

**Registration form**

**Basic Chemistry CEU Training Course \$100.00  
48 HOUR RUSH ORDER PROCESSING FEE ADDITIONAL \$50.00**

**Start and finish dates:** \_\_\_\_\_

*You will have 90 days from this date in order to complete this course*

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

**Name** \_\_\_\_\_ **Signature** \_\_\_\_\_

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

**Address:** \_\_\_\_\_

**City** \_\_\_\_\_ **State** \_\_\_\_\_ **Zip** \_\_\_\_\_

**Email** \_\_\_\_\_ **Fax ( )** \_\_\_\_\_

**Phone:**  
**Home ( )** \_\_\_\_\_ **Work ( )** \_\_\_\_\_

**Operator ID #** \_\_\_\_\_ **Exp. Date** \_\_\_\_\_

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

Wastewater Collection \_\_\_\_\_ Wastewater Treatment \_\_\_\_\_ Distribution \_\_\_\_\_

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

**Technical Learning College PO Box 3060, Chino Valley, AZ 86323  
Toll Free (866) 557-1746 Fax (928) 272-0747 [info@tlch2o.com](mailto:info@tlch2o.com)**

**If you've paid on the Internet, please write your Customer #** \_\_\_\_\_

**Please invoice me, My PO #** \_\_\_\_\_

## **DISCLAIMER NOTICE**

I understand that it is my responsibility to ensure that this CEU course is either approved or accepted in my State for CEU credit. I understand State laws and rules change on a frequent basis and I believe this course is currently accepted in my State for CEU or contact hour credit, if it is not, I will not hold Technical Learning College responsible. I also understand that this type of study program deals with dangerous conditions and that I will not hold Technical Learning College, Technical Learning Consultants, Inc. (TLC) liable for any errors or omissions or advice contained in this CEU education training course or for any violation or injury caused by this CEU education training course material. I will call or contact TLC if I need help or assistance and double-check to ensure my registration page and assignment has been received and graded.

*You can obtain a printed version of the course manual from TLC for an additional \$89.95 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.

## **Grading Information**

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.

## **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 \$50.00. 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.

**Do not solely depend on TLC's Approval list for it may be outdated.**

**All downloads are electronically tracked and monitored for security purposes.**

**Some States and many employers require the final exam to be proctored.**

***We will stop mailing the certificate of completion so we need your e-mail address. We will e-mail the certificate to you, if no e-mail address; we will mail it to you.***

## Basic Chemistry Answer Key

Name \_\_\_\_\_ Phone# \_\_\_\_\_

*You are solely responsible to ensure this course is accepted by your State for credit. Do not solely depend on TLC's Approval list for it may be outdated.*

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

*Method of Course acceptance confirmation. Please fill this section*

Website \_\_\_\_\_ Telephone Call \_\_\_\_\_ Email \_\_\_\_\_ Spoke to \_\_\_\_\_

Did you receive the approval number if necessary? \_\_\_\_\_

What is the approval number if necessary? \_\_\_\_\_

*You are responsible to ensure that TLC receives the Assignment and Registration Key. Please call us to ensure that we received it. No refunds.*

*Please circle, underline, bold or X only one correct answer*

- |                 |                 |                 |
|-----------------|-----------------|-----------------|
| 1. A B C D E F  | 15. A B C D E F | 29. A B C D E F |
| 2. A B C D E F  | 16. A B C D E F | 30. A B C D E F |
| 3. A B C D E F  | 17. A B C D E F | 31. A B C D E F |
| 4. A B C D E F  | 18. A B C D E F | 32. A B C D E F |
| 5. A B C D E F  | 19. A B C D E F | 33. A B C D E F |
| 6. A B C D E F  | 20. A B C D E F | 34. A B C D E F |
| 7. A B C D E F  | 21. A B C D E F | 35. A B C D E F |
| 8. A B C D E F  | 22. A B C D E F | 36. A B C D E F |
| 9. A B C D E F  | 23. A B C D E F | 37. A B C D E F |
| 10. A B C D E F | 24. A B C D E F | 38. A B C D E F |
| 11. A B C D E F | 25. A B C D E F | 39. A B C D E F |
| 12. A B C D E F | 26. A B C D E F | 40. A B C D E F |
| 13. A B C D E F | 27. A B C D E F | 41. A B C D E F |
| 14. A B C D E F | 28. A B C D E F | 42. A B C D E F |

43. A B C D E F      75. A B C D E F      107. A B C D E F  
44. A B C D E F      76. A B C D E F      108. A B C D E F  
45. A B C D E F      77. A B C D E F      109. A B C D E F  
46. A B C D E F      78. A B C D E F      110. A B C D E F  
47. A B C D E F      79. A B C D E F      111. A B C D E F  
48. A B C D E F      80. A B C D E F      112. A B C D E F  
49. A B C D E F      81. A B C D E F      113. A B C D E F  
50. A B C D E F      82. A B C D E F      114. A B C D E F  
51. A B C D E F      83. A B C D E F      115. A B C D E F  
52. A B C D E F      84. A B C D E F      116. A B C D E F  
53. A B C D E F      85. A B C D E F      117. A B C D E F  
54. A B C D E F      86. A B C D E F      118. A B C D E F  
55. A B C D E F      87. A B C D E F      119. A B C D E F  
56. A B C D E F      88. A B C D E F      120. A B C D E F  
57. A B C D E F      89. A B C D E F      121. A B C D E F  
58. A B C D E F      90. A B C D E F      122. A B C D E F  
59. A B C D E F      91. A B C D E F      123. A B C D E F  
60. A B C D E F      92. A B C D E F      124. A B C D E F  
61. A B C D E F      93. A B C D E F      125. A B C D E F  
62. A B C D E F      94. A B C D E F      126. A B C D E F  
63. A B C D E F      95. A B C D E F      127. A B C D E F  
64. A B C D E F      96. A B C D E F      128. A B C D E F  
65. A B C D E F      97. A B C D E F      129. A B C D E F  
66. A B C D E F      98. A B C D E F      130. A B C D E F  
67. A B C D E F      99. A B C D E F      131. A B C D E F  
68. A B C D E F      100. A B C D E F      132. A B C D E F  
69. A B C D E F      101. A B C D E F      133. A B C D E F  
70. A B C D E F      102. A B C D E F      134. A B C D E F  
71. A B C D E F      103. A B C D E F      135. A B C D E F  
72. A B C D E F      104. A B C D E F      136. A B C D E F  
73. A B C D E F      105. A B C D E F      137. A B C D E F  
74. A B C D E F      106. A B C D E F      138. A B C D E F

