

## Atomic Structure

### Chapter 1

1. The force of attraction between the nucleus and an orbital electron is called the electron  
A. Valence                      C. Binding energy  
B. Transition number   D. Valence number
2. The schematic display most often employed to represent the structure of the atom was developed by:  
A. Charles Dalton        C. Michael Crookes  
B. Neils Bohr              D. Charles Darwin
3. The chemical properties of an atom are primarily controlled by its  
A. Number of protons        C. Atomic weight  
B. Number of neutrons      D. Valence number
4. The orderly arrangement of the elements by their atomic number and chemical properties is found in a/an:  
A. Emission spectrum   C. Auger table  
B. Table of contents    D. Periodic table
5. The principal unit of energy measurement on the atomic scale is the-  
A. Electron volt            C. Coulomb  
B. Neutron                  D. Farad
6. The atomic number of the atom is determined by those particles which have an atomic mass unit of 1 and a single positive charge called-  
A. Electrons    C. Protons  
B. Positrons    D. Neutrons
7. The majority of the mass of the nucleus's is derived from  
A. Protons and electrons      C. Protons, neutrons and electrons  
B. Protons and neutrons      D. Alpha, beta, gamma
8. An atom that loses an orbital electron from the electrical influence of the nucleus has undergone:  
A. Radioactive decay      C. Ionization  
B. Subluxation              D. Covalent bonding
9. The number of outer shell electrons is known as the  
A. Electron quota        C. Valence  
B. Orbital energy        D. Quantum mottle

10. In the symbol  ${}^{60}\text{Co}_{27}$ , the number in the lower right-hand corner indicates the:
- Mass number
  - Atomic number
  - Isotope number
  - Ionization level
11. In the previous question, the number in the upper left-hand corner indicates the
- Mass number
  - Atomic number
  - Isotope number
  - Ionization level
12. A neutral atom that loses an electron by ionization is termed a
- Negative atom
  - Positive atom
  - Negative ion
  - Positive ion
13. The smallest division of a substance possessing the same chemical and physical properties of the substance as a whole is called a/an-
- Atom
  - Element
  - Molecule
  - Isotope
14. The tiny particles possessing a negative charge of  $1.6 \times 10^{-9}$  Coulombs that orbit the nucleus of an atom are termed:
- Electrons
  - Protons
  - Neutrons
  - Photons
15. The centralized portion of an atom, the nucleus, is primarily composed of particles called the
- 1. Electrons    2. Neutrons    3. Protons*
- 1 & 2 only
  - 1 & 3 only
  - 2 & 3 only
  - 1, 2, & 3
16. The photons produced during the orbital transitions of electrons from a higher to lower energy are termed:
- Characteristic radiations
  - Corpuscular radiations
  - Vacancy radiations
  - Field radiations
17. The formula  $2n^2$  is used to calculate:
- Minimum number of electrons in an orbital shell
  - Maximum number of electrons in an orbital shell
  - Total number of electrons in the atom
  - Number of outer shell electrons in an atom

18. The atomic mass of an atom can be estimated by adding the atomic masses of the  
1. *Protons*    2. *Neutrons*    3. *Electrons*  
A. 1 & 2 only    C. 2 & 3 only  
B. 1 & 3 only    D. 1, 2, & 3
19. The highest electron binding energy of an atom is found in the electron's level.  
A. First energy orbital    C. Third energy orbital  
B. Second energy orbital    D. All are the same
20. A given atom has the following binding energies: K shell - 1000 eV, L shell - 70 eV, M shell - 10 eV. During a M-L transition, the photon energy emitted will be  
A. 910 eV    C. 60 eV  
B. 80 eV    D. Unable to determine
21. The chemical bond formed when two or more atoms share electrons is termed  
A. Ionic bonding    C. Covalent bonding  
B. Polar bonding    D. Valence bonding
22. The interconvertibility of mass and energy first proposed by Einstein is expressed by the equation-  
A.  $E = \frac{1}{2}mv^2$     C.  $E = mc^2$   
B.  $E = hv$     D.  $E = 2v^2/\lambda$
23. The octet rule states that the most chemically stable atoms have an outer shell configuration with:  
A. Two electrons    C. Seven electrons  
B. Four electrons    D. Eight electrons
24. The natural state of matter with the highest energy due to the movement of atoms is the  
A. Gaseous state  
B. Liquid state  
C. Plastic state  
D. Solid state
25. About 99% of the atom's mass is located within the  
A. Orbital shell  
B. Valence shell  
C. Nucleus  
D. Alpha particle

