience stomach discomfort.
A. Stachybotrys
B. Sodium chlorate
C. Sodium chlorite
D. Trihalomethanes
E. None of the Above

56. Some people who use drinking water containing ________________ well in excess of EPA's standard could experience irritating effects to their eyes and nose. Some people who drink water containing chloramines well in excess of the EPA's standard could experience stomach discomfort or anemia.
A. Bromate
B. Chlorite
C. Chlorine Dioxide
D. Disinfection Byproducts (DBPS)
E. None of the Above

57. Some people who drink water containing ________________ in excess of the EPA's standard over many years may experience problems with their liver, kidneys, or central nervous systems, and may have an increased risk of getting cancer.
A. Bromate
B. Chlorite
C. Chlorine Dioxide
D. Disinfection Byproducts (DBPS)
E. None of the Above

58. Some people who drink water containing ________________in excess of the EPA's standard over many years may have an increased risk of getting cancer.
A. Bromate
B. Chlorite
C. Chlorine Dioxide
D. Disinfection Byproducts (DBPS)
E. Haloacetic Acids

59. Some people who drink water containing ________________ in excess of the EPA's standard over many years may have an increased risk of getting cancer.
A. Bromate
B. Chlorite
C. Chlorine Dioxide
D. Disinfection Byproducts (DBPS)
E. Acids

60. Some infants and young children who drink water containing _______________ in excess of the EPA's standard could experience nervous system effects. Similar effects may occur in fetuses of pregnant women who drink water containing chlorite in excess of the EPA's standard. Some people may experience anemia.
A. Bromide
B. Chlorite
C. Chlorine Dioxide
D. Disinfection Byproducts (DBPS)
E. Haloacetic Acids

61. In December 1998, the EPA established the Stage 1 Disinfectants/Disinfection Byproducts Rule that requires public water systems to use treatment measures to reduce the formation of _______________and to meet the following specific standards.
A. Bromate
B. Chlorite
C. Chlorine Dioxide
D. Disinfection Byproducts (DBPS)
E. Haloacetic Acids

62. Some infants and young children who drink water containing _______________in excess of the EPA's standard could experience nervous system effects. Similar effects may occur in fetuses of pregnant women who drink water containing chlorine dioxide in excess of the EPA's standard. Some people may experience anemia.
A.   Bromate
B. Chlorite
C. Chlorine Dioxide
D. Disinfection Byproducts (DBPS)
E. Haloacetic Acids

63. _______________form when disinfectants added to drinking water to kill germs react with naturally-occurring organic matter in water.
A.   Bromate
B. Chlorite
C. Chlorine Dioxide
D. Disinfection Byproducts (DBPS)
E. None of the Above

64. _______________are formed when disinfectants used in water treatment plants react with bromide and/or natural organic matter (i.e., decaying vegetation) present in the source water.
A.   Bromate
B. Chlorite
C. Chlorine Dioxide
D. Disinfection Byproducts (DBPS)
E. None of the Above

65. _______________ for which regulations have been established have been identified in drinking water, including trihalomethanes, haloacetic acids, bromate, and chlorite.
A.   Bromate
B. Chlorite
C. Chlorine Dioxide
D. Disinfection Byproducts (DBPS)

66. ________________are a group of four chemicals that are formed along with other disinfection byproducts when chlorine or other disinfectants used to control microbial contaminants in drinking water react with naturally occurring organic and inorganic matter in water.
A. HAA5
B. Chloroform
C. THM
D. Chlorite
E. Bromate

67. The trihalomethanes are ________________, bromodichloromethane, dibromochloromethane, and bromoform.
A. HAA5
B. Chloroform
C. THM
D. Chlorite
E. Bromate

68. ________________are a group of chemicals that are formed along with other disinfection byproducts when chlorine or other disinfectants used to control microbial contaminants in drinking water react with naturally occurring organic and inorganic matter in water.
A. HAA5
B. Chloroform
C. THM
D. Chlorite
E. Bromate

69. The regulated haloacetic acids, known as ________________, are: monochloroacetic acid, dichloroacetic acid, trichloroacetic acid, monobromoacetic acid, and dibromoacetic acid.
A. HAA5
B. Chloroform
C. THM
D. Chlorite
E. Bromate

70. ________________is a chemical that is formed when ozone used to disinfect drinking water reacts with naturally occurring bromide found in source water.
A. HAA5
B. Chloroform
C. THM
D. Chlorite
E. Bromate

71. ________________ is a byproduct formed when chlorine dioxide is used to disinfect water.
A. HAA5
B. Chloroform
C. THM
D. Chlorite
E. Bromate

72. EPA has published the **Stage 1 Disinfectants/Disinfection Byproducts Rule** to regulate chlorite at a monthly average level of ________________ in drinking water.
A. Cryptosporidium
B. 1 PPM
C. Turbidity
D. SWTR
E. MCLG

73. One of the key regulations developed and implemented by the United States Environmental Protection Agency (**USEPA**) to counter pathogens in drinking water is the ________________.
A. Cryptosporidium
B. 1 PPM
C. Turbidity
D. SWTR
E. MCLG

74. The ________________specifies treatment criteria to assure that these performance requirements are met; they include turbidity limits, disinfectant residual, and disinfectant contact time conditions.
A. Cryptosporidium
B. 1 PPM
C. Turbidity
D. SWTR
E. MCLG

75. The **Interim Enhanced Surface Water Treatment Rule** was established in December 1998 to control ________________, and to maintain control of pathogens while systems lower disinfection byproduct levels to comply with the **Stage 1 Disinfectants/Disinfection Byproducts Rule**.
A. Cryptosporidium
B. 1 PPM
C. Turbidity
D. SWTR
E. MCLG

76. The EPA established a ________________ of zero for all public water systems and a 99% removal requirement for Cryptosporidium in filtered public water systems that serve at least 10,000 people.
A. Cryptosporidium
B. 1 PPM
C. Turbidity
D. SWTR
E. MCLG

77. ________________is an indicator of the physical removal of particulates, including pathogens.
A. Cryptosporidium
B. 1 PPM
C. Turbidity
D. SWTR
E. MCLG

78. The EPA is also planning to develop other rules to further control _______________.
A. Stage 1 Disinfectants/Disinfection Byproducts Rule
B. Cryptosporidium
C. Coliform bacteria
D. Fecal Coliform and E coli
E. None of the Above

79. The EPA has been promulgating a Long Term 1 Enhanced Surface Water Treatment Rule, for systems serving fewer than 10,000 people. This is to improve physical removal of Cryptosporidium, and to maintain control of pathogens while systems comply with _______________.
A. Stage 1 Disinfectants/Disinfection Byproducts Rule
B. Cryptosporidium
C. Coliform bacteria
D. Fecal Coliform and E coli
E. None of the Above

80. _________________are common in the environment and are generally not harmful. However, the presence of these bacteria in drinking water is usually a result of a problem with the treatment system or the pipes which distribute water, and indicates that the water may be contaminated with germs that can cause disease.
A. Stage 1 Disinfectants/Disinfection Byproducts Rule
B. Cryptosporidium
C. Coliform bacteria
D. Fecal Coliform and E coli
E. None of the Above

81. _______________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. Stage 1 Disinfectants/Disinfection Byproducts Rule
B. Cryptosporidium
C. Coliform bacteria
D. Fecal Coliform and E coli
E. None of the Above

82. _______________ is a parasite that enters lakes and rivers through sewage and animal waste. It causes cryptosporidiosis, a mild gastrointestinal disease. However, the disease can be severe or fatal for people with severely weakened immune systems.
A. Stage 1 Disinfectants/Disinfection Byproducts Rule
B. Cryptosporidium
C. Coliform bacteria
D. Fecal Coliform and E coli
E. None of the Above

83. The EPA and CDC have prepared advice for those with severely compromised immune systems who are concerned about _______________.
A. Stage 1 Disinfectants/Disinfection Byproducts Rule
B. Cryptosporidium
C. Coliform bacteria
D. Fecal Coliform and E coli
E. None of the Above

84. _______________is a parasite that enters lakes and rivers through sewage and animal waste. It causes gastrointestinal illness (e.g. diarrhea, vomiting, and cramps).
A. Halogen(s)
B. Heterotrophic Plate Count Bacteria
C. Giardia lamblia
D. Elements
E. Iodine

85. _________________A broad group of bacteria including non-pathogens, pathogens, and opportunistic pathogens; they may be an indicator of poor general biological quality of drinking water. Often referred to as HPC.
A. Halogen(s)
B. Heterotrophic Plate Count Bacteria
C. Giardia lamblia
D. Elements
E. Iodine

86. The halogens are a chemical series. They are the elements in Group 17 (old-style: VII or VIIA) of the periodic table: fluorine (F), chlorine (Cl), bromine (Br), iodine (I), astatine (At) and the as yet undiscovered _________________.
A. Halogen(s)
B. Heterotrophic Plate Count Bacteria
C. Giardia lamblia
D. Elements
E. Ununseptium

87. The periodic table is the single most unifying concept in chemistry. It is a structured listing of all known _________________, or substances, that consist of one type of atom.
A. Halogen(s)
B. Heterotrophic Plate Count Bacteria
C. Giardia lamblia
D. Elements
E. Iodine

88. _________________ cannot be reduced to simpler substances.
A. Halogen(s)
B. Heterotrophic Plate Count Bacteria
C. Giardia lamblia
D. Elements
E. Iodine

89. The term _______________means "salt-former" and compounds containing halogens are called "salts".
A. Halogen(s)
B. Heterotrophic Plate Count Bacteria
C. Giardia lamblia
D. Elements
E. Iodine

90. The word halogen was coined to mean _______________ which produce salt in union with a metal. It comes from 18th c. scientific French nomenclature based on erring adaptations of Greek roots.
A. Halogen(s)
B. Heterotrophic Plate Count Bacteria
C. Giardia lamblia
D. Elements
E. Iodine

91. __________________ are highly reactive, and as such can be harmful or lethal to biological organisms in sufficient quantities.
A. Halogen(s)
B. Heterotrophic Plate Count Bacteria
C. Giardia lamblia
D. Elements
E. Iodine

92. Chlorine and __________________ are both used as disinfectants for such things as drinking water, swimming pools, fresh wounds, dishes, and surfaces.
A. Halogen(s)
B. Heterotrophic Plate Count Bacteria
C. Giardia lamblia
D. Elements
E. Iodine

93. They kill bacteria and other potentially harmful microorganisms, a process known as __________________. Their reactive properties are also put to use in bleaching.
A. Hydrohalic acids
B. Halides or Halide ions
C. Diatomic interhalogen compounds
D. Chlorine
E. None of the Above

94. __________________ is the active ingredient of most fabric bleaches and is used in the production of most paper products.
A. Hydrohalic acids
B. Halides or Halide ions
C. Diatomic interhalogen compounds
D. Chlorine
E. None of the Above

95. These elements are diatomic molecules in their natural form. They require one more electron to fill their outer electron shells, and so have a tendency to form a __________________negative ion.
A. Hydrohalic acids
B. Halides or Halide ions
C. Diatomic interhalogen compounds
D. Chlorine
E. None of the Above

96. This negative ion is referred to as a halide ion; salts containing these ions are known as ___________________.

A. Hydrohalic acids
B. Halides or Halide ions
C. Diatomic interhalogen compounds
D. Chlorine
E. None of the Above

97. ___________________combined with a single hydrogen atom form the hydrohalic acids (i.e., HF, HCl, HBr, HI), a series of particularly strong acids.

