

**Registration form**

**Metalloids 109 CEU Training Course \$100  
48 HOUR RUSH ORDER PROCESSING FEE ADDITIONAL \$50.00**

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

Name \_\_\_\_\_ Signature \_\_\_\_\_  
*(This will appear on your certificate as above)*

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

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

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Wastewater Treatment \_\_\_\_\_ Other \_\_\_\_\_

**Technical Learning College TLC PO Box 3060, Chino Valley, AZ 86323  
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## **State Approval Listing URL...**

<http://www.abctlc.com/downloads/PDF/CEU%20State%20Approvals.pdf>

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

## **AFFIDAVIT OF EXAM COMPLETION**

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

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

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For security purposes, please fax or e-mail a copy of your driver's license and always call us to confirm we've received your assignment and to confirm your identity.

# Metalloids 109 Answer Key

Name \_\_\_\_\_

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Did you check with your State agency to ensure this course is accepted for credit?  
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***You can electronically complete this assignment in Adobe Acrobat DC.***

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

1. A B C D

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| 70. A B     | 91. A B C D  | 112. A B C D | 133. A B C D |
| 71. A B C D | 92. A B C D  | 113. A B C D | 134. A B C D |
| 72. A B C D | 93. A B C D  | 114. A B C D | 135. A B C D |
| 73. A B C D | 94. A B C D  | 115. A B     | 136. A B C D |
| 74. A B C D | 95. A B C D  | 116. A B C D | 137. A B C D |
| 75. A B C D | 96. A B C D  | 117. A B C D | 138. A B C D |
| 76. A B C D | 97. A B C D  | 118. A B C D | 139. A B C D |
| 77. A B C D | 98. A B C D  | 119. A B C D | 140. A B C D |
| 78. A B C D | 99. A B C D  | 120. A B C D | 141. A B C D |
| 79. A B C D | 100. A B C D | 121. A B C D | 142. A B C D |
| 80. A B C D | 101. A B C D | 122. A B C D | 143. A B C D |
| 81. A B C D | 102. A B C D | 123. A B C D | 144. A B C D |
| 82. A B C D | 103. A B C D | 124. A B C D | 145. A B C D |
| 83. A B C D | 104. A B     | 125. A B C D | 146. A B C D |
| 84. A B C D | 105. A B C D | 126. A B C D | 147. A B C D |
| 85. A B C D | 106. A B C D | 127. A B C D | 148. A B C D |
| 86. A B C D | 107. A B C D | 128. A B C D | 149. A B C D |
| 87. A B C D | 108. A B C D | 129. A B C D | 150. A B C D |
| 88. A B C D | 109. A B C D | 130. A B C D |              |
| 89. A B C D | 110. A B C D | 131. A B C D |              |

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**Please Sign that you understand and will abide with TLC's Rules.**

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**Signature**

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

## METALLOIDS 109 CEU TRAINING COURSE

### CUSTOMER SERVICE RESPONSE CARD

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

Please rate the difficulty of your course.

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

5. How would you improve the course?

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## Metalloids 109 CEU Training Course Assignment

You will have 90 days from the start of this assignment to have successfully completed and submit this assignment back to TLC. If you need course assistance, please call us at (928) 468-0665. You can find online assistance for this course on the in the Search function on Adobe Acrobat PDF to help find the answers.

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

### **Metalloid Section**

1. Some water quality parameters to consider monitoring, depending on your arsenic treatment technology, include?  
A. Heavy metals                      C. Iron, pH, manganese, alkalinity, and aluminum  
B. Near-metalloids                  D. None of the Above
2. Arsenic, boron, silicon, germanium, antimony and tellurium are commonly classified as?  
A. Metalloids                          C. Metals and nonmetals  
B. Organic contaminants            D. None of the Above
3. One or more from among selenium, polonium or which term are sometimes added to the list? Boron is sometimes excluded from the list, by itself or together with silicon.  
A. Arsenates                          C. Arsenide  
B. Arsenic alloys                      D. None of the Above
4. Which of the following is sometimes not regarded as a metalloid, the inclusion of antimony, polonium and astatine as metalloids has also been questioned?  
A. Platinum                          C. Selenium  
B. Tellurium                          D. None of the Above
5. Drinking water contaminants that can cause health effects after continuous long-term exposure at levels greater than the maximum contaminant level are considered which type of contaminants?  
A. Thermodynamically stable form    C. Chronic  
B. Incomplete                          D. None of the Above
6. Some examples of chronic drinking water contaminants regulated by EPA include inorganic contaminants like arsenic, cadmium, and copper; organic contaminants such as pesticides and which term and radiological contaminants like radium and uranium?  
A. Metalloids                          C. Metals and nonmetals  
B. Industrial chemicals                D. None of the Above
7. If your water system has installed \_\_\_\_\_ treatment, it might cause the water to react differently in the distribution system.  
A. Elements                          C. Inorganic contaminant or arsenic  
B. Organic contaminants or arsenic    D. None of the Above
8. A change in the taste, odor or appearance of the water at customers' taps may be the first indication of a metal or nonmetal.  
A. True    B. False