26. Ionization of an atom may occur from exposing the atom to  
*1. Heat 2. Electric current 3. Radiation*  
 A. 1 only  
 B. 2 only  
 C. 3 only  
 D. 1, 2, & 3
27. The electron binding energy is dependent upon the  
*1. Amount of neutrons 2. Amount of protons 3. Electron to nucleus distance*  
 A. 1 & 2 only C. 2 & 3 only  
 B. 1 & 3 only D. 1, 2, & 3
28. Which of the following atoms would possess the highest energy for its K shell electron?  
 A.  $^{16}_8\text{O}$       C.  $^{63}_{29}\text{Cu}$   
 B.  $^{23}_{11}\text{Na}$       D.  $^{126}_{53}\text{I}$
29. An atom that has seven orbital electrons belongs to a group of elements known as  
 A. Inert gasses  
 B. Noble gasses  
 C. Halogens  
 D. Rare earth elements
30. Two or more chemicals with the same chemical formula, but having different chemical properties, are termed:  
 A. Isomers      C. Isobars  
 B. Isotopes      D. Isotones
31. The formation of molecules can be accomplished through the interaction of valence electrons by a process termed  
 A. Ionic bonding      C. Both of the above  
 B. Covalent bonding      D. Neither of the above
32. The mass of an orbital electron is about \_\_\_\_\_ the mass of a proton.  
 A. 1/000      C. 20 times  
 B. 1/10      D. 2000 times
33. Which of the following is true concerning the K shell electrons of two different atoms?  
 A. The electron binding energy is the same for both atoms  
 B. The electron binding energy is characteristic of each atom  
 C. The heavier element will have more K shell electrons  
 D. All of the above