A. Hydrohalic acids
B. Halides or Halide ions
C. Diatomic interhalogen compounds
D. Chlorine
E. None of the Above

98. ___________________combine with each other to form interhalogen compounds.

A. Hydrohalic acids
B. Halides or Halide ions
C. Diatomic interhalogen compounds
D. Chlorine
E. None of the Above

99. ___________________ (BrF, ICl, ClF, etc.) bear strong superficial resemblance to the pure halogens.

A. Hydrohalic acids
B. Halides or Halide ions
C. Diatomic interhalogen compounds
D. Chlorine
E. None of the Above

100. Many synthetic organic compounds such as plastic polymers, and a few natural ones, contain halogen atoms; these are known as halogenated compounds or organic ___________________.

A. Hydrohalic acids
B. Halides or Halide ions
C. Diatomic interhalogen compounds
D. Chlorine
E. None of the Above

101. ___________________is by far the most abundant of the halogens, and the only one needed in relatively large amounts (as chloride ions) by humans.

A. Hydrohalic acids
B. Halides or Halide ions
C. Diatomic interhalogen compounds
D. Chlorine
E. None of the Above

102. ___________________ ions play a key role in brain function by mediating the action of the inhibitory transmitter GABA and are also used by the body to produce stomach acid.
A. Fluorine
B. Bromine
C. Chloride
D. Astatine
E. Iodine

103. ___________________is needed in trace amounts for the production of thyroid hormones such as thyroxine.
A. Fluorine
B. Bromine
C. Chloride
D. Astatine
E. Iodine

104. Neither fluorine nor ___________________ are believed to be really essential for humans, although small amounts of fluoride can make tooth enamel resistant to decay.
A. Fluorine
B. Bromine
C. Chloride
D. Astatine
E. Iodine

105. All halogens have 7 electrons in their ________________, giving them an oxidation number of -1.
A. Fluorine
B. Bromine
C. Chloride
D. Astatine
E. None of the Above

106. This halogen exists, at room temperature, in this state of matter, solid form.
A. Fluoride
B. Bromine
C. Chlorine, Fluorine
D. Astatine, Iodine

107. This halogen exists, at room temperature, in this state of matter, liquid form.
A. Fluoride
B. Bromine
C. Chlorine, Fluorine
D. Astatine, Iodine
E. None of the Above

108. A measure of the acidity of water. The ________________ scale runs from 0 to 14 with 7 being the mid point or neutral.
A. Logarithmic
B. pH
C. Acidity
D. Alkaline
E. Neutral

109. A ________________ of less than 7 is on the acid side of the scale with 0 as the point of greatest acid activity.
A. Logarithmic
B. pH
C. Acidity
D. Alkaline
E. Neutral

110. A ________________ of more than 7 is on the basic (alkaline) side of the scale with 14 as the point of greatest basic activity.
A. Logarithmic
B. pH
C. Acidity
D. Alkaline
E. Neutral

111. The acidity of a water sample is measured on a pH scale. This scale ranges from **0** (maximum acidity) to **14** (maximum alkalinity). The middle of the scale, **7**, represents the neutral point. The acidity increases from _______________ toward **0**.
A. Logarithmic
B. pH
C. Acidity
D. Alkaline
E. Neutral

112. Because the pH scale is logarithmic, a difference of one pH unit represents a tenfold change. For example, the _______________ of a sample with a pH of **5** is ten times greater than that of a sample with a pH of **6**. A difference of 2 units, from **6** to **4**, would mean that the acidity is one hundred times greater, and so on.
A. Logarithmic
B. pH
C. Acidity
D. Alkaline
E. Neutral

113. Normal rain has a_______________of **5.6** – slightly acidic because of the carbon dioxide picked up in the earth's atmosphere by the rain.
A. Logarithmic
B. pH
C. Acidity
D. Alkaline
E. Neutral

In this section you are to identify a specific halogen by the information that is provided.

114. **Boiling Point:** -188.14 °C (85.01 K, -306.652 °F)
A. Fluorine
B. Bromine
C. Chloride
D. Astatine
E. None of the Above

115. **Number of Protons/Electrons:** 9
A. Fluorine
B. Bromine
C. Chloride
D. Astatine
E. None of the Above

116. **Number of Neutrons:** 10
A. Fluorine
B. Bromine
C. Chloride
D. Astatine
E. None of the Above

117. **Crystal Structure:** Cubic **Density @ 293 K:** 1.696 g/cm^3 **Color:** Greenish
A. Fluorine
B. Bromine
C. Chloride
D. Astatine
E. None of the Above

118. **Date of Discovery:** 1886 **Discoverer:** Joseph Henri Moissan
A. Fluorine
B. Bromine
C. Chloride
D. Astatine
E. None of the Above

119. **Name Origin:** From the Latin word fluo (flow)
A. Fluorine
B. Bromine
C. Chloride
D. Astatine
E. None of the Above

120. **Melting Point:** -7.2 °C (265.95 K, 19.04 °F)
A. Fluorine
B. Bromine
C. Iodine
D. Astatine

121. **Atomic Number:** 9
A. Fluorine
B. Bromine
C. Chloride
D. Astatine
E. None of the Above

122. **Atomic Mass:** 18.998404 amu
A. Fluorine
B. Bromine
C. Chloride
D. Astatine
E. None of the Above

123. **Melting Point:** -219.62 °C (53.530006 K, -363.31598 °F)
A. Fluorine
B. Bromine
C. Chloride
D. Astatine
E. None of the Above

124. **Boiling Point:** 58.78 °C (331.93 K, 137.804 °F)
A. Fluorine
B. Bromine
C. Iodine
D. Astatine
E. Chlorine

125. **Boiling Point:** 184.0 °C (457.15 K, 363.2 °F)
A. Fluorine
B. Bromine
C. Iodine
D. Astatine
E. Chlorine

126. **Number of Protons/Electrons:** 53
A. Fluorine
B. Bromine
C. Iodine
D. Astatine
E. Chlorine

127. **Number of Neutrons:** 74
A. Fluorine
B. Bromine
C. Iodine
D. Astatine
E. Chlorine

128. **Number of Protons/Electrons:** 35
A. Fluorine
B. Bromine
C. Iodine
D. Astatine
E. Chlorine

129. **Color:** Red
A. Fluorine
B. Bromine
C. Iodine
D. Astatine
E. Chlorine

130. **Date of Discovery:** 1826
A. Fluorine
B. Bromine
C. Iodine
D. Astatine
E. Chlorine

131. **Discoverer:** Antoine J. Balard
A. Fluorine
B. Bromine
C. Iodine
D. Astatine
E. Chlorine

132. **Atomic Number:** 85
A. Fluorine
B. Bromine
C. Chloride
D. Astatine
E. Chlorine

133. **Atomic Mass:** (210.0) amu
A. Fluorine
B. Bromine
C. Chloride
D. Astatine
E. Chlorine

134. **Name Origin:** From the Greek word brômos (stench)
A. Fluorine
B. Bromine
C. Iodine
D. Astatine
E. Chlorine

135. **Uses:** Poisonous
A. Fluorine
B. Bromine
C. Iodine
D. Astatine
E. Chlorine

136. **Obtained From:** Sea Water
A. Fluorine
B. Bromine
C. Iodine
D. Astatine
E. Chlorine

137. **Atomic Number:** 53
A. Fluorine
B. Bromine
C. Iodine
D. Astatine
E. Chlorine

138. **Atomic Mass:** 126.90447 amu
A. Fluorine
B. Bromine
C. Iodine
D. Astatine
E. Chlorine

139. **Melting Point:** 113.5 °C (386.65 K, 236.3 °F)
A. Fluorine
B. Bromine
C. Iodine
D. Astatine
E. Chlorine

140. **Number of Neutrons:** 45
A. Fluorine
B. Bromine
C. Iodine
D. Astatine
E. Chlorine

141. **Density @ 293 K:** 3.119 g/cm^3
A. Fluorine
B. Bromine
C. Iodine
D. Astatine
E. Chlorine

142. **Crystal Structure:** Orthorhombic **Density @ 293 K:** 4.93 g/cm^3 **Color:** Blackish
A. Fluorine
B. Bromine
C. Iodine
D. Astatine
E. Chlorine

143. **Date of Discovery:** 1811
A. Fluorine
B. Bromine
C. Iodine
D. Astatine
E. Chlorine

144. **Discoverer:** Bernard Courtois
A. Fluorine
B. Bromine
C. Iodine
D. Astatine
E. Chlorine

145. **Name Origin:** From the Greek word iôdes (violet)
A. Fluorine
B. Bromine
C. Iodine
D. Astatine
E. Chlorine

146. **Uses:** Required in humans
A. Fluorine
B. Bromine
C. Iodine
D. Astatine
E. Chlorine

147. **Obtained From:** Sodium and potassium compounds
A. Fluorine
B. Bromine
C. Iodine
D. Astatine
E. Chlorine

148. **Melting Point:** 302.0 °C (575.15 K, 575.6 °F)
A. Fluorine
B. Bromine
C. Chloride
D. Astatine
E. Chlorine

149. **Boiling Point:** 337.0 °C (610.15 K, 638.6 °F)
A. Fluorine
B. Bromine
C. Chloride
D. Astatine
E. Chlorine

150. **Number of Protons/Electrons:** 85
A. Fluorine
B. Bromine
C. Chloride
D. Astatine
E. Chlorine