9. A metalloid is a \_\_\_\_\_ with properties that are in-between or a mixture of those of metals and nonmetals.

- A. Near-metalloid
- B. Metalloid
- C. Chemical element
- D. None of the Above

10. Other elements less commonly recognized as metalloids include carbon, \_\_\_\_\_, selenium, polonium and astatine.

- A. Platinum
- B. Tellurium
- C. Aluminum
- D. None of the Above

11. On a standard periodic table which missing term as well as the elements commonly recognized as metalloids, occur in or near a diagonal region of the p-block?

- A. Elements
- B. Metalloids
- C. Thermodynamically stable forms
- D. None of the Above

12. Some periodic tables include a dividing line between metals and nonmetals and it is generally the elements adjacent to this line or, less frequently, one or more of the elements adjacent to those elements, which are identified as?

- A. Metalloids
- B. Organic contaminants
- C. Metals and nonmetals
- D. None of the Above

### Near Metalloids

13. Elements such as these are occasionally called or described as, \_\_\_\_\_, or the like. They are located near the elements commonly recognized as metalloids, and usually classified as either metals or nonmetals.

- A. Elements
- B. Near-metalloids
- C. Thermodynamically stable forms
- D. None of the Above

14. Which of the following falls into this loose category tend to show 'odd' packing structures, marked covalent chemistry, and amphoterism?

- A. Metalloids
- B. Metals
- C. Organic contaminants
- D. None of the Above

15. Nonmetals in the \_\_\_\_\_ ' category include carbon, phosphorus, selenium and iodine.

- A. Organic contaminant
- B. Metal
- C. Near-metalloid
- D. None of the Above

16. This applies to their most thermodynamically stable forms under ambient conditions: carbon as graphite; phosphorus as black phosphorus; and which missing term as grey selenium?

- A. Black arsenic
- B. Arsenic alloys
- C. Selenium
- D. None of the Above

17. These elements are alternatively described as being \_\_\_\_\_, showing metalloidal character, or having metalloid-like or some metalloid(al) or metallic properties.

- A. Metalloids
- B. Near metalloidal
- C. Metals and nonmetals
- D. None of the Above



### Allotropes

18. The diamond allotrope of carbon is clearly?  
A. Element                      C. Nonmetallic  
B. A heavy metal                D. None of the Above
19. Phosphorus, selenium, tin, and which missing term have allotropes that display borderline or either metallic or nonmetallic behavior?  
A. Black arsenic                C. Bismuth  
B. Arsenic alloy                D. None of the Above

### Other Metalloids

20. Given there is no agreed definition of a metalloid, some other elements include hydrogen, beryllium, nitrogen, phosphorus, \_\_\_\_\_, zinc, gallium, tin, iodine, lead, bismuth and radon.  
A. Tellurium                      C. Sulfur  
B. Amorphous tellurium        D. None of the Above
21. Elements that are otherwise sometimes referred to as?  
A. Metalloids                    C. Elements  
B. Poor metals                 D. None of the Above
22. Which of the following can form alloys with, or modify the properties of, metals?  
A. Toxic metals                 C. Nonmetallic elements  
B. Metalloids                    D. None of the Above

### Heavy Metals

23. Heavy metals include the transition metals, some metalloids, lanthanides, and actinides.  
A. True    B. False
24. Which of the following is a member of a loosely defined subset of elements that exhibit metallic properties?  
A. Metalloid                      C. Toxic metal  
B. A heavy metal                D. None of the Above
25. Many different definitions have been proposed—some based on density, some on atomic number or atomic weight, and some on?  
A. Toxic metals                 C. Chemical properties or toxicity  
B. Metalloid                      D. None of the Above
26. Which of the following has been called a "misinterpretation" in an IUPAC technical report due to the contradictory definitions and its lack of a "coherent scientific basis"?  
A. Metalloid                      C. Toxic metal  
B. Heavy metal                    D. None of the Above
27. There is an alternative term \_\_\_\_\_, for which no consensus of exact definition exists either.  
A. Toxic metal                    C. Poor metal  
B. Metalloid                      D. None of the Above

28. Depending on context, \_\_\_\_\_ can include elements lighter than carbon and can exclude some of the heaviest metals.