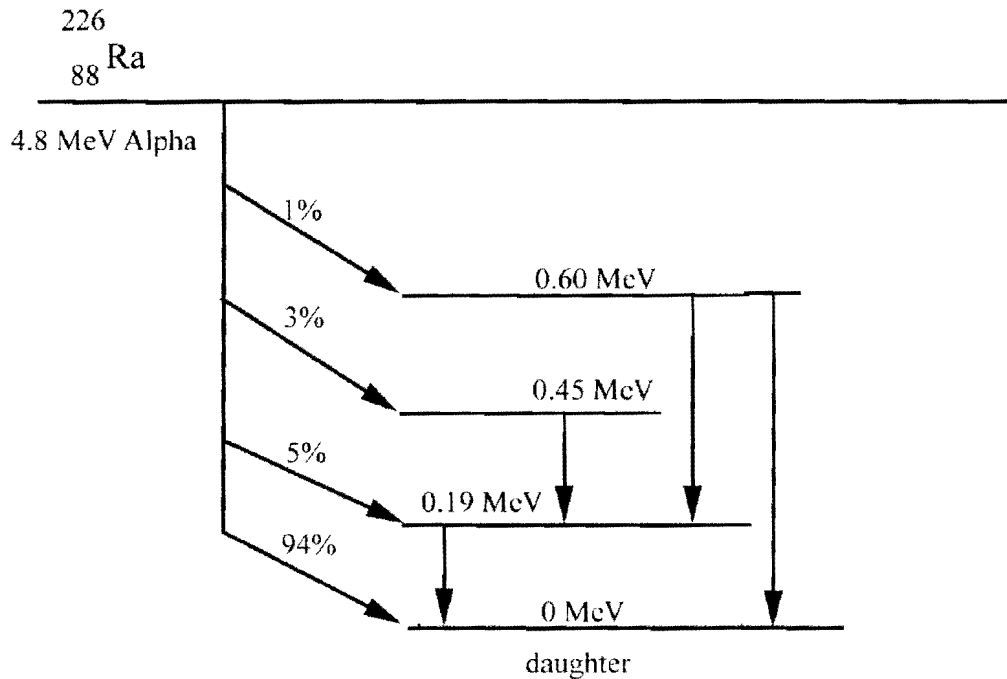
34. In a neutral atom the electrical neutrality is achieved by maintaining a balance between the  
A. Protons and electrons C. Electrons and positrons  
B. Neutrons and positrons D. Protons and neutrons
35. The atomic particle which has a weight of 1 amu and carries no charge is called a/an  
A. Proton C. Neutron  
B. Electron D. Negatron
36. Nuclides having the same atomic number but different atomic masses are termed  
A. Isotopes C. Isobars  
B. Isotones D. Neutrinos
37. The physical state of matter is related to the degree of molecular attraction. Which state corresponds to the highest degree of molecular attraction  
A. Solid C. Plastic  
B. Liquid D. Gas
38. A neutral atom that gains an electron will have a:  
A. Neutral charge C. Positive charge  
B. Negative charge
39. The chemical bonding of two atoms by the transfer of an electron is a form of \_\_\_\_\_ bonding.  
A. Ionic C. Mutual  
B. Covalent D. Polar
40. Characteristic radiation emission occurs when:  
A. Electrons move from lower to higher orbital shells  
B. Electrons move from higher to lower orbital shells  
C. The atom has an unstable nucleus  
D. The atom undergoes nuclear fission
41. The mass energy equivalent value for an electron is:  
A. 0.60 MeV C. 0.391 MeV  
B. 0.147 MeV D. 0.511 MeV
42. An electron with a lowest binding energy is most likely located in the:  
A. K shell C. M shell  
B. L shell D. It is the same for all electrons
43. Which of the three fundamental particles has the lowest atomic mass?  
A. Electron C. Proton  
B. Photon D. Neutron

44. The most chemically stable elements having a filled outer shell configuration are termed
- Alkali metals
  - Alkaline metals
  - Nobel gases
  - Halogens
45. The physical characteristics of the atom are controlled by the atom's
- Atomic number
  - Atomic mass
  - Valence number
  - Electron binding energy
46. The Stability of a nucleus is highly dependent upon the of the nucleus
- N-Z ratio
  - e- - e+ ratio
  - A-N ratio
  - All of the above
47. The nuclear particle possessing a single positive charge with a mass of  $1.67 \times 10^{-24}$  gm is termed the:
- Neutron
  - Positron
  - Proton
  - Electron
48. The term applied to the raising of an electron to a higher energy orbit within a given atom is called:
- Excitation
  - Ionization
  - Stabilization
  - Neutralization
49. The maximum number of inner or K shell electrons in any atom is:
- 1
  - 2
  - 4
  - 8
50. The smallest part of an element that retains all the characteristic properties of that element in bulk is called a/an:
- Molecule
  - Atom
  - Coulomb
  - Nuclide
51. The following atoms are:  ${}^{13}_6\text{C}$ ,  ${}^{14}_7\text{N}$ ,  ${}^{16}_8\text{O}$
- Isotopes
  - Isobars
  - Isotones
  - Isomers
52. The principal force involved with nuclear binding is the
- Electromagnetic force
  - Weak force
  - Gravitational force
  - Strong force