151. **Number of Neutrons:** 125
A. Fluorine
B. Bromine
C. Chloride
D. Astatine
E. Chlorine

152. **Crystal Structure:** Unknown **Density @ 293 K:** Unknown
A. Fluorine
B. Bromine
C. Chloride
D. Astatine
E. Chlorine

153. **Color:** Unknown
A. Fluorine
B. Bromine
C. Chloride
D. Astatine
E. Chlorine

154. **Date of Discovery:** 1940
A. Fluorine
B. Bromine
C. Chloride
D. Astatine
E. Chlorine

155. **Discoverer:** D.R. Corson
A. Fluorine
B. Bromine
C. Chloride
D. Astatine
E. Chlorine

156. **Name Origin:** From the Greek word astatos (unstable)
A. Fluorine
B. Bromine
C. Chloride
D. Astatine
E. Chlorine

157. **Uses:** No uses known **Obtained From:** Man-made
A. Fluorine
B. Bromine
C. Chloride
D. Astatine
E. Chlorine

158. **Atomic Number:** 17
A. Fluorine
B. Bromine
C. Chloride
D. Astatine
E. Chlorine

159. **Atomic Mass:** 35.4527 amu
A. Fluorine
B. Bromine
C. Chloride
D. Astatine
E. Chlorine

160. **Melting Point:** -100.98 °C (172.17 K, -149.764 °F)
A. Fluorine
B. Bromine
C. Chloride
D. Astatine
E. Chlorine

161. **Boiling Point:** -34.6 °C (238.55 K, -30.279997 °F)
A. Fluorine
B. Bromine
C. Chloride
D. Astatine
E. Chlorine

162. **Number of Protons/Electrons:** 17 **Number of Neutrons:** 18
A. Fluorine
B. Bromine
C. Chloride
D. Astatine
E. Chlorine

163. **Crystal Structure:** Orthorhombic **Density @ 293 K:** 3.214 g/cm^3
A. Fluorine
B. Bromine
C. Chloride
D. Astatine
E. Chlorine

164. **Color:** Green **Uses**: Water purification, bleaches
A. Fluorine
B. Bromine
C. Chloride
D. Astatine
E. Chlorine

165. **Uses:** Refrigerants
A. Fluorine
B. Bromine
C. Chloride
D. Astatine
E. None of the Above

166. **Atomic Number:** 35
A. Fluorine
B. Bromine
C. Iodine
D. Astatine
E. Chlorine

167. **Atomic Mass:** 79.904 amu
A. Fluorine
B. Bromine
C. Iodine
D. Astatine
E. Chlorine

168. **Obtained From**: Salt
A. Fluorine
B. Bromine
C. Chloride
D. Astatine
E. Chlorine

169. **Date of Discovery:** 1774 **Discoverer:** Carl Wilhelm Scheele
A. Fluorine
B. Bromine
C. Chloride
D. Astatine
E. Chlorine

170. **Name Origin:** From the Greek word khlôros (green)
A. Fluorine
B. Bromine
C. Chloride
D. Astatine
E. Chlorine

Chlorine Gas Information and Identifiers

171. **TLV/IDLH**:
A. 1 ppm
B. 0.5ppm/15 minutes
C. 25 ppm
D. 3 ppm
E. 70.9

172. **NIOSH IDHL:**
A. 1 ppm
B. 0.5ppm/15 minutes
C. 25 ppm
D. 3 ppm
E. 70.9

173. **CAS No.:**
A. FO2100000
B. 7782-50-5
C. Poison gas
D. 1 ppm
E. 1017 20

174. **DOT UN:**
A. FO2100000
B. 7782-50-5
C. Poison gas
D. 1 ppm
E. 1017 20

175. **DOT label:**
A. FO2100000
B. 7782-50-5
C. Poison gas
D. 1 ppm
E. 1017 20

176. **RTECS No.:**
A. FO2100000
B. 7782-50-5
C. Poison gas
D. 1 ppm
E. 1017 20

177. **TLV/TWA**:
A. FO2100000
B. 7782-50-5
C. Poison gas
D. 1 ppm
E. 1017 20

178. **TLV/STEL**:
A. 1 ppm
B. 0.5ppm/15 minutes
C. 25 ppm
D. 3 ppm
E. 70.9

179. **Vapor density**:
A. -101 degrees C (-149.8 degrees F)
B. -34.6 degrees C (-30.28 degrees F)
C. 1.41 at 20 degrees C (68 degrees F) and a pressure of 6.86 atm
D. 2.5
E. 4,800 mm Hg

180. **Melting point:**
A. -101 degrees C (-149.8 degrees F)
B. -34.6 degrees C (-30.28 degrees F)
C. 1.41 at 20 degrees C (68 degrees F) and a pressure of 6.86 atm
D. 2.5
E. None of the Above

181. **Vapor pressure at 20 degrees C (68 degrees F):**
A. -101 degrees C (-149.8 degrees F)
B. -34.6 degrees C (-30.28 degrees F)
C. 1.41 at 20 degrees C (68 degrees F) and a pressure of 6.86 atm
D. 2.5
E. 4,800 mm Hg

182. **NIOSH Ceiling**:
A. 1 ppm
B. 0.5ppm/15 minutes
C. 25 ppm
D. 3 ppm
E. 70.9

183. **PEL/TWA**:
A. 1 ppm
B. 0.5ppm/15 minutes
C. 25 ppm
D. 3 ppm
E. 70.9

184. **Molecular weight:**
A. 1 ppm
B. 0.5ppm/15 minutes
C. 25 ppm
D. 3 ppm
E. 70.9

185. **Boiling point (at 760 mm Hg):**
A. -101 degrees C (-149.8 degrees F)
B. -34.6 degrees C (-30.28 degrees F)
C. 1.41 at 20 degrees C (68 degrees F) and a pressure of 6.86 atm
D. 2.5
E. 4,800 mm Hg

186. **Specific gravity (liquid):**
A. -101 degrees C (-149.8 degrees F)
B. -34.6 degrees C (-30.28 degrees F)
C. 1.41 at 20 degrees C (68 degrees F) and a pressure of 6.86 atm
D. 2.5
E. 4,800 mm Hg

187. Flammable gases and vapors form explosive mixtures with _____________.
A. Corrosive material
B. Amber liquid
C. Pungent odor
D. Chlorine
E. Phosgene

188. Contact between _____________ and many combustible substances (such as gasoline and petroleum products, hydrocarbons, turpentine, alcohols, acetylene, hydrogen, ammonia, and sulfur), reducing agents, and finely divided metals may cause fires and explosions.
A. Corrosive material
B. Amber liquid
C. Pungent odor
D. Chlorine
E. Phosgene

189. Contact between _____________ and arsenic, bismuth, boron, calcium, activated carbon, carbon disulfide, glycerol, hydrazine, iodine, methane, oxomonosilane, potassium, propylene, and silicon should be avoided.
A. Corrosive material
B. Amber liquid
C. Pungent odor
D. Chlorine
E. Phosgene

190. Chlorine is a greenish-yellow gas with a characteristic _____________.
A. Corrosive material
B. Amber liquid
C. Pungent odor
D. Chlorine

191. It condenses to an _____________at approximately -34 degrees C (-29.2 degrees F) or at high pressures.
A. Corrosive material
B. Amber liquid
C. Pungent odor
D. Chlorine
E. Phosgene

192. Odor thresholds ranging from 0.08 to part per million (ppm) parts of air have been reported. Prolonged exposures may result in _____________.
A. Corrosive material
B. Amber liquid
C. Olfactory fatigue
D. Chlorine
E. Phosgene

193. Cylinders of chlorine may burst when exposed to elevated temperatures. Chlorine in solution forms a _____________.
A. Corrosive material
B. Amber liquid
C. Pungent odor
D. Chlorine
E. Phosgene

194. Chlorine reacts with hydrogen sulfide and water to form hydrochloric acid, and it reacts with carbon monoxide and sulfur dioxide to form _____________ and sulfuryl chloride. Chlorine is also incompatible with moisture, steam, and water.
A. Corrosive material
B. Amber liquid
C. Pungent odor
D. Chlorine
E. Phosgene

195. Containers of _____________ may explode in the heat of the fire and should be moved from the fire area if it is possible to do so safely. If this is not possible, cool fire exposed containers from the sides with water until well after the fire is out.
A. Corrosive material
B. Amber liquid
C. Pungent odor
D. Chlorine
E. Phosgene

196. The American Conference of Governmental Industrial Hygienists (**ACGIH**) has assigned chlorine a _____________of 0.5 ppm (1.5 mg/m(3)) as a TWA for a normal 8-hour workday and a 40-hour workweek and a short-term exposure limit (**STEL**) of 1.0 ppm (2.9 mg/m(3)) for periods not to exceed 15 minutes.
A. STEL
B. PEL
C. TLV
D. REL
E. STD

197. Exposures at the _____________ concentration should not be repeated more than four times a day and should be separated by intervals of at least 60 minutes [ACGIH 1994, p. 15].
A. STEL
B. PEL
C. TLV
D. REL
E. STD

198. The current Occupational Safety and Health Administration (**OSHA**) _____________ for chlorine is 1 ppm (3 milligrams per cubic meter (mg/m(3))) as a ceiling limit. A worker's exposure to chlorine shall at no time exceed this ceiling level [29 CFR 1910.1000, Table Z-1].
A. STEL
B. PEL
C. TLV
D. REL
E. STD

199. It is important to understand the forms of chlorine which are present because each has a different disinfecting capability. The acid form, _____________, is a much stronger disinfectant than the hypochlorite ion, OCL-.
A. Chlorination
B. HOCL
C. Disinfection
D. Disinfectant
E. None of the Above

200. The National Institute for Occupational Safety and Health (**NIOSH**) has established a _____________for chlorine of 0.5 ppm mg/m(3)) as a TWA for up to a 10-hour workday and a 40-hour workweek and a short-term exposure limit (**STEL**) of 1 ppm (3 mg/m(3))[NIOSH 1992].
A. STEL
B. PEL
C. TLV
D. REL
E. STD

201. In 1774, in his small experimental laboratory, Swedish pharmacist Carl Wilhem ____________ released a few drops of hydrochloric acid onto a piece of manganese dioxide. Within seconds, a greenish-yellow gas arose.
A. Scheele
B. Davy
C. Hypochlorite solution
D. Hypochlorous acid
E. None of the Above