139. A B C D E F

144. A B C D E F

149. A B C D E F

140. A B C D E F

145. A B C D E F

150. A B C D E F

141. A B C D E F

146. A B C D E F

142. A B C D E F

147. A B C D E F

143. A B C D E F

148. A B C D E F

**Please fax the answer key to TLC  
(928) 272-0747**

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**BASIC CHEMISTRY  
CEU TRAINING COURSE**

**CUSTOMER SERVICE RESPONSE CARD**

NAME: \_\_\_\_\_

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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How about the price of the course?

Poor\_\_\_\_ Fair \_\_\_\_ Average \_\_\_\_ Good\_\_\_\_ Great\_\_\_\_

How was your customer service?

Poor\_\_\_ Fair \_\_\_\_ Average \_\_\_\_ Good \_\_\_\_ Great\_\_\_\_

Any other concerns or comments.

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## Basic Chemistry CEU Training Course Assignment

**The Assignment (Exam) is also available in Word on the Internet for your Convenience, please visit [www.ABCTLIC.com](http://www.ABCTLIC.com) and download the assignment and e-mail it back to TLC.**

You will have 90 days from the start of this course 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. We prefer if this exam is proctored. No intentional trick questions. If you should need any assistance, please email all concerns and the completed manual to [info@tlch2o.com](mailto:info@tlch2o.com).

We would prefer that you utilize the enclosed answer sheet in the front, but if you are unable to do so, type out your own answer key. Please include your name and address on your answer key and make copy for yourself. You can e-mail or fax your Answer Key along with the Registration Form to TLC. **(S) Means answer may be plural or singular. Multiple Choice Section, One answer per question and please use the answer key.**

### Introduction to Chemistry

1. The properties of chemical bonds formed between atoms is to create \_\_\_\_\_.  
A. Solutes  
B. Molecules  
C. Organic chemistry  
D. Chemical compounds  
E. Biochemistry  
F. None of the Above
2. Chemistry studies the involvement of electrons and various forms of energy in photochemical reactions, oxidation-reduction reactions, \_\_\_\_\_, and separation of mixtures.  
A. Chemical element(s)  
B. An electron  
C. Changes in phases of matter  
D. Photon  
E. Energy and entropy  
F. None of the Above
3. Chemistry is a branch of physical science but distinct from?  
A. Physics  
B. Neurochemistry  
C. Organic chemistry  
D. Analytical chemistry  
E. Biochemistry  
F. None of the Above

### Chemistry Sub-disciplines

4. Chemistry is divided into several major sub-disciplines. There are also several main cross-disciplinary and?  
A. Nuclear chemistry  
B. More specialized fields of chemistry  
C. Organic chemistry  
D. Analytical chemistry  
E. Biochemistry  
F. None of the Above
5. Which of the following terms incorporates standardized experimental methods in the field of chemistry?  
A. Nuclear chemistry  
B. Neurochemistry  
C. Organic chemistry  
D. Analytical chemistry  
E. Biochemistry  
F. None of the Above

6. Which of the following terms and organic chemistry are related, as in medicinal chemistry or neurochemistry?
- A. Materials chemistry    D. Theoretical chemistry  
 B. Biochemistry    E. Organic chemistry  
 C. Nuclear chemistry    F. None of the Above
7. The distinction between organic and inorganic disciplines is not absolute and there is much overlap, most importantly in the sub-discipline of\_\_\_\_\_.
- A. Nuclear chemistry    D. Organometallic chemistry  
 B. Neurochemistry    E. Biochemistry  
 C. Organic chemistry    F. None of the Above
8. \_\_\_\_\_is the preparation, characterization, and understanding of substances with a useful function.
- A. Materials chemistry    D. Theoretical chemistry  
 B. Biochemistry    E. Organic chemistry  
 C. Nuclear chemistry    F. None of the Above
9. Which of the following terms is the study of neurochemicals; including transmitters, peptides, proteins, lipids, sugars, and nucleic acids?
- A. Nuclear chemistry    D. Analytical chemistry  
 B. Neurochemistry    E. Biochemistry  
 C. Organic chemistry    F. None of the Above
10. Which of the following terms is a large component of nuclear chemistry, and the table of nuclides is an important result and tool for this field?
- A. Materials chemistry    D. Theoretical chemistry  
 B. Biochemistry    E. Modern Transmutation  
 C. Nuclear chemistry    F. None of the Above
11. \_\_\_\_\_ is the study of the structure, properties, composition, mechanisms, and reactions of organic compounds.
- A. Nuclear chemistry    D. Analytical chemistry  
 B. Neurochemistry    E. Biochemistry  
 C. Organic chemistry    F. None of the Above
12. Which of the following terms is the study of the physical and fundamental basis of chemical systems and processes?
- A. Nuclear chemistry    D. Analytical chemistry  
 B. Neurochemistry    E. Biochemistry  
 C. Physical chemistry    F. None of the Above

### Commonly found Chemical Types

13. Many chemicals are commonly available in\_\_\_\_\_.
- A. Chemistry laboratory    D. Forms of energy  
 B. Chemical substance(s)    E. Pure form  
 C. Chemical(s)    F. None of the Above

14. Which of the following terms is a form of matter that has constant chemical composition and characteristic properties?