53. The average nuclear binding energy that must be exceeded to remove nucleons from the nucleus is in the range of:  
A. 5-8 eV      C. 5-8 MeV  
B. 5-8 keV     D. 5-8 GeV
54. Atoms with different types of nuclear configurations are termed  
A. Elements    C. Molecules  
B. Nuclides    D. Mixtures
55. The term used to describe the process in which light nuclei combine to form a heavier nucleus is:  
A. Fusion        C. Nuclear capture  
B. Fission       D. De-excitation
56. The difference between the true mass of an atom and the sum of the free masses of its constituents is termed the:  
A. Transition mass    C. Relative mass  
B. Mass deficit        D. Atomic mass
57. Which of the following elements does not exhibit a high capture cross section ( or slow neutrons?)  
A. Boron  
B. Cadmium  
C. Lead  
D. Lithium
58. Which of the following neutrons is not normally associated with the ejection of nucleons from the target atom  
A. Relativistic neutrons      C. Thermal neutrons  
B. Intermediate neutrons      D. Fast neutrons
59. The vast majority of spontaneous radioactive decay and fission processes are  
A. Endoergic    C. Endothermic  
B. Exoergic     D. None of the above
60. The end result of a radioactive decay series is a/an  
A. Unstable nuclide    C. Fusionable nuclide  
B. Fissionable nuclide D. Stable nuclide
61. The principal emission particle associated with the transformation of a proton into a neutron is:  
A. Beta-          C. Alpha-  
B. Beta+          D. Alpha+

62. An alpha particle is most similar to the nucleus of a atom.  
 A. Hydrogen  
 B. Deuterium  
 C. Helium  
 D. Lithium
63. If the activity of a radioactive source is 400 mR/hr. and has a half-life of 6 hours, what will the activity of this source be in one day?  
 A. 133 mR/hr.            C. 12.5 mR/hr.  
 B. 25 mR/hr.             D. 6.25 mR/hr.
64. The specific term used to designate a nuclear excited state is  
 A. Isotope                C. Isotone  
 B. Isomer                D. Isobar
65. After an alpha decay, the daughter nuclide will have an atomic mass number \_\_\_\_\_ amu lower than the parent.  
 A. One                    C. Four  
 B. Two                    D. Six

*Pertaining to the diagram of the decay scheme below, answer questions 66-69.*



66. This is an example of a \_\_\_\_\_ particle decay scheme.  
 A. Positive            C. Both of the above  
 B. Negative           D. Neither of the above