- A. Metalloids
- B. Heavy metal
- C. Toxic metals
- D. None of the Above

29. Which of the following occur naturally in the ecosystem with large variations in concentration?

- A. Metalloids
- B. Heavy metals
- C. Toxic metals
- D. None of the Above

30. Waste-derived fuels are especially prone to contain heavy metals, so \_\_\_\_\_ are a concern in consideration of waste as fuel.

- A. Elements
- B. Heavy metals
- C. Poor metals
- D. None of the Above

31. One of the largest problems associated with the persistence of \_\_\_\_\_ is the potential for bioaccumulation and biomagnification causing heavier exposure for some organisms than is present in the environment alone.

- A. Elements
- B. Heavy metals
- C. Poor metals
- D. None of the Above

32. Living organisms require varying amounts of "heavy metals". Iron, cobalt, copper, \_\_\_\_\_, molybdenum, and zinc are required by humans.

- A. Tellurium
- B. Cadmium
- C. Manganese
- D. None of the Above

33. Other heavy metals such as mercury, plutonium, and lead are \_\_\_\_\_ that have no known vital or beneficial effect on organisms, and their accumulation over time in the bodies of animals can cause serious illness.

- A. Toxic metals
- B. Metalloid
- C. Elements lighter than carbon
- D. None of the Above

34. Certain elements that are normally toxic are, for certain organisms or under certain conditions, beneficial. Examples include vanadium, tungsten, and even?

- A. Platinum
- B. Cadmium
- C. Aluminum
- D. None of the Above

### Toxic Metals

35. Which of the following are metals that form poisonous soluble compounds and have no biological role?.

- A. Toxic metals
- B. Metalloids
- C. Manganese
- D. None of the Above

36. Often heavy metals are thought as synonymous, but \_\_\_\_\_ also have toxicity, such as beryllium, and not all heavy metals are particularly toxic, and some are essential, such as iron.

- A. Lighter metals
- B. Metalloids
- C. Heavy metals
- D. None of the Above

37. Which of the following is when considered in abnormally high, toxic doses? A difference is that there is no beneficial dose for these with no biological role.

- A. Metalloids
- B. Trace elements
- C. Toxic metals
- D. None of the Above

38. Toxic metals sometimes imitate the action of an essential element in the body, interfering with the metabolic process to cause illness.

- A. True
- B. False

39. \_\_\_\_\_ particularly heavy metals are toxic, but some heavy metals are essential, and some, such as bismuth, have a low toxicity.

- A. Some metals
- B. Metalloid
- C. Many metals
- D. None of the Above

40. Most often the definition includes at least \_\_\_\_\_, lead, mercury and the radioactive metals. Metalloids (arsenic, polonium) may be included in the definition.

- A. Tellurium
- B. Cadmium
- C. Manganese
- D. None of the Above

### Heavy Metals in Water

41. Which of the following can be naturally occurring?

- A. Light metals
- B. Harmful health effects
- C. High heavy metals concentrations
- D. None of the Above

42. Water in these areas may have \_\_\_\_\_ due to the combination of naturally occurring deposits and mine waste.

- A. The metallic elements
- B. Human life-biological anomalies
- C. Heavy metal contamination
- D. None of the Above

43. Water samples are usually taken randomly within a contaminated area and offsite to identify the source of contamination and the pathway it travels, into the drinkable groundwater system.

- A. True
- B. False

44. Accurate determination of \_\_\_\_\_ is important to identify cumulative risks to people drinking water derived from these areas.

- A. The metallic elements
- B. Human life-biological anomalies
- C. Heavy metal contamination
- D. None of the Above

### Treating Heavy Metal Contamination in Water

45. Which of the following is a difficult expensive problem to address?

- A. Harmful health effect
- B. Water samples
- C. Heavy metal water contamination
- D. None of the Above

46. There are some new technologies being developed that actually treat the water in the ground which operate more efficiently and quickly, decreasing costs

- A. True
- B. False

47. If groundwater is contaminated with \_\_\_\_\_, an alternative source of drinking water must be used to prevent harmful health effects, until the water is treated to meet standards protective of human health and the environment

- A. Heavy metals
- B. Metalloids
- C. Toxic metals
- D. None of the Above

### Health Significance of Metals in the Environment

48. The heavy metals are those having densities five times greater than water, and the \_\_\_\_\_, those having lesser densities.