- A. Chemical bond(s)
- B. Chemical substance(s)
- C. Chemical(s)
- D. A chemical substance
- E. Chemical reactions
- F. None of the Above

15. \_\_\_\_\_ can be chemical elements, chemical compounds, ions or alloys.

- A. Chemical reactions
- B. Chemical substance(s)
- C. Chemical(s)
- D. A pure chemical compound
- E. Physical chemistry
- F. None of the Above

16. Which of the following terms are called 'pure' to set them apart from mixtures.

- A. Chemical bond(s)
- B. Chemical substance(s)
- C. Chemical(s)
- D. Forms of energy
- E. Physical chemistry
- F. None of the Above

17. \_\_\_\_\_ convert one chemical substance into another.

- A. Chemistry laboratory
- B. Chemical substance(s)
- C. Chemical(s)
- D. Chemical reactions
- E. Physical chemistry
- F. None of the Above

18. Forms of energy are not considered to be \_\_\_\_\_, and thus they are not "substances" in this regard.

- A. Chemical bond(s)
- B. Matter
- C. Chemical(s)
- D. Forms of energy
- E. Physical chemistry
- F. None of the Above

19. The definition a chemical substance can either be a \_\_\_\_\_ or a pure chemical compound.

- A. Pure chemical element
- B. Chemical substance(s)
- C. Chemical(s)
- D. Pure chemical compound
- E. Physical chemistry
- F. None of the Above

20. What is the study of elementary particles, atoms, molecules, substances, metals, crystals and other aggregates of matter?

- A. Nuclear chemistry
- B. Neurochemistry
- C. Organic chemistry
- D. Analytical chemistry
- E. Traditional chemistry
- F. None of the Above

21. Chemistry is generally the study of various result of interactions between atoms, leading to rearrangements of the \_\_\_\_\_ which hold atoms together.

- A. Chemical bonds
- B. Chemical substance(s)
- C. Chemical(s)
- D. Chemical compound
- E. Physical chemistry
- F. None of the Above

22. Which term is a transformation of some substances into one or more different substances?

- A. Chemical element(s)
- B. An electron
- C. Atom
- D. A chemical reaction
- E. Energy and entropy
- F. None of the Above

23. Which term means the basis of a chemical transformation is the re-arrangement of electrons in the chemical bonds between atoms?

- A. Chemical element(s)
- B. Metamorphous
- C. Chemistry
- D. Chemical reaction
- E. Chemical equation
- F. None of the Above

24. The number of atoms on the left and the right in the equation for a \_\_\_\_\_ is equal.

- A. Chemical transformation
- B. Atomic balance
- C. Chemical propertie(s)
- D. The type of chemical reaction(s)
- E. Mixture of substances
- F. None of the Above

25. \_\_\_\_\_ expresses a type of chemical reaction and the energy changes that may accompany it are constrained by certain basic rules.

- A. Chemical substance(s)
- B. Atomic balancing
- C. Chemical propertie(s)
- D. Chemical law(s)
- E. Mixture of substances
- F. None of the Above

26. What important considerations are invariably important in almost all chemical studies?

- A. Chemical element(s)
- B. An electron
- C. The type of chemical reaction(s)
- D. Mixture of substances
- E. Energy and entropy
- F. None of the Above

27. What are classified in terms of their structure, phase, as well as their chemical compositions?

- A. Chemical substance(s)
- B. Atom(s)
- C. Chemical propertie(s)
- D. The type of chemical reaction(s)
- E. Mixture of substances
- F. None of the Above

### **Matter**

28. \_\_\_\_\_ is generally defined as anything that has rest mass and volume (it takes up space) and is made up of particles.

- A. Chemical element(s)
- B. An electron
- C. Atom
- D. Matter
- E. Energy and entropy
- F. None of the Above

29. The particles that make up matter have rest mass as well - not all particles have rest mass, such as?

- A. Chemical element(s)
- B. An electron
- C. Atom
- D. The photon
- E. Energy and entropy
- F. None of the Above

30. According to the text, matter can be a pure chemical substance or?

- A. Chemical bond(s)
- B. Chemical substance(s)
- C. Chemical(s)
- D. Forms of energy
- E. A mixture of substances
- F. None of the Above

### Atom

31. What is the space that contains dense core of the atomic nucleus?

- A. Chemical element(s)
- B. An electron
- C. Atom
- D. Photon
- E. Electron cloud
- F. None of the Above

32. The nucleus is dense; the mass of a nucleon is 1,836 times that of an electron, yet the radius of \_\_\_\_\_ is about 10,000 times that of its nucleus.

- A. Nucleus
- B. An electron
- C. An atom
- D. Ion
- E. Cloud
- F. None of the Above

33. What is the smallest entity that can be envisaged to retain the chemical properties of the element, such as electronegativity, ionization potential, preferred oxidation state(s), coordination number, and preferred types of bonds to form (e.g., metallic, ionic, covalent)?

- A. Nucleus
- B. An electron
- C. The atom
- D. Negatively-charged electron(s)
- E. Positively charged proton(s)
- F. None of the Above

### Element

34. The standard presentation of \_\_\_\_\_ is in the periodic table, which orders elements by atomic number.

- A. Chemical element(s)
- B. An electron
- C. Atom
- D. Photon
- E. Energy and entropy
- F. None of the Above

### Compound

35. The properties of a compound bear little similarity to those of its?

- A. Chemical bond(s)
- B. Elements
- C. Chemical(s)
- D. Forms of energy
- E. Physical chemistry
- F. None of the Above

### Chemical Compounds

36. \_\_\_\_\_ represents substances, but not all substances are compounds.