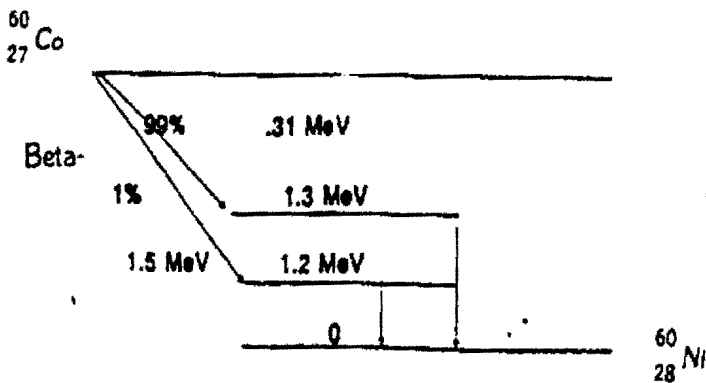


67. The principal daughter nuclide for this decay scheme is:
- A.  ${}_{89}^{226}\text{Ac}$  C.  ${}_{86}^{222}\text{Rn}$   
 B.  ${}_{86}^{226}\text{Ra}$  D.  ${}_{86}^{226}\text{Rn}$
68. The average energy of the particle emission is:
- A. 4.8 MeV C. 413 keV  
 B. 600 keV D. 190 keV
69. In order to achieve a grounded state, the majority of the alpha emissions are associated with a:
- A. 0.60 MeV gamma emission C. 0.19 MeV positron emission  
 B. 0.45 MeV beta emission D. No secondary emission
70. The most likely radionuclides undergoing spontaneous beta decay will possess an unfavorably high N-Z ratio or have an excess of:
- A. Neutrons  
 B. Protons  
 C. Positrons  
 D. Electrons
71. Nuclides with relatively long periods or lifetimes in an excited state are referred to as being
- A. Grounded C. Modulated  
 B. Mass bound D. Metastable
72. The radioactive decay of  ${}^A_Z\text{C}$  into  ${}^A_Z\text{N}$  is an example of
- A. Isobaric decay C. Isotropic decay  
 B. Isotonic decay D. Isomeric decay
73. The rate of radioactive decay is greatly influenced by:
- A. Chemical bonding C. Temperature changes  
 B. Pressure changes D. None of the above
74. The fusion process occurs only in nuclides possessing a:
- A. Low atomic number C. Both of the above  
 B. High atomic number D. Neither of the above
75. The production of nuclides possessing the same atomic mass and different atomic numbers (isobars) will result from:
1. Beta- decay 2. Beta+ decay 3. Electron capture
- A. 1 only C. 3 only  
 B. 2 only D. 1, 2, & 3

76. After beta decay, the daughter nuclide will have an atomic mass that is \_\_\_\_\_ the parent nuclide.  
A. Higher than            C. The same as  
B. Lower than
77. The instability of most lighter nuclides normally results from an  
A. Excess of neutrons    C. Excess of neutrinos  
B. Excess of protons    D. Excess of mesons
78. The emission of a beta particle is associated with the transformation of a \_\_\_\_\_ into a/an  
A. Neutron/proton        C. Proton/neutron  
B. Photon/proton        D. Neutron/electron
79. Which of the following are examples of heavy charged particles  
1. *Alpha*                    2. *Tritons*            3. *Deuterons*  
A.     1 & 2 only  
B.     1 & 3 only  
C.     2 & 3 only  
D.     1, 2, & 3
80. A radioactive source has a half-life of eight hours. How long would it take to reduce a 200 millicurie/hr. source to a level of 12.5 millicurie/hr.?  
A. 8 hours        C. 24 hours  
B. 16 hours      D. 32 hours
81. Which of the following radionuclides is most likely to decay by alpha decay?  
A. C-14            C. Sn-113  
B. Mo-99          D. Po-218
82. The average energy it takes to remove an electron from an orbital shell in a gas is about  
A. 34 eV        C. 4.2 keV  
B. 69 eV        D. 6.7 keV
83. Which of the following elements does not exhibit a high capture cross section for slow neutrons?  
A. Boron  
B. Cadmium  
C. Lead  
D. Lithium

Pertaining to the diagram of the decay scheme below, answer questions 84 - 87.

$^{60}_{27}\text{Co}$



84. This is an example of a \_\_\_\_\_ particle decay scheme.  
 A. Positive      C. Both of the above  
 B. Negative      D. Neither of the above
85. The principal daughter nuclide for this decay scheme is:  
 A.  $^{60}_{27}\text{Co}$       C.  $^{60}_{28}\text{Fe}$   
 B.  $^{60}_{28}\text{Ni}$       D.  $^{56}_{25}\text{Mn}$
86. The major particulate emissions will possess an energy of about  
 A. 0.31 MeV      C. 1.3 MeV  
 B. 1.2 MeV      D. 1.5 MeV
87. In order to achieve a grounded state, the energy of the gamma emission following the major particle emission is:  
 A. 1.5 MeV      C. 1.2 MeV  
 B. 1.3 MeV      D. .31 MeV
88. After alpha decay, the atomic number of the parent nuclide is-.  
 A. Increased by 2                      C. Decreased by 1  
 B. Increased by 4                      D. Decreased by 2
89. Which of the following neutrons is not normally associated with the ejection of nucleons from the target atom?  
 A. Relativistic neutrons              C. Thermal neutrons  
 B. Intermediate neutrons              D. Fast neutrons

90. The bluish light seen around the core of swimming pool reactors due to electron velocities greater than the speed of light in the medium is called:
- A. Rutherford radiation
  - B. Cerenkov radiation
  - C. Bragg radiation
  - D. Barn radiation