202. The fact that the greenish-yellow gas was actually an element was only recognized several decades later by English chemist Sir Humphrey ____________. Until that time, people were convinced that the gas was a compound of oxygen.
A. Scheele
B. Davy
C. Hypochlorite solution
D. Hypochlorous acid

203. ____________ gave the element its name on the basis of the Greek word khloros, for greenish-yellow. In 1810 he suggested the name "chloric gas" or "chlorine."
A. Scheele
B. Davy
C. Hypochlorite solution
D. Hypochlorous acid
E. None of the Above

204. When the first men to set foot on the moon returned to earth (Apollo 11 mission: 24.7.69) a ____________was chosen as one of the disinfectants for destroying any possible moon germs.
A. Scheele
B. Davy
C. Hypochlorite solution
D. Hypochlorous acid
E. None of the Above

205. When released to air, chlorine will react with water to form _____________and hydrochloric acid, which are removed from the atmosphere by rainfall.
A. Scheele
B. Davy
C. Hypochlorite solution
D. Hypochlorous acid
E. None of the Above

206. Chlorine is slightly soluble in water. It reacts with water to form hypochlorous acid and hydrochloric acid. The hypochlorous acid breaks down rapidly. The _____________also breaks down; its breakdown products will lower the pH of the water (makes it more acidic).
A. Scheele
B. Davy
C. Hypochlorite solution
D. Hypochlorous acid
E. None of the Above

207. Because it is highly reactive, chlorine is usually found in nature bound with other ____________ like sodium, potassium, and magnesium.
A. Elements
B. Reactive
C. Sodium chloride
D. Co-products
E. None of the Above

208. Chlorine is one of the most abundant chemical ____________ on Earth. It is ubiquitous in soils, minerals, plants and animals. Seawater is a huge reservoir of dissolved chlorine weathered from the continents and transported to the oceans by Earth's rivers.
A. Elements
B. Reactive
C. Sodium chloride
D. Co-products
E. None of the Above

209. Chlorine is also one of the most useful chemical elements. Each chemical element has its own set of unique properties and chlorine is known as a very reactive element--so ____________, in fact, that it is usually found combined with other elements in the form of compounds.
A. Elements
B. Reactive
C. Sodium chloride
D. Co-products
E. None of the Above

210. Chlorine is produced industrially from the compound sodium chloride, one of the many salts found in geologic deposits formed from the slow evaporation of ancient seawater. When electricity is applied to a brine solution of ____________, chlorine gas (Cl_2), caustic soda (NaOH) and hydrogen gas (H_2).
A. Elements
B. Reactive
C. Sodium chloride
D. Co-products
E. None of the Above

211. Chlorine gas cannot be produced without producing caustic soda, so chlorine and caustic soda are known as "____________," and their economics are inextricably linked.
A. Elements
B. Reactive
C. Sodium chloride
D. Co-products
E. None of the Above

212. Caustic soda, also called "____________," is used to produce a wide range of organic and inorganic chemicals and soaps. In addition, the pulp and paper, alumina and textiles industries use caustic soda in their manufacturing processes.
A. Elements
B. Reactive
C. Sodium chloride
D. Co-products
E. None of the Above

213. The "chlor-alkali" industry obtains two very useful chemicals by applying ____________to sea salt.
A. Elements
B. Reactive
C. Sodium chloride
D. Co-products
E. None of the Above

214. Chlorine can be added as _____________, calcium hypochlorite or chlorine gas. When any of these is added to water, chemical reactions occur.
A. Hypochlorous acid
B. Break down
C. Chlorine demand
D. Sodium hypochlorite

215. All three forms of chlorine produce _____________when added to water.
A. Hypochlorous acid
B. Break down
C. Chlorine demand
D. Water temperature decreases
E. Hypochlorite ion

216. Hypochlorous acid is a weak acid but a strong disinfecting agent. The amount of hypochlorous acid depends on the pH and _____________.
A. Hypochlorous acid
B. Break down
C. Chlorine demand
D. Water temperature
E. Hypochlorite ion

217. Under normal water conditions, hypochlorous acid will also chemically react and break down into a _____________.
A. Hypochlorous acid
B. Break down
C. Chlorine demand
D. Water temperature decreases
E. Hypochlorite ion

218. The _____________is a much weaker disinfecting agent than hypochlorous acid, about 100 times less effective.
A. Hypochlorous acid
B. Break down
C. Chlorine demand
D. Water temperature decreases
E. Hypochlorite ion

219. As the temperature is decreased, the ratio of _____________increases. Temperature plays a small part in the acid ratio.
A. Hypochlorous acid
B. Break down
C. Chlorine demand
D. Water temperature decreases
E. Hypochlorite ion

220. The ratio of hypochlorous acid is greater at _____________, but pathogenic organisms are actually harder to kill. All other things being equal, higher water temperatures and a lower pH are more conducive to chlorine disinfection.
A. Hypochlorous acid
B. Lower temperatures
C. Chlorine demand
D. Water temperature increases
E. Less effective

221. 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. Hypochlorous acid
B. Lower temperatures
C. Chlorine demand
D. Water temperature increases
E. Less effective

222. As the concentration of the chlorine increases, the required ______________to disinfect decreases.
A. Hypochlorous acid
B. Lower temperatures
C. Chlorine demand
D. Water temperature increases
E. Contact time

223. Chlorination is more effective as ______________.
A. Hypochlorous acid
B. Lower temperatures
C. Chlorine demand
D. Water temperature increases
E. Less effective

224. Chlorination is ______________as the water's pH increases (becomes more alkaline).
A. Hypochlorous acid
B. Lower temperatures
C. Chlorine demand
D. Water temperature increases
E. Less effective

225. Chlorination is ______________in cloudy (turbid) water.
A. Hypochlorous acid
B. Lower temperatures
C. Chlorine demand
D. Water temperature increases
E. Less effective

226. When ______________ is added to the water supply, part of it combines with other chemicals in water (like iron, manganese, hydrogen sulfide, and ammonia) and is not available for disinfection.
A. Superchlorination
B. Chlorination
C. Chlorine demand
D. Simple chlorination
E. Chlorine

227. The amount of chlorine that reacts with the other chemicals plus the amount required to achieve disinfection is the _____________of the water.
A. Superchlorination
B. Chlorination
C. Chlorine demand
D. Simple chlorination
E. Chlorine

228. The safest way to be sure that the amount of chlorine added is sufficient is to add a little more than is required. This will result in a ____________residual that can be measured easily. This chlorine residual must be maintained for several minutes depending on chlorine level and water quality.
A. Superchlorination
B. Chlorination
C. Chlorine demand
D. Simple chlorination
E. Free Chlorine

229. The Test kit should specify that it measures the free chlorine residual and not the ____________.
A. Superchlorination
B. Chlorination
C. Chlorine demand
D. Simple chlorination
E. Total Chlorine

230. Once ____________ has combined with other chemicals it is not effective as a disinfectant. If a test kit does not distinguish between free chlorine and chlorine combined with other chemicals, the test may result in an overestimation of the chlorine residual.
A. Superchlorination
B. Chlorination
C. Chlorine demand
D. Simple chlorination
E. Chlorine

231. Chlorine will kill bacteria in water, but it takes some time. The time needed depends on the concentration of chlorine. Two methods of chlorination are used to disinfect water: **simple chlorination** and ____________.
A. Superchlorination
B. Chlorination
C. Chlorine demand
D. Simple chlorination
E. Chlorine

232. ____________involves maintaining a low level of free residual chlorine at a concentration of 0.30.5 mg/1 for at least 30 minutes. The residual is measured at the faucet most distant from the where chlorine is added to the water supply.
A. Superchlorination
B. Chlorination
C. Chlorine demand
D. Simple chlorination

233. To ensure the proper contact time of at least 30 minutes, a holding tank can be installed. Pressure tanks, while often thought to be sufficient, are usually too small to always provide 30 minutes of _____________.
A. Contact Time
B. Chlorination
C. Chlorine demand
D. Simple chlorination

234. The measured amount of _____________ in the water should be the same as the amount added. But water is not 100% pure. There are always other substances (interfering agents) such as iron, manganese, turbidity, etc., which will combine chemically with the chlorine.
A. Chlorine
B. Chlorine demand
C. Free chlorine
D. Residual
E. CT

235. This is called the _____________. Naturally, once chlorine molecules are combined with these interfering agents they are not capable of disinfection. It is free chlorine that is much more effective as a disinfecting agent.
A. Chlorine
B. Chlorine demand
C. Free chlorine
D. Residual
E. CT

236. So let's look now at how free, total and combined chlorine are related. When a chlorine residual test is taken, either a total or a _____________residual can be read.
A. Chlorine
B. Chlorine demand
C. Free chlorine
D. Residual
E. CT

237. _____________residual is a much stronger disinfecting agent. Therefore, most water regulating agencies will require that your daily chlorine residual readings be of free chlorine residual.
A. Chlorine
B. Chlorine demand
C. Free chlorine
D. Residual
E. CT

238. Break-point chlorination is where the chlorine demand has been satisfied and any additional chlorine will be considered _____________.
A. Chlorine
B. Chlorine demand
C. Free chlorine
D. Residual
E. CT

239. Disinfection to eliminate fecal and coliform bacteria may not be sufficient to adequately reduce pathogens such as Giardia or viruses to desired levels. Use of the _____________ disinfection concept is recommended to demonstrate satisfactory treatment, since monitoring for very low levels of pathogens in treated water is analytically very difficult.
A. Chlorine
B. Chlorine demand
C. Free chlorine
D. Residual
E. CT

240. The _____________ concept, as developed by the United States Environmental Protection Agency (Federal Register, 40 CFR, Parts 141 and 142, June 29, 1989), uses the combination of disinfectant residual concentration (mg/L) and the effective disinfection contact time (in minutes) to measure effective pathogen reduction.
A. Chlorine
B. Chlorine demand
C. Free chlorine
D. Residual
E. CT

241. All surface water treatment systems shall ensure a minimum reduction in pathogen levels: _____________in Giardia; and 4-log reduction in viruses. These requirements are based on unpolluted raw water sources with Giardia levels of = 1 cyst/100 L, and a finished water goal of 1 cyst/100,000 L (equivalent to 1 in 10,000 risk of infection per person per year).
A. Chlorine
B. Chlorine demand
C. Free chlorine
D. Residual
E. None of the Above