- A. Bulk chemical(s)
- B. Chemical(s)
- C. Mechanical processe(s)
- D. Compound(s)
- E. A pure chemical compound
- F. None of the Above

37. Organic compounds are \_\_\_\_\_ based primarily on carbon and hydrogen atoms.

- A. Bulk chemical(s)
- B. Chemical(s)
- C. Mechanical processe(s)
- D. Compound(s)
- E. A pure chemical compound
- F. None of the Above

38. Compounds containing bonds between carbon and a metal are called?

- A. Organometallic compound(s)
- B. Chemical substance(s)
- C. Isomer(s)
- D. Mixture(s)
- E. Chemical substance(s)
- F. None of the Above

39. Covalent compounds are compounds in which components share?

- A. Nucleus
- B. Electrons
- C. The atom
- D. Negatively-charged electrons
- E. Positively charged protons
- F. None of the Above

40. In organic chemistry, \_\_\_\_\_ represents that there can be more than one chemical compound with the same composition and molecular weight.

- A. Organometallic compound(s)
- B. Chemical substance(s)
- C. Isomer(s)
- D. Mixture(s)
- E. Chemical substance(s)
- F. None of the Above

41. Which term usually have substantially different chemical properties, may be isolated and do not spontaneously convert to each other?

- A. Isomers
- B. Chemical(s)
- C. Mechanical processe(s)
- D. Compound(s)
- E. A pure chemical compound
- F. None of the Above

### Substances versus Mixtures

42. All matter consists of various elements and \_\_\_\_\_, but these are often intimately mixed together.

- A. Chemical compounds
- B. Chemical substance(s)
- C. Isomer(s)
- D. Mixture(s)
- E. Chemical mixtures
- F. None of the Above

### Chemicals versus Chemical Substances

43. What is the best term that is synonymous with "chemical" for professional chemists, the meaning of the word chemical varies for non-chemists?

- A. Organometallic compound(s)
- B. Chemical mixtures
- C. Isomer(s)
- D. Mixture(s)
- E. Chemical substance(s)
- F. None of the Above

### Molecule

44. A molecule is the smallest indivisible portion of a pure chemical substance that has its unique set of chemical properties, that is, its potential to undergo a certain set of \_\_\_\_\_ with other substances.

- A. Tetra atomic molecule(s)
- B. Ions
- C. Chemical reactions
- D. Existence of identifiable molecule(s)
- E. Isolated chemical element(s)
- F. None of the Above

45. Molecules are a set of atoms bound together by covalent bonds, such that the structure is electrically neutral and \_\_\_\_\_ are paired with other electrons either in bonds or in lone pairs.

- A. Molecule(s)
- B. Ionic compounds
- C. Structure
- D. Charged polyatomic collection(s)
- E. All valence electrons
- F. None of the Above

46. Molecules exist as electrically neutral units, unlike ions. When this rule is broken, giving the "molecule" a charge, the result is sometimes named a molecular ion or?

- A. Tetra atomic molecule(s)
- B. Ions
- C. A molecule
- D. A polyatomic ion
- E. Isolated chemical element(s)
- F. None of the Above

47. \_\_\_\_\_ is residing in solids (for example, common sulfate or nitrate ions) are generally not considered "molecules" in chemistry.

- A. Molecule(s)
- B. Ionic compounds
- C. Structure
- D. Charged polyatomic collection(s)
- E. A chemical substance
- F. None of the Above

48. The "inert" or noble gas elements (helium, neon, argon, krypton, xenon and radon) are composed of lone atoms as their smallest discrete unit, but the other isolated?

- A. Tetra atomic molecule(s)
- B. Ions
- C. A molecule
- D. Existence of identifiable molecule(s)
- E. Chemical element(s)
- F. None of the Above

49. \_\_\_\_\_ is used to compose familiar substances such as water, air, and many organic compounds like alcohol, sugar, gasoline, and the various pharmaceuticals.

- A. Identifiable molecules
- B. Ions
- C. A molecule
- D. Existence of identifiable molecule(s)
- E. Isolated chemical element(s)
- F. None of the Above

50. Not all substances or chemical compounds consist of discrete molecules, and indeed most of the solid substances that make up the solid crust, mantle, and core of the Earth are chemical compounds without?

- A. Molecule(s)
- B. Ionic compounds
- C. Structure
- D. Charged polyatomic collection(s)
- E. A chemical substance
- F. None of the Above

51. These other types of substances, such as \_\_\_\_\_ and network solids, are organized in such a way as to lack the existence of identifiable molecules.

- A. Tetra atomic molecule(s)
- B. Ions
- C. Ionic compounds
- D. Existence of identifiable molecule(s)
- E. Isolated chemical element(s)
- F. None of the Above

52. One of the main characteristics of a \_\_\_\_\_ is its geometry often called its structure.

- A. Molecule(s)
- B. Ionic compounds
- C. Structure
- D. Charged polyatomic collection(s)
- E. A chemical substance
- F. None of the Above

53. While the structure of diatomic, triatomic or tetra atomic molecules may be trivial, \_\_\_\_\_, that are constituted of more than six atoms can be crucial for its chemical nature.

- A. Tetra atomic molecule(s)
- B. Ions
- C. A molecule
- D. Existence of identifiable molecule(s)
- E. The structure of polyatomic molecules
- F. None of the Above

### Substance and Mixture

54. Which term is a kind of matter with a definite composition and set of properties?

- A. Molecule(s)
- B. Ionic compounds
- C. Structure
- D. Charged polyatomic collection(s)
- E. A chemical substance
- F. None of the Above

### Mole and Amount of Substance

55. The mole is a unit of measurement that denotes an amount of substance also called?

- A. An amount of substance
- B. A triple point
- C. Crystal structure
- D. Chemical amount
- E. Multipole balance
- F. None of the Above

### Phase

56. The chemical classifications are independent of these \_\_\_\_\_ classifications; however, some more exotic phases are incompatible with certain chemical properties.

- A. An ionic bond
- B. Another atom
- C. Multiple solid phases
- D. Phase transition
- E. Bulk phase
- F. None of the Above

57. \_\_\_\_\_ is of a chemical system that have similar bulk structural properties, over a range of conditions, such as pressure or temperature.