- A. Toxic metals
- B. Metalloids
- C. Light metals
- D. None of the Above

49. Which of the following are sodium, magnesium, and potassium?

- A. Toxic metals
- B. Metalloids
- C. Light metals
- D. None of the Above

50. Some metals such as sodium, potassium, \_\_\_\_\_, calcium, and iron are found in living tissue and are essential to human life-biological anomalies arise when they are depleted or removed.

- A. Platinum
- B. Manganese
- C. Magnesium
- D. None of the Above

### Arsenic Introduction Metalloid

51. Arsenic is a chemical element with symbol As and the atomic number is 33.

- A. 33
- B. 13
- C. 19
- D. None of the Above

52. Arsenic occurs in many minerals, usually in conjunction with which missing term and as a pure elemental crystal?

- A. Naturally occurring elements
- B. Inorganics
- C. Sulfur and metals
- D. None of the Above

53. Arsenic is a metalloid. It can exist in this missing term, although only the gray form has important use in industry.

- A. Various allotropes
- B. The trioxide
- C. Inorganic forms
- D. None of the Above

54. Which of the following is based solely on possible health risks and exposure over a lifetime with an adequate margin of safety, are called maximum contaminant level goals?

- A. MCLs
- B. MCLG
- C. Non-enforceable health goals
- D. None of the Above

55. In 1974, Congress passed the Safe Drinking Water Act. This law requires EPA to determine the level of contaminants in drinking water at which no adverse health effects are likely to occur.

- A. True
- B. False

56. Pollutants are any physical, chemical, biological or radiological substances or matter in water.

- A. True
- B. False

57. Which of the following for arsenic is zero?  
 A. MCLs                      C. Safe Drinking Water Act limit  
 B. MCLG                      D. None of the Above
58. Based on the MCLG, EPA has set an enforceable regulation for arsenic, called a maximum contaminant level, at?  
 A. 00.10 mg/L or 1 ppb                      C. 0.010 mg/L or 10 ppb  
 B. 0.050 mg/L or 1.0 ppb                      D. None of the Above
59. Which of the following are set as close to the health goals as possible, considering cost, benefits and the ability of public water systems to detect and remove contaminants?  
 A. MCLs                      C. ppb  
 B. MCLG                      D. None of the Above
60. The main uses of which missing term is for strengthening alloys of copper and especially lead?  
 A. Alloys of copper                      C. Metallic arsenic  
 B. Inorganic arsenic                      D. None of the Above
61. Arsenic is a common n-type dopant in semiconductor electronic devices, and the optoelectronic compound of \_\_\_\_\_ is the most common semiconductor in use after doped silicon.  
 A. Gallium arsenide                      C. Phosphorus acid  
 B. Arsenate                      D. None of the Above
62. Arsenic and its compounds, especially of this missing term are used in the production of pesticides, herbicides, and insecticides. These applications are declining, however.  
 A. Naturally occurring element                      C. Trioxide  
 B. Inorganic arsenic                      D. None of the Above
63. Which of the following of groundwater is a problem that affects millions of people across the world?  
 A. Metalloid contamination                      C. Inorganic arsenic contamination  
 B. Arsenic contamination                      D. None of the Above
64. Arsenic, a naturally occurring element, is found throughout the environment; for most people, food is?  
 A. A naturally occurring element                      C. The major source of exposure  
 B. Inorganic arsenic                      D. None of the Above
65. Acute high-level inhalation exposure to arsenic dust or fumes has resulted in gastrointestinal effects; central and peripheral nervous system disorders have occurred in workers acutely exposed to?  
 A. The Metalloid                      C. Inorganic arsenic  
 B. The trioxide                      D. None of the Above
66. Chronic inhalation exposure to this missing term in humans is associated with irritation of the skin and mucous membranes.  
 A. Alloys of copper                      C. The trioxide  
 B. Inorganic arsenic                      D. None of the Above

67. EPA has classified inorganic arsenic as a?  
A. Group A, human carcinogen                      C. Group B, human carcinogen  
B. Prevalence of type 2 diabetes                      D. None of the Above
68. Chronic dermal exposure has resulted in gastrointestinal effects, anemia, peripheral neuropathy, skin lesions, hyperpigmentation, and liver or kidney damage in humans  
A. True    B. False