242. Disinfection CT values shall be calculated daily using either the _____________and the disinfectant residual at the same time, or by using the lowest CT value if it is calculated more frequently. Actual CT values are then compared to required CT values.
A. Chlorine
B. Chlorine demand
C. Free chlorine
D. Residual
E. None of the Above

243. _____________has long been an accepted and effective part of many water treatment programs.
A. Enzymes
B. Oxidation chemistry
C. Oxidizing chemicals
D. Oxidant
E. Microbiocides

244. _____________used in today's water treatment programs include: chlorine, chlorine dioxide, bromine, bromine/chlorine releasing compounds, ozone and hydrogen peroxide.
A. Enzymes
B. Oxidation chemistry
C. Oxidizing chemicals
D. Oxidant
E. Microbiocides

245. The primary killing mechanism these types of ____________ use is oxidizing protein groups within a microorganism.
A. Enzymes
B. Oxidation chemistry
C. Oxidizing chemicals
D. Oxidant
E. Microbiocides

246. Proteins are the basic components of essential cellular ____________ that are necessary for life-sustaining cellular processes such as respiration.
A. Enzymes
B. Oxidation chemistry
C. Oxidizing chemicals
D. Oxidant
E. Microbiocides

247. The destruction of these proteins deprives the cell of its ability to carry out fundamental life functions and quickly kills it. One ____________ is chlorine dioxide, which appears to provide an additional killing mechanism.
A. Enzymes
B. Oxidation chemistry
C. Oxidizing chemicals
D. Oxidant
E. Microbiocides

248. Chlorine dioxide is able to diffuse readily through hydrophobic lipid layers of an organism, allowing it to react with ____________, which directly inhibits protein synthesis.
A. Cellular amino acids
B. Oxidation chemistry
C. Oxidizing chemicals
D. Oxidant
E. Microbiocides

249. Amino acids are the basic building blocks of all cellular proteins, destruction of these molecules has a ____________on the microorganism.
A. Process-contaminated
B. Water solubility
C. Devastating effect
D. Extremely reactive
E. Oxidizing microbiocide

250. Chlorine gas is a pulmonary irritant with intermediate _____________that causes acute damage in the upper and lower respiratory tract.
A. Process-contaminated
B. Water solubility
C. Devastating effect
D. Extremely reactive
E. Oxidizing microbiocide

251. Chlorine is _____________with most elements. Because its density is greater than that of air, the gas settles low to the ground. It is a respiratory irritant, and it burns the skin. Just a few breaths of it are fatal.
A. Process-contaminated
B. Water solubility
C. Devastating effect
D. Extremely reactive
E. Oxidizing microbiocide

252. Chlorine gas is likely the most widely used ____________.
A. Process-contaminated
B. Water solubility
C. Devastating effect
D. Extremely reactive
E. Oxidizing microbiocide

253. The combination of high chlorine demand in ____________systems and the dissociation process in alkaline systems creates the need for greater chlorine feed to obtain the same microbial efficacy. This results in a higher concentration of HCl in the cooling system.
A. Process-contaminated
B. Water solubility
C. Devastating effect
D. Extremely reactive
E. Oxidizing microbiocide

254. Since HCl removes ____________, pH depression and system corrosion could occur. In low pH water the passive, metal oxide layers protecting the metal may resolubulize, exposing the surface to corrosion.
A. Odor threshold
B. Alkalinity
C. Moderate water solubility
D. Negative impact
E. None of the Above

255. At free mineral acidity (pH <4.3), many passivating inhibitors become ineffective, and corrosion will proceed rapidly. Increased chloride may also have a ____________on system corrosion. The chloride ion (Cl^-) can damage or penetrate the passive oxide layer, leading to localized damage of the metal surface.
A. Odor threshold
B. Alkalinity
C. Moderate water solubility
D. Negative impact
E. None of the Above

256. Exposure to chlorine gas may be prolonged because its moderate water solubility may not cause upper airway symptoms for several minutes. In addition, the _____________is greater than that of air, causing it to remain near ground level and increasing exposure time.
A. Odor threshold
B. Alkalinity
C. Moderate water solubility
D. Negative impact
E. None of the Above

257. The _____________for chlorine is approximately 0.3-0.5 parts per million (ppm); however, distinguishing toxic air levels from permissible air levels may be difficult until irritative symptoms are present.
A. Odor threshold
B. Alkalinity
C. Moderate water solubility
D. Negative impact
E. None of the Above

258. Cellular injury is believed to result from the oxidation of functional groups in cell components, from reactions with tissue water to form hypochlorous and hydrochloric acid, and from the generation of _____________.
A. Odor threshold
B. Alkalinity
C. Moderate water solubility
D. Negative impact
E. None of the Above

259. Although the idea that chlorine causes _____________by generating free oxygen radicals was once accepted, this idea is now controversial.
A. Odor threshold
B. Alkalinity
C. Moderate water solubility
D. Negative impact
E. None of the Above

260. The predominant targets of the acid are the _____________ of the ocular conjunctivae and upper respiratory mucus membranes.
A. Hydrochloric acid is highly soluble in water.
B. Hydrochloric acid
C. Epithelia
D. Chlorine exposure
E. None of the Above

261. Hypochlorous acid is also highly water soluble with an injury pattern similar to _____________.
A. Hydrochloric acid is highly soluble in water.
B. Hydrochloric acid
C. Epithelia
D. Chlorine exposure
E. None of the Above

262. Hypochlorous acid may account for the toxicity of elemental chlorine and _____________to the human body.
A. Hydrochloric acid is highly soluble in water.
B. Hydrochloric acid
C. Epithelia
D. Chlorine exposure
E. None of the Above

263. Chlorine gas, when mixed with ammonia, reacts to form chloramine gas. In the presence of water, chloramines decompose to ammonia and hypochlorous acid or _____________.
A. Hydrochloric acid is highly soluble in water.
B. Hydrochloric acid
C. Epithelia
D. Chlorine exposure
E. None of the Above

264. The early response to _____________depends on the (1) concentration of chlorine gas, (2) duration of exposure, (3) water content of the tissues exposed, and (4) individual susceptibility.
A. Hydrochloric acid is highly soluble in water.
B. Hydrochloric acid
C. Epithelia
D. Chlorine exposure
E. None of the Above

265. The immediate effects of chlorine gas toxicity include acute inflammation of the conjunctivae, nose, pharynx, larynx, trachea, and bronchi. Irritation of the airway mucosa leads to local edema secondary to active arterial and capillary hyperemia. _____________results in filling the alveoli with edema fluid, resulting in pulmonary congestion.
A. Hydrochloric acid is highly soluble in water.
B. Hydrochloric acid
C. Epithelia
D. Chlorine exposure
E. None of the Above

266. The hallmark of pulmonary injury associated with chlorine toxicity is pulmonary edema, manifested as _____________. Noncardiogenic pulmonary edema is thought to occur when there is a loss of pulmonary capillary integrity.
A. Hydrochloric acid is highly soluble in water.
B. Hydrochloric acid
C. Epithelia
D. Chlorine exposure
E. None of the Above

267. Calcium or ____________reacts explosively or forms explosive compounds with many common substances such as ammonia, amines, charcoal, or organic sulfides
A. Bleaching agents
B. Sodium hypochlorite
C. pH
D. Hypochlorite form
E. None of the Above

268. ____________is a solution made from reacting chlorine with a sodium hydroxide solution. These two reactants are the major co-products from most chlor-alkali cells.
A. Bleaching agents
B. Sodium hypochlorite
C. pH
D. Hypochlorite form
E. None of the Above

269. Sodium hypochlorite has a variety of uses and is an excellent ____________agent.
A. Bleaching agents
B. Sodium hypochlorite
C. pH
D. Hypochlorite form
E. None of the Above

270. Sodium hypochlorite also significantly increases the ____________ of the water. When sodium hypochlorite is used, it must be counterbalanced by a strong acid like sodium bisulfate or muriatic acid to keep the pH within the ideal range.
A. Bleaching agents
B. Sodium hypochlorite
C. pH
D. Hypochlorite form
E. None of the Above

271. The ____________of chlorine has been used since 1850. The most widely used form of hypochlorite is the liquid, sodium hypochlorite (NaOCl), with more than 150 tons per day consumed in the United States.
A. Bleaching agents
B. Sodium hypochlorite
C. pH
D. Hypochlorite form
E. None of the Above

272. Sodium hypochlorite application in cooling water is essentially the same as with gas chlorine; HOCl is produced as the active toxicant. The HOCl is equally susceptible to process contamination and has the same ____________as gas chlorine and displays the same tendency to A. Bleaching agents
B. Sodium hypochlorite
C. pH
D. Hypochlorite form
E. None of the Above

273. ____________differs from chlorine gas in two respects: method of feed and hydrolization properties.
A. Bleaching agents
B. Sodium hypochlorite
C. pH
D. Hypochlorite form
E. None of the Above

274. Sodium hypochlorite can either be gravity-fed or applied with a metering pump. The latter is generally recognized as a consistently more accurate method. The second difference, in hydrolysis, lies in the end products. The NaOCl reaction with water liberates ____________ (NaOH).
A. Bleaching agents
B. Sodium hypochlorite
C. pH
D. Hypochlorite form
E. None of the Above

275. The addition of NaOH differs in that it tends to add alkalinity to the water. In large concentrations it may artificially elevate ____________, leading to precipitation of calcium carbonate.
A. Bleaching agents
B. Sodium hypochlorite
C. pH
D. Hypochlorite form
E. None of the Above

276. While NaOCl eliminates low ____________ corrosion as a concern, the use of large quantities in contaminated systems still introduces a high concentration of the chloride ion, which can be very aggressive to cooling system metals. Many of the other problems associated with chlorine remain present with sodium hypochlorite.
A. Bleaching agents
B. Sodium hypochlorite
C. pH
D. Hypochlorite form
E. None of the Above

277. Sodium hypochlorite has a long history. Around 1785 the Frenchman Berthollet developed liquid ______________based on sodium hypochlorite.
A. Bleaching agents
B. Sodium hypochlorite
C. pH
D. Hypochlorite form
E. None of the Above

278. ______________is a clear, slightly yellowish solution with a characteristic odor.
A. pH
B. Sodium hypochlorite
C. Salt electrolysis system
D. Caustic soda
E. None of the Above

279. ______________has a relative density of is 1,1 (5,5% watery solution).
A. pH
B. Sodium hypochlorite
C. Salt electrolysis system
D. Caustic soda
E. None of the Above