- A. An amount of substance
- B. A triple point
- C. Crystal structure
- D. A phase is a set of states
- E. Multipole balance
- F. None of the Above

58. The phase of matter is defined by \_\_\_\_\_, which is when energy put into or taken out of the system.

- A. An ionic bond
- B. Another atom
- C. Multiple solid phases
- D. The phase transition
- E. Bulk phase
- F. None of the Above

59. The distinction between phases can be continuous instead of having a discrete boundary, in this case the matter is considered to be in \_\_\_\_\_.

- A. An amount of substance
- B. A triple point
- C. Crystal structure
- D. A supercritical state
- E. Multipole balance
- F. None of the Above

60. There are three phases of solid iron (alpha, gamma, and delta) that will vary based upon?

- A. An ionic bond
- B. Another atom
- C. Multiple solid phases
- D. Phase transition
- E. Temperature and pressure
- F. None of the Above

61. Another phase commonly encountered is the \_\_\_\_\_, which is the state of substances dissolved in aqueous solution (that is, in water).

- A. An amount of substance
- B. A triple point
- C. Crystal structure
- D. Aqueous phase
- E. Multipole balance
- F. None of the Above

62. Less familiar phases include plasmas, \_\_\_\_\_ condensates and fermionic condensates and the paramagnetic and ferromagnetic phases of magnetic materials.

- A. Bose–Einstein
- B. Another atom
- C. Multiple solid phases
- D. Phase transition
- E. Bulk phase
- F. None of the Above



## Bonding

63. Atoms sticking together in \_\_\_\_\_ are said to be bonded with one another.
- A. An amount of substance
  - B. A triple point
  - C. Molecules or crystals
  - D. Pressure or temperature
  - E. Multipole balance
  - F. None of the Above
64. More than simple attraction and repulsion, the energies and distributions characterize the availability of an electron to bond to?
- A. Chemical element(s)
  - B. An electron
  - C. Another atom
  - D. Photon
  - E. A chemical bond
  - F. None of the Above
65. Which term is formed when a metal loses one or more of its electrons, becoming a positively charged cation?
- A. An ionic bond
  - B. Another atom
  - C. Multiple solid phases
  - D. Phase transition
  - E. Bulk phase
  - F. None of the Above

## Energy

66. What type of transformation is accompanied by a change in one or more of these kinds of structures, it is invariably accompanied by an increase or decrease of energy of the substances involved?
- A. Chemical reaction(s)
  - B. Energy exchange
  - C. Chemical equation
  - D. Breaking of chemical bonds
  - E. Chemical
  - F. None of the Above

## pH Section

67. What is the theory that states that an acid is a substance that produces Hydronium ions when it is dissolved in water, and a base is one that produces hydroxide ions when dissolved in water?
- A. Newton's
  - B. Alkalinity
  - C. Lord Calvin's
  - D. Amadeus
  - E. Arrhenius
  - F. None of the Above
68. What is the term associated with a charged species, an atom or a molecule, that has lost or gained one or more electrons?
- A. A proton
  - B. Ion
  - C. Anti-matter
  - D. An electron
  - E. A cation
  - F. None of the Above
69. What is a substance that has the ability to reduce other substances and is reductive in nature?
- A. Protons
  - B. An electron donor
  - C. Anti-matter
  - D. Electrons
  - E. Cations
  - F. None of the Above
70. Pure water has a pH very close to?
- A. 5
  - B. 6
  - C. 7
  - D. 7.7
  - E. 7.5
  - F. None of the Above

71. According to the manual, \_\_\_\_\_ determines a parameter using a concentration cell with transference by measuring the potential difference.

- A. Primary pH standard values
- B. Alkalinity
- C. pH
- D. pH measurement(s)
- E. Measurement of pH
- F. None of the Above

72. Mathematically speaking, pH is the negative logarithm of the activity of the (solvated) hydronium ion, often expressed as the measurement of?

- A. Electrons
- B. Alkalinity
- C. Hydronium ion concentration
- D. Cation measurement(s)
- E. Ions
- F. None of the Above

73. When measuring alkalinity in determining a stream's ability to neutralize acidic pollution from rainfall or wastewater, this measurement can be one of the best measures of the sensitivity of the stream to acid inputs.

- A. True
- B. False

74. One definition of pH is that it is defined as the decimal logarithm of the reciprocal of the \_\_\_\_\_,  $a_{H^+}$ , in a solution.

- A. Hydrogen ion activity
- B. Ion-selective electrode(s)
- C. (Solvated) hydronium ion
- D. Brønsted–Lowry acid–base theory
- E. Acid-base behavior
- F. None of the Above

75. With respect to standard buffer values, when more than two buffer solutions are used the electrode can be calibrated by fitting observed pH values to a straight line.

- A. True
- B. False

76. Commercial standard buffer solutions usually come with information about value and a correction factor to be applied for what temperatures?

- A. 4 °C
- B. 25 °C
- C. 39 °F
- D. 10 °C
- E. 70 °F
- F. None of the Above

77. Because the pH scale is logarithmic, therefore pH is?

- A. Universal indicator
- B. A dimensionless quantity
- C. A Spectrophotometer
- D. Excess of Ion concentrations
- E. A set of non-linear equations
- F. None of the Above

78. What is the new pH scale is referred to as?

- A. Total scale
- B. POH
- C. P3H
- D.  $Ph_3$
- E. POE
- F. None of the Above

79. Alkalinity is able to neutralize \_\_\_\_\_ and is measured in a quantitative capacity in an aqueous solution.

- A. Acid
- B. Base
- C. pH
- D. pH measurement(s)
- E. Bond formation
- F. None of the Above

80. When using a visual comparison of the test solution with a standard color chart, measuring pH values should be done to the?

- A. Universal indicator
- B. Colorwheel measurement
- C. Nearest whole number
- D. Spectrophotometer Example
- E. Lab test
- F. None of the Above

81. According to the manual, this device/method/calculation consists of a mixture of indicators which shows a continuous color change from pH 2 to pH 10.

- A. Universal indicator
- B. Colorimeter of spectrophotometer
- C. Spectrophotometer
- D. Excess of alkaline earth metal concentrations
- E. A set of non-linear simultaneous equations
- F. None of the Above

82. \_\_\_\_\_ is an example of a mathematical procedure for calculating the concentrations of all chemical species that are present in the solution?