### **Arsine**

69. EPA has classified arsine for Risk factor for type 2 diabetes.  
A. True    B. False
70. Drinking water regulations require public water systems to monitor for arsenic at the exit point from the distribution system.  
A. True    B. False
71. You may, however, want to test your distribution system water for arsenic to be sure that the water being delivered has arsenic levels below the?  
A. Drinking water regulations    C. MCL  
B. MCLG                                      D. None of the Above
72. If your water system has installed some form of arsenic treatment, keep in mind that the treatment you installed may change the \_\_\_\_\_ in other ways.  
A. Water quality                      C. Arsenic and hydrogen  
B. Distribution system    D. None of the Above
73. A change in the taste, odor or appearance of the water at \_\_\_\_\_ may be the first indication of a problem.  
A. Pipe scales                      C. Customers' taps  
B. The distribution system    D. None of the Above
74. Which of the following to consider when monitoring, depending on your arsenic treatment technology, include iron, pH, manganese, alkalinity, and aluminum?  
A. Arsenic acid                      C. Some water quality parameters  
B. Readily soluble                      D. None of the Above
75. The current drinking water standard or Maximum Contaminant Level set by the U.S. Environmental Protection Agency is 0.010 mg/L or parts per million, this is equivalent to?  
A. 50 ppb to 10 ppb                      C. 10 ug/L (micrograms per liter) or 10 ppb  
B. 0.010 mg/L or 100 ppb                      D. None of the Above
76. In 2001, the U.S. Environmental Protection Agency (EPA) reduced the regulatory MCL from which term on the basis on bladder and lung cancer risks?  
A. 50 ppb to 10 ppb                      C. 10 ug/L (micrograms per liter) or 10 ppb  
B. 0.010 mg/L or 100 ppb                      D. None of the Above
77. Long term exposure to drinking water containing arsenic at levels higher than \_\_\_\_\_ increases the chances of getting cancer, while for lower arsenic water levels the chances are less.  
A. 50 ppb to 10 ppb                      C. 10 ug/L (micrograms per liter) or 10 ppb  
B. 10 ppb                                      D. None of the Above

78. If your water has arsenic levels above which term, you should obtain drinking water from another source or install a home treatment device?

- A. 50 ppb to 10 ppb      C. 10 ug/L (micrograms per liter) or 10 ppb  
B. 10 ppb      D. None of the Above

79. Concentrations above which term will increase the risk of long-term or chronic health problems, the higher the level and length of exposure?

- A. 50 ppb to 10 ppb      C. 10 ug/L (micrograms per liter) or 10 ppb  
B. 10 ppb      D. None of the Above

80. Children are at greater risk (to any agent in water) because of their greater water consumption on a per unit?

- A. Body weight basis      C. Exposures and risks for the fetus  
B. Cancer risk is long-term exposure      D. None of the Above

81. Pregnant women may wish to reduce which term because arsenic has been found at low levels in mother's milk and will cross the placenta, increasing exposures and risks for the fetus?

- A. Arsenic exposures      C. Exposures and risks  
B. Risk factor      D. None of the Above

82. If your water has arsenic levels above this term, you should immediately stop drinking the water until you can either obtain water from another source or install and maintain treatment.

- A. 50 ppb to 10 ppb      C. 10 ug/L (micrograms per liter) or 10 ppb  
B. 200 ppb      D. None of the Above

### Physical Characteristics

83. The three most common arsenic allotropes are metallic gray, yellow and which term, with gray being the most common?

- A. Black arsenic      C. Phosphorus acid  
B. Aluminum arsenide      D. None of the Above

84. Which of the following is brittle and has a relatively low Mohs hardness of 3.5?

- A. Arsenate      C. Gray arsenic  
B. Solid yellow arsenic      D. None of the Above

85. Nearest and next-nearest neighbors form which term, with the three atoms in the same double-layer being slightly closer than the three atoms in the next?

- A. Synthetic arsenates      C. Alloy-like intermetallic compounds  
B. A distorted octahedral complex      D. None of the Above

86. Solid yellow arsenic is produced by rapid cooling of arsenic vapor,  $As_4$ . It is rapidly transformed into which term by light?

- A. Phosphorus acid      C. Gray arsenic  
B. Solid yellow arsenic      D. None of the Above

87. Which of the following is similar in structure to red phosphorus?  
A. Arsenic acid                      C. Arsenic trioxide  
B. Black arsenic                      D. None of the Above

### Isotopes

88. Naturally occurring term is composed of one stable isotope.  
A. Arsenic                      C. Phosphorus acid  
B. Arsenate                      D. None of the Above

### Chemistry

89. When heated in air, arsenic oxidizes to arsenic trioxide; the fumes from this reaction have an odor resembling garlic odor and can be detected on striking arsenide minerals such as with this term with a hammer.

- A. Synthetic arsenates                      C. Arsenic trioxide  
B. Arsenopyrite                      D. None of the Above

90. Arsenic along with some arsenic compounds sublimates upon heating at atmospheric pressure, converting directly to a gaseous form without an intervening liquid state at 614 °C.  
A. True    B. False

91. Arsenic makes arsenic acid with concentrated nitric acid, arsenious acid with dilute nitric acid, and which term with concentrated sulfuric acid?

- A. Synthetic arsenates    C. Alloy-like intermetallic compounds  
B. Arsenic trioxide                      D. None of the Above

### Compounds

92. Arsenic compounds resemble in some respects those of which missing term, which occupies the same group (column) of the periodic table?

- A. Phosphorus                      C. Phosphorus acid  
B. Solid yellow arsenic    D. None of the Above

93. The most common oxidation states for arsenic are: -3 in the arsenides, such as alloy-like intermetallic compounds; and +3 in the arsenites, arsenates (III), and?

- A. Synthetic arsenates                      C. Alloy-like intermetallic compounds  
B. Most organoarsenic compounds                      D. None of the Above

94. Which of the following also bonds readily to itself as seen in the square  $As_3-4$  ions in the mineral skutterudite?

- A. Arsenic                      C. Phosphorus acid  
B. Solid yellow arsenic                      D. None of the Above

### Inorganic

95. Arsenic forms colorless, odorless, crystalline oxides  $As_2O_3$  ("\_\_\_\_\_") and  $As_2O_5$ , which are hygroscopic and readily soluble in water to form acidic solutions.

- A. Synthetic arsenates    C. Alloy-like intermetallic compounds  
B. White arsenic                      D. None of the Above

96. Arsenic (V) acid is a weak acid, its salts are called?

- A. White arsenic                      C. Phosphorus acid  
B. Arsenates                      D. None of the Above



97. Synthetic arsenates include this term, calcium arsenate, and lead hydrogen arsenate.  
 A. Paris Green                      C. Alloy-like intermetallic compounds  
 B. Phosphorus acid                D. None of the Above
98. The protonation steps between the arsenate and arsenic acid are similar to those between?  
 A. Phosphate and phosphoric acid            C. Gray arsenic and Arsenous acid  
 B. Arsenates and Arsenous acid                D. None of the Above
99. Unlike phosphorus acid, this term is genuinely tribasic, with the formula  $\text{As}(\text{OH})_3$ .  
 A. Arsenous acid                      C. Phosphorus acid  
 B. Arsenate                            D. None of the Above
100. A broad variety of this term of arsenic are known.  
 A. Arsenic acid                      C. Alloy-like intermetallic compounds  
 B. Sulfur compounds                D. None of the Above
101. In which of the following terms, arsenic has a formal oxidation state of +2 in  $\text{As}_4\text{S}_4$ , which features As-As bonds so that the total covalency of As is still three?  
 A.  $\text{As}_4\text{S}_{10}$                       C. Phosphorus acid  
 B.  $\text{As}_2\text{S}_{12}$                       D. None of the Above

### Alloys

102. Arsenic is used as the group 5 element in the III-V semiconductors \_\_\_\_\_, indium arsenide, and aluminum arsenide.  
 A. Arsenic                              C. Gallium arsenide  
 B. Aluminum arsenide                D. None of the Above
103. Other arsenic alloys include the II-IV semiconductor?  
 A. Arsenic                              C. Cadmium arsenide  
 B. Gallium arsenide                D. None of the Above

### SOC Section

#### SOC Introduction

104. Metanoia or "blue baby syndrome" from ingestion of elevated levels of nitrogen.  
 A. True    B. False
105. All public water systems must monitor for?  
 A. Valuable Organic Compounds (VOCs)            C. Maximum Constant Levels (MCL)  
 B. Nitrate and Nitrite                                    D. None of the Above

### Volatile Organic Compounds (VOCs)

#### VOCs Explained

106. Which of the following are organic chemicals that have a high vapor pressure at ordinary, room-temperature conditions?  
 A. Volatile Organic Compounds (VOCs)            C. Maximum Contaminant Levels (MCL)  
 B. Polychlorinated Biphenyls (PCBs)                D. None of the Above
107. Which of the following \_\_\_\_\_ are of VOCs?  
 A. All organic chemicals                      C. Elevated odors  
 B. Most scents or odors                        D. None of the Above

108. Which of the following are regulated by law, especially indoors, where concentrations are the highest?

- A. Anthropogenic VOCs
- B. Aqueous solvents
- C. Benzene
- D. None of the Above

### Specific Components

#### Paints and Coatings

109. Which of the following are required to spread a protective or decorative film? Approximately 12 billion liters of paints are produced annually.

- A. Solvents
- B. Benzene
- C. Cleaning products
- D. None of the Above

#### Chlorofluorocarbons and Chlorocarbons

110. Which of the following are banned or highly regulated, were widely used cleaning products and refrigerants?

- A. Solvents
- B. Benzene
- C. Chlorofluorocarbons
- D. None of the Above

#### Benzene

111. Benzene is a known human carcinogen.

- A. True
- B. False

112. Which of the following evaporates into the air quickly and the vapor of benzene is heavier than air allowing the compound to sink into low-lying areas?

- A. Solvents
- B. Benzene
- C. Cleaning products
- D. None of the Above

113. Which of the following has also been known to contaminate food and water and if digested can lead to vomiting, dizziness, sleepiness, rapid heartbeat?

- A. Benzene
- B. Sodium chloride
- C. Aqueous solvents
- D. None of the Above

#### Methylene Chloride

114. Which of the following is converted to carbon monoxide and a person will suffer the same symptoms as exposure to carbon monoxide?

- A. Carbon dioxide
- B. Benzene
- C. Methylene chloride
- D. None of the Above

#### Perchloroethylene

115. Perchloroethylene is a Volatile organic compound that has been linked to causing cancer in animals. It is also suspected to cause many of the breathing related symptoms of exposure to VOC's.

- A. True
- B. False

116. To avoid exposure to perchloroethylene: Be careful if a \_\_\_\_\_ is coming from clothing when picked up from the dry cleaner.

- A. Weak odor
- B. Liquid
- C. Strong chemical odor
- D. None of the Above

### MTBE

117. MTBE was used as an octane booster and?
- A. Food preserver
  - B. Coloring additive
  - C. Oxygenated-additive
  - D. None of the Above

### Formaldehyde

118. Many building materials such as paints, adhesives, wall boards, and ceiling tiles slowly emit?
- A. Perchloroethylene
  - B. Formaldehyde
  - C. MTBE
  - D. None of the Above

### Health Risks

119. Which of the following are important in the creation of smog?
- A. Cool weather
  - B. VOCs
  - C. Rain
  - D. None of the Above

### Health effects include:

120. Some organics can cause cancer in animals; some are suspected or known to cause cancer in humans.
- A. True
  - B. False

### Reducing Exposure

121. Use products with VOCs in well ventilated areas.
- A. True
  - B. False

122. Architects and engineers implement best practices in ventilation and mechanical systems, the owner must maintain good \_\_\_\_\_ thereafter.

- A. Perchloroethylene free homes
- B. VOCs levels
- C. Air quality levels
- D. None of the Above

123. \_\_\_\_\_ is the property of some chemical elements to exist in two or more different forms, known as allotropes of these elements.

- A. Allotropy or allotropism
- B. Allotropes
- C. Polymorphism
- D. None of the Above

124. Which of the following are different structural modifications of an element; the atoms of the element are bonded together in a different manner?

- A. Allotropy
- B. Molecular formulae
- C. Allotropes
- D. None of the Above

125. The term allotropy is used for elements only, not for compounds. The more general term, used for any crystalline material, is?

- A. Allotropy or allotropism
- B. Allotropes
- C. Polymorphism
- D. None of the Above

### What are Inorganic Compounds?

#### Inorganic Chemical Introduction

126. Which of the following in biological systems incorporates carbohydrates into the molecular structure?

- A. Volatile Organic Compounds (VOCs)
- B. Organic compounds
- C. Polychlorinated Biphenyls (PCBs)
- D. None of the Above

127. Which of the following are rather simple chemicals present in ground water?  
 A. Synthetic Organic Chemicals (SOCs)      C. Inorganic compounds  
 B. Organic compounds      D. None of the Above
128. Which of the following are dissolved from the rock/soil that make up the aquifer or water-bearing rock formations below the soil surface?  
 A. Organic compounds      C. Inorganic compounds  
 B. Minerals      D. None of the Above
129. Which of the following were once living, or are living and can bring life to cells?  
 A. Organic compounds      C. Inorganic compounds  
 B. Minerals      D. None of the Above
130. Which of the following were never living, without carbon and cannot bring life to cells?  
 A. Inorganic compounds      C. Typical examples of organic life  
 B. Carbon life forms      D. None of the Above

### **Bioinorganic Compounds**

131. The phosphates in DNA, and metal complexes containing ligands that range from \_\_\_\_\_, commonly peptides, to ill-defined species such as humic acid, and to water (e.g., coordinated to gadolinium complexes employed for MRI).  
 A. Biological macromolecules      C. Molecular symmetry  
 B. Inter alia      D. None of the Above

### **Solid State Compounds**

132. Which of the following uses techniques such as crystallography to gain an understanding of the properties that result from collective interactions between the subunits of the solid?  
 A. VSEPR theory      C. Molecular symmetry  
 B. Solid state inorganic chemistry      D. None of the Above

### **Theoretical Inorganic Chemistry**

133. Which of the following using the tools and models of theoretical chemistry and computational chemistry, expands into bonding in simple and then more complex molecules?  
 A. Crystallography      C. Theoretical chemistry and computational chemistry  
 B. Bohr model of the atom      D. None of the Above
134. Which of the following is the province of inorganic chemistry?  
 A. Symmetry      C. Quantum mechanical descriptions  
 B. Qualitative approaches      D. None of the Above

### **Qualitative Theories**

135. Which of the following powerfully predicts, or at least rationalizes, the structures of main group compounds?  
 A. Crystallography theory      C. Theoretical chemistry theory  
 B. VSEPR theory      D. None of the Above

### Molecular Symmetry Group Theory

136. A central construct in inorganic chemistry is the theory of?

- A. Crystallography theory
- B. Molecular symmetry
- C. Theoretical chemistry and computational chemistry
- D. None of the Above

### Coordination Compounds

137. The "metal" usually is a metal from the groups 3-13, as well as the trans-lanthanides and trans-actinides, all chemical compounds can be described as?

- A. Reactivity
- B. Coordination complexes
- C. Man-made inorganic compound
- D. None of the Above

138. The stereochemistry of coordination complexes can be a topical theme within this specialization is?

- A. Supramolecular coordination chemistry
- B. Classical coordination chemistry
- C. Bath tub chemistry
- D. None of the Above

### Main Group Compounds

139. Which of the following are from groups 1, 2 and 13-18 (excluding hydrogen) of the periodic table?

- A. Minerals
- B. Elements
- C. Man-made inorganic compounds
- D. None of the Above

140. Which of the following have been known since the beginnings of chemistry, e.g., elemental sulfur and the distillable white phosphorus?

- A. Main group compounds
- B. Organometallic compounds
- C. Metal-metal bonded dimetallic complexes
- D. None of the Above

141. Experiments on oxygen, by Lavoisier and Priestley not only identified an important diatomic gas, but also opened the way for describing compounds and reactions according to?

- A. Transition metals
- B. Stoichiometric ratios
- C. Transition metal compounds
- D. None of the Above

142. The discovery of a practical synthesis of ammonia using iron catalysts by Carl Bosch and Fritz Haber in the early 1900s deeply impacted mankind, demonstrating the significance of?

- A. Transition metal synthesis
- B. Inorganic chemical synthesis
- C. Metal-metal synthesis
- D. None of the Above

143. According to the text, main group compounds are  $\text{SiO}_2$ ,  $\text{SnCl}_4$ , and  $\text{N}_2\text{O}$ . Many main group compounds can also be classed as?

- A. Transition metals
- B. Organometallic
- C. Transition metal compounds
- D. None of the Above

144. Which of the following are the fullerenes, buckytubes and binary carbon oxides?

- A. Inorganics
- B. Organometallic compounds
- C. Organic compounds
- D. None of the Above

### Transition Metal Compounds

145. Compounds with a metal from group 3 or 12 are sometimes also incorporated into this group, but also often classified as?

- A. Transition metal compounds    C. Carbonyls compounds  
B. Main group compounds        D. None of the Above

146. Transition metal compounds show a rich coordination chemistry, varying from tetrahedral for titanium (e.g.,  $\text{TiCl}_4$ ) to square planar for some nickel complexes to octahedral for \_\_\_\_\_ of cobalt.

- A. Organometallic complexes    C. Coordination complexes  
B. Organometallic compounds    D. None of the Above

147. Which of the following can be found in biologically important compounds, such as iron in hemoglobin?

- A. Transition metals                C. Metal complexes  
B. Organometallic complexes    D. None of the Above

### Organometallic Compounds

148. Which of the following employs more specialized preparative methods than was traditional in Werner-type complexes?

- A. Transition metal compounds    C. Metal-metal chemistry  
B. Organometallic chemistry      D. None of the Above

### Cluster Compounds

149. Clusters can be found in all classes of?

- A. Transition metal compounds    C. Chemical compounds  
B. Organometallic compounds    D. None of the Above

150. Which of the following uses techniques such as crystallography to gain an understanding of the properties that result from collective interactions between the subunits of the solid?

- A. Crystallography                    C. Computational chemistry  
B. Solid state inorganic chemistry    D. None of the Above

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