280. Sodium hypochlorite as a bleaching agent for domestic use it usually contains 5% sodium hypochlorite (with a _______________ of around 11, it is irritating). If it is more concentrated, it contains a concentration 10-15% sodium hypochlorite (with a pH of around 13, it burns and is corrosive).
A. pH
B. Sodium hypochlorite
C. Salt electrolysis system
D. Caustic soda
E. None of the Above

281. Sodium hypochlorite is _______________.
A. pH
B. Sodium hypochlorite
C. Salt electrolysis system
D. Caustic soda
E. None of the Above

282. Chlorine evaporates at a rate of 0,75 gram active chlorine per day from the solution. Then heated sodium hypochlorite disintegrates. This also happens when sodium hypochlorite comes in contact with acids, sunlight, certain metals and poisonous and corrosive gasses, including chlorine gas. _______________is a strong oxidator and reacts with flammable compounds and reductors.
A. pH
B. Sodium hypochlorite
C. Salt electrolysis system
D. Caustic soda
E. None of the Above

283. Sodium hypochlorite solution is a _______________that is inflammable. These characteristics must be kept in mind during transport, storage and use of sodium hypochlorite.
A. pH
B. Sodium hypochlorite
C. Salt electrolysis system
D. Caustic soda
E. None of the Above

284. Due to the presence of _______________in sodium hypochlorite, the pH of the water is increased.
A. pH
B. Sodium hypochlorite
C. Salt electrolysis system
D. Caustic soda
E. None of the Above

285. When ________________dissolves in water, two substances form, which play a role in oxidation and disinfection.
A. pH
B. Sodium hypochlorite
C. Salt electrolysis system
D. None of the Above

286. These are hypochlorous acid (HOCl) and the less active _______________
A. pH
B. Sodium hypochlorite
C. Salt electrolysis system
D. Caustic soda
E. None of the Above

287. The _______________ of the water determines how much hypochlorous acid is formed. While sodium hypochlorite is used, acetic acid (HCl) is used to lower the pH.
A. pH
B. Sodium hypochlorite
C. Salt electrolysis system
D. Caustic soda
E. None of the Above

288. Sulfuric acid (H2SO4) can be used as an alternative for acetic acid. Less harmful gasses are produced when _______________is used. Sulfuric acid is a strong acid that strongly reacts with bases and that is very corrosive.
A. pH
B. Sodium hypochlorite
C. Salt electrolysis system
D. Caustic soda
E. None of the Above

289. Sodium hypochlorite can be produced by dissolving salt in softened water, which results in a concentrated brine solution. The solution is electrolyzed and forms a _______________solution in water. This solution contains 150 g active chlorine (Cl2) per liter. During this reaction the explosive hydrogen gas is also formed.
A. pH
B. Sodium hypochlorite
C. Salt electrolysis system
D. Caustic soda
E. None of the Above

290. Sodium hypochlorite can be produced by adding chlorine gas (Cl2) to _______________.
A. pH
B. Sodium hypochlorite
C. Salt electrolysis system
D. Caustic soda
E. None of the Above

291. Hypochlorite neutralizes sulphur hydrogen gas (SH) and ammonia (NH3). It is also used to _______________in metal industries.
A. pH
B. Sodium hypochlorite
C. Salt electrolysis system
D. Caustic soda
E. None of the Above

292. Hypochlorite can be used to prevent algae and _______________in cooling towers. In water treatment, hypochlorite is used to disinfect water. In households, hypochlorite is used frequently for the purification and disinfection of the house.
A. pH
B. Sodium hypochlorite
C. Salt electrolysis system
D. Caustic soda
E. None of the Above

293. _______________is divided into hydrochloric acid (HCl) and oxygen (O). The oxygen atom is a very strong oxidator.
A. pH
B. Sodium hypochlorite
C. Salt electrolysis system
D. Caustic soda
E. None of the Above

294. _______________is effective against bacteria, viruses and fungi. Sodium hypochlorite disinfects the same way as chlorine does.
A. pH
B. Sodium hypochlorite
C. Salt electrolysis system
D. Caustic soda
E. None of the Above

295. The advantage of the _______________ is that no transport or storage of sodium hypochlorite is required. When sodium hypochlorite is stored for a long time, it becomes inactive.
A. pH
B. Sodium hypochlorite
C. Salt electrolysis system
D. Caustic soda
E. None of the Above

296. Another advantage of the on site process is that chlorine lowers the pH and no other acid is required to lower pH. The _______________ that is produced is explosive and as a result ventilation is required for explosion prevention. This system is slow and a buffer of extra hypochlorous acid needs to be used.
A. Poisonous gasses
B. Hydrogen gas
C. Pathogenic microorganisms
D. None of the Above

297. When sodium hypochlorite is used, acetic or sulphuric acid are added to the water. An overdose can produce _______________. If the dosage is too low, the pH becomes too high and can irritate the eyes.
A. Poisonous gasses
B. Hydrogen gas
C. Pathogenic microorganisms
D. None of the Above

298. Because sodium hypochlorite is used both to oxidize pollutions (urine, sweat, cosmetics) and to remove ______________, the required concentration of sodium hypochlorite depends on the concentrations of these pollutions. The amount of organic pollution determines the required concentration. If the water is filtered before sodium hypochlorite is applied, less sodium hypochlorite is needed.
A. Poisonous gasses
B. Hydrogen gas
C. Pathogenic microorganisms
D. None of the Above

299. _____________ with chlorine is very popular in water and wastewater treatment because of its low cost, ability to form a residual, and its effectiveness at low concentrations.
A. Chlorination
B. HOCL
C. Disinfection
D. Disinfectant
E. None of the Above

300. Although it is used as a _____________, it is a dangerous and potentially fatal chemical if used improperly. Despite the fact the disinfection process may seem simple, it is actually a quite complicated process.
A. Chlorination
B. HOCL
C. Disinfection
D. Disinfectant
E. None of the Above

301. _____________ in wastewater treatment systems is a fairly complex science which requires knowledge of the plant's effluent characteristics. When free chlorine is added to the wastewater, it takes on various forms depending on the pH of the wastewater.
A. Chlorination
B. HOCL
C. Disinfection
D. Disinfectant
E. None of the Above

302. Ammonia present in the effluent can also cause problems as ____________ are formed, which have very little disinfecting power.
A. Chlorination
B. HOCL
C. Disinfection
D. Disinfectant
E. None of the Above

303. Some methods to overcome the types of ____________ formed are to adjust the pH of the wastewater prior to chlorination or to simply add a larger amount of chlorine.
A. Chlorine
B. Chlorine gas
C. Hypochlorus acid
D. Ammonia

304. An adjustment in the pH would allow the operators to form the most desired form of chlorine, ____________, which has the greatest disinfecting power.
A. Chlorination
B. Chlorine gas
C. Hypochlorus acid
D. Ammonia
E. NaOCl

305. Adding larger amounts of chlorine would be an excellent method to combat the chloramines because the ammonia present would bond to the chlorine but further addition of chlorine would stay in the ____________or hypochlorite ion state.
A. Chlorination
B. Chlorine gas
C. Hypochlorus acid
D. Ammonia
E. NaOCl

306. Chlorine gas, when exposed to water reacts readily to form ____________, HOCl, and hydrochloric acid. $Cl_2 + H_2O \rightarrow HOCl + HCl$
A. Chlorination
B. Chlorine gas
C. Hypochlorus acid
D. Ammonia
E. NaOCl

307. If the pH of the wastewater is greater than 8, the ____________will dissociate to yield hypochlorite ion. $HOCl \leftrightarrow H^+ + OCl^-$ If, however, the pH is much less than 7, then HOCl will not dissociate.
A. Chlorination
B. Chlorine gas
C. Hypochlorus acid
D. Ammonia
E. NaOCl

308. If ____________ is present in the wastewater effluent, then the hypochlorus acid will react to form one three types of chloramines depending on the pH, temperature, and reaction time.
A. Chlorination
B. Chlorine gas
C. Hypochlorus acid
D. Ammonia
E. NaOCl

309. _____________ solutions degrade with Chlorate-forming reaction due to age, temperature, light and minor reduction in pH.
A. Chlorination
B. Chlorine gas
C. Hypochlorus acid
D. Ammonia
E. NaOCl

310. _____________ solutions degrade with Oxygen-producing reaction that occurs when metals, such as iron, copper or nickel, or metal oxides are brought into contact with the solution.
A. Chlorination
B. Chlorine gas
C. Hypochlorus acid
D. Ammonia
E. NaOCl

311. NaOCl solutions degrade with _____________-producing reaction when solution pH falls below 6.
A. Chlorination
B. Chlorine
C. Hypochlorus acid
D. Ammonia
E. NaOCl

312. Initial solution strength may affect the stability of a _____________ solution.
A. Chlorination
B. Chlorine gas
C. Hypochlorus acid
D. Ammonia
E. NaOCl

313. pH solution may affect the stability of a _____________ solution.
A. Chlorination
B. Chlorine gas
C. Hypochlorus acid
D. Ammonia
E. NaOCl

314. Temperature of the solution may affect the stability of a _____________ solution.
A. Chlorination
B. Chlorine gas
C. Hypochlorus acid
D. Ammonia
E. NaOCl

315. Exposure of the solution to sunlight may affect the stability of a _____________ solution.
A. Chlorination
B. Chlorine gas
C. Hypochlorus acid
D. Ammonia
E. NaOCl

316. There is no threshold value for sodium hypochlorite exposure. Various health effects occur after exposure to ______________.
A. Chlorination
B. Chlorine gas
C. Hypochlorus acid
D. NaOCl

317. People are exposed to sodium hypochlorite by inhalation of aerosols. This causes coughing and a sore throat. After swallowing ______________the effects are stomach ache, a burning sensation, coughing, diarrhea, a sore throat and vomiting.
A. Chlorination
B. Chlorine gas
C. Hypochlorus acid
D. Ammonia
E. NaOCl

318. ______________on skin or in eyes causes redness and pain. After prolonged exposure, the skin can become sensitive.
A. Chlorination
B. Chlorine gas
C. Hypochlorus acid
D. Ammonia
E. NaOCl

319. ______________is poisonous for water organisms. It is mutagenic and very toxic when it comes in contact with ammonium salts.
A. Chlorination
B. Chlorine gas
C. THM
D. Ammonia
E. None of the Above

320. Hypochlorite solutions can liberate toxic gases such as ______________. Chlorine's odor or irritant properties generally provide adequate warning of hazardous concentrations.
A. Chlorination
B. Chlorine
C. Hypochlorus acid
D. Ammonia
E. NaOCl

321. Prolonged, low-level exposures, such as those that occur in the workplace, can lead to olfactory fatigue and tolerance of ______________ irritant effects.
A. Chlorination
B. Chlorine
C. Hypochlorus acid
D. Ammonia
E. NaOCl

322. ______________ is heavier than air and may cause asphyxiation in poorly ventilated, enclosed, or low-lying areas.
A. Chlorination
B. Chlorine gas
C. Hypochlorus acid
D. Ammonia
E. NaOCl

323. Direct contact with hypochlorite solutions, powder, or ____________causes severe chemical burns, leading to cell death and ulceration. Because of their relatively larger surface area/weight ratio, children are more vulnerable to toxicants affecting the skin.
A. Chlorination
B. Chlorine gas
C. Hypochlorus acid
D. Ammonia
E. None of the Above

324. Ingestion of hypochlorite solutions causes vomiting and corrosive injury to the gastrointestinal tract. Household bleaches (3 to 6% sodium hypochlorite) usually cause ______________, but rarely cause strictures or serious injury such as perforation.
A. Chlorination
B. Chlorine gas
C. Hypochlorus acid
D. Ammonia
E. None of the Above

325. Commercial bleaches may contain higher concentrations of ______________and are more likely to cause serious injury.
A. Chlorination
B. Chlorine gas
C. Hypochlorus acid
D. Ammonia
E. NaOCl

326. ____________is rare, but has been reported following the ingestion of household bleach. Pulmonary complications resulting from aspiration may also be seen after ingestion.
A. Chlorination
B. Chlorine gas
C. Hypochlorus acid
D. Calcium hypochlorite
E. None of the Above

327. Sodium and calcium hypochlorite are manufactured by the ______________ of sodium hydroxide or lime.
A. Chlorination
B. Chlorine gas
C. Hypochlorus acid
D. Calcium hypochlorite
E. None of the Above

328. Sodium and ______________are used primarily as oxidizing and bleaching agents or disinfectants. They are components of commercial bleaches, cleaning solutions, and disinfectants for drinking water and wastewater purification systems and swimming pools.
A. Chlorination
B. Chlorine gas
C. Hypochlorus acid
D. Calcium hypochlorite
E. None of the Above

329. It can easily and be stored and transported when it is produced on-site. Dosage is simple. Transport and storage of sodium hypochlorite are safe. Sodium hypochlorite is as effective as chlorine gas for disinfection. ______________produces residual disinfectant.
A. Chlorination
B. Chlorine gas
C. Hypochlorus acid
D. Calcium hypochlorite
E. None of the Above

330.______________is a dangerous and corrosive substance. While working with sodium hypochlorite, safety measures have to be taken to protect workers and the environment.
A. Chlorination
B. Chlorine gas
C. Hypochlorus acid
D. Calcium hypochlorite
E. None of the Above

Respiratory Protection Section

331. In the control of those occupational diseases caused by breathing air contaminated with harmful dusts, fogs, fumes, mists, gases, smokes, sprays, or vapors, the primary objective shall be to prevent ______________.
A. Employer
B. Employee
C. Atmospheric contamination
D. Respirator
E. None of the Above

332. The above rule statement shall be accomplished as far as feasible by accepted engineering ______________ (for example, enclosure or confinement of the operation, general and local ventilation, and substitution of less toxic materials).
A. Employer
B. Employee
C. Atmospheric contamination
D. Respirator
E. None of the Above

333 .When effective engineering controls are not feasible, or while they are being instituted, appropriate ______________ shall be used pursuant to the RP Rule.
A. Employer
B. Employee
C. Atmospheric contamination
D. Respirator
E. None of the Above

334. Respirators shall be provided by the ______________ when such equipment is necessary to protect the health of the employee.
A. Employer
B. Employee
C. Atmospheric contamination

335. The ______________ shall provide the respirators which are applicable and suitable for the purpose intended.
A. Employer
B. Employee
C. Atmospheric contamination
D. Respirator
E. None of the Above

336. Air-purifying respirator means a respirator with an air-purifying filter, cartridge, or canister that removes ______________by passing ambient air through the air-purifying element.
A. Employer
B. Employee
C. Atmospheric contamination
D. Respirator
E. None of the Above

337. Atmosphere-supplying ______________ means a respirator that supplies the respirator user with breathing air from a source independent of the ambient atmosphere, and includes supplied-air respirators (SARs) and self-contained breathing apparatus (SCBA) units.
A. Employer
B. Employee
C. Atmospheric contamination
D. Respirator
E. None of the Above

338. Canister or cartridge means a container with ______________, or combination of these items, which removes specific contaminants from the air passed through the container.
A. Employer
B. Employee
C. Atmospheric contamination
D. Respirator
E. None of the Above

339. Demand ______________ means an atmosphere-supplying respirator that admits breathing air to the facepiece only when a negative pressure is created inside the facepiece by inhalation.
A. Employer
B. Employee
C. Atmospheric contamination
D. Respirator
E. None of the Above

340. ______________means any occurrence such as, but not limited to, equipment failure, rupture of containers, or failure of control equipment that may or does result in an uncontrolled significant release of an airborne contaminant.
A. Employer
B. Employee
C. Atmospheric contamination
D. Respirator
E. None of the Above

341. ______________exposure means exposure to a concentration of an airborne contaminant that would occur if the employee were not using respiratory protection.
A. Employer
B. Employee
C. Atmospheric contamination
D. Respirator
E. None of the Above

342. End-of-service-life indicator (ESLI) means a system that warns the ______________ user of the approach of the end of adequate respiratory protection, for example, that the sorbent is approaching saturation or is no longer effective.
A. Employer
B. Employee
C. Atmospheric contamination
D. Respirator
E. None of the Above

343. ______________means a respirator intended to be used only for emergency exit.
A. Fit factor
B. Escape-only respirator
C. Filter or air purifying element
D. Helmet
E. Fit test

344. ______________means a component used in respirators to remove solid or liquid aerosols from the inspired air.
A. Fit factor
B. Escape-only respirator
C. Filter or air purifying element
D. Helmet
E. Fit test

345. Filtering facepiece (dust mask) means a negative pressure particulate respirator with a filter as an integral part of the ______________ or with the entire facepiece composed of the filtering medium.
A. Fit factor
B. Escape-only respirator
C. Filter or air purifying element
D. Helmet
E. Facepiece

346. ______________means a quantitative estimate of the fit of a particular respirator to a specific individual, and typically estimates the ratio of the concentration of a substance in ambient air to its concentration inside the respirator when worn.
A. Fit factor
B. Escape-only respirator
C. Filter or air purifying element
D. Helmet
E. Fit test

347. ______________means the use of a protocol to qualitatively or quantitatively evaluate the fit of a respirator on an individual.
A. Fit factor
B. Escape-only respirator
C. Filter or air purifying element
D. Helmet
E. Fit test

348. ______________ means a rigid respiratory inlet covering that also provides head protection against impact and penetration.
A. Fit factor
B. Escape-only respirator
C. Filter or air purifying element
D. Helmet
E. Fit test

349. ______________means a filter that is at least 99.97% efficient in removing monodisperse particles of 0.3 micrometers in diameter.
A. Fit factor
B. Escape-only respirator
C. High efficiency particulate air (HEPA) filter
D. Helmet
E. Fit test

350. Hood means a respiratory inlet covering that completely covers the ______________and may also cover portions of the shoulders and torso.
A. Facepiece
B. Head and neck
C. Dangerous atmosphere
D. Oxygen
E. Respirator

351. Immediately dangerous to life or health (IDLH) means an ______________ that poses an immediate threat to life, would cause irreversible adverse health effects, or would impair an individual's ability to escape from a dangerous atmosphere.
A. Facepiece
B. Head and neck
C. Atmosphere
D. Oxygen
E. Respirator

352. Interior structural firefighting means the physical activity of ______________, rescue or both, inside of buildings or enclosed structures which are involved in a fire situation beyond the incipient stage.
A. Fire suppression
B. Head and neck
C. Dangerous atmosphere
D. Oxygen
E. Respirator

353. Loose-fitting ______________ means a respiratory inlet covering that is designed to form a partial seal with the face.
A. Facepiece
B. Head and neck
C. Dangerous atmosphere
D. Oxygen
E. Respirator

354. Negative pressure respirator (tight fitting) means a respirator in which the air pressure inside the facepiece is negative during inhalation with respect to the______________ outside the respirator.
A. Facepiece
B. Head and neck
C. Ambient air pressure
D. Oxygen
E. Respirator

355. Oxygen deficient atmosphere means an atmosphere with an ______________ content below 19.5% by volume.
A. Facepiece
B. Head and neck
C. Dangerous atmosphere
D. Oxygen
E. Respirator

356. Physician or other ______________ means an individual whose legally permitted scope of practice (i.e., license, registration, or certification) allows him or her to independently provide, or be delegated the responsibility to provide, some or all of the health care services.
A. Qualitative fit test
B. Respirator
C. Licensed health care professional
D. Self-contained breathing apparatus
E. Air-purifying device

357. Positive pressure respirator means a respirator in which the pressure inside the ______________ inlet covering exceeds the ambient air pressure outside the respirator.
A. Qualitative fit test
B. Respiratory
C. Licensed health care professional
D. Self-contained breathing apparatus
E. Air-purifying device

358. Powered air-purifying respirator (PAPR) means an ______________ respirator that uses a blower to force the ambient air through air-purifying elements to the inlet covering.
A. Qualitative fit test
B. Respirator
C. Licensed health care professional
D. Self-contained breathing apparatus
E. Air-purifying

359. Pressure demand ______________ means a positive pressure atmosphere-supplying respirator that admits breathing air to the facepiece when the positive pressure is reduced inside the facepiece by inhalation.
A. Quantifier fit test
B. Respirator
C. Licensed health care professional
D. Self-contained breathing apparatus
E. Air-purifying device

360. ______________ means a pass/fail fit test to assess the adequacy of respirator fit that relies on the individual's response to the test agent.
A. Qualitative/Quantitative fit test
B. Respirator
C. Licensed health care professional
D. Self-contained breathing apparatus
E. Air-purifying device

361. ______________ means an assessment of the adequacy of respirator fit by numerically measuring the amount of leakage into the respirator.
A. Qualitative/Quantitative fit test
B. Respirator
C. Licensed health care professional
D. Self-contained breathing apparatus
E. Air-purifying device

362. Respiratory inlet covering means that portion of a ______________ that forms the protective barrier between the user's respiratory tract and an air-purifying device or breathing air source, or both. It may be a facepiece, helmet, hood, suit, or a mouthpiece respirator with nose clamp.
A. Qualitative/Quantitative fit test
B. Respirator
C. Licensed health care professional
D. Self-contained breathing apparatus
E. Air-purifying device

363. ______________ means an atmosphere-supplying respirator for which the breathing air source is designed to be carried by the user.
A. Qualitative/Quantitative fit test
B. Respirator
C. Licensed health care professional
D. Self-contained breathing apparatus
E. Air-purifying device

364. Service life means the period of time that a ______________, filter or sorbent, or other respiratory equipment provides adequate protection to the wearer.
A. Qualitative/Quantitative fit test
B. Respirator
C. Licensed health care professional
D. Self-contained breathing apparatus
E. Air-purifying device

365. Supplied-air respirator (SAR) or airline______________ means an atmosphere-supplying respirator for which the source of breathing air is not designed to be carried by the user.
A. Qualitative/Quantitative fit test
B. Respirator
C. Licensed health care professional
D. Self-contained breathing apparatus
E. Air-purifying device

366. Tight-fitting ______________ means a respiratory inlet covering that forms a complete seal with the face.
A. Facepiece
B. Seal check
C. Respirator(s)
D. Employer
E. Atmosphere-supplying respirators

367. User ______________ means an action conducted by the respirator user to determine if the respirator is properly seated to the face.
A. RP program
B. Seal check
C. Respirator(s)
D. Employer
E. Atmosphere-supplying respirators

368. In any workplace where respirators are necessary to protect the health of the employee or whenever respirators are required by the employer, the employer shall establish and implement a written ______________with worksite-specific procedures.
A. RP program
B. Seal check
C. Respirator(s)
D. Employer
E. Atmosphere-supplying respirators

369. The ______________shall be updated as necessary to reflect those changes in workplace conditions that affect respirator use.
A. RP program
B. Seal check
C. Respirator(s)
D. Employer
E. Atmosphere-supplying respirators

370. Your employer shall include in the program, procedures for selecting ______________for use in the workplace.
A. RP program
B. Seal check
C. Respirator(s)
D. Employer
E. Atmosphere-supplying respirators

371. Your employer shall include in the program, medical evaluations of ______________ required to use respirators.
A. RP program
B. Seal check
C. Respirator(s)
D. Employees
E. Atmosphere-supplying respirators

372. Your employer shall include in the program, fit testing procedures for tight-fitting ______________.
A. RP program
B. Seal check
C. Respirator(s)
D. Employer
E. Atmosphere-supplying respirators

373. Your employer shall include in the program, procedures for proper use of ______________ in routine and reasonably foreseeable emergency situations.
A. RP program
B. Seal check
C. Respirator(s)
D. Employer
E. Atmosphere-supplying respirators

374. Your ______________ shall include in the program, procedures and schedules for cleaning, disinfecting, storing, inspecting, repairing, discarding, and otherwise maintaining respirators.
A. RP program
B. Seal check
C. Respirator(s)
D. Employer
E. Atmosphere-supplying respirators

375. Your employer shall include in the program, procedures to ensure adequate air quality, quantity, and flow of breathing air for ______________.
A. RP program
B. Seal check
C. Respirator(s)
D. Employer
E. Atmosphere-supplying respirators

376. Your ______________ shall include in the program, training of employees in the respiratory hazards to which they are potentially exposed during routine and emergency situations.
A. RP program
B. Seal check
C. Respirator(s)
D. Employer
E. Atmosphere-supplying respirators

377. Your employer shall include in the program, training of employees in the proper use of ______________, including putting on and removing them, any limitations on their use, and their maintenance.
A. RP program
B. Seal check
C. Respirator(s)
D. Employer
E. Atmosphere-supplying respirators

378. An employer may provide respirators at the request of ______________or permit employees to use their own respirators, if the employer determines that such respirator use will not in itself create a hazard.
A. RP program
B. Seal check
C. Respirator(s)
D. Employees
E. Atmosphere-supplying respirators

379. The ______________ must establish and implement those elements of a written respiratory protection program necessary to ensure that any employee using a respirator voluntarily is medically able to use that respirator, and that the respirator is cleaned, stored, and maintained so that its use does not present a health hazard to the user.
A. Program effectiveness
B. Health hazard
C. Respirator(s)
D. Employer
E. Employee

380. Exception: ______________ are not required to include in a written respiratory protection program those employees whose only use of respirators involves the voluntary use of filtering facepieces (dust masks).
A. Program effectiveness
B. Health hazard
C. Respirator(s)
D. Employer
E. Employee

381. The employer shall designate a program administrator who is qualified by appropriate training or experience that is commensurate with the complexity of the program to administer or oversee the respiratory protection program and conduct the required evaluations of ______________.
A. Program effectiveness
B. Health hazard
C. Respirator(s)
D. Employer
E. Employee

382. The employer shall provide respirators, training, and medical evaluations at no cost to the ______________.

A. Program effectiveness
B. Health hazard
C. Respirator(s)
D. Employer
E. Employee

383. Selection of respirators. Requires the ______________ to evaluate respiratory hazard(s) in the workplace, identify relevant workplace and user factors, and base respirator selection on these factors.

A. Program effectiveness
B. Health hazard
C. Respirator(s)
D. Employer
E. Employee

384. The ______________ shall select and provide an appropriate respirator based on the respiratory hazard(s) to which the worker is exposed and workplace and user factors that affect respirator performance and reliability.

A. Program effectiveness
B. Health hazard
C. Respirator(s)
D. Employer
E. Employee

385. The ______________ shall select a NIOSH-certified respirator. The respirator shall be used in compliance with the conditions of its certification.

A. Program effectiveness
B. Health hazard
C. Respirator(s)
D. Employer
E. Employee

386. The ______________ shall identify and evaluate the respiratory hazard(s) in the workplace; this evaluation shall include a reasonable estimate of employee exposures to respiratory hazard(s) and an identification of the contaminant's chemical state and physical form.

A. Program effectiveness
B. Health hazard
C. Respirator(s)
D. Employer
E. Employee

387. Where the employer cannot identify or reasonably estimate the employee exposure, the ______________ shall consider the atmosphere to be IDLH.

A. Program effectiveness
B. Health hazard
C. Respirator(s)
D. Employer
E. Employee

388. The employer shall select respirators from a sufficient number of ______________ models and sizes so that the respirator is acceptable to, and correctly fits, the user.
A. Program effectiveness
B. Health hazard
C. Respirator(s)
D. Employer
E. Employee

389. Respirators for IDLH atmospheres. The ______________ shall provide the following respirators for employee use in IDLH atmospheres:
A. Program effectiveness
B. Health hazard
C. Respirator(s)
D. Employer
E. Employee

390. A ______________certified by NIOSH for a minimum service life of thirty minutes.
A. Full facepiece pressure demand SCBA
B. IDLH atmospheres
C. Respirator(s)
D. Employer
E. Not IDLH

391. Respirators provided only for escape from ______________shall be NIOSH-certified for escape from the atmosphere in which they will be used.
A. Full facepiece pressure demand SCBA
B. IDLH atmospheres
C. Respirator(s)
D. Employer
E. Not IDLH

392. All oxygen-deficient atmospheres shall be considered ______________. Exception: If the employer demonstrates that, under all foreseeable conditions.
A. Full facepiece pressure demand SCBA
B. IDLH atmospheres
C. Respirator(s)
D. Employer
E. Not IDLH

393. Respirators for atmospheres that are ______________. The employer shall provide a respirator that is adequate to protect the health of the employee and ensure compliance with all other OSHA statutory and regulatory requirements, under routine and reasonably foreseeable emergency situations.
A. Full facepiece pressure demand SCBA
B. IDLH atmospheres
C. Respirator(s)
D. Employer
E. Not IDLH

394. The ______________ selected shall be appropriate for the chemical state and physical form of the contaminant.
A. Full facepiece pressure demand SCBA
B. IDLH atmospheres
C. Respirator(s)
D. Employer
E. Not IDLH

395. For protection against gases and vapors, your employer shall provide an atmosphere-supplying ______________.
A. Full facepiece pressure demand SCBA
B. IDLH atmospheres
C. Respirator(s)
D. Employer
E. Not IDLH

396. For protection against gases and vapors, your ______________ shall provide an air-purifying respirator, provided that the respirator is equipped with an end-of-service-life indicator (ESLI) certified by NIOSH for the contaminant.
A. Full facepiece pressure demand SCBA
B. IDLH atmospheres
C. Respirator(s)
D. Employer
E. Not IDLH

397. If there is no ESLI appropriate for conditions in the employer's workplace, the ______________ implements a change schedule for canisters and cartridges that is based on objective information or data that will ensure that canisters and cartridges are changed before the end of their service life.
A. Full facepiece pressure demand SCBA
B. IDLH atmospheres
C. Respirator(s)
D. Employer
E. Not IDLH

398. The employer shall describe in the respirator program the information and data relied upon and the basis for the ______________change schedule and the basis for reliance on the data.
A. Canister and cartridge
B. Particulates
C. Air-purifying respirator
D. Aerodynamic diameters
E. None of the Above

399. For protection against ______________, the employer shall provide an atmosphere-supplying respirator.
A. Canister and cartridge
B. Particulates
C. Air-purifying respirator
D. Aerodynamic diameters
E. None of the Above

400. For protection against ______________, the employer shall provide an air-purifying respirator equipped with a filter certified by NIOSH.

A. Canister and cartridge
B. Particulates
C. Air-purifying respirator
D. Aerodynamic diameters
E. None of the Above

You are finished with your assignment; please complete the Registration page and the Customer Survey sheet on the rear page. You can fax this information to us.

"For God so loved the world that he gave his one and only Son, that whoever believes in him shall not perish but have eternal life. For God did not send his Son into the world to condemn the world, but to save the world through him.

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

Call us a couple hours after faxing to ensure that we received your paperwork.

Rush Grading Service
If you need this assignment graded and the results mailed to you within a 48-hour period, prepare to pay an additional rush service handling fee of $40.00. This fee may not cover postage costs. If you need this service, simply write RUSH on the top of your Registration Form. We will place you in the front of the grading and processing line.

Thank you…