- A. Universal indicator
- B. pH log
- C. A set of linear equations
- D. Chemical speciation calculation
- E. A set of non-linear simultaneous equations
- F. None of the Above

83. According to the manual, under normal circumstances, strong acids and bases are compounds that, for practical purposes, are completely dissociated in water, this means that the concentration of hydrogen ions in acidic solution can be taken to be equal to the concentration of the acid. The pH is then equal to minus the logarithm of?

- A. The concentration value
- B. The pH
- C. The Spectrophotometer
- D. End-point pH
- E. A set of non-linear simultaneous equations
- F. None of the Above

84. The sum of all the titratable bases is the alkalinity of water and its acid-neutralizing capacity. What would cause the measured value to vary significantly?

- A. Acid
- B. Alkalinity
- C. pH
- D. pH measurement(s)
- E. End-point pH
- F. None of the Above

85. For strong acids and bases, no calculations are necessary except in extreme situations. The pH of a solution containing a weak acid requires the solution of a quadratic equation.

- A. True
- B. False

86. If the pH of a solution contains a weak base, this may require?

- A. The solution of a cubic equation
- B. The solution of a linear equation
- C. The solution of a squared equation
- D. A set of linear simultaneous equations
- E. A set of non-linear simultaneous equations
- F. None of the Above

87. While the general case requires the pH solution of?

- A. The solution of a cubic equation
- B. The solution of a linear equation
- C. The solution of a squared equation
- D. A set of linear simultaneous equations
- E. A set of non-linear simultaneous equations
- F. None of the Above

88. Because alkalinity is significant in many uses and treatments of natural waters and wastewaters, the measured values also may include contributions from \_\_\_\_\_ or other bases if these are present.

- A. Acids
- B. Light metals
- C. Rare earths
- D. Borates, phosphates, silicates
- E. Caustics
- F. None of the Above

89. Calculations are not necessary except in extreme situations for strong acids and bases. The pH of a solution containing a weak acid requires?

- A. The concentration value
- B. The solution of a quadratic equation
- C. The Spectrophotometer
- D. Visual comparison
- E. The solution of a cubic equation
- F. None of the Above

90. What factor is key in determining the suitability of water for irrigation?

- A. pH of 8
- B. pH of 7
- C. pH of 3
- D. Alkaline earth metal concentrations
- E. Borates, phosphates, silicates
- F. None of the Above

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

- A. Universal indicator
- B. Colorwheel measurement
- C. Spectrophotometer
- D. Visual comparison
- E. Chemical speciation
- F. None of the Above

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

- A. 1
- B. 2
- C. 5
- D. 10
- E. 100
- F. None of the Above

93. According to the manual, this key water measurement is used for the interpretation and control of water and wastewater treatment processes.

- A. Acid
- B. Alkalinity
- C. pH
- D. Chemical ion
- E. Hydrogen bond formation
- F. None of the Above

94. \_\_\_\_\_ for all practical purposes are completely dissociated in water.

- A. Strong acids and bases
- B. Strong bases
- C. Chemical ions in chains
- D. Strong bases and weak acids
- E. Weak acids and weak bases
- F. None of the Above

95. Sodium hydroxide, NaOH, is an example of?

- A. Strong acid and base
- B. Strong base
- C. Weak base
- D. Strong base and weak acid
- E. Weak acids and weak bases
- F. None of the Above

96. According to the text, what is the pH of pure water at 50 °C?

- A. 7.7
- B. 8.0
- C. 9.0
- D. 6.55
- E. 7.00
- F. None of the Above

## Alkalinity Section

### Introduction

97. Alkalinity is a measure of \_\_\_\_\_ and can be interpreted in terms of specific substances only when the chemical composition of the sample is known.
- A. Universal indicator
  - B. pH
  - C. An aggregate property of water
  - D. Excess of alkaline earth metal concentrations
  - E. A set of non-linear simultaneous equations
  - F. None of the Above
98. Alkalinity of water is its acid-neutralizing capacity, the sum of all the titratable bases and the measured value may vary significantly with the \_\_\_\_\_ used.
- A. Acid
  - B. Alkalinity
  - C. pH
  - D. pH measurement(s)
  - E. End-point pH
  - F. None of the Above
99. Alkalinity in excess of \_\_\_\_\_ is significant in determining the suitability of water for irrigation.
- A. Universal indicator
  - B. pH
  - C. Spectrophotometer
  - D. Alkaline earth metal concentrations
  - E. A set of non-linear simultaneous equations
  - F. None of the Above
100. \_\_\_\_\_ measurements are used in the interpretation and control of water and wastewater treatment processes.
- A. Acid
  - B. Alkalinity
  - C. pH
  - D. A set of non-linear simultaneous equation
  - E. Bond formation
  - F. None of the Above

### Hard Water Section

101. Water contains various amounts of \_\_\_\_\_, some of which impart a quality known as hardness.
- A. Water hardness
  - B. Carbonate hardness
  - C. The calcium-magnesium distinction
  - D. Calcium (Ca) and magnesium (Mg)
  - E. Dissolved minerals
  - F. None of the Above

### Occurrence of Hard Water

102. Hard water is caused by soluble, divalent, \_\_\_\_\_.
- A. Water hardness
  - B. Metallic cations
  - C. Carbon dioxide (CO<sub>2</sub>)
  - D. Calcium (Ca) and magnesium (Mg)
  - E. Noncarbonate hardness
  - F. None of the Above
103. Strontium, aluminum, barium, and iron are usually present in large enough concentrations to contribute significantly to the?
- A. Water hardness
  - B. Carbonate hardness
  - C. Total hardness
  - D. Calcium (Ca) and magnesium (Mg)
  - E. Noncarbonate hardness
  - F. None of the Above
104. Water hardness varies considerably in different geographic this is due to different geologic formations, and is a function of the contact time between water and?
- A. Water hardness
  - B. Lime softening
  - C. Carbon dioxide (CO<sub>2</sub>)
  - D. Calcium (Ca) and magnesium (Mg)
  - E. Limestone deposits
  - F. None of the Above

105. \_\_\_\_\_ is dissolved as water passes over and through dolomite and other magnesium-bearing minerals?

- A. Dissolved minerals
- B. Ion exchange process
- C. Membrane method(s)
- D. Total hardness
- E. Magnesium
- F. None of the Above

### Expressing Water Hardness Concentration

106. Which of the following terms is generally expressed as a concentration of calcium carbonate, in terms of milligrams per liter as  $\text{CaCO}_3$ ?

- A. Water hardness
- B. Lime softening
- C. Carbon dioxide ( $\text{CO}_2$ )
- D. Calcium (Ca) and magnesium (Mg)
- E. Noncarbonate hardness
- F. None of the Above

### Types of Water Hardness

107. Hardness can be categorized by either of two methods: calcium versus magnesium hardness and carbonate versus?

- A. Dissolved minerals
- B. Non-carbonate hardness
- C. Membrane method(s)
- D. Total hardness
- E. Magnesium
- F. None of the Above

108. \_\_\_\_\_ caused by calcium is called calcium hardness, regardless of the salts associated with it?

- A. Water hardness
- B. Carbonate hardness
- C. Hardness
- D. Calcium (Ca) and magnesium (Mg)
- E. Noncarbonate hardness
- F. None of the Above

109. Which of the following terms is based on hardness from either the bicarbonate salts of calcium or the normal salts of calcium and magnesium involved in causing water hardness?

- A. The carbonate-noncarbonate distinction
- B. Lime softening
- C. Carbon dioxide ( $\text{CO}_2$ )
- D. Calcium (Ca) and magnesium (Mg)
- E. Noncarbonate hardness
- F. None of the Above

110. Calcium and magnesium combined with carbonate ( $\text{CO}_3$ ) also contribute to?

- A. Water hardness
- B. Carbonate hardness
- C. The calcium-magnesium distinction
- D. Calcium (Ca) and magnesium (Mg)
- E. Noncarbonate hardness
- F. None of the Above

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

- A. Water hardness
- B. Lime softening
- C. Carbon dioxide ( $\text{CO}_2$ )
- D. Calcium (Ca) and magnesium (Mg)
- E. Noncarbonate hardness
- F. None of the Above

112. Calcium and magnesium combined with nitrate may also contribute to \_\_\_\_\_, although it is a very rare condition.

- A. Water hardness
- B. Carbonate hardness
- C. The calcium-magnesium distinction
- D. Calcium (Ca) and magnesium (Mg)
- E. Noncarbonate hardness
- F. None of the Above

113. Because it can be removed by heating, carbonate hardness is sometimes called “\_\_\_\_\_”.

- A. Water hardness
- B. Temporary hardness
- C. Carbon dioxide (CO<sub>2</sub>)
- D. Calcium (Ca) and magnesium (Mg)
- E. Noncarbonate hardness
- F. None of the Above

### Inorganic Chemistry

114. Inorganic chemistry is the study of the synthesis and behavior of?

- A. Myriad organic compounds
- B. Inorganic compounds
- C. Some metals
- D. Ionic compounds
- E. Inorganic and organometallic compounds
- F. None of the Above

115. Which of the following terms has applications in every aspect of the chemical industry—including catalysis, materials science, pigments, surfactants, coatings, medicine, fuel, and agriculture?

- A. Crystallization
- B. Inorganic salts
- C. Electrically neutral
- D. Organometallic chemistry
- E. Lead, mercury, and arsenic
- F. None of the Above

### Key Concepts

116. According to the text, many inorganic compounds are ionic compounds, consisting of \_\_\_\_\_ joined by ionic bonding.

- A. Myriad organic compounds
- B. Inorganic compounds
- C. Some metals
- D. Cations and anions
- E. Electron affinity (anions)
- F. None of the Above

117. In any salt, the proportions of the ions are such that the electric charges cancel out, so that the bulk compound is?

- A. A shiny crystal
- B. An inorganic salt
- C. Electrically neutral
- D. A sub-discipline of organometallic chemistry
- E. Electrically positive
- F. None of the Above

118. The ions are described by their oxidation state and their ease of formation can be inferred from the ionization potential (for cations) or from the electron affinity (anions) of the?

- A. Myriad organic compound
- B. Inorganic compound
- C. Metal
- D. Ionic compound
- E. Anions
- F. None of the Above

119. Which of the following terms are the sulfates and the halides?

- A. Crystals
- B. Oxides, the carbonates
- C. Electrically neutral cations
- D. Sub-discipline of organometallic chemistry like
- E. Sulfites
- F. None of the Above

120. Inorganic salts typically are poor conductors in the?

- A. Myriad
- B. Inorganic compound mixture
- C. Customer's coffee
- D. Ionic compound
- E. Solid state
- F. None of the Above

121. Another important feature is their solubility in water, e.g.?  
 A. And ease of crystallization      D. Sub-discipline of organometallic chemistry  
 B. Inorganic salts                      E. Ionic compound  
 C. Electrically neutral                F. None of the Above
122. According to the text, with redox reactions one reactant, the oxidant, lowers its \_\_\_\_\_ and another reactant, the reductant, has its oxidation state increased. The net result is an exchange of electrons.  
 A. pH                                        D. Ionic count  
 B. Redox state                          E. Electron affinity (anions)  
 C. Oxidation state                      F. None of the Above
123. \_\_\_\_\_ can occur indirectly as well, e.g., in batteries, a key concept in electrochemistry.  
 A. Crystallization                      D. Electron exchange  
 B. Inorganic salts                      E. Regeneration  
 C. Electrically neutral charges      F. None of the Above
124. Which of the following terms does the HSAB theory takes into account polarizability and size of ions?  
 A. Supramolecular coordination chemistry      D. Grouping by their structural similarities  
 B. Classical coordination compounds            E. Organometallic chemistry  
 C. Inorganic compounds                          F. None of the Above
125. Soil may contain iron sulfide as pyrite or?  
 A. Often similar reactivity            D. Man-made inorganic compounds  
 B. Coordination complexes            E. Nature-made inorganic compounds  
 C. Classification of compounds      F. None of the Above
126. Inorganic compounds can be found multitasking as biomolecules: as electrolytes (sodium chloride), in energy storage (ATP) or in construction?  
 A. Supramolecular coordination chemistry      D. Grouping compounds  
 B. Classical coordination compounds            E. Organometallic chemistry  
 C. Inorganic compounds                          F. None of the Above
127. Which of the following terms was ammonium nitrate for soil fertilization through the Haber process?  
 A. Compound                              D. Man-made inorganic compound  
 B. Complexed mineral                  E. Nature-made inorganic compounds  
 C. Cation                                    F. None of the Above
128. Subdivisions of inorganic chemistry are organometallic chemistry, \_\_\_\_\_ and bioinorganic chemistry.  
 A. Supramolecular coordination chemistry      D. Grouping compounds  
 B. Classical coordination compounds            E. FUBAR chemistry  
 C. Cluster chemistry                          F. None of the Above



### Descriptive Inorganic Chemistry

129. Descriptive inorganic chemistry focuses on the \_\_\_\_\_ based on their properties.

- A. Classification of reactivity
- B. Classification of coordination complexes
- C. Classification of compounds
- D. Classification of inorganic compound
- E. Classification of nature
- F. None of the Above

130. Partly the classification focuses on the position in the periodic table of the heaviest element in the compound, partly by grouping compounds by their?

- A. Supramolecular similarities
- B. Classical coordination compounds
- C. Inorganic compounds similarities
- D. Structural similarities
- E. Organometallic chemistry similarities
- F. None of the Above

131. When studying inorganic compounds, one often encounters parts of the different classes of inorganic chemistry; an organometallic compound is characterized by its coordination chemistry, and may show interesting?

- A. Often similar reactivity
- B. Coordination complexes
- C. Classification of compounds
- D. Man-made inorganic compound
- E. Solid state properties
- F. None of the Above

### Different classifications are:

#### Coordination Compounds

132. Which of the following terms is almost all organic and inorganic compounds that can be used as ligands?

- A. Supramolecular coordination chemistry
- B. Classical coordination compounds
- C. Inorganic compounds
- D. Modern coordination compounds
- E. Organometallic chemistry
- F. None of the Above

133. 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. Classification of compounds
- D. Man-made inorganic compound
- E. Small nuclear explosions
- F. None of the Above

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

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

#### Main Group Compounds

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

- A. Often similar flavors
- B. Coordination colors
- C. Elements
- D. Man-made inorganic compounds
- E. Minerals
- F. None of the Above

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

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

137. 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. Diatomic gases
- C. Stoichiometric ratios
- D. Metal carbonyls
- E. Transition metal compounds
- F. None of the Above

138. 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. Organometallic chemistry synthesis
- C. Organometallic synthesis
- D. Metal-metal synthesis
- E. Inorganic chemical synthesis
- F. None of the Above

139. 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 “\_\_\_\_\_”, as they contain organic groups, e.g.,  $\text{B}(\text{CH}_3)_3$ .

- A. Transition metals
- B. An important diatomic gas
- C. Organometallic
- D. Metal carbonyls and even metal alkoxides
- E. Transition metal compounds
- F. None of the Above

140. Which of the following terms represents the fullerenes, buckytubes and binary carbon oxides?

- A. Transition metal compounds
- B. Organometallic chemistry
- C. Organometallic compounds
- D. Metal-metal bonded dimetallic complexes
- E. Organic compounds
- F. None of the Above

### Transition Metal Compounds

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

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

142. 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. Transition metal compounds
- B. Organometallic complexes
- C. Organometallic compounds
- D. Metal-metal bonded dimetallic complexes
- E. Coordination complexes
- F. None of the Above

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

- A. Transition metals
- B. Complexes
- C. Organometallic complexes
- D. Metal complexes
- E. Transition metal compounds
- F. None of the Above

### Organometallic Compounds

144. Usually, M-C-H group the metal (M) in these species can either be a main group element or a?

- A. Transition metal compound
- B. Transition metal
- C. Organometallic compound
- D. Metal-metal bonded dimetallic complex
- E. Organic compound
- F. None of the Above

145. Which of the following terms is more relaxed to include also highly lipophilic complexes such as metal carbonyls and even metal alkoxides?

- A. Transition metals
- B. An important diatomic gas
- C. An organometallic compound
- D. Metal carbonyls and even metal alkoxides
- E. Transition metal compounds
- F. None of the Above

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

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

147. Which of the following terms represents the ability to manipulate complexes in solvents of low coordinating power, enabled the exploration of very weakly coordinating ligands such as hydrocarbons?

- A. Transition metals
- B. Synthetic gas methodology
- C. Synthetic methodology
- D. Synthetic carbonyl and even metal alkoxides
- E. Transition metal compounds
- F. None of the Above

### Cluster Compounds

148. Clusters can be found in all classes of?

- A. Transition metal compounds
- B. Organometallic chemistry
- C. Organometallic compounds
- D. Chemical compounds
- E. Organic compounds
- F. None of the Above

149. \_\_\_\_\_ organometallic chemistry, main group chemistry, and bioinorganic chemistry?

- A. Transition metals
- B. Inorganic systems
- C. Organometallic systems
- D. Metal carbonyls and even metal alkoxides
- E. Transition metal compounds
- F. None of the Above

150. The interface is the chemical basis of nanoscience or nanotechnology and specifically arise from the study of quantum size effects in?

- A. Transition metal compounds
- B. Organometallic chemistry
- C. Organometallic compounds
- D. Metal-metal bonded dimetallic complexes
- E. Organic compounds
- F. None of